The 14th International Conference on Virtual Learning
VIRTUAL LEARNING – VIRTUAL REALITY

Phase II - Period 2010-2020: e-Skills for the 21st Century
Phase III - Period 2020-2030: Intelligence Learning –
Knowledge Society and Learning Culture

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ICVL 2019 dedicated to The Institute of Atomic Physics (IFA) - 70 years, Magurele, where the first Romanian electronic computer CIFA-1

ICVL and CNIV Coordinator: PhD. Marin Vlada, University of Bucharest

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Proceedings of the 14th International Conference On Virtual Learning

OCTOBER 25-26, 2019, UNIVERSITY OF BUCHAREST

MODELS & METHODOLOGIES, TECHNOLOGIES, SOFTWARE SOLUTIONS
Phase II - Period 2010-2020: e-Skills for the 21st Century

ICVL 2019
INTERNATIONAL CONFERENCE ON VIRTUAL LEARNING

editura universității din bucurești, 2019

ICVL and CNIV Partners: Grigore Albeanu, Mircea Popovici, Radu Jugureanu, Adrian Adăscăliței, Olimpius Istrate

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MOTTO

„The informatics/computer science re-establishes not only the unity between the pure and the applied mathematical sciences, the concrete technique and the concrete mathematics, but also that between the natural sciences, the human being and the society. It restores the concepts of the abstract and the formal and makes peace between arts and science not only in the scientist' conscience, but in their philosophy as well."

Grigore C. Moisil (1906-1973)
Professor at the Faculty of Mathematics, University of Bucharest,
Member of the Romanian Academy,
Computer Pioneer Award of IEEE, 1996
http://www.icvl.eu/2006/grcmoisil

"*We are born with the need to learn and live with it throughout our lives. It is for the human being what is the breath for the human body*"

Solomon Marcus (1925-2016)
Professor at the Faculty of Mathematics, University of Bucharest,
Member of the Romanian Academy, An encyclopedic personality and a pioneer in the fields of Mathematical Linguistics, Grammars and Finite Automata
https://en.wikipedia.org/wiki/Solomon_Marcus

"Learning is evolution of knowledge over time"

Roger E. Bohn
Professor of Management and expert on technology management,
University of California, San Diego, USA,
Graduate School of International Relations and Pacific Studies
http://irps.ucsd.edu/faculty/faculty-directory/roger-e-bohn.htm

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About ICVL 2019

ICVL Project – www.icvl.eu

2010 – TOWARDS A LEARNING AND KNOWLEDGE SOCIETY – 2030
VIRTUAL ENVIRONMENTS FOR EDUCATION AND RESEARCH

C^{3}VIP: "Consistency-Competence-Clarity-Vision-Innovation-Performance"

Partners: Ph. D. Prof. Grigore Albeanu, Ph. D. Mircea Dorin Popovici, Prof. Radu Jugureanu, Ph. D. Adrian Adăscăliței, Ph D. Olimpius Istrate

Institutions: The Romanian Ministry of Research and Innovation, University of Bucharest

October 25-26, 2019 – BUCHAREST, EUROPE-ROMANIA

Location: University of Bucharest - The Faculty of Mathematics and Computer Science, BUCHAREST, ROMANIA

Organizers: University of Bucharest, The Faculty of Mathematics and Computer Science and The Faculty of Psychology and Educational Sciences

Participate

The Conference is structured such that it will:

- provide a vision of European e-Learning and e-Training policies;
- take stock of the situation existing today;
- work towards developing a forward looking approach.

The Conference will consider the perspectives and vision of the i-2010 programme and how this will stimulate the promotion, and development of e-Learning content, products and services and the contribution of these to lifelong learning.

Participation is invited from researches, teachers, trainers, educational authorities, learners, practitioners, employers, trade unions, and private sector actors and IT industry.

Conference Organisation

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Dr. Marin Vlada	Professor of Computer Science, University of Bucharest, Romania, *European INTUITION Consortium member*

Research papers – Major Topics

The papers describing advances in the theory and practice of Virtual Environments for Education and Training (VEL&T), Virtual Reality (VR), Virtual Laboratory (VirtLab), Information and Knowledge Processing (I&KP), as well as practical results and original applications. The education category includes both the use of Web Technologies, Computer Graphics (CG) and Virtual Reality Applications, New tools, methods, pedagogy and psychology, Case studies of Web Technologies and Streaming Multimedia Applications in Education, experience in preparation of courseware.

Thematic Areas / Sections

- **MODELS & METHODOLOGIES (M&M)**
- **TECHNOLOGIES & VIRTUAL LABORATORY (TECH)**
- **SOFTWARE SOLUTIONS (SOFT)**
- **"Intel® Education" – Innovation in Education and Research (IntelEdu)**

Objectives

2010 – Towards a Learning and Knowledge Society – 2030

Phase II **- Period 2010-2020**: e-Skills for the 21st Century
Phase III **- Period 2020-2030**: Intelligence Learning –
Knowledge Society and Learning Culture

Relevant topics include but are not restricted to:

- National Policies and Strategies on Virtual Learning
- National Projects on Virtual Universities
- International Projects and International Collaboration on Web-based Education
- Dot-com Educational Institutions and their Impact on Traditional Universities
- Educational Portals for education and training
- Reusable Learning Objects for e-Learning and e-Training
- Testing and Assessment Issues of Web-based Education
- Academia/Industry Collaboration on Web-based Training
- Faculty Development on Web-based Education
- Funding Opportunities for Projects in Web-based Education

Learning and the use of Information and Communication Technologies (I&CT) will be examined from a number of complementary perspectives:

- **Education** – supporting the development of key life skills and competences
- **Research** – emerging technologies and new paradigms for learning
- **Social** – improving social inclusion and addressing special learning needs
- **Enterprise** – for growth, employment and meeting the needs of industry
- **Employment** – lifelong learning and improving the quality of jobs
- **Policy** – the link between e-Learning and European / National policy imperatives
- **Institutional** – the reform of Europe's education and training systems and how I&CT can act as catalyst for change
- **Industry** – the changing nature of the market for learning services and the new forms of partnership that are emerging

General Objectives

The implementation of the Information Society Technologies (IST) according to the European Union Framework-Programme (FP7), Digital Agenda-Europe 2020

- The development of a Romanian Framework supporting the professional and management initiatives of the educational community.
- The organization of the activities concerning the cooperation between the educational system and the economical companies to find out an adequate distribution of the human resources over the job market.
- To promote and implement the modern ideas for both the initial and continuing education, to promote the team based working, to attract and integrate the young graduates in the Research and Development projects, to promote and implement IT&C for initial and adult education activities.

Particular objectives

The development of Research, projects, and software for E-Learning, Software and Educational Management fields

- To promote and develop scientific research for e-Learning, Educational Software, Virtual Reality and Virtual Laboratory.
- To create a framework for a large scale introduction of the e-Learning approaches in teaching activity.
- To assist the teaching staff and IT&C professionals in the usage of the modern technologies for teaching both in the initial and adult education.
- To improve the cooperation among students, teachers, pedagogues, psychologists and IT professionals in specification, design, coding, and testing of the educational software.

- To increase the teachers' role and responsibility to design, develop and use of the traditional technologies and IT&C approaches in a complementary fashion, both for initial and adult education.
- To promote and develop information technologies for the teaching, management and training activities.
- To promote and use Educational Software Packages for the initial and adult education.

Thematic Areas/Sections

Models & Methodologies (M&M):

- Innovative Teaching and Learning Technologies
- Web-based Methods and Tools in Traditional, Online Education and Training
- Collaborative E-Learning, E-Pedagogy,
- Design and Development of Online Courseware
- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Cognitive Modelling and Intelligent systems
- Algorithms and Programming for Modelling

Technologies & Virtual Laboratory (TECH):

- Innovative Web-based Teaching and Learning Technologies
- Advanced Distributed Learning (ADL) technologies
- Web, Virtual Reality/AR and mixed technologies
- Web-based Education (WBE), Web-based Training (WBT)
- New technologies for e-Learning, e-Training and e-Skills
- Educational Technology, Virtual Laboratory, Web-Lecturing Technology
- Mobile E-Learning, Communication Technology Applications
- Computer Graphics and Computational Geometry
- Intelligent Virtual Environment

Software Solutions (SOFT):

- New software environments for education & training
- Software and management for education
- Virtual Reality Applications in Web-based Education
- Computer Graphics, Web, VR/AR and mixed-based applications for education & training, business, medicine, industry and other sciences
- Multi-agent Technology Applications in WBE and WBT
- Streaming Multimedia Applications in Learning
- Scientific Web-based Laboratories and Virtual Labs
- Software Computing in Virtual Reality and Artificial Intelligence
- Avatars and Intelligent Agents

Innovation in education and research (IntelEDU):

- Digital Curriculum, collaborative rich-media applications, student software, teacher software
- Improved Learning Methods, interactive and collaborative methods to help teachers incorporate technology into their lesson plans and enable students to learn anytime, anywhere
- Professional Development, readily available training to help teachers acquire the necessary ICT skills
- Connectivity and Technology, group projects and improve communication among teachers, students, parents and administrators

Topics of interest include but are not limited to:

Virtual Environments for Learning (VEL):

- New technologies for e-Learning, e-Training and e-Skills
- New software environments for education & training
- Web & Virtual Reality technologies
- Educational Technology and Web-Lecturing Technology
- Advanced Distributed Learning (ADL) technologies
- Innovative Web-based Teaching and Learning Technologies
- Software and Management for Education
- Intelligent Virtual Environment

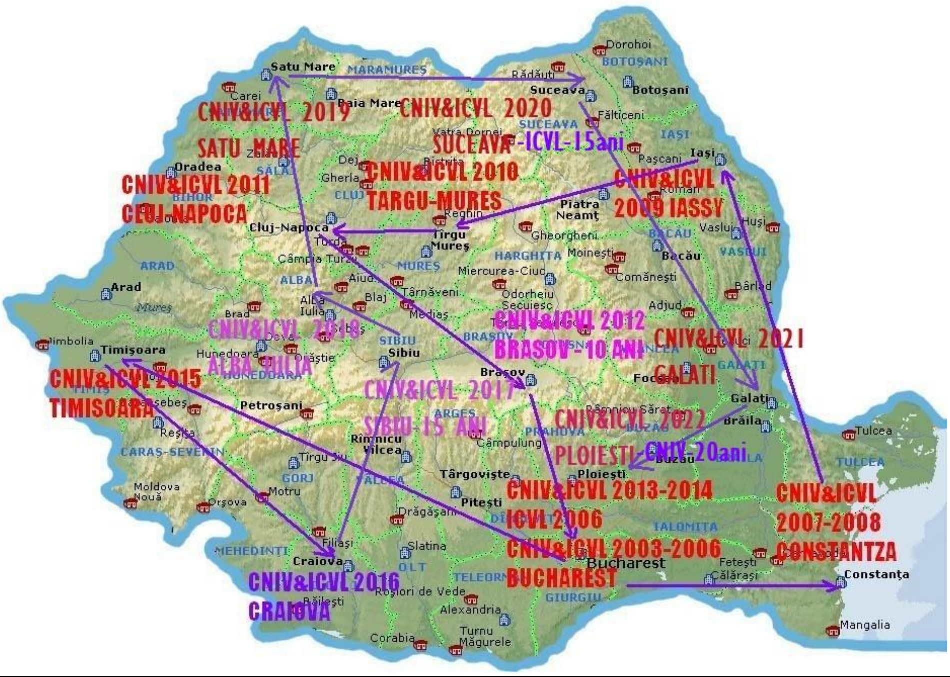
Virtual Reality (VR):

- Computer Graphics and Computational Geometry
- Algorithms and Programming for Modeling
- Web & Virtual Reality-based applications
- Virtual Laboratory and Technologies
- Graphics applications for education & training, business, medicine, industry and other sciences
- Scientific Web-based Laboratories and Virtual Labs
- Software Computing in Virtual Reality

Knowledge Processing (KP):

- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Multi-agent Technology Applications in WBE and WBT
- Streaming Multimedia Applications in Learning
- Mobile E-Learning, Communication Technology Applications
- Cognitive Modelling, Intelligent systems
- New Software Technologies, Avatars and Intelligent Agents
- Software Computing in Artificial Intelligence

Tournament ICVL Project (founded 2006, http://c3.icvl.eu/) and CNIV Project (founded 2003, http://c3.cniv.ro/): Future vs. Vision.



Section

MODELS & METHODOLOGIES

Models and Methodologies (M&M):

- Innovative Teaching and Learning Technologies
- Web-based Methods and Tools in Traditional, Online Education and Training
- Collaborative E-Learning, E-Pedagogy,
- Design and Development of Online Courseware
- Information and Knowledge Processing
- Knowledge Representation and Ontologism
- Cognitive Modelling and Intelligent systems
- Algorithms and Programming for Modelling

Blended Teaching and Learning and Implementation of Online Laboratories in STEM Education Using a Virtual Learning Environment

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Abstract

This keynote paper is about ePedagogical Challenges / Difficult Tasks for STEM Study Programs Leading to International Accreditation in 21th Century: Implementation of E-learning, Blended Learning, Virtual Learning Environments (for example Moodle), Virtual and Remote Laboratories, OER (Open Educational Resources) and MOOC (Massive Open Online Courses).

Keywords: Blended teaching and learning model for STEM, ePedagogy, Virtual Learning Environment, Virtual and Remote Laboratories, Open Educational Resources, Massive Open Online Courses.

1 Introduction

This review paper presents the current e-pedagogical methods to develop a Project Design for STEM (Science, Technology, Engineering and Mathematics) Education Study Programs including online laboratories.

2 Preparing STEM Teachers to use blended learning environments

Luând în considerație experiența celor patru universități și competența Facultății de Științe ale Educației din Iași, recomandăm ca pregătirea profesorilor pentru blended and online teaching să conțină 12 capitole/module pe care le detaliem în articol. These modules can be completed sequentially in the order below, however they can also be viewed as stand-alone resources.

2.1 Online Teaching Skills

This module/chapter enables instructors to determine their readiness to teach online. Through self-evaluation and reflection, teachers can develop an action plan to improve their practice and become an effective online teacher. They will also discover the pedagogical, technical and administrative skills required for successful online teaching and learning.

Agenda (Topics and Subtopics): Teaching online vs. teaching face-to-face (similarities and differences); Online teaching skills (Pedagogical; Technical; Administrative); Self-assessment activity

Learning Outcomes. By the end of this module, participants should be able to: Compare skills required for online versus face-to-face teaching success; Identify the necessary skills for successful online teaching; Assess personal readiness to teach online.

2.2 Instructional Design Models and Theories of Learning

This chapter/module introduces the advantages benefits and impact of instructional design methodology used during course development. Learning theories (from behaviourism, cognitivism, constructivism and connectivism) will be identified in relation to common instructional design models such as:

ADDIE (Analysis, Design, Development, Implementation, Evaluation);

Gagne's Nine Events of Instruction (Gain attention; Inform learners of objectives; Stimulate recall of prior learning; Present the content; Provide "learning guidance"; Elicit performance /practice; Provide feedback; Assess performance; Enhance retention and transfer to the job);

ARCS (Attention, Relevance, Confidence, Satisfaction) and Backward Design (Identify the results desired / big ideas and skills; Determine acceptable levels of evidence that support that the desired results have occurred / culminating assessment tasks; Design activities that will make desired results happen / learning events).

Key characteristics of these learning theories, models and processes for course design are presented, to ensure that instructor apply an appropriate framework to his/her teaching approach.

Learning Outcomes. By the end of this module, participants should be able to: Identify key characteristics of selected, commonly used instructional design models; Identify three main learning theories (behaviorism, cognitivism, constructivism), and their relationships to instructional design models; Recommended steps for module/course design using instructional design and learning theory.

2.3 Online Course Development

This chapter/module emphasizes the importance of planning stages in the development of online courses when using a project and team-based approach. In this module participants will discover the roles and responsibilities of team members and potential institutional resources in the online course development process, as these differ from face-to-face, individual teaching approaches. In this section, students will develop the main elements of a lesson plan (storyboard) for one module (week, unit) of a future online course.

The goal of this chapter/module is for participants to identify the project-based process of instructional design as well as institutional resources and team roles related to the development of online courses. The team-based approach (used in the development of blended and online courses) together with the need for the course to be developed ahead of time (as opposed to just-in-time teaching) is quite different from the individual-based approach to teaching that is common in face-to-face teaching. If participants are delivering a full program in blended and online teaching and learning, it is recommended that they to include this module after Instructional Design Models and Theories of Learning.

Topics: Planning to Teach Online: The Importance of Planning; Process of Online Course Development (Institutional Procedures and Resources; Instructional Design Team Members' Roles); Lesson Plan / storyboard (Purpose; Main Elements)

Learning Outcomes. By the end of this module, participants should be able to: Explain the importance of the course planning process; Explain the stages in online course development; Identify roles and responsibilities of different team members in online course development; Develop a lesson plan (storyboard) for one module (week, unit) of their future online course.

At the same time, within this module the characteristics and the didactic principles for generating the contents delivered online can be discussed, as follows:

Characteristics of virtual instructional content [36]:

1. Granularity and sequentiality of the knowledge conveyed. The didactic knowledge, as the main reference to be accessed, is structured so that there is certain independence of the entities that compose it, but also to ensure certain solidarity of the whole.

2. Modularity, respectively the property of ensuring a global articulation of the content elements and a circumstantial reconfiguration. Each cognitive element is linked or "seeks" another element that leads to enrichment on the whole. Something can be linked to something else, the combinatorics being endless.

3. Flexible dimensioning of the contents, according to the "extent" of the educated, in accordance with multiple individualities and particularities. Individualization involves a multi-storey configuration of the contents so that each subject will find in the offer made available convenient elements, that will interest them and that they can understand.

4. Ensuring a particular performance and rhythms of access and comprehension. No one is obliged to go to the whole cognitive complex and understand everything. Each can progress at its own specific pace.

5. The entrance to the field of knowledge can be done through several places, none imposing itself as privileged. What is important can be learned without knowing all the elements of the ensemble. "Fractal" learning has finally found a concrete form of manifestation. Access to knowledge remains open, with no single "royal gate" entering the edifice of knowledge.

6. The self-structuring character of the content, in the sense that it is self-managing and self-edifying, through the methodological elements that accompany the actual knowledge path. Throughout, the learner finds methodological indices of understanding, additional markers of significance and broadening of the edifice of knowledge. You are given not only knowledge, but also ways of interpreting them, paths to new meanings, alternatives of search and understanding.

At the same time, the structuring of such content must respect the following didactic principles [37]: 1. Relevance (Refers to the adequacy / suitability of the issues raised in support in relation to the needs, objectives and goals of the user - the student, the teacher, etc.).). 2. Transparency / accessibility (Refers to those characteristics of the medium that, from a cognitive point of view, contribute to facilitating access and use. 3. Validity (Refers to the internal consistency of the content / materials, to the way the content and method are supports each other - which facilitates the teaching-learning process 4. Attractiveness (This principle summarizes all those characteristics of the curricular support that appeal to the student and, as a result, contributes to reinforcing the motivation for learning it. 5. Flexibility (Se refers to the individual modalities – both cognitive and affective – of approaching the teaching-learning process, to those characteristics of the curricular support that are sensitive to the individual specificity of the user, including the differences between the different groups) 6. The open / generative character (It refers to the characteristic of the curricular support to facilitate cognitive development and transfer of what has been learned in other contexts and in more general tasks). 7. Participation (It refers to the ability of the curricular support to offer the student and the teacher the possibility to make choices and to share the responsibility in the teaching-learning process). 8. Socialization (It refers to the "added value", namely: the exercise of collaborative skills, the search / valorization of otherness, the formation of an intercultural awareness).

2.4 Learning Outcomes as Master Plan for Design

This module introduces the role of learning outcomes in online, face-to-face and blended course design. During this module blended teachers will use Bloom's Taxonomy of Educational Objectives to develop clear learning outcomes for an online or blended course or module. They will also evaluate students learning outcomes to make sure they are specific, measurable, attainable, relevant and timed appropriately for the length of your course or module.

Topics. Recommendations for Outcomes Based Education:

Why Learning Outcomes: What are Learning Outcomes; What is the Purpose of Learning Outcomes;

Introduction to Course Design Cycle: Constructive Alignment (Learners construct meaning from what they do to learn. The teacher makes a deliberate alignment between the planned learning activities and the learning outcomes.)

Writing Learning Outcomes. Learning Outcome statements may be broken down into three main components: an action word that identifies the performance to be demonstrated; a learning statement that specifies what learning will be demonstrated in the performance; a broad statement of the criterion or standard for acceptable performance.

Bloom's Taxonomy of Educational Objectives (guide to choosing action words):

Affective, Cognitive, and Psychomotor domains; Action Words for Learning Domains

Evaluating Learning Outcomes: SMART outcomes: Specific skills/value/knowledge;

Measurable and/or demonstrable; Attainable by students at current level; Relevant for students, course, program, degree; Timed appropriately for module or course length

Evaluating Achievement of Learning Outcomes: Assessment Strategies

Learning Outcomes. By the end of this module, participants should be able to: Explain the role of learning outcomes in (online, face-to-face, and blended) course design; Apply Bloom's Taxonomy of Educational Objectives to write clear, succinct learning outcomes

2.5 Benefits and Challenges of Online Education

This module addresses the benefits and challenges of online teaching and learning for both instructors and students. They will review the skills required for successful teaching and learning in online environments, as well as discover strategies to overcome challenges and techniques to assist students. This module is designed to help instructors feel prepared to teach online.

Topics: Skills for Successful Online Learning: Online Learning Quiz for Students; Instructor Assistance with Skills; Online Teaching Skills.

Learning Outcomes. By the end of this module, participants should be able to: Describe the potential benefits and challenges of online teaching and learning for both student and instructor; Outline strategies to address challenges related to online teaching and learning; Develop strategies to assist students in online environments; Self-evaluate readiness for teaching online.

2.6 Assessment in Online Environments

This module introduces strategies for planning assessments, grading student work and providing effective feedback in online learning environments. You will discover how to select formative and summative assessment tools and activities, as well as how to develop grading rubrics and generate effective feedback in relation to student learning outcomes. Appropriate use of self and peer assessments will also be covered.

Topics: Place and Purpose of Assessment: Assessment in Constructive Alignment; Formative and Summative Assessment; Assessment Tools and Activities; Effective Feedback through Grading Rubrics: Characteristics of Effective Feedback; Grading Rubrics.

Learning Outcomes. By the end of this module, participants should be able to: Explain the purpose of assessment from the perspective of constructive alignment; Distinguish between formative and summative assessment; Identify characteristics of effective feedback; Select a grading rubric for an online assessment; Determine when self and peer assessments might be effective and viable options.

2.7 Communication Strategies in Online Environments

This module introduces teachers to tools and strategies that can help them communicate effectively with students in the online environment. They will review how you can apply the

Community of Inquiry model to increase cognitive, social and teaching presence, as well as tips and techniques for planning and moderating effective online discussions. In this module, teachers will design a communicative learning activity to increase interactivity in the online environment.

Agenda. Topics and Subtopics: Online Courses as "Communities of Inquiry": What is Community of Inquiry; Cognitive, Social & Teaching Presence; Types of Asynchronous Communication: Meaningful Online Discussion; Discussion Board/Forum Facilitation; Types of Synchronous Communication: When to Use Synchronous Communication; Preparing for a Synchronous Session.

Learning Outcomes. By the end of this module, participants should be able to: Distinguish between the various types of communication available in online contexts; Outline the importance of clarity in written expression; Design a communicative learning activity that will increase the level of interactivity in the online environment.

2.8 Synchronous and Asynchronous Tools

8 Synchronous and Asynchronous Tools

This module introduces appropriate synchronous and asynchronous technological tools for online learning activities and communication. In this module, teachers will be expected to apply one synchronous and one asynchronous tool in the design of an online or blended course or module. Educational technologies such as discussion boards, web-conferencing, blogs, wikis and social media will also be evaluated.

Agenda. Topics and Subtopics: Defining Educational Technology Tools: What is Educational Technology; Synchronous vs. Asynchronous Technologies (Purpose of each type and when to use); Selecting Educational Technologies: SECTIONS Model for Selecting Technology (Students; Ease of use; Costs; Teaching functions; Interaction; Organisational issues; Networking; Security and privacy).

Learning Outcomes. By the end of this module, participants should be able to: Evaluate a variety of educational technologies on the basis of hands-on experience, including experience with LCMS (Learning and Content Management Systems), email, discussion boards, blogs, ePortfolio, wikis, social media, text chat, and web-conferencing; Apply one synchronous and one asynchronous tool in the design of a course or module; Explain choice of educational technology based on considerations of purpose of activity, learning outcomes, and learner characteristics in selection process.

2.9 Online Learning Communities

This module introduces strategies for building a sense of community among online learners and activities based in social learning theory to ensure successful educational experiences. In this module, you will compare methods for developing online social presence and identify strategies and activities for developing and maintaining supportive online communities.

Agenda. Topics and Subtopics: Defining Online Learning Communities: Function; Identity; Participation; Interaction

Online Learning Communities and Online Classes/Collaboration: Using Ice-breakers/ Intros in Online Spaces; Learner/Peer Feedback; Group Assignments; Strategies to Develop Successful Online Learning Communities: Modeling; Articulation; Coaching; Exploration; Reflection; Scaffolding.

Coaching is a form of development in which a person called a coach supports a learner or client in achieving a specific personal or professional goal by providing training and guidance.

Instructional scaffolding provides sufficient support to promote learning when concepts and skills are being first introduced to students.

Learning Outcomes. By the end of this module, participants should be able to: Develop strategies for building social presence in online courses; Compare different methods of creating community online; Identify how to use educational technology and design learning activities that help to develop online learning communities.

2.10 Interaction, Engagement and Motivation

This module introduces strategies for improving student interaction, engagement, and motivation in online and blended learning environments. According to Keller's ARCS Model, there are four major conditions for motivation: Attention, Relevance, Confidence, and Satisfaction. In this module, you will analyze the conditions for learner motivation, and develop strategies for improving student interaction, engagement, and motivation in a course or module that you would like to design or redesign for online or blended delivery.

Topics: Interaction and Engagement: Equivalency Theorem; Modes of Interaction [Student-student interaction (live); Student-student interaction (online); Student-content interaction; Student-teacher interaction]; Motivation for Learning: Why Should We Motivate; Primary Motivational States; Keller's ARCS Model; Learning Outcomes. By the end of this module, participants should be able to: Describe several strategies for improving interaction and engagement in a course; Analyze the four major conditions for motivation according to Keller's ARCS Model; Develop strategies for improving motivation for learning.

2.11 Gamification in Education

This module introduces the concept of gamification, which involves using the same kinds of thinking and processes that drive games, but in a non-gaming context. Motivation in gaming is intrinsic and comes from the joy and sense of accomplishing something that requires skills, effort, and correct decisions. In this module, you will learn how gaming principles can be applied to online and blended courses to keep students engaged and appropriately challenged.

Gamification means: The use of game thinking and game mechanics to engage users and solve problems.

Topics: What is Gamification: Game Time; What Happens When We Play a Game; Making Predictions; Gaming Principles in Learning.

Learning Outcomes. By the end of this module, participants should be able to: Explain what "gamification" means; Describe several gaming principles used in education.

3 Online laboratories in engineering education

Developing critical thinking while students work with virtual resources is very important and students need to understand what kind of results they collect and analyze for each experiment. It is important for the student to be able not only to perform the experiment correctly but also to interpret the results correctly. Online laboratories [37]-[64] are fundamental to the experiments performed by students during the individual study (see an example in Figure 4.). Thus, remote students can acquire introductory experiences and become familiar with real life phenomena. These on-line experiments can be conceived in various fields of engineering study. Software simulations that use the web are called "Virtual Labs" and use only the software. "Remote labs" consist of real hardware and allow people to use real-world hardware equipment through software.

3.1 Remote Labs used in Engineering Education Programmes

ABET (Accreditation Board for Engineering and Technology) includes in their program outcomes the expectation that students will have "the ability to design and conduct experiments" and "the ability to use the techniques, skills, and modern engineering tools". EUR-ACE (European Accredited Engineer) program criteria expect students to have: "Ability to select and use appropriate equipment, tools, and methods", as well as, "An understanding of applicable techniques and methods, and of their limitations."

Many STEM programs now incorporate remote (and/or virtual) labs into their instruction: to save money; to extend scarce resources, or to share equipment with another institution; for pedagogical reasons. Depending on how the labs are deployed, those benefits are likely to include: increased student access to equipment (time-on-task per student); greater flexibility in lab scheduling; a wider range of possible assignments or activities, and; enhanced opportunities for collaboration among students. If labs are accessed online, students can (potentially) be engaged in learning at any time and from anywhere they have Internet access, as opposed to hands-on activities that rely on the times that campus buildings are open and staff members are available. Increased access opens the door to activities that may take longer than a typical class meeting time or multi-part assignments that require students to use equipment for several short periods over the span of a week or more, both of which pose logistical barriers in a hands-on environment. Finally, there may be enhanced opportunities for student collaboration when labs are accessed online, by removing the same time same place constraints posed by traditional work groups. For tomorrow's engineer, working on a team whose members are scattered around the country (or around the globe) may be the norm and giving students practice with skills useful in this work environment (communication and teamwork, for example) can give them a head-start.

3.2 Experiment Course Delivery

1. The Experiment course, based on pedagogical considerations, began with an introductory lecture on "X" to familiarize students with the topic and its applications in various domains.

2. The students then reviewed the theory section and took an online self-evaluation to assess their knowledge level before performing the experiment.

3. Next, Students will be introduced to the simulation and animation, followed by a question and answer session. This reinforced and improved understanding of concepts introduced in the theory session.

4. Students then perform the experiment using the Remote Panel, and subsequently are able to visualize and analyze their results. This process offered the added benefit of helping students to understand the debugging process in real time.

5. Students then will give individualized assignments to deepen and extend their cognitive grasp of the concepts in each application along with assessments to evaluate their overall understanding of the subject knowledge.

To effectively utilize the RT Lab, each student who starts the experiment should follow the steps below:

a. Become familiar with the aim, objective and theory behind the experiment.

b. Understand thoroughly the procedure, prerequisites, hardware details and each step involved in conducting the experiment, along with the procedural details of how to effectively use the Remote Panel.

c. Undertake self-evaluation to assess knowledge and understanding of theoretical concepts.

d. View the animation to gain a procedural understanding of the experiment.

e. Perform a simulation of the experiment to deepen understanding of the theory and its application.

f. Perform the experiment in a real-world setting using the Remote Panel to achieve hands-on experience.

g. Undertake assignments in various contexts to realize implications and broad applicability of the theory.

h. Study the suggested references for additional information.

Components of Remote Laboratory

The existing remote-laboratory solutions are heterogeneous. A set of typical components of a remote laboratory are identified, some of these components can be duplicated:

1) The experiment itself.

2) Instrumentation devices and equipment allowing the control of the experiment as well acquiring results from the experimentation; this equipment could be based on standard equipment or custom-made interfaces.

3) A laboratory server that will assure the control and monitoring of the experiment, through the control of the instrumentation devices and equipment.

4) A server that will assure the link between remote users and the laboratory server, normally through the Internet; the solution for this server varies from dedicated applications and very “naïf” web servers (normally presenting a simple description of the experiment and containing additional learning materials) to a complex LMS handling the users and time allocation for the use of the experiments (booking system). This component could be decomposed into a set of web servers (or layers) with specific functions, namely, performing the presentation of related materials (experiment information, theoretical background, etc.), user authentication, experiment booking, management of the learning path, etc. The referred functionalities can be accessed through a web portal, acting as the front page for experiments established by an institution or by an inter institution consortium, providing access to a pool of remote experiments.

5) A webcam server that can be used by remote user to get a visual and audio feedback of the experiment status; this functionality could also be included in the previously referred web server, but it is common to rely on a dedicated hardware–software platform to accomplish this goal.

6) Collaborative tools allowing audio, video, and chat communications between users.

7) Client workstations assuring remote users to be connected to the experiment and associated resources; it is important to stress that some remote laboratories rely on a simple web browser, while others will need to have specific plug-ins or download client programs in order to get proper access to the experiment (in case using LabView-based server platforms).

4 Science, Technology, Engineering and Mathematics (STEM) Education in Europe

Studies on Education Policies and Practices in Europe funded by the European Commission have shown that in European education systems in Europe: STEM studies have a low attractiveness and the labor market in the STEM-related sectors is not satisfied. The Scientix Moodle program [34] was designed as a platform for peer learning for an exchange of best practices between STEM teachers throughout the European Union. The latest courses on the Moodle platform have been developed by teachers from different countries who shared their experiences of using different tools and teachers in classrooms. Courses are self-paced and can be accessed by anyone at any time, and users do not need to create a Moodle account to study. Created by European Schoolnet, the Future Classroom Lab (FCL) has six learning areas; visitors can explore key elements in delivering 21st century learning: student and teacher skills and roles, learning styles, learning environment design, current and emerging technology in education, the socio-economic requirements and expectations affecting education [35]

5 Conclusions

It is obvious that learning in the knowledge society involves an effort to renew teaching practices by integrating the innovations brought by the new information and communication technologies, this effort assuming courage, creativity and collaborative activism from several actors, both "traditional" (teacher, didactician, school manager, etc.), as well as "modern" (computer scientist, system engineer, web-designer, etc.). The present and future challenges will be brought not only by the dynamics inherent in the contents of knowledge, but also by the ways of making them available that cannot be neglected. On the contrary, they can print another value to the learning contents, which will be put in a new light precisely by the new frames of knowledge transmission. Therefore, teacher training should be oriented not only to learning content in the future, but also to new technologies with a view to integrating them for use in the learning process. Teachers need to develop new skills, not only to select and manage pre-existing pedagogical objects, but also to construct, in whole or in part, important parts of them, to intelligently combine or re-assign content modules, to reconfigure curricular assemblies, appropriate in one situation or another, to encourage the students to come with their share of contribution. A good teacher will have not so much competence over the content, but for the presentation of that content through the use of technical supports that maximize and motivate the learning process.

References

[1] Harasim, L. (2017). Learning theory and online technologies. Routledge.
[2] Vaughan, Norman D., Martha Cleveland-Innes, and D. Randy Garrison. Teaching in blended learning environments: Creating and sustaining communities of inquiry. Athabasca University Press, 2013. http://www.aupress.ca/books/120229/ebook/99Z_Vaughan_et_al_2013-Teaching_in_Blended_Learning_Environments.pdf
[3] West, Richard E. "Foundations of Learning and Instructional Design Technology." (2018). https://edtechbooks.org/pdfs/print/lidtfoundations/_lidtfoundations.pdf
[4] Bersin, Josh.The blended learning book: Best practices, proven methodologies, and lessons learned. John Wiley & Sons, 2004.
[5] Garrison, D. Randy, and T. Anderson. "A framework for research and practice." *E-Learning in the 21st Century* (2003): 32-47.
[6] (37)Moodle elearning, Electrical Engineering Faculty, Technical University “Gh. Asachi” Iași, România, http://moodle.ee.tuiasi.ro/, accessed Aug. 2019
[7] Lu, Jingyan, and Nancy Wai Ying Law. "Understanding collaborative learning behavior from Moodle log data." Interactive Learning Environments 20.5 (2012): 451-466.
[8] Auer, M. E., & Gravier, C. (2009). Guest editorial: The many facets of remote laboratories in online engineering education. IEEE Transactions on Learning Technologies, (4), 260-262.
[9] J.A. Svoboda: The Electronic Teaching Assistant: the Circuit Design Lab, Interactive Illustrations and Electric Circuit Study Applets. http://people.clarkson.edu/~jsvoboda/eta/
[10] Learning objects that cover a broad-based electromechanical engineering program, http://electronics.wisc-online.com/; and https://www.wisc-online.com/learn/technical/
[11] Zutin, D. G., Auer, M. E., Maier, C., & Niederstätter, M. (2010, April). Lab2go—A repository to locate educational online laboratories. In Education Engineering (EDUCON), 2010 IEEE (pp. 1741-1746). IEEE
[12] M. E. Auer, A. Pester, D. G. Zutin, "Open Source Portal for Online Laboratories", Proceedings of the 4th International Conference on Remote Engineering and Virtual Instrumentation-REV, Kassel University Press, 2007, ISBN 978-3-89958-278-9.
[13] IEEE Transactions on Learning Technologies (TLT), Special Issue On The Many Facets Of Remote Laboratories In Online Engineering Education, https://www.computer.org/csdl/trans/lt/2009/04/index.html
[14] Auer, M. E. (2001, April). Virtual lab versus remote lab. In 20th World Conference on Open Lerning And Distance Education. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.455.8054&rep=rep1&type=pdf
[15] Nedic, Z., Machotka, J., & Nafalski, A. (2003). Remote laboratories versus virtual and real laboratories (Vol. 1, pp. T3E-T3E). IEEE. http://www.icee.usm.edu/ICEE/conferences/FIEC2003/papers/1077.pdf
[16] Balamuralithara, B., & Woods, P. C. (2009). Virtual laboratories in engineering education: The simulation lab and remote lab. Computer Applications in Engineering Education, 17(1), 108-118. http://www.academia.edu/download/34880001/Virtual_Lab.pdf
[17] Feisel, L. D., & Rosa, A. J. (2005). The role of the laboratory in undergraduate engineering education. Journal of Engineering Education, 94(1), 121-130. http://chem.engr.utc.edu/asee/2005/jee-feisel-paper.pdf

[18] Kuchirka, Y., Petriv, M., Baran, S., Ursutiu, D., & Samoila, C. (2016). Online Teaching and Laboratory Course on Measurement Methods. International Journal of Online Engineering, 12(3). http://www.online-journals.org/index.php/i-joe/article/download/5233/3847

[19] Viegas, C., Marques, A., & Alves, G. R. (2017, October). 21st Century Challenges in Engineering and Technological learning. In Proceedings of the 5th International Conference on Technological Ecosystems for Enhancing Multiculturality (p. 11). ACM. https://repositorio.grial.eu/bitstream/grial/1094/1/a11-viegas-preprint.pdf

[20] Zutin, D. G., Auer, M. E., Maier, C., & Niederstätter, M. (2010, April). Lab2go—A repository to locate educational online laboratories. In Education Engineering (EDUCON), 2010 IEEE (pp. 1741-1746). http://www.ieec.uned.es/investigacion/educon2010/searchtool/EDUCON2010/papers/2010S10C03.pdf

[21] Auer, M. E., Pester, A., & Zutin, D. G. (2007). Open source portal for online laboratories. In Proceedings of the 4th International Conference on Remote Engineering and Virtual Instrumentation-REV 2007. https://www.researchgate.net/publication/228744950_Open_Source_Portal_for_Online_Laboratories

[22] Harms, U. (2000). Virtual and remote labs in physics education. Proceedings of the Second European Conference on Physics Teaching in Engineering Education, Budapest, Hungary (pp. 1-6). ftp://labattmot.ele.ita.br/ele/lfilipe/Lab_Real_Remoto/Artigos/Lab_Remoto/Harms_U_Virtual_Real_Remote_Lab_Physics_Education.pdf

[23] Virtual laboratories in teaching and learning science, http://blog.scientix.eu/2015/08/virtual-laboratories-in-teaching-and-learning-science/

[24] Ursutiu, D., Ghercioiu, M., Samoila, C., & Cotfas, P. (2009). FPGA LabVIEW Programming, Monitoring and Remote Control. International Journal of Online Engineering (iJOE), 5(2), 34-41. http://journals.sfu.ca/onlinejour/index.php/i-joe/article/viewFile/874/917

[25] Gilibert, M., Picazo, J., Auer, M. E., Pester, A., Cusidó, J., & Ortega, J. A. (2006). 80C537 Microcontroller remote lab for e-learning teaching. International Journal of Online Engineering (iJOE), 2(4). http://journals.sfu.ca/onlinejour/index.php/i-joe/article/viewFile/364/325

[26] Nedungadi, P., Ramesh, M. V., Pradeep, P., & Raman, R. (2018). Pedagogical Support for Collaborative Development of Virtual and Remote Labs: Amrita VLCAP, pp.219-240. In Auer, M. E., Azad, A. K., Edwards, A., & de Jong, T. (Eds.). (2018). Cyber-Physical Laboratories in Engineering and Science Education. Springer. https://link.springer.com/book/10.1007%2F978-3-319-76935-6

[27] Electrical Engineering course with simulations using MultiSim, http://moodle.scientix.eu/course/view.php?id=426

[28] Future Classroom Lab (FCL), http://fcl.eun.org/

[29] Virtual Labs Projects India, http://vlabs.iitkgp.ernet.in/vlt/index.html

[30] Gomes, L., & Zubía, J. G. (2008). Advances on remote laboratories and e-learning experiences (Vol. 6). Universidad de Deusto. http://www.academia.edu/download/30915693/Advances_on_remote_labs.pdf

[31] Zubía, J. G., & Alves, G. R. (Eds.). (2012). Using remote labs in education: two little ducks in remote experimentation (Vol. 8). Universidad de Deusto. http://www.academia.edu/download/43694802/UNED_Labs_a_network_of_virtual_and_remot20160313-20624-1s6g487.pdf

[32] Tawfik, M., Salzmann, C., Gillet, D., Lowe, D., Saliah-Hassane, H., Sancristobal, E., & Castro, M. (2014, February). Laboratory as a Service (LaaS): A model for developing and implementing remote laboratories as modular components. In Remote Engineering and Virtual Instrumentation (REV), 2014 11th International Conference on (pp. 11-20). IEEE., http://r-libre.teluq.ca/906/1/REV2014-LaaS_Tawfik_et_al_R-Libre.pdf

[33] (64) Halimi, W., Salzmann, C., Gillet, D., & Saliah-Hassane, H. (2018). Standardization layers for remote laboratories as services and open educational resources. In *Online Engineering & Internet of Things* (pp. 874-884). Springer, Cham. https://pdfs.semanticscholar.org/9025/1b4eed3957666ca90c90467fe5e715192fad.pdf

[34] Electrical Engineering course with simulations using MultiSim, http://moodle.scientix.eu/course/view.php?id=426

[35] Future Classroom Lab (FCL), http://fcl.eun.org/

[36] Cucoș, Constantin (2006). Informatizarea în educaţie. Aspecte ale virtualizării formării, Editura Polirom, Iaşi.

[37] North, Brian şi colab. (2005), Quality in Language Teaching-Learning, în http://www.quiltnetwork.org/home.php?page=author&PHPSESSID=8ab07d5f70c15f200f1842481e1476eb.

Onto-DeclarProg: An Educational Ontology for Declarative Programming

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Abstract

Software development efficiency is dependent on the right programming paradigm selection. Thus, it is important to understand the characteristics of each paradigm in order to make the best option. Educational ontologies on programming paradigms can offer the support for a more informed selection. The paper presents such an educational ontology on declarative programming, Onto-DeclarProg, that was implemented in Protégé and integrates two ontologies that were previously developed, one on logic programming (LogicProgramming-Teaching-Onto) and one on functional programming (FunctionProg-Onto). The methodology that was applied to ontology development is described. Also, some examples of applications are discussed.

Keywords: Educational ontology, Computer programming, Declarative programming, Functional programming, Logic programming

1 Introduction

One of the main ways of improving the efficiency of software development is the selection of the most suitable programming paradigm. Among the current used computer programming paradigms types we can mention: the imperative programming paradigm (including the procedural paradigm), the declarative programming paradigm (including the paradigms of logic programming and functional programming), the object oriented programming paradigm, the events-based programming paradigm, the agent-based programming paradigm and the service oriented programming paradigm. Each type of paradigm has specific computer programming languages. However, some programming languages can support a variety of programming paradigms as, for example, C++, C#, Java, CommonLisp, Perl, PHP and Python, which support the imperative, object oriented and functional programming paradigms. An informed selection of the right computer programming paradigm for a certain application can be based on some educational ontologies for each type of paradigm. Thus, it is important to develop such ontologies viewed as educational resources for teaching in universities and for software developers. In this paper, we focus on the declarative programming paradigm with its two main types of programming, logic programming and functional programming. We have developed in Protégé an educational ontology for declarative programming, Onto-DeclarProg, that integrates two previously developed ontologies, LogicProgramming-Teaching-Onto, an ontology on logic programming, and FunctionProg-Onto, an ontology on functional programming, by following a methodology that is described.

The paper is organized as follows. Section 2 presents some basic issues on the declarative programming paradigm. The methodology that was followed for the Onto-DeclarProg educational ontology development as well as the ontology itself are described in section 3. The final section concludes the paper and highlights some future work.

2 The Declarative Programming Paradigm

The most used computer programming paradigms are the imperative programming paradigm (which includes procedural programming) and the declarative programming paradigm. An imperative program implements an algorithm that solve a problem and is composed by a set of statements that change the status of the program, while a declarative program specifies what is doing the program not how it is done, and it is composed of relations or properties that need to be fulfilled. In this last case, the execution model of the programming language will solve the problem.

The declarative programming is a non-procedural programming paradigm that is also named as descriptive programming by some specialists. It includes mainly three types of computer programming paradigms: logic programming, functional programming and constraints programming, as shown in Figure 1. In general, the declarative programming languages does not allow side effects. Examples of declarative programming languages are: Prolog (a logic programming language), Haskell (a functional programming language), and SQL (a database interrogation language). In this paper, we focus on the logic programming and functional programming paradigms with a specific programming language, Prolog and Haskell, respectively.

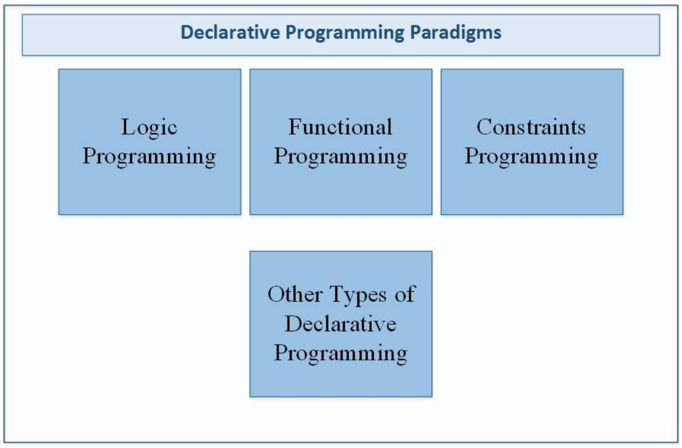


Figure 1. The declarative programming paradigms – a modular view

The logic programming is based on symbolic logic, more specific, on first order predicates logic calculus, and uses for solution search a reasoning mechanism embedded in the logic programming language. The representative logic programming language is Prolog. Logic programming is usually applied for the implementation of artificial intelligence applications.

The functional programming is based on Lambda calculus and allows the definition of mathematical functions. Recursion is the main programming mechanism used for function definition. Examples of functional programming languages are Lisp, Haskell, Miranda etc. Functional programming is applied in the telecommunication industry, aerospace industry etc.

3 The Declarative Programming Educational Ontology Development

3.1 The methodology

The development of the declarative programming educational ontology, Onto-DeclarProg was performed by following a methodology that integrates some basic guidelines for ontology development reported in the literature as e.g. the ontological approach applied in e-learning systems (Panagiotopoulos et al, 2012), the collaborative ontology development for higher

education (Oprea, 2016), and the specific frameworks for ontology engineering described in (Mizoguchi, 2004).
The main steps of the methodology are given below.

Methodology

Input: Declarative Programming course specification and course resources
Output: the educational ontology for Declarative Programming, Onto-DeclarProg

Step 1. Develop an ontology with basic concepts of computer programming;
Step 1.1 Identify and define the concepts of computer programming that are used in declarative programming;
Step 1.2 Generate an ontology with *Step 1.1* identified concepts (Onto-CP0);
Step 2. Develop an ontology for logic programming;
Step 2.1 Identify and define the basic concepts of logic programming;
Step 2.2 Generate an ontology with *Step 2.1* identified concepts (Onto-LP1);
Step 2.3 Identify and define the advanced concepts of logic programming;
Step 2.4 Generate an ontology with *Step 2.3* identified concepts (Onto-LP2);
Step 3. Develop an ontology for functional programming;
Step 3.1 Identify and define the basic concepts of functional programming;
Step 3.2 Generate an ontology with *Step 3.1* identified concepts (Onto-FP1);
Step 3.3 Identify and define the advanced concepts of functional programming;
Step 3.4 Generate an ontology with *Step 3.3* identified concepts (Onto-FP2);
Step 4. Generate by merging or other technique the Declarative Programming ontology (Onto-DeclarProg) from the previous generated ontologies Onto-CP0, Onto-LP1, Onto-LP2, Onto-FP1, and Onto-FP2.

The course specification includes course title and level, pre-requisite courses, year of study, number of hours/week for course teaching and laboratory work. The main course resources are textbooks, lecture notes (as e.g PowerPoint slides, PDF files) and software tools (e.g. declarative programming languages such as functional programming language and logic programming language). The output of the proposed methodology is the educational ontology for the Declarative Programming course, Onto-DeclarProg, which is defined by (1).

(1) Onto-DeclarProg = *Unify*{Onto-CP0, Onto-LP1, Onto-LP2, Onto-FP1, Onto-FP2}

The structure of a general educational ontology on declarative programming is shown in Figure 2.

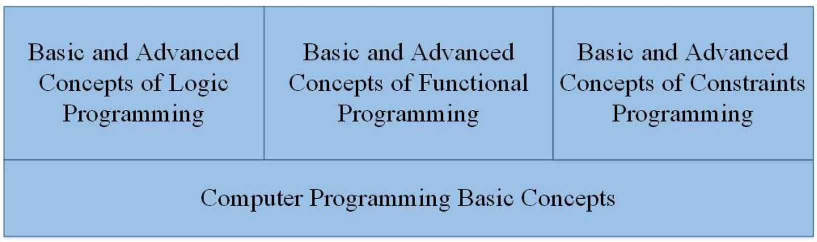


Figure 2. The structure of a general educational ontology on declarative programming

The specific structure of the proposed ontology is depicted in Figure 3.

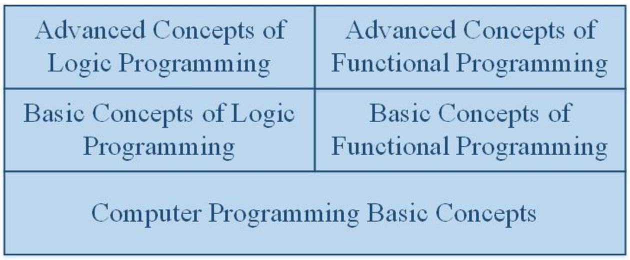


Figure 3. The structure of the proposed educational ontology on declarative programming

The modular structure of the Onto-DeclarProg ontology is shown in Figure 4.

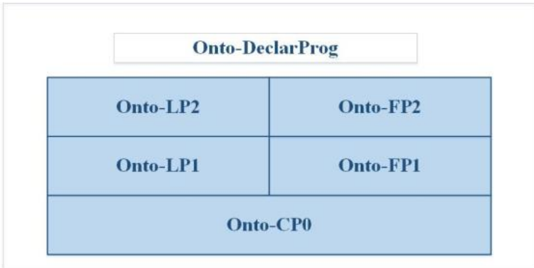


Figure 4. The modular structure of the Onto-DeclarProg ontology

In our implementation of the declarative programming ontology, Onto-DeclarProg, we have used two previously developed prototype educational ontologies, an ontology for logic programming teaching, LogicProgramming-Teaching-Onto (Oprea, 2017), and an ontology for functional programming teaching, FunctionProg-Onto (Oprea, 2018).

According to our methodology, the two ontologies can be defined as follows: the logic programming ontology - LogicProgramming-Teaching-Onto={Onto-LP1, Onto-LP2} and the functional programming ontology - FunctionProg-Onto={Onto-FP1, Onto-FP2}.

3.2 The Onto-DeclarProg ontology

The course of *Declarative programming* is usually taught to students of the Computer Science specialization, at undergraduate level. The course is included in the computer programming domain, which contains basic programming courses such as imperative programming and object-oriented programming, and more specialized courses such as the declarative programming course that usually tackles logic programming and functional programming.

We have designed an educational ontology for the *Logic Programming and Functional Programming* course taught at Petroleum-Gas University of Ploiesti by following the steps of the methodology described in the previous section, and we have implemented the resulted ontology in Protégé (a Java-based ontology development tool) as an OWL ontology.

The course specification and main resources of the *Logic Programming and Functional Programming* course (renamed as *Declarative Programming*) are:

Course specification:

- Course title: *Declarative programming* (*Logic Programming and Functional Programming*);
- Course level: undergraduate;
- Year of study: third year, second semester;

- Prerequisite courses: *Computer programming*; *Data structure and algorithms*;
- Number of hours/week for course teaching and laboratory work: 2 hours/week - course teaching and 2 hours/week - laboratory work.

Course main resources:
Textbooks (*Logic Programming*):

- (Bramer, 2013) for basic and advanced concepts of logic programming and introduction to Prolog logic programming language;
- (Metakides and Nerode, 1998) for basic knowledge of Logic Programming and its relation to other computer programming paradigms;
- (Oprea, 1999) for basic knowledge of logic programming in Prolog and applications (expert systems in Prolog);
- (Russel and Norvig, 2010) for basic knowledge of symbolic logic (first order predicates logic);

Textbooks (*Functional Programming*):

- (Bird, 1998) for basic concepts and introduction to Haskell functional programming language;
- (Giumale, 1997) for basic knowledge of Functional Programming and its relation to other computer programming paradigms;
- (Hutton, 2016) for basic and advanced concepts of functional programming in Haskell programming language;
- (Michaelson, 1989) for Lambda Calculus;

Course lecture notes:

- PowerPoint slides for 2018-2019 academic year;

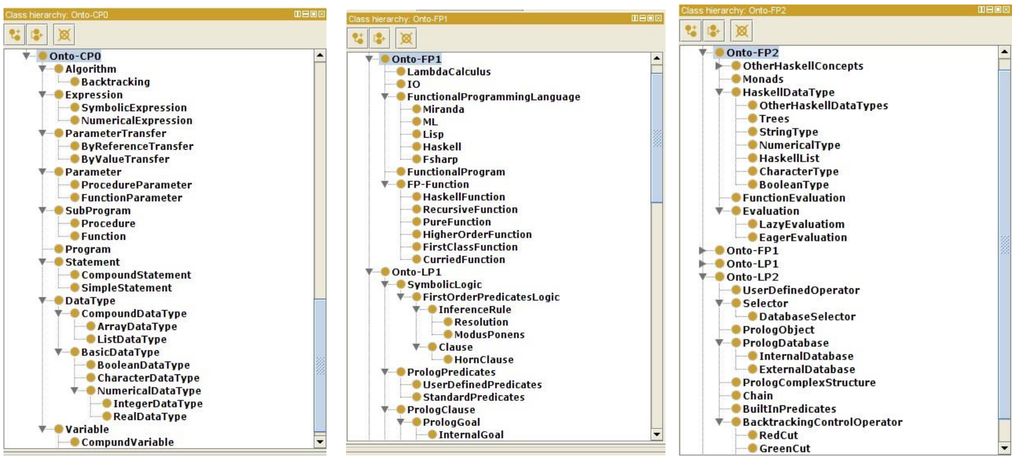
Software tools:

- Prolog programming language (e.g. LPA Prolog);
- Haskell programming language (e.g. HUGS).

According to the followed methodology we have added to the educational ontology of the *Logic Programming and Functional Programming* course, some basic concepts from computer programming, as for example: variable, expression, datatype, basic datatype (numerical datatypes, string, character etc), compound datatype (list, array etc), statement, function, procedure, function/procedure parameters, parameter transfer etc.

The ontology implementation was performed in Protégé 4.3 under the OWL format. Each identified concept of the ontology was defined as a class in Protégé. Figure 5 shows a screenshot with some concepts of declarative programming that were included in the ontology (in Figure 5 (a) - basic computer programming concepts from Onto-CP0; in Figure 5 (b) - basic concepts of logic programming and functional programming from Onto-LP1 and Onto-FP1; in Figure 5 (c) - some advanced concepts of logic programming and functional programming from Onto-LP2 and Onto-FP2).

We have defined the relationships between concepts as object properties and some data properties. Our ontology uses apart from the implicit relations between classes (i.e. taxonomic relations of type *is_a* and *has*) provided by Protégé, some explicit relations (i.e. object properties) such as *basedOn* and *hasComputationModel* (with its sub-relations *hasLambdaCalculusModel*, *hasFirstOrderPredicateCalculusModel*). These relations allow a more complex interconnection between classes through the inferences performed by the Protégé 4.3 Reasoner (FaCT++). Examples of data properties that were defined are *functionName*, *predicateName* (string type) and *functionArity*, *predicateArity* (int type).



(a) (b) (c)

Figure 5. Screenshots with some concepts of the Onto-DeclarProg ontology (Protégé 4.3)
(a) Onto-CP0, (b) Onto-LP1 and Onto-FP1, (c) Onto-LP2 and Onto-FP2

In its present form, the Onto-DeclarProg ontology in the OWL format can be used for the courses of *Declarative programming* and *Logic programming and functional programming* as a vocabulary of terms. Other examples of applications for which the ontology can be used are:

- applications of logic programming:
  - expert systems developed for different types of applications in various domains of expertise,
  - natural languages processing,
  - compilers writing;
- applications of functional programming:
  - functions definition for mobile phones specific applications.

4 Conclusion and Future Work

The paper presented an educational ontology for declarative programming, Onto-DeclarProg, in the OWL format that can be used by undergraduate students of the Computer Science specialization at the courses of *Declarative Programming* or *Logic Programming and Functional Programming*. The ontology was developed by following the guidelines of a methodology that was described in section 3 and was implemented in Protégé 4.3. In its current form, the ontology can be used also by software developers as an introductory educational material for the declarative programming paradigm.

As a future work we intend to extend the Onto-DeclarProg ontology with more concepts related to different types of applications.

References

Books:

Bird, R. (1998): *Introduction to functional programming using Haskell*. Prentice Hall.

Bramer, M. (2013): *Logic programming with Prolog*, Springer.

Giumale, C. (1997): *Functional programming – A pragmatic perspective* (in Romanian). Technical Publishing House, Bucharest.

Hutton, G. (2016): *Programming in Haskell*. Cambridge University Press.

Metakides, G. and Nerode, A. (1998): *Principles of logic and logic programming* (translation in Romanian). Tehnical Publishing House, Bucharest.

Michaelson, G. (1989): *An introduction to functional programming through Lambda Calculus*, Addison-Wesley.

Oprea, M. (1999): *Artificial Intelligence – Logic Programming and Expert Systems* (in Romanian). Ploiesti University Publishing House, Ploiesti.

Russel, S. and Norvig, P. (2010): *Artificial Intelligence - A Modern Approach*. Prentice Hall, New Jersey.

Book Chapters:

Mizoguchi, R. (2004): Ontology engineering environments. In S. Staab and R. Studer (Eds): *Handbook on Ontologies*. Springer.

Journal Articles:

Boyce, S. and Pahl, C. (2007): Developing domain ontologies for course content. *Data & Knowledge Engineering 93*, 1-18.

Oprea, M. (2016): A case study of collaborative ontology development for higher education. *International Journal of Artificial Intelligence 14*, 2, 70-97.

Conference Proceedings:

Oprea, M. (2018): An OWL prototype educational ontology for functional programming, *Proceedings of ICVL 2018*, 51-56.

Oprea, M. (2017): On the development of an educational ontology for logic programming, *Proceedings of ICVL 2017*, 63-69.

Panagiotopoulos, I., Kalou, A., Pierrakeas, C., Kameas, A. (2012): An ontological approach for domain knowledge modeling and management in e-learning systems. In *Proceedings of AIAI 2012 International Workshop AI in Education: Innovations and Applications*, Halkidiki, Greece, 95-104.

Computer Programs:

Protégé: http://protégé.stanford.edu.

On the Development of a Student Evaluation Model

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Abstract

Academic student evaluation for a certain discipline from the university curricula involves a variety of assessments (such as laboratory work, periodical tests, projects assessment, final examination) that need to be integrated in the final mark by keeping also the objective vision related to the whole group of students that studied that discipline. Starting from this observation, we have developed a preliminary form of a student evaluation model that is presented in the paper. An example of model application is also detailed.

Keywords: Student evaluation model, Project assessment, Laboratory work assessment, Discipline activities assessment

1 Introduction

Student evaluation is an important activity of the university educational process as it provides valuable feedback related to the efficiency of teaching activity and learning activity. A variety of methods were proposed in the literature for student performance evaluation starting from the traditional model to more complex models such as those based on artificial intelligence. The development of e-learning platforms and intelligent tutoring systems under the framework of virtual learning environments raise new challenges for the identification of more appropriate student evaluation models. Moreover, the traditional model of academic education evolved in the last decades to combined educational models (such as blended educational model) that include new technologies and pedagogical strategies.

The evaluation of students' performance is quite complex involving the analysis of several activities related to each discipline from the curricula, course attendance, laboratory work, projects, seminars, periodical tests and final examination. In this context, it is required an efficient student evaluation model that take into account all these issues and also keep an objective vision related to the whole group of students that studied that discipline in the same academic year. Starting from this observation, the paper presents a preliminary form of a student evaluation model and describes an example of model application.

The paper is organized as follows. Section 2 presents some basic issues on the evaluation of student performance, reviewing some models reported in the literature. The proposed student evaluation model and an example of model application are described in section 3. The final section concludes the paper and highlights some future work.

2 Academic Student Evaluation

The evaluation of student performance at a certain discipline is made by the professor / teacher who taught the course taking into account the results of all activities that the student should performed for that discipline (as e.g. course attendance, laboratory work, periodical tests, projects, final examination). The titular professor of a course performs directly the student final examination and the student course attendance evaluation (i.e. analyze all activities that are performed by student in direct relation with the professor) and indirectly, the other activities of the student, that were evaluated by the laboratory assistant or tutor. In case an e-learning platform is used for the educational process than some evaluations can be made automatically, as e.g. online questionnaire tests analysis and the analyze of other student activities performed on the e-learning platform.

Several student evaluation models were proposed in the literature. We've made a selection of some models and briefly present them as follows.

One of the first student evaluation models based on fuzzy logic that were reported is described in (Chen and Lee, 1999). The model applies fuzzy inference system (FIS) in two variants: adaptive neuro-fuzzy inference system (ANFIS) and Mamdani FIS.

A recent student performance evaluation model that uses Mamdani FIS and ANFIS models for the course of Network Analysis studied by students from the Electronic and Communication specialization was reported in (Deshmukh et al., 2018). The model is using fuzzy rules evaluating student' strengths and student' weaknesses.

Another recent student evaluation model was proposed for the Italian academic system (Bacci et al., 2017) and is based on a multidimensional finite mixture IRT model.

The use of concept maps in student evaluation is tackled in (Jain et al., 2014). The authors developed the AISLE tool (i.e. an artificial intelligence-based student learning evaluation model) in order to improve the use of intelligent techniques in the evaluation of student's understanding of a particular course topic with concept maps.

As student collaborative learning skill is an important issue for the evaluation of student performance, it is recommended to include it in the overall analysis. For example, a way to assess the students' ability for collaborative problem solving when they are working together at a project can be similar with Co-Measure rubric developed for researchers and teachers to assess the student collaboration when working in K-12 STEAM activities as shown in (Herro et al., 2017).

Other student evaluation models that are based on artificial intelligence apply various techniques of data mining, machine learning, knowledge-based systems, case-based reasoning, computational intelligence etc. Two such models are described in (Oprea, 2014): a rule based expert system and a feed forward artificial neural network.

Quantifying student activities can be performed in various ways. An example is given by the Student Activity Meter (SAM) that is presented in (Govaerts et al., 2011) which visualizes learners' activities within online learning environments. SAM is a very useful tool for teachers and learners. It captures the user activities and thus, is a basis for student behavior analysis. The collaboration between learners and awareness are categories of visualizations supporting self-reflection.

Finally, different metrics for evaluation of student models such as skill modeling and models of affect and motivation were reported in the literature (see e.g. (Pelánek, 2015)). Some examples are: mean absolute error, root mean square error, and area under curve.

The main conclusion of our brief review on some existing student evaluation models is that most of the recent reported models are based on artificial intelligence techniques and that new improvements are still needed for a more complete student evaluation model by analyzing more student skills as, for example, the collaborative skills of the student, when working together with other students to the same project. In the next section it is proposed a preliminary form of a student evaluation model that applies an extensive analysis of student activities and skills.

3 The Proposed Student Evaluation Model

3.1 Model description

The student evaluation model integrates a quantitative student evaluation with a qualitative student evaluation and provides via an overall student performance evaluation the final mark. The quantitative student evaluation is based on the analysis of student activities that are quantified by marks (usually, average marks) such as laboratory work (quantified by an average mark, $M_{LabWork}$), periodical tests (quantified by an average mark, M_{Tests}), semester project (quantified by a mark, $M_{Project}$), and final examination (quantified by a mark, M_{Exam}). The qualitative student evaluation is based on the analysis of different issues such as student interest for the course (reflected in course attendance, involvement in the interaction between professor and students at different lectures of the course under the form of questions and answers etc), different student skills (e.g. collaborative problem solving ability), student ranking in relation to its colleagues from the same group. The proposed student evaluation model in represented in Figure 1.

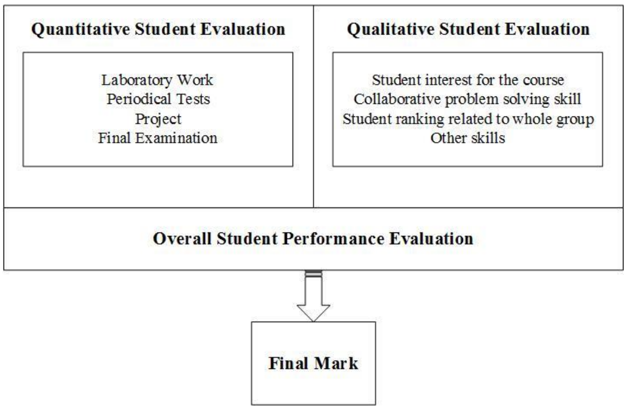

Figure 1. The student evaluation model

The overall quantitative student evaluation is made with the generic formula (1), where the weights, p_1, p_2, p_3, p_4 are given as percentage values by the titular professor of each discipline from the curricula and their sum is 100%. The resulted mark is M_1.

$$(1) \quad M_1 = p_1 * M_{LabWork} + p_2 * M_{Tests} + p_3 * M_{Project} + p_4 * M_{Exam}$$

The overall qualitative student evaluation is made with heuristic rules provided by the titular professor for each discipline from the curricula. The analyzed issues are viewed as variables having fuzzy values. For example, the issue of student interest for the course is given by the StudInterest variable and can have the following linguistic values: *highInterest*, *lowInterest*, *moderateInterest*, *noInterest*. The overall qualitative student evaluation is made with heuristic rules that provides a conversion from fuzzy values to the numerical values of a mark, M_2, in order to make the overall student evaluation that provides the final mark, M_{Final}, with the generic formula (2), where the weights, w_1, w_2 are given as percentage values by the titular professor of each discipline from the curricula, and their sum is 100%.

$$(2) \quad M_{Final} = w_1 * M_1 + w_2 * M_2$$

The resulted final mark, M_{Final}, can be converted in a linguistic value, if it is required.

3.2 Example of model application

The application of the proposed student evaluation model is illustrated for the course of Artificial Intelligence that is taught to undergraduate Computer Science specialization students at Petroleum-Gas University of Ploiesti in the first semester of the last year of study. The main educational resources of the course are the basic textbook on artificial intelligence (Russel and Norvig, 2010), the book (Oprea, 2017) and the course lectures PowerPoint slides. The course has the following activities associated: course lectures teaching, laboratory work, periodical tests (at least two tests - online or written), a semester project (with collaborative work of three or four students) and final examination.

We consider the evaluation of three students whose activities results at the course of Artificial Intelligence are shown in Table 1 (quantitative student evaluation results) and Table 2 (qualitative student evaluation results).

Table 1. Quantitative student evaluation results at the Artificial Intelligence course

Mark / **Student Name**	$M_{LabWork}$	M_{Tests}	$M_{Project}$	M_{Exam}	M_1
Irimescu Ioana	9.50	9.75	10	10	**9.925**
Predescu George	8.50	7.00	8	7.50	**7.65**
Stroescu Adrian	9.75	9.65	10	9.75	**9.79**

The overall quantitative evaluation result is performed with formula (1), where the current values of the weights p_1, p_2, p_3, p_4 are 10%, 10%, 20%, 60%, respectively. The resulted values of M_1 are given in the last column of Table 1.

The overall qualitative evaluation result is performed with heuristic rules given by the professor of the Artificial Intelligence course. Some examples of rules are given below.

Rule R1
IF StudInterest = highInterest **AND** Ranking = BestStud AND CollabAbility = high
THEN QualEval = Excellent;

Rule R2
IF StudInterest = moderateInterest **AND** Ranking = Average **AND** CollabAbility = good
THEN QualEval = Good;

Rule R3
IF StudInterest = lowInterest **AND** Ranking = LastStud **AND** CollabAbility = low
THEN QualEval = Poor;

Examples of conversion rules (i.e. rules that convert linguistic values into numerical values representing marks) are given as follows.

Rule RC1
IF QualEval = Excellent **THEN** $M_2 = 10$;

Rule RC2
IF QualEval = VeryGood **THEN** $M_2 = 9$;

Rule RC3
IF QualEval = Good **THEN** $M_2 = 8$;

Rule RC7
IF QualEval = Poor **THEN** $M_2 = 4$;

Table 2. Qualitative student evaluation results at the Artificial Intelligence course

Mark / Student Name	StudInterest	Ranking	CollabAbility	QualEval	M_2
Irimescu Ioana	highInterest	BestStud	high	*Excellent*	**10**
Predescu George	moderateInterest	Average	good	*Good*	**8**
Stroescu Adrian	highInterest	BestStud	high	*Excellent*	**10**

The final mark is obtained with formula (2), where the values of the weights, w_1 and w_2 are 90% and 10%, respectively. Table 3 presents the final marks obtained by students at the Artificial Intelligence course. As the values of the final mark need to be integer, they were rounded.

Table 3. Overall student evaluation results at the Artificial Intelligence course

Mark / Student Name	M_{Final}
Irimescu Ioana	**10**
Predescu George	**8**
Stroescu Adrian	**10**

4 Conclusion and Future Work

The paper presented a student evaluation model for higher education that performs a quantitative and qualitative evaluation of student activities and skills related to a certain course. The application of the model was illustrated on a case study. The main advantage of the proposed model is the explicit inclusion of the qualitative evaluation of student abilities (performed with heuristic rules) in the overall student performance evaluation.

As a future work we will extend the model to a more general form in order to allow its adjusting according to the course requirements specified by the titular professor.

References

Books:

Oprea, M. (2017): *Artificial intelligence - Theoretical and applicative elements* (in Romanian). Petroleum-Gas University Publishing House, Ploiesti.

Russel, S. and Norvig, P. (2010): *Artificial Intelligence - A Modern Approach.* Prentice Hall, New Jersey.

Journal Articles:

Bacci, S., Bartolucci, F., Grilli, L. (2017): Evaluation of student performance through a multidimensional finite mixture IRT model. *Multivariate Behavioral Research, 52*, 6, 732-746.

Chen, S. M., Lee, C. H. (1999): New methods for students' evaluation using fuzzy sets. *Fuzzy Sets and Systems*, 209-218.

Deshmukh, V., Mangalwede, S., Rao, D. H. (2018): Student performance evaluation using data mining techniques for engineering education. *Advances in Science, Technology and Engineering Systems Journal, 3*, 6, 259-264.

Herro, D., Quigley, C., Andrews, J., Delacruz, G. (2017): Co-Measure: developing an assessment for student collaboration in STEAM activities. *International journal of STEM Education, 4*, 26.

Jain, G. P., Gurupur, V. P, Schroeder, J. L., Faulkenberry, E. D. (2014): Artificial intelligence-based approach for analyzing a student's understanding of a topic. *IEEE Transactions on Learning Technologies, 7*, 3, 267-279.

Pelánek, R. (2015): Metrics for evaluation of student models. *Journal of Educational Data Mining, 7*, 2.

Conference Proceedings:

Govaerts, S., Verbert, K., Duval, E. (2011): Evaluating the student activity meter: two case studies. In H Leung et al. (Eds.): *ICWL 2011*, LNCS 7048, 188-197.

Oprea, M. (2014): On the use of artificial intelligence techniques for students evaluation, *Proceedings of ICVL 2014*, 46-51.

On the Development of Educational Applications of Artificial Intelligence

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Abstract

Artificial intelligence provides a variety of methods and techniques that can be applied with success to real world systems (e.g. environmental pollution monitoring systems, industrial systems). Experimenting such methods and techniques first on some educational applications would improve the performance of further developed real systems that are based on them. The paper presents some educational applications that apply different approaches of artificial intelligence (such as reinforcement learning - a machine learning technique, pattern recognition methods, agent-based modelling).

Keywords: Educational application, Artificial intelligence, Reinforcement learning, Pattern recognition, Robotics

1 Introduction

Artificial intelligence became in the last decades an important area of Computer Science and Robotics that provided different methods and techniques with successful real world applications in industry, finance, economy, medicine, agriculture, education, management, civil engineering etc. Teaching artificial intelligence to undergraduate students from universities is a challenging task that requires the development of various educational applications with real world correspondence, according to the latest achievements in the domain. In this sense, the paper presents some educational applications of artificial intelligence and focus on three intelligent systems developed by undergraduate students from the Computer Science specialization of the Petroleum-Gas University of Ploiesti for their diploma project presented in July 2019.

The paper is organized as follows. Section 2 briefly presents the main approaches of artificial intelligence. Some educational applications of artificial intelligence are described in section 3. The final section concludes the paper.

2 Artificial Intelligence

The main approaches types of artificial intelligence are symbolic approaches and computational intelligence approaches. Symbolic approaches are based on symbolic logic (such as propositional logic and first order predicates logic) and includes a variety of methods and techniques specific to machine learning, case-based reasoning, knowledge-based systems, pattern recognition, intelligent agents, multi-agent systems, informed search etc. The computational intelligence approaches includes methods and techniques that are inspired from biology, nature etc. Examples of computational intelligence approaches are: fuzzy logic, artificial neural networks, genetic algorithms, nature-inspired approaches such as ant colony optimization, particle swarm intelligence and so on.

Figure 1 shows a representation of the artificial intelligence main approaches and some specific methods.

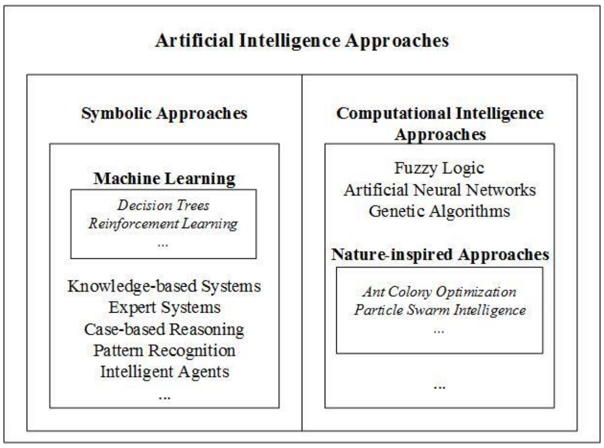

Figure 1. Main approaches of artificial intelligence

Each approach has a number of specific methods and techniques. For example, decision trees and reinforcement learning (with the particular case of Q-learning) are methods specific to the machine learning approach. For every methods and technique specific to an artificial intelligence approach it is provided a theoretical and practical knowledge. Teaching and learning efficiency can be increased by using appropriate examples and applications, developed in simulated or real world environments by tutors and students. For example, learning the topic of expert systems can be improved by giving as examples some educational expert systems applied in different domains. In the next section we shall present some examples of educational applications of artificial intelligence.

3 Educational Applications of Artificial Intelligence

The majority of worldwide universities use as a textbook in artificial intelligence the book *Artificial Intelligence - A Modern Approach* (Russel and Norvig, 2010) written by Stuart Russel and Peter Norvig that was published in three editions, 1995, 2005 and 2010. This textbook provides illustrative examples and applications for the approaches that are presented. We have used this textbook as a basic reference for the course of Artificial Intelligence taught in the final year to undergraduate students of the Computer Science specialization. Also, we have used in the last two academic years the book (Oprea, 2017) that describes some intelligent systems developed in the last years at Petroleum-Gas University of Ploiesti under national and international research projects. Some examples of such applications are EXPERT_AT, an expert system for optimal control (temperature control for an industrial process), CharReco, an intelligent handwritten characters recognition system (for the Romanian alphabet), SBC-Mediu, a multi-expert system for environmental protection (for air, water and soil pollution analysis). Another application of artificial intelligence (using the intelligent agents approach) that was developed in the last years is: an agent-based virtual enterprise for civil engineering (ABVE-Construct) described in (Oprea, 2014). All these applications that were developed by research activities were used also as educational resources for teaching the courses of Artificial Intelligence (at undergraduate level), Software Agents and Intelligent Agents (at two MSc study programs). More applications were developed by students for projects with topics in the artificial intelligence domain either at semester projects or diploma projects.

We have selected three diploma projects that were developed by three students in the academic year 2018-2019 and were presented in July 2019, with topics from machine learning, intelligent agents (intelligent robotics) and pattern recognition.

3.1 Reinforcement learning application

An important technique of machine learning is reinforcement learning (see e.g. (Sutton and Barto, 1998) for an introduction to the topic). This technique can be applied to mobile robotics, e-learning systems, intelligent tutoring systems, games etc. One of the diploma projects (Ilă, 2019) developed a reinforcement learning type machine learning system for a game, Smart Bird, similar to the Flappy Bird game.

Flappy Bird is a simple game in which the bird must go through some obstacles represented by pipes and with every pipe passed the score is incremented with a point, the only actions that the bird can do are jumping or nothing, this actions being represented as inputs from an outsider player. Starting from this idea the project Smart Bird was implemented by using Reinforcement Learning, more precisely Q-Learning (an algorithm whose goal is to learn a policy which tells the agent what actions to take).

In the case of Smart Bird the concept remains the same as in the case of Flappy Bird, but the only thing that is different is that the actions aren't anymore represented by inputs from an outsider player, they are being controlled now by the Q-Learning algorithm.

An important thing to highlight is that the agent has every state rewarded, if the agent is alive, meaning that the agent does not touched any obstacle or ground, the agent receives a reward of 1, otherwise if it dies, meaning that the agent touched an obstacle or ground, it will receive a reward of -1000.

After the system has been implemented both graphically and logically, the agent was left to learn how to get through the pipes, this being possible through the rewards received from the actions taken by the agent in the environment.

The Smart Bird system was implemented using different software products like Unity, Visual Studio Community 2017, Adobe Flash and Paint 3D. It is composed of a logic module and a graphic module, the link between the two models being realized by the Q-learning type reinforcement learning technique.

The experiments that were run showed that after a sufficient number of iterations (e.g. 286 iterations for one of the experiments) the agent starts to learn. The parameters of the system are: iterations number, learning rate, exploration rate, attenuation rate, precision, rewards. Figure 2 shows a screenshot of an experiment that was run for Smart Bird, while Figure 3 presents the agent script with the parameters of the game.

Figure 2. A screenshot of SmartBird experiment run

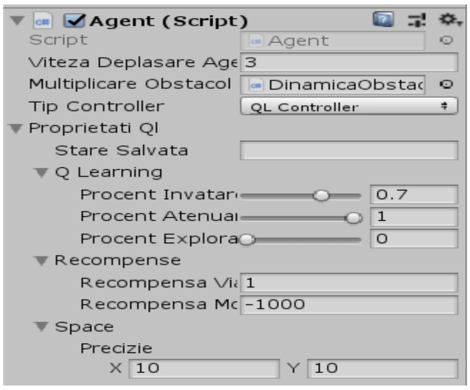

Figure 3. Screenshot of agent script

3.2 Intelligent robotics application

Another type of artificial intelligence application is provided by intelligent robotics, either mobile robotics or industrial robotics and other types of robots such as unmanned aerial vehicles (i.e. drones). Usually, such system involves more robots or drones and can be modelled with intelligent agents or a multi-agent approach (as in (Weiss, 1999)). Two examples of intelligent robotics applications are given in (Hassan and Liu, 2017), where multiple autonomous industrial robots are working in unstructured and complex 3D environments requiring the partitioning and allocation of their working surfaces, and in (Thomaz and Breazeal, 2008), where it is discussed the development of teachable robots. One of our students developed for his diploma project (Neagu, 2019) a simulated multi-drone system for an application (environment monitoring) by using Gazebo 8.0 software tool. The system can be used for industrial applications, as e.g. monitoring and manipulation of objects (i.e. parts of an industrial piece) in a fabrication process. The main software instruments that were used for the simulated system development are: Ubuntu 16.04, the Robot Operating System (ROS), Gazebo 8.0 (for drones 3D modeling), ROS packages for Gazebo, plugins Ardupilot Gazebo, Software In The Loop (SITL) for simulation of Ardupilot firmware, Blender (for Aruco board simulation).

Figure 4 shows an example of simulated environment in Gazebo, with two drones that were modelled.

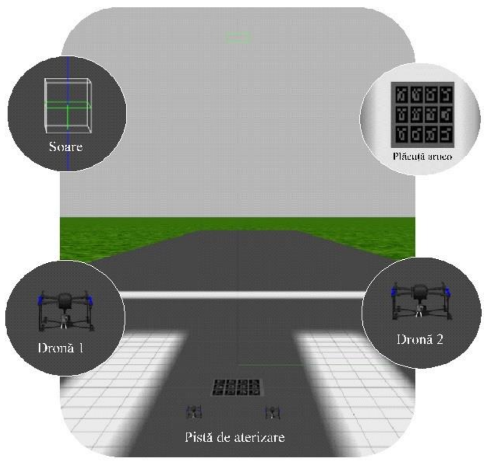

Figure 4. An example of simulated environment in Gazebo

Figure 5 presents the structure of a multi-drone system with three drones of 3D Robotics Iris Plus type simulated in Gazebo. Each drone is viewed as an intelligent agent.

Figure 5. A simulated multi-drone system

For a better understanding of a real world application development, the student constructed a physical drone by assembling its components as shown in Figure 6.

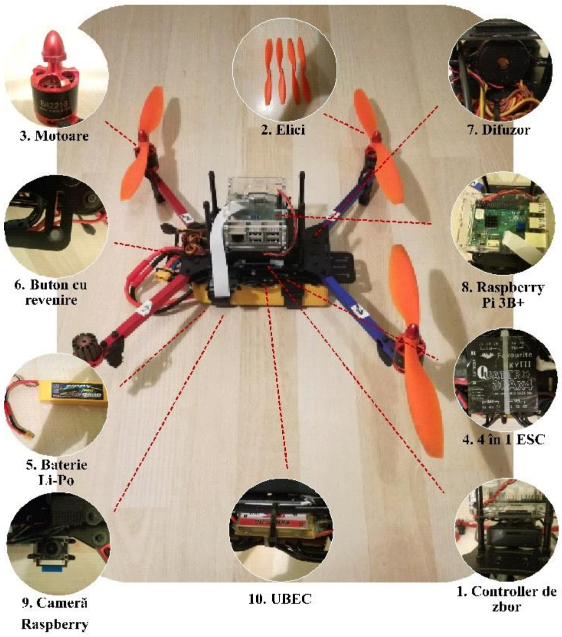

Figure 6. The physical drone.

As a future work the student proposed the development of a real world multi-drone system with two drones for environmental monitoring in a certain geographical area.

3.3 Pattern recognition application

Another important area of artificial intelligence is pattern recognition for computer vision. Some achievements and perspectives related to this field are highlighted in (Duin and Pękalska, 2007). Apart from the statistical and syntactical methods that can be used for pattern recognition, computational intelligence methods proved to be proper for visual pattern recognition as it is emphasized in (Pisharady et al., 2014). The last student application that was developed for the diploma project (Zaman, 2019) presents a system, Signet, for sign language recognition.

Signet performs a simple pattern recognition to a test image with characters of a sign language by using a rule based system. The alphabet codification of a sign language is made by dactilemes. Each dactileme has associated one or more 2D black and white images. Signet uses a models base with dactilemes for each character of the Romanian sign language. The characteristics of the test image are extracted with the *extractLBPFeatures* Matlab local binary pattern function. The texture descriptor is used for image analysis. The test image features are compared with the models images features and if a similar model is identified than the test image is recognized, being associated to it the sign of the model.

Figure 7 shows the Romanian sign language alphabet.

Figure 7. The sign language alphabet for Romanian language
(source: http://dlmg.ro/dictionar)

The software tools used for the development of the Signet sign recognition system are Matlab (application implementation), Adobe Photoshop (processing the test and model images) and Paint (creating test and model images).

The student proposed as a future work the application of a more informed pattern recognition method (as e.g. a computational intelligence method) on RGB images with dactilemes.

4 Conclusion

The paper presented some educational applications of artificial intelligence focusing on three intelligent systems developed by students for their diploma project that can be used as educational resources for teaching the course of Artificial Intelligence. The main benefit of developing such applications by students is a better understanding of the specific artificial intelligence methods as well as an improvement of the student skills and knowledge on using a variety of software tools that are currently used in the software industry.

References

Books:

Oprea, M. (2017): *Artificial intelligence - Theoretical and applicative elements* (in Romanian). Petroleum-Gas University Publishing House, Ploiesti.

Pisharady, P. K., Vadakkepart, P., Poh, L. A. (2014): *Computational intelligence in multi-feature visual pattern recognition*, Springer.

Russel, S. and Norvig, P. (2010): *Artificial Intelligence - A Modern Approach*. Prentice Hall, New Jersey.

Sutton, R. S., Barto, A. G. (1998): *Reinforcement Learning: An Introduction*. MIT Press, Cambridge.

Weiss, G. (1999): *Multiagent systems - A modern approach to distributed artificial intelligence*. The MIT Press, Cambridge.

Journal Articles:

Duin, R. P., Pękalska, E. (2007): The science of pattern recognition: Achievements and perspectives. *Studies in Computational Intelligence* (SCI), *63*, 221-259.

Hassan, M., Liu, D. (2017): Simultaneous area partitioning and allocation for complete coverage by multiple autonomous industrial robots. *Autonomous Robots*, *41*, 1609-1628.

Oprea, M. (2014): ABVE-Construct: An agent-based virtual enterprise model for civil engineering. *Scalable Computing: Practice and Experience*, *15*, 3, 231-248.

Thomaz, A. L., Breazeal, C. (2008): Teachable robots: Understanding human teaching behavior to build more effective robot learners. *Artificial Intelligence*, *172*, 716-737.

Technical Reports:

Ilă, A. (2019): *Design and implementation of a reinforcement learning type machine learning system* (in Romanian), Petroleum-Gas University of Ploiesti, BSc Diploma project, Computer Science specialization, July 2019.

Neagu, Ș. (2019): *Design and implementation of an informatics application for environment monitoring with a multi-drone cooperative system* (in Romanian), Petroleum-Gas University of Ploiesti, BSc Diploma project, Computer Science specialization, July 2019.

Zaman, C. (2019): *Design and implementation of an informatics application for sign language recognition* (in Romanian), Petroleum-Gas University of Ploiesti, BSc Diploma project, Computer Science specialization, July 2019.

Digital Citizenship in Higher Education: What Students Should Know

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Abstract

The technological explosion, communication and information possibilities, entertainment, commerce, etc., with the help of mobile devices and the Internet, not only offer us new challenges and opportunities, but also directly affect our position and role as citizens, our lives, day by day becoming more influenced and connected to the digital world. Although we are experiencing a profound change, we also must face a confusing, overwhelming reality, if we do not know how to handle it correctly. This is the reason why in this article, we aim to illustrate synthetically, possible content suggestions for the courses in order to get the minimum or more advanced digital skills, which will allow all students to be prepared to face the digital challenges.Therefore, we suggest that each student be taught about digital citizenship, either in a separate training module, or incorporated in the curriculum of diverse disciplines (both at bachelor and master programmes). In this respect, it is compulsory that every teacher should know the three principles of a digital citizenship, defined by Ribble (2015), each having three sub-themes or elements: Respect (Digital Etiquette, Digital Access, Digital Law), Educate (Digital Communication, Digital Literacy, Digital Commerce) and Protect (Digital Rights and Responsibility, Digital Security, Digital Health and Welfare). „Respect", „Educate", and „Protect" are key principles both in the digital and in the real world. We consider these principles compulsory for any teacher, to help students be ready for the digital challenges. By understanding and operating these components / topics, students will learn how to be safe, social and savvy online. In addition, digital citizenship involves putting these principles into practice by using them in daily activities, considering common values such as involvement, solidarity, equality, dignity, security and respect, both for themselves and those around them.

Keywords: digital citizenship, inclusion, curriculum, higher education

1 Introduction – why a digital citizenship?

Today, a digital citizen is a person who, by developing a set of skills, is / will be able to be actively, positively and responsibly engaged in both real and virtual communities, locally, nationally and globally (CIET, 2018). In this way, digital citizenship becomes a comprehensive concept aimed at preparing anyone to be able to use information and communication technologies (ICTs) in a responsible, efficient and effective way, benefiting from the opportunities that a digital society can facilitate, and, at the same time, being aware of the risks they can be exposed to. Thus, it becomes obvious that digital citizenship is more than a set of resources and rules constantly updated on the responsible and efficient use of ICTs, while being an educational instrument, with rules and principles that are correlated, and which can be transposed into the current activities that any individual carries out in a society increasingly dominated by technology.

Almost no one doubts that training is needed to ensure active citizenship in a digital world. Therefore, for any person or institution interested in developing training courses in the field of digital citizenship, it is important to know the key areas on which such training is based. One way to organize and incorporate digital citizenship into education is by strengthening its principles of Respect, Education and Safety / Protection (REP), as well as the elements embodied in each of these principles (Ribble, 2015). The REP Triad is tailored to prepare a citizen for active, safe, but also responsible participation, both in offline and online communities. Moreover, since technologies are in continuous evolution, the competences acquired will help citizens have a responsible online behavior in the communities in which they are active, both now and in the future (Ribble, 2015). Each of the three principles is organized around three themes, incorporating nine essential elements. For each of these, training can be carried out, as follows (Ribble and Park, 2019):

1. *Respect* (both for oneself and others), with the following components: (a) *Digital access* - not everyone has the same opportunities in relation to technology. These may vary depending on different socio-economic factors, location, physical conditions, etc. People who have benefitted from better opportunities in terms of access should be more involved in helping those with fewer opportunities. (b) *Digital etiquette* - any online user should understand that the way he uses ICTs has an impact not only on himself, but also on the other people's digital footprint, whether it's a text, audio or video message. (c) *Digital law* - the ease with which technologies and applications specific to online information and communication can be used has caused some problems, such as data theft, harassment, etc., not knowing or ignoring the fact that even for reprehensible online behaviors there is legislation that punishes these deviations.
2. *Education*, both for oneself and others, focusing on the components: (a) *Digital literacy* - facilitated by technology, learning can occur anytime, anywhere, from information from friends, family or other contacts that are made in the online environment. However, we must remain vigilant in critically analyzing this online content and, more than that, be aware that technology is evolving, just as our competencies should be continually updated. (b) *Digital communication* - represents the digital exchange of information. Depending on their own communication needs, each user will have to identify the way / ways in which he will express his messages, so that his "voice" is heard by the targeted audience. (c) *Digital commerce* - nowadays, technologies allow us to sell and buy products anywhere in the world. With all the benefits it offers, we must also be aware of the shortcomings and risks behind these types of transactions, which may affect us.
3. *Digital security / protection*, for both your own person and those around us, including: (a) *Digital rights and responsibilities* - they are extensions of the real ones applied to the digital sphere. Each person must know what rights and responsibilities they have in the online environment, in order to protect themselves and to be active, responsible citizens involved in society. (b) *Digital security* - being digital citizens means that we also have responsibilities regarding the protection and security of our data and of those around us. Failure to take these obligations into account, means exposing ourselves, and others with whom we are in contact, to the risks of intrusion by other online users. (c) *Digital health and well-being* - beyond the opportunities provided by technologies, they also have adverse effects. In this regard, we must maintain a balance between real life and that dominated by technology, for example, by establishing usage limits and offline interactions with family and those in our circle of knowledge.

Thus, the three principles, explored through nine distinct domains, address various components of digital citizenship. By understanding and operating these components / themes, a digital citizen will be able to respect, educate and protect themselves and others in the online environment. In addition, digital citizenship involves putting these principles and related issues into the practice of daily activities, considering common values such as involvement, solidarity, equality, dignity, security and respect for both themselves and those around them.

A first conclusion that emerges is that, any person who browses online and / or regularly uses ICT, has at least a dual citizenship, namely national citizenship and digital citizenship, the latter being less known and explored. As in the case of active citizenship the digital citizenship involves specific skills and abilities, participation and responsibility, rights and duties. In this sense, the purpose of this article is to explore the nine minimum elements of the REP principles, which any digital citizenship course should include, providing answers to questions such as:

1. *Respect*: Who has / does not have digital access and why? What factors prevent a citizen from becoming a digital user? Is the inter-generational digital divide an obstacle to mastering new technologies? Is there a code of good manners on the Internet? What are the rules of good behavior when writing text, posting a picture, or sharing a video sequence? What are the risks and how do we deal with them?
2. *Education*: Do young people / adults know how to manage a media-saturated society? How can we develop our digital communication skills? What kind of digital knowledge and skills do we need for digital literacy? How can we improve our digital literacy? Do we have the ability to critically and effectively use digital media? What kind of difficulties do we face in the online environment and how do we overcome these obstacles? Do we understand the new digital paradigm and its transformative role? What is financial education in a digital world and why do we need it? Do we know how to recognize and use the products and services of the digital economy (electronic payments via mobile phone, electronic wallet, Internet banking, online brokers, crowdfunding, etc.)? Are we prepared to face the digital financial risks (phishing, spyware, SIM card swap, profiling and hacking based on digital traces, etc.)? Do we know how to use financial risk control tools (data theft protection, PIN protection, etc.)? What are the rights of consumers and what kind of remedial procedures exist in the digital sphere?
3. *Safety/Protection*: What are digital rights and responsibilities? What is the privacy and protection of personal data? Can we identify the problems we face (how online rights and freedoms are threatened)? How are the responsibilities assumed? What obligations exist? What is digital security? Do we know what cyber threats are (malware, hacking, etc.)? Do we know what measures to take (how to protect ourselves?)? Do we know how to use the right security tools for security and (self)-digital protection? What are digital health and well-being? How can technology influence health / well-being? What is the influence exerted by the new digital media on health behavior? What does a "healthy" relationship with technology mean? How can users whose lives are increasingly dominated by technology and especially mobile devices (smartphones, smartwatch) and / or gadgets have healthy digital habits? What can we do? What are the ways in which we can support the development of literacy skills for digital health and well-being?

Thus, it can be noted that, depending on the interests of the users and the purposes for which they want to become familiar with these concepts, each of the nine domains can be approached individually, but at the same time integrated, outlining the portrait of a global digital citizenship.

2 REP elements

Digital Access. According to the report "Digital 2019: Global Digital Overview", released in January 2019, over 56% of the world's population was online. If we refer to 2018, the increase in the number of online users is amazing, every day the online population adding almost 1 million new users globally, a trend registered in 2019, when only within 3 months, the online population reached 58% of total global population.

According to the United Nations (UN, 2011), Internet access, whether done at home or elsewhere, has become a fundamental right of all citizens. However, despite the technological developments and infrastructure needed to access the digital and / or online environment from any type of device, not everyone has access to the Internet. We are talking about the "digital divide", a notion associated with increasing differences between the less privileged members of a society (especially poor, rural, elderly or disabled people) and those with higher incomes, living in urban or suburban areas, having and using computers and other types of devices to access the Internet.

Digital Etiquette. It is defined as a set of appropriate and acceptable rules regarding the online behavior of users (Ribble, 2015). A related term is commonly found for the plural form, "online ethics", which refers to the acceptable use of digital resources in an online social environment.

Thus, as in any society, in the digital world, we should follow the rules of good behaviour, which are applicable to everyone, regardless of age, geographical location, socio-economic status, disability, etc. Digital etiquette primarily refers to respect, either for yourself, for the person next to you, or for the person "behind" the screen. Moreover, digital etiquette is not something that we should take lightly, it is absolutely necessary in terms of our online identity.

Digital Law. The Internet is a public space, and its explosive growth determined the necessity of a definition for legal issues when you are either working on the Internet or just having an online presence / identity. Even though the Internet has become, in a relatively short time, a democratic environment, in which millions of individuals operate without limits and discrimination, as in any democracy, there are many users who understand freedom of expression otherwise and, for various reasons, break the rules (sometimes intentionally, sometimes unintentionally, but becoming criminals). Therefore, it is important for each person to know what protection and prevention measures exist, what information and advice on the meaning of these rights and freedoms in practice exist in the Internet space, how they can be exercised, as well as the access procedure in appeals etc.

Digital Communication can be regarded as the ability to create, evaluate, present and communicate digital content, using a variety of technologies. It involves the use, manipulation and adaptation of digital media content to effectively express ideas to others (Eynon, Klages and Vianna, 2013). Digital communication includes multimedia forms of expression, such as text, images and / or video, but also different platforms for digital social media interaction, which explicitly facilitate discussion flows, instant messaging between two or more people, and other types of participatory activities.

Digital Literacy. If literacy refers to the individual's ability to write and read at a minimal, but satisfactory level, to understand and use written communication in traditional environments, digital literacy refers to the same skills transposed into the digital environment.

In 2003, UNESCO defined literacy as "the ability to identify, understand, interpret, create, communicate and calculate, using printed and written materials, associated with variable contexts. It involves a continuous learning process that allows the individual to achieve his / her goals, develop his / her knowledge and potential and to really get involved in the community he is part of and in the larger society ”(UNESCO, 2004, p. 13). Just as literacy is important for the efficient functioning of people in a society, so digital literacy is the link between a digital citizen and his or her active participation in contemporary digital society.

Digital Commerce. The penetration of the “terrible child” of the twentieth century, the Internet, in daily life and activity, represented not only a fundamental and irreversible change for everyone, but also led to the creation of an economy based on the intrinsic qualities of the Internet, the net-economy, in which technology connects anyone to anything and where communication, standards and open markets dominate (Grosseck, 2006). We are talking more and more about tele-work, digital worker, digital workforce, digital jobs, virtual organizations, e-commerce, electronic transactions, etc. In other words, we are talking about a digital economy in which we find almost all types of online resident businesses, in direct connection with innovation, globalization and sustainable development and which "has a great potential to increase productivity, income and social welfare" (Folea, 2018).

In the broadest sense, digital economic literacy falls within the concepts of economic literacy and financial education, but it has its unique aspects, due to the nature of the products and the risks involved in the digital environment (Chetty et al, 2017; OECD, 2018). Although some previous studies (for example, OECD 2017) have described various aspects of digital financial literacy, there is still no standardized definition of digital economic literacy (OECD, 2019). Therefore, it is necessary to teach the students the basic elements of digital literacy (Morgan, Huang and Trinh, 2019): a) knowledge of digital financial products and services (electronic payments through mobile phone, electronic wallet, Internet banking, online brokers, crowdfunding etc.); b) awareness of digital financial risks (phishing, spyware, SIM card swap, profiling and hacking based on digital traces, etc.); c) control of financial risks (protection against data theft, PIN, etc.), as well as d) knowledge of consumer rights and remediation procedures.

Digital Rights and Responsibilities. The phrase "digital rights and responsibilities" refers to those freedoms extended to everyone in a digital world (access, use, creation, distribution, publication of digital content, using various electronic devices or communications networks), as well as assuming responsibility, respecting the rights of others, not to violate them in the activities carried out in virtual spaces.

Digital Security. Along with the remarkable advantages, the Internet has also opened a real Pandora's Box of legal issues, which must be considered very carefully. We need to know what kind of risks are involved, such as the use of unlicensed software from unauthorized sources, the poor security of personal data, computer frauds, insecure banking transactions, phishing, spamming, unauthorized access to social networks / or e-mail accounts, the inclusion of abusive clauses in the contracts closed online, mass surveillance and censorship, privacy violation while processing personal data, and so on. Basically, it is necessary for any person to have a minimum knowledge of digital security, to be able to detect the threats that appear, and to use the most suitable tools for data protection.

Digital Health and Well-being. We live in an era where technology has produced major effects on the health field, and the Internet (especially through its social media contributions) has become a good barometer of the paradigm shift in health and well-being. Digital health is a term used to cover almost everything related to the health / care field assisted by the new information and communication technologies or, more popularly, "medicine from / on the Internet". On the other hand, digital well-being represents that state of well-being, both physical and psychological, intellectual, social, moral of the users of the digital world, which involves both creating and maintaining a "healthy" relationship with technology.

Therefore, in any digital citizenship course, it is necessary to introduce basic elements through which students will be taught how to take care of their own health and digital well-being in digital environments.

3 Conclusions

As we have seen throughout this article, digital citizenship is an umbrella term used to describe a range of topics related to digital access, responsible use of technology, digital financial literacy, digital footprints, and even physical and psychological well-being. It is clear that digital citizenship can take different forms, being considered and approached in different ways by different people. What is important, however, is the recognition that, in order to progress in the new digital society / economy, we need new knowledge and skills, based on the digital age. The digital citizenship model outlined in this paper brings a modern approach to the attention of all the teachers / trainers, managing to turn a technical specialization process into a dynamic, efficient and relevant experience, for the formation of generations of responsible and active citizens.

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References

Centrul de Informare EuropeDirect Timișoara (CIET) (2018): *Ghidul cetățeanului digital. Europa la degetele tale*. https://www.europedirect-tm.ro/wp-content/uploads/2018/12/Ghidul_cetateanului_digital_2018.pdf.

Chetty, K., Qigul, L., Wenwei, L., Josie, J., Gcora, N., & Shenglin, B. (2017): *Bridging the Digital Divide: Measuring Digital Literacy. G20 Insights*. https://www.g20-insights.org/policy_briefs/bridging-digital-divide-measuring-digital-literacy/.

Eynon, B., Klages, M. & Vianna, E. (2013): *Learning matters: Report on the core competency task force*. New York, NY: La Guardia Community College.

Folea, V. (2018): *Trecerea la societatea digitală în țările Uniunii Europene. Studiu de caz România*. Rezumat teză de doctorat, http://doctorat.snspa.ro/wp-content/uploads/2018/09/Rezumat-31Aug2018.docx.

Grosseck, G. (2006): *Marketing și comunicare pe Internet*. Iași: Editura Lumen.

Morgan, P. J., Huanh, B., & Trinh, L. Q. (2019): *The future of work and education for the digital age.the need to promote digital financial literacy for the digital age.* T20 Conference, Japan, https://t20japan.org/wp-content/uploads/2019/03/t20-japan-tf7-3-need-promote-digital-financial-literacy.pdf.

OECD (2017): *G20/OECD INFE report on adult financial literacy in G20 countries*, http://www.oecd.org/daf/fin/financial-education/G20-OECDINFE-report-adult-financial-literacy-in-G20-countries.pdf.

OECD (2018): *G20/OECD INFE Policy Guidance on Digitalisation and Financial Literacy*, http://www.oecd.org/finance/G20-OECD-INFE-Policy-Guidance-Digitalisation-Financial-Literacy-2018.pdf.

OECD (2019): *Draft OECD Recommendation on Financial Literacy and Education*. Paris: OECD, http://www.oecd.org/daf/fin/financialeducation/recommendation-on-financial-literacy-and-education.htm.

Ribble, M. (2015): *Digital Citizenship in Schools. Nine Elements All Students Should Know*. Third Edition. International Society for Technology in Education.

Ribble, M. & Park, M. (2019): *The Digital Citizenship Handbook for School Leaders: Fostering Positive Interactions Online*. International Society for Technology in Education.

UN General Assembly (16.05.2011): *Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression*, Frank La Rue, https://www2.ohchr.org/english/bodies/hrcouncil/docs/17session/A.HRC.17.27_en.pdf

UNESCO (2004): *The Plurality of Literacy and its Implications for Policies. UNESCO Education Sector Position Paper*, http://unesdoc.unesco.org/images/0013/001362/136246e.pdf.

E-Learning Urban Landscape Changes in Post-Socialist Romania Using Digital Mapping

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Abstract

This paper is based on the research results of an internal fellowship project implemented in 2019 and supported by the STAR-UBB Institute, belonging to Babeș-Bolyai University of Cluj-Napoca, Romania. The project is titled "Digital Cluj-Napoca: Enabling Learning and Research by Integrating the Most Recent Trends for Knowing about and Using Urban Areas". The aim of this project was to create an open source online digital product (i.e. an interactive map integrated into a new website) to be used by Geography university students and their professors during the educational process within Human and Regional Geography, when studying the theory of representations. This interactive map is created for Cluj-Napoca and, together with other information on the website, it (re)presents the urban changes it has undergone from late 19th century to the present day, using diverse images and text as media for obtaining the necessary information (photographs, remote sensing images, Google street view, mass-media articles, etc.). Our focus was on industrial sites. For this paper, we chose two of them: "Ursus" Breweries and "Flacăra" Clothing Factory. Using the product ensures correct learning of concepts and supports users' development of their critical thinking and professional skills for territorial analysis.

Keywords: Representations, Web sources, Digital map, Urban development

1. Introduction and Theoretical Background

Geography higher education in Romania was the focus of a series of studies in recent years, aiming at describing students' competences to explore, present and represent space. The urban space and its changes has been a generous topic in this educational context (Bagoly-Simó et al., 2016; Ursu et al., 2019), while attention to land use changes in general, in post-socialist Romania, has been a hot research theme (Petrișor and Petrișor, 2018).

The opportunities of e-learning Geography enabled Romanian researchers to consider the use of diverse tools and software: Facebook (Dulamă et al., 2015), GIS (Ilovan et al., 2016a), Google

Earth (Osaci-Costache et al., 2015), all this taking into account the relevance and usefulness of online research methods for Geography (Ilovan et al, 2016b). In addition, studies assessed the influence of media on education (Cuc, 2014b), of communication systems (Cuc, 2014a) and of learning programmes (Manea, 2015) on supporting education, besides other factors that lead to academic success (Cuc, 2019; Stan and Manea, 2015). To sum up, studies on academic success and assessment in higher education have shown the high diversity of factors influencing students' learning achievement. These research results form the basis of our educational project.

Developing university students' competences to explore, present and represent the urban space, so relevant for their professional improvement (Ursu et al., 2019), was an objective of this project. However, the aim of this paper is to offer university students feedforward – proved to be highly useful (Dulamă and Ilovan, 2016) – when working with digital sources, like the website we created: https://a60194.wixsite.com/digitalcluj and the integrated interactive map (Echipa Digital Cluj-Napoca, 2019a).

This website was created within the project *Digital Cluj-Napoca: Enabling Learning and Research by Integrating the Most Recent Trends for Knowing about and Using Urban Areas*, coordinated by the first author. The project was financed by STAR-UBB Institute (The Institute of Advanced Studies in Science and Technology), within an Advanced Internal Fellowship (didactic excellence informed by scientific research). This fellowship project was hosted by the Centre for Research on Settlements and Urbanism belonging to the Faculty of Geography, and unfolded in July and August 2019. The aim of the project was to realise an open source online digital product, with a didactic aim, for the professors, researchers and students of Babeș-Bolyai University and not only. This digital product is based on the theory of representations considered in Human Geography and in other sciences as well (Sociology, Architecture, Anthropology, etc.).

Specialty literature renders the researchers' interest in studying human communities and their living environment using this theory, but there are not enough digital products that enable university students' fast learning of its main ideas and ways of integrating it in research and didactic projects. This project fills in the gap and, in addition, gets participants involved in activities based on the online environment (collecting the data, digitising data, creating the interactive map, and creating the website itself).

The final products of the project (map and website) present information about the factories of Cluj-Napoca Municipium, where the urban changes from the end of the 19th century to nowadays are rendered by means of using varied images (photographs, remote sensing images, Google street view) and text. In this paper, we chose two factories as case studies: "Ursus" Breweries and "Flacăra" Clothing Factory to exemplify the urban landscape changes, while connecting the theory of representations with ICT within the project is the topic of another forthcoming paper (Ilovan et al., 2019).

2. Material and Method

2.1. Data Collecting, Procedure and Research Material

The research material was represented by the research process carried out by the authors of this paper, the Internet mediated documentation and the use of the printed sources, as rendered in the references part available on the website created for Digital Cluj-Napoca (Echipa Digital Cluj-Napoca, 2019a). We collected the data through bibliographic research, using visual methods and the content analysis method for interpreting the data. We also considered how to analyse and interpret data in educational sciences (Magdaș, 2018). Both statistical-based methods (with their debated relevance and challenges – Petrişor, 2019) and qualitative ones (Ilovan and Doroftei, 2017) were used when approaching online information within our project on Digital Cluj-Napoca.

2.2. Participants

The fellowship project had as target group the members of the Centre for Research on Settlements and Urbanism, teaching staff and researchers of the entire Research Strategic Infrastructure of Babeş-Bolyai University, as well as Bachelor, M.Sc. and Ph.D. students, who would freely use the online digital product, and colleagues who created the digital product (map and the website hosting it). The latter formed the Digital Cluj-Napoca Team and are the authors of this paper: one full professor from the Faculty of Psychology and Sciences of Education, one associate professor from the Faculty of Geography, and, from the same faculty: two Ph.D. students and three M.Sc. students. As mentioned above, the scientific coordinator (Dr. Oana-Ramona Ilovan, the fellowship holder), participated in research, in July and August 2019, and guided the process of completing the study.

3. Results and Discussions

This section includes six sub-chapters, presenting and discussing the following: the use of web sources and its challenges; information quantity on the website; analysis of the digital map; information quality and suggestions for the future users of the website and digital map; analysis of the urban landscape changes, based on online mass media articles; analysis of the online information, similarities and differences between the two case studies.

3.1. The use of web sources and its challenges

Taking information from the online environment may seem easy, but there are issues concerning information clarity and veracity. Specialists from Open Source Intelligence (OSINT) (information analysts) research open sources: mass media, written publications, and web sources. Such research supposes attention and high synthesis capacity when collecting relevant information (Cernat, 2017). Because most of the information analysts activate in fields of national security, they pay a lot of attention to information credibility, relevance and completeness (Niţu, 2011). Analysts mix analytical methods with conventional and non-conventional ones, observing scientific rigour, and also using their imagination and intuition (Niţu, 2011).

At present, the syntagm "fake news" – "syntagm of year 2017" according to Collins Dictionary – (Singh, 2017), is present in the official declarations of important statement (Trump, 2017) and in numerous papers and books, especially about fighting fake news (Bârgăoanu, 2018). The Romanian Information System posted on its Facebook page an educational video (SRI, 2019) on ways of controlling fake news and questions that help us establish information veracity in the online environment ("Has anyone else written about this topic? How credible is the information source? Has anybody signed the article? Who is the author? Is the tone neutral and informative? Does the content match the title? Is the publication date recent? Who is quoted?") (SRI, 2019).

Popa (2015) proposes four criteria for selecting and capitalising information. He suggests realising a table (Table 1) for "preliminary assessment", and proposes information analysis on three levels (low, medium, high), in order to select the most relevant true information.

Table 1. Preliminary assessment of data and information sources

Document title	Source	Preliminary assessment			
		Credibility	Objectivity	Accuracy	Relevance

Source: Popa, 2015, p. 162

Considering the strategy proposed by Popa (2015), we notice that official declarations have high credibility level, and publications provided by national and international bodies have a high level of credibility, objectivity, accuracy, and relevance. Assessing information from sure sources is easier, and the analyst establishes only the information relevance for his or her study, whilst assessing mass media articles is more difficult.

The above-mentioned theoretical information was very useful for us when we realised the website for our project, because most information was from mass media articles.

3.2. Information quantity on the website

For each factory, the information on the website was structured in an (a) abstract about its evolution, (b) images (photographs or other representations of the factory in the online environment or in printed books), and (c) the list of references for text and images.

For "Ursus" Breweries, we posted on the website 18 images and their sources as well as 11 sources (accessed between 1 and 9 July 2019) for the abstract on the history of this factory. For "Flacăra" Clothing Factory, we posted 75 images and their sources and 15 sources for the text (same accession period as above). In addition, five other sources – monographs of Cluj-Napoca Municipium or of the Cluj County – were used for each. All the available online sources for the text of the abstract were used and mentioned in the reference list posted on the site for each factory, while a selection was realised in the case of the images. However, most of the images we found for each factory were uploaded.

3.3. Analysis of the digital map on the website

In this part, we included only a synthesis of the results of the entire project related to the map, as details are available in a forthcoming paper (Ilovan et al., 2019). The map was titled *Digital Cluj-Napoca Map (1850-1989)* (https://a60194.wixsite.com/digitalcluj/ evolutia-industriei-in-cluj-napoca). The structure of the map is explained by the legend, and the following elements were represented: the transport network (European, national and county roads, tram line and railway) and the hydrographical network, the industrial units according to four evolution periods (before 1918, 1919-1947, 1948-1960, and 1961-1989) and the industrial areas (East, Central, and West). It is a map of the main industrial units of Cluj-Napoca during 1850 and 1989.

It was realised in Autodesk AutoCAD 2015 programme. Geographers usually use GIS programmes, but we considered here that AutoCAD was more appropriate because, in Urbanism and in city mapping at large scale, the details are very important and AutoCAD is realised for high precision. Its disadvantage in comparison to GIS is that it lacks certain automatisation in realising maps. Therefore, realising this map in AutoCAD was mainly a manual process.

3.4. Information quality and suggestions for future users of the website and digital map

Text information is objectively presented in the form of short of longer text abstracts. For further information, the users should access the references included on the website for each factory, especially the mass media links that were at the basis of most of the presented information. Information was presented in a chronological order related to the evolution of factories and many concrete data are included (e.g. number of employees, production). In addition, for each factory a visual discourse is made up of images from diverse online and printed sources.

In case users take website information for their projects, they should make a synthesis of this information first. Information on the site is filtered and more complex studies require more in-depth research. Users should compare the information from the website (map, text and images) with information from other sources (direct observation, oral history, printed and online sources).

3.5. Analysis of the urban landscape changes, based on online mass media articles

The presented information about the two case studies (Tables 2 and 3) had as source the online mass media. In Tables 2 and 3, we systemised this information in several categories (causes of factory closure, situation after 1989, impact on the urban landscape, and conclusions), but without including here the source of each information piece. Identification of sources can be realised on the website of the project, where information from other sources is available as well (monographs of Cluj County and of Cluj-Napoca).

Table 2. Urban landscape changes following the closure of "Ursus" Breweries (set up in 1878)

Causes of factory closure	High operating costs; lack of flexibility of the factory location; pressure for the respective spaces to be used more efficiently; city sprawl; factory location in the central city area which prevents its extension and is against urbanism regulations.
Situation after 1989	In 2006, the factory was taken over by SAB Miller, which decided closure of production four years later. In 2010, the factory was closed and in 2013 was partly demolished. A small beer house was set up, with terrace and restaurant, and the rest of the land was sold by SAB Miller to influential businessmen of Cluj-Napoca. In 2016, "Platinia" commercial and residential complex was opened (187 varied-size apartments, with an average price of approximately 1,500 Euro/m^2; 400 Euro/m^2 is the price of land in the respective area). If "Ursus" Breweries decided to sell the land of the former factory, its price would reach about 4 million Euro.
Impact on the urban landscape	They have kept one building where unfiltered beer is produced for the "Cluj Beer Factory" Restaurant (the clients can see how the technological process takes place). The area formerly occupied by "Ursus" Breweries is occupied at present by "Platinia" commercial and residential complex. A radical urban landscape change has taken place: from industrial landscape to a modern luxury residential and commercial one. A landscape contrast is to be noticed between six or eight storeys high "Platinia" complex and the much lower "Ursus" Beer Factory. Transition was made from an industrial unit to spaces for the tertiary sector. Another contrast is introduced by their functions (small production unit, on one hand, and large consumption areas on the other).
Conclusions	Landscape radically changed and people are now interested in its residential and relaxation functions ("Platinia" Mall). The initial idea of creating a beer museum would have increased even more the attractiveness of the area from an architectural point of view, and a cultural landscape would have been created which would have been more consistent with the modern building services complex.

Source: Echipa Digital Cluj-Napoca, 2019b

Table 3. Urban landscape changes following the closure of "Flacăra" Clothing Factory (set up in 1948)

Causes of factory closure	Low profit and fiscal value of the factory; large debts and insolvency; investors were not able to fully regenerate the buildings of the former factory; permanent changes in shareholding.
Situation after 1989	The factory was set up in 1949, and at the beginning of the 1950s it produced military uniforms; later on, it produced clothing for export and it was privatised in 1997. In 2002, it underwent partition and its land and buildings were bought by a real estate company. In 2008 (a real estate boom), the land of the former factory – 18,000 m^2 – was sold for almost 1,000 de Euro/m^2. The factory underwent partition, and the machineries were taken over by the underwear producer Jolidon, and the real estate assets were sold to a foreign company: LBBW Immobilien, the real estate division of a German financial group. The latter even got approval to erect a part of the buildings the investors wished for (there were plans for a mixt functions assembly planned to be

	20 storeys high). They eventually sold their shares to iQUEST company. In 2009, there were plans for a grandiose project. This was a multifunctional assembly with five towers and two entries from different streets, underground parking on three levels, with a total of 1,100 parking lots and, between the buildings the architects planned green areas for recreation, restaurants and coffee shops, and even a swimming pool for residents. Another stage in the factory history was when spaces were rented for approximately one Euro/m^2 to young artists. They did not receive any utilities for the rent, but their presence was important for these utilities to be introduced and the more comfortable spaces had high rents. In 2015, iQUEST company announced that they would move their headquarters from Cluj-Napoca to an A class office building, on the industrial platform of the former "Flacăra" Clothing Factory. The total land surface was of approximately 18,200 m^2, the offices occupying 6,000 m^2. A promise realised in the mass media was that the company would keep and renovate the factory buildings, but this did not happen. They built the new building for the headquarters of iQUEST on the place of the former factory which was demolished.
Impact on the urban landscape	The construction of the building for the IT company determined complete erasure of the former "Flacăra" Clothing Factory. The industrial landscape was transformed radically into a modern one, with high stately buildings. Transition was made from industrial units to services.
Conclusions	A defining element is the factory partition in smaller factories and real estate companies belonging to businessmen influential in the city. The area has become more attractive to people because of the aspect of the buildings and the promenade. If the initial idea of arranging sports fields would have been maintained, the attractiveness of the area would have been higher and the cultural landscape created would have been one for recreation activities.

Source: Echipa Digital Cluj-Napoca, 2019c

3.6. Analysis of the online information for the two case studies

Similarities. Similarly to industry at the national level, the industry of Cluj-Napoca had approximately the same fate: factories were not modernised and thus their productivity and profitability were decreasing down to eventual bankruptcy. After most of the factories were closed, the land owners sold the respective plots, following real estate development with commercial and residential functions. "Ursus" Breweries (set up in 1878) and "Flacăra" Clothing Factory (1948) observed the same pattern. Both factories were in a critical situation at the beginning of the 2000s and soon their activity closed.

The causes leading to closure and demolishment were: the decrease of their fiscal value and profit, insolvency, location problems, lack of regeneration for buildings, sale of their land to businessmen that built real estates for residential and service purposes. The economic factor was the one that dictated land use. The factories, having large land surface, were sold at small prices (because of the state of buildings and soil) and with few improvement works, the price of the 'clean' land was higher than the initial one.

A major change of landscape has taken place: from authentic industrial landscape to one with large and high modern buildings for residential or service purposes.

Differences. In the case of "Flacăra" Clothing Factory, the management was unstable. This was generated by factory partition, which led to the appearance of new shareholders who did not succeed in straightening the situation. In the case of "Ursus" Breweries, even if a big part of it was demolished, investment was made for setting up a small beer house with terrace and restaurant, besides the fact that the rest of the land was sold to those who built "Platinia" residential and commercial complex. The small beer house created a contrast in landscape to "Platinia", while "Flacăra" Clothing Factory was completely replaced by the new headquarters of the iQUEST IT

Company. However, the building of the clothing factory hosted for a short period artists' workshops (similarly to the Paintbrush Factory), but that was not considered profitable by the owners of the building.

4. Conclusions

Using the digital map and the website, besides enabling correct learning of geographical concepts, it supports its creators' and users' development of critical thinking and of some necessary competences when realising territorial analyses (i.e. analysing maps, analysing and interpreting territorial relations at the urban level, identifying solutions to real territorial development problems).

A follow up to this project could be the involvement of the target group in field research to get direct contact with characteristic problems of the former and present industrial areas (e.g. economic, social and environmental).

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References

Bagoly-Simó, P., Dulamă, M.E., Ilovan, O.-R., Kosinszki, S.-A. and Răcăşan, B.S. (2016): Exploring Map Drawing Skills of Geography Teacher Training Students. In: Chiş, V. and Albulescu, I. (eds.), *4th ERD Conference, European Proceedings of Social and Behavioural Sciences* 18, 41-47.

Bârgăoanu, A. (2018). *#FakeNews. Noua cursă a înarmării* [#FakeNews. New Race for Arming]. Evrika, Bucureşti.

Cernat, M. (2017): OSINT – *cine, ce, unde, când, cum?* [who, what, where, when, how?], https://intelligence.sri.ro/osint-cine-ce-unde-cand-cum/ (accessed 12 July 2019).

Cuc, M.C. (2014a): Development of a Communication System for Capitalizing Cultural Diversity. *3rd CY-ICER, Procedia Social and Behavioral Sciences* 143, 63-67.

Cuc, M.C. (2014b): The Influence of Media on Formal and Informal Education. *3rd CY-ICER, Procedia Social and Behavioral Sciences* 143, 68-72.

Cuc, M.C. (2019): The Relationship between Self-Esteem and Academic Success. *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 36-43.

Dulamă, M.E. and Ilovan, O.-R. (2016): How Powerful Is Feedforward in University Education? A Case Study in Romanian Geography Education on Increasing Learning Efficiency. *Educational Sciences-Theory & Practice* 16, 3, 827-848.

Dulamă, M.E., Ilovan, O.-R., Ciascai, L. and Maroşi, Z. (2015): E-learning Geography. How Powerful Is Facebook for Geography University Students? In: Vlada, M., Albeanu, G., Adăscăliţei, A. and Popovici, M. (eds.), *Proceedings of the 10th ICVL*, 121-127.

Echipa Digital Cluj-Napoca [Digital Cluj-Napoca Team] (2019a): *Digital Cluj-Napoca. Facilitarea învăţării şi cercetării integrând ultimele tendinţe privind cunoaşterea şi utilizarea spaţiului urban* [Digital Cluj-Napoca. Enabling Learning and Research by Integrating the Latest Trends in Knowing about and Using the Urban Area], https://a60194.wixsite.com/digitalcluj.

Echipa Digital Cluj-Napoca [Digital Cluj-Napoca Team] (2019b): *Fabrica de bere „Ursus" (1878)* ["Ursus" Breweries (1878)], https://a60194.wixsite.com/digitalcluj/copia-cug (accessed 6 August 2019).

Echipa Digital Cluj-Napoca [Digital Cluj-Napoca Team] (2019c): *Întreprinderea de confecţii „Flacăra" (1948)* ["Flacăra" Clothing Factory (1948)], https://a60194.wixsite.com/digitalcluj/copia-mucart (accessed 6 August 2019).

Ilovan, O.-R. and Doroftei, I. (eds.) (2017): *Qualitative Research in Regional Geography. A Methodological Approach.* Presa Universitară Clujeană, Cluj-Napoca, DOI: http://doi.org/10.23740/QUAL_METHODS2017

Ilovan, O.-R., Dulamă, M.E., Boțan, C.N. and Buș, R.M. (2016a): Using GIS in Initial Professional Training for Territorial Planning During Geography University Studies. In: Vlada, M., Albeanu, G., Adăscăliței, A. and Popovici, M. (eds.), *Proceedings of the 11th ICVL,* 58-65.

Ilovan, O.-R., Dulamă, M.E., Boțan, C.N., Magdaș, I. and Vana, V.M. (2016b): Quality in Geographical Research? Territorial Planning Students' Online Research Methods. In: Chiș, V. and Albulescu, I. (eds.), *4th ERD Conference, European Proceedings of Social and Behavioural Sciences* 18, 210-216.

Ilovan, O.-R., Maroși, Z., Adorean, E.-C., Ursu, C.-D., Kobulniczky, B., Dulamă, M.E. and Colcer, Al.-M. (2019): Learning and Research by Integrating the ICT and the Theory of Representations: Mapping the Industrial Areas of Cluj-Napoca. *Romanian Review of Geographical Education* 8, 2 – under print.

Magdaș, I. (2018). *Prezentarea și prelucrarea datelor cercetării în științele educației. Ghid pentru studenți* [Presenting and Processing Research Data in the Sciences of Education. A Students' Guide]. Presa Universitară Clujeană, Cluj-Napoca.

Manea, A.D. (2015): Lifelong Learning Programs-An Effective Means of Supporting Continuing Education. *4th International Conference on Adult Education in Universities: Local and Regional Perspectives, Procedia Social and Behavioral Sciences* 142, 454-458.

Nițu, I. (coord.) (2011): *Ghidul analistului de informații. Compendiu pentru analiştii debutanţi* [Guide for Information Analysts. Compedium for Beginners]. Editura Academiei Naţionale de Informaţii „Mihai Viteazul", București.

Osaci-Costache, G., Ilovan, O.-R., Meseșan, F. and Dulamă, M.E. (2015): Google Earth Helping Virtual Learning in the Geographical University Education System in Romania. In: Vlada, M., Albeanu, G., Adăscăliței, A. and Popovici, M. (eds.), *Proceedings of the 10th ICVL,* 114-120.

Petrișor, Al.-I. (2019): The Use and Misuse of Statistics in Research: Theory and Practice. *Romanian Statistical Review* 2, 59-70.

Petrișor, Al.-I. and Petrișor, L.E. (2018): Transitional Dynamics Based Trend Analysis of Land Cover and Use Changes in Romania during 1990-2012. *Present Environment and Sustainable Development* 12, 2, 215-231.

Popa, I. (2015). Metoda scenariilor în analiza informațiilor de securitate națională. Studiu teoretic-aplicativ [Using Scenerio Building Method for National Security Intelligence Analysis. Theoretical and Practical Study]. In: Marian, C., Ivan, A. and Basarabă, A. (eds.), *Globalizare. Identitate. Securitate* [Globalization. Identity. Security]. CA Publishing, Cluj-Napoca, 157-178.

Serviciul Român de Informații (SRI) [Romanian Intelligence Service] (2019): *FakeNews. Câteva întrebări simple și un singur sfat. #SRI #awareness* [FakeNews. Several Simple Questions and One Piece of Advice. #SRI #awareness], https://www.facebook.com/sri.oficial/videos/379420989509315/ (accessed 12 July 2019).

Singh, A. (2017): "Cuffing season" and "Corbynmania" are Named Words of the Year by Collins Dictionary. *The Telegraph*, 2 November 2017, https://www.telegraph.co.uk/news/2017/11/02/cuffing-season-corbynmania-named-words-year-collins-dictionary/) (accessed 12 July 2019).

Stan, C. and Manea, A.D. (2015): The Divergent Relationship between Assessment and Self-Assessment in Higher Education. Experimental Results. *3rd ERD Conference, Procedia Social and Behavioral Sciences* 209, 497-502.

Trump, D. (2017). President Donald Trump: I'm not against the Media, Just "Fake News". *CNBC,* 27 February 2017, https://www.youtube.com/watch?v=FT-afm785UE (accessed 12 July 2019).

Ursu, C.-D., Dulamă, M.E. and Chiș, O. (2019): The Competences to Explore, Present and Represent the Urban Space. *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 349-357.

Studying the Urban Landscape at University: Web-based Research and Visual Imagery

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Abstract

Due to technological progress and ever-lower costs in accessing and using the abundant online information, the academia is more prone to use an increasing variety of digital materials to enable students learn Geography. In this study, I documented the research activity I had realised in the past, using picture postcards for Romania and Cluj-Napoca. This paper includes recommendations for research with picture postcards from web sources, in comparison to accessing similar information, in a printed form, available in libraries, archives, and personal collections. My research focuses on assessing, at the university level, the usefulness, for Geography students' education and training, of visual imagery hosted by websites selling picture postcards of the cities in Romania, mainly representations circulated during the socialist period (1948-1989). I explored diverse printed and online sources. However, in several previous papers, I considered the opportunity to create a coherent scientific study using research material identified on a commercial website and, as a case study, the landscape changes of Cluj-Napoca and the way they were rendered by representations in picture postcards, along the 20th century. I concluded that the used website was very valuable in realising my research when the researcher had a high competence level of identifying, analysing and interpreting the visual information.

Keywords: Romania, Cluj-Napoca, Picture postcards, Socialist cities, Representations

1. Introduction

E-learning is more and more part of research and learning, being often an economic way of education and training. Educational research showed that students' learning experience is improved when using the web in a creative manner and this in a context in which curriculum and research design are affected themselves by the use of the web (DeSchryver, 2017). In addition, using both traditional and online sources improves these activities at the university level.

University students are trained to do research, not only to learn and be able to teach Geography. Thus, both professors and university students use web sources to do research. Photographs enable students' understanding and learning of Geography contents. When these are accessible as digital materials, both time and money (for transport, accommodation and living expenses in the place where the library, the archive or the person having the personal collection of photographs are located) are saved and they facilitate e-learning Geography and research in this field.

Recent research on the topic of Information and Communication Technology (ICT) and education is a result of the above-mentioned situation and has shown the main interests within Romanian geographical university education. The following themes have been considered so far: Facebook and e-learning (Dulamă et al., 2015), students' online research methods (Ilovan et al., 2016a), the usefulness of web sources in geography bibliographical research and learning (Ilovan et al., 2018b), and Google Earth and geographical education (Osaci-Costache et al., 2015).

Images are a resource that the academia access to learn about places (Rose, 2012). The use of images and ICT has been one hot topic of educational research at the international level: image processing (Bahr and Okubo, 2013), images and the user experience during digital learning (Gratch and Warren, 2018), landscape changes through systematic repeat photography (Sanseverino et al., 2016), and images of landscapes in relation to nation-building (Tyner et al., 2015). In addition, Romanian researchers manifested interest in land use changes in post-socialist Romania, using diverse images and ICT to document the impact of political and economic changes on the landscape (Petrişor and Petrişor, 2018), and in representations and ideology (Ilovan and Maroşi, 2018; Ilovan, 2019).

The aim of my present research is to assess, at the university level, the usefulness, for Geography students' education and training, of the visual imagery hosted by a commercial website – www.okazii.ro – selling picture postcards of the cities in Romania, mainly representations circulated during the socialist period (1948-1989). It should be clarified here that, although the website was selling picture postcards, downloading the scanned images of those postcards was free. So, I did not buy the physical postcards (like collectors do), I just used the scanned images for research.

Many free web sources are available to use for analysing landscape changes. Because I connected landscape changes in the urban area with representations, I searched for the available free web sources where picture postcards could be found. I analysed the usefulness of the website information on www.okazii.ro in the documentation for a study on representations and development in Romania and a landscape study of Cluj-Napoca urban area. I also analysed the issues faced by the researcher in documenting and using this web source in order to determine how to solve them.

2. Material and Method

2.1. Participants

The investigation involved the author of this paper, her experience during the research conducted for two papers on using picture postcards for analysing the urban landscape of socialist Romania (Ilovan and Maroşi, 2018; Ilovan, 2019), already published, and another one still ongoing research on the above-mentioned topic.

2.2. Data Collecting, Procedure and Research Material

Data collecting and procedure. In general, it is crucial to offer university students indications and requirements for solving tasks, even models. Dulamă and Ilovan (2016) proved that feedforward was powerful in Geography university education and ensuring this when doing research with visual imagery is one of the objectives of this study. In this study, I documented the research activity I had realised in the past, using picture postcards for Romania and Cluj-Napoca. So, there are two levels I consider in this paper and they often interfere: first, my past research on picture postcards and, second, my present reflections from a methodological perspective on how I realised the research mentioned at the first level (in the past). As a result, in this research, I used reflections on my documentation process applied in my papers about Romania and Cluj-Napoca.

The research objectives of the present paper are: to offer a model of research with visual imagery (i.e. feedforward for students and researchers alike); to offer a discussion about the challenges of working with picture postcards from the online environment and not necessarily restricted to it, because many are common to those of conducting research in libraries and archives; to enable future learning activities based on such visual materials.

For my three past articles, the collected data was interpreted through the content analysis method and visual methodology. My choice of a digital source was motivated by a faster and cheaper process of data collecting. The need for the researcher's mobility is true in the majority of cases when visual imagery is collected from libraries, archives and personal collections, because all of these sources usually do not provide a digital collection and therefore the researcher needs to access the physical collection of picture postcards, select the needed sample and scan it (this process is highly time consuming).

The research material of the present article was the research activity based on the mentioned digital visual material and carried out on the Internet by the author of this paper, and by the use of the complementary printed sources (the latter contextualised the respective picture postcards).

3. Results and Discussions

This section includes three parts advocating for good research practice when using picture postcards from web sources as research material: (1) analysis of the methodology for researching with picture postcards; (2) analysis of the competence to use picture postcards from web sources in research and learning; (3) valorisation of information in picture postcards – here the proposed research model based on the case study of Cluj-Napoca.

3.1. Analysis of the methodology for researching with picture postcards

The first series of picture postcards was selected and downloaded from www.okazii.ro (selling picture postcards, among other products and services) during July-September 2018 (more than 200 pieces), paying special attention to the industrial landscape. The second series of 150 picture postcards was collected in October and November 2018, during the unfolding of the writing activity for our 3rd paper. In that paper, we included the picture postcards from this second series, when we focused on other features of the urban area than those introduced solely by industrial objectives (i.e. factories).

There are some difficulties during collecting the research material (i.e. the picture postcards). At the moment of selecting the images and in fact during the entire research process (not only selecting, but also analysing and interpreting picture postcards), I realised that it is important for the researcher to know well the represented places. For instance, the fact that not all picture postcards have a title explicitly mentioning the place they depict, requires the researcher to recognise the place. Researcher's high competence level or continuous training to achieve this can help overcome the challenges.

Picture postcards on my topic were identified in other sources, too (libraries and archives in Romania and Germany), but their use in research required scanning (I experienced also this). Currently, the easiest and most economical way to obtain picture postcards about any place in Romania is searching the www. Searching with the key words "carte poștală Cluj" (in English, "Cluj postcard"), a selection of the images was realised.

This is a subjective form of research based on interpreting representations, having the theory of representations as background. Here, it is important to underline that usually the urban landscape is imbued with many juxtaposed layers of meaning. This means that the landscape is a representation of diverse meanings and discourses. Using photographs to analyse the urban landscape it means that we use representations of representations, because those photographs are representations in themselves (they are representing the landscape or the urban "reality"). Furthermore, during research with images, we represent again these representations, in a written text and visual discourse (i.e. by selecting certain picture postcards) about the visual discourse articulated by the picture postcards of the period.

Our interpretation of the selected picture postcards is shaped by the lens through which we choose to read the respective representations: in my case, that of the impact of the Communist ideology on the Romanian society and on the urban landscape. Nevertheless, one should take into account that the represented places are highly textured in cultural meaning (although that of the dominant culture – here the political one – is more visible). Some of the representations are more generous in the sense that they render multiple cultural layers of the respective landscape, although the dominant visual discourse subordinates them. Picture postcards depict the urban landscape of Romania in a certain way that can be read by employing a de-constructivist approach of the clues pointing at the dominant political and socio-cultural discourse of the period.

The methodology I used for the visual imagery I selected was based on qualitative content analysis and semiology. I did not use a quantitative contents analysis with a series of coding categories because my visual imagery was also a sample I selected of the available picture postcards, not the entire lot: "As Rose (2007, p. 72) asserted, 'numbers do not translate easily into significance'. A multi-method approach is highly recommended for interpreting visual culture" (Brito-Henriques, 2014, p. 322). Although making statistics was not an objective (cf. Petrişor, 2019, for a discussion about the 'compulsory statistics' in scientific research), one can mention that approximately 350 picture postcards were selected and analysed (in the first stage, more than 200 pieces and, in the second one, approximately 150 pieces).

My scientific analysis in the results and discussion parts of the respective papers (Ilovan and Maroşi, 2018; Ilovan, 2019) is based on the semiotic analysis of the photos in picture postcards. This approach was necessary in order to identify the underlying meanings which were so closely related to the political ideology of communism. I analysed the Romanian urban imagery proposed/produced by the Party propaganda (as it was strongly related to what was the focus of the development of Romania at a certain moment). The selected part of the geography of places is rendered in the picture postcards, which is why that can be easily related to certain discourses.

Representations in connection to development of Romania and political power were searched for and found, thus it is crucial that students learn to use the online information in the form of picture postcards with information from other visual and text sources.

3.2. Analysis of the competence to use picture postcards from web sources in research and learning

One of our recent studies on the visual materials from web sources (Magdaş et al., 2018) shows that one needs a certain competence level in designing digital visual materials use in e-learning Geography. This proves to be the case also for researching with visual imagery: the criteria we identified in our previous research (Magdaş et al., 2018) are also relevant here in order to assess the researcher's and student's competence level. These assessment criteria (in brackets) refer to the following aspects: *choosing of visual materials* (optimal number; correctness; clarity; relevance; specification of the source) and *using visual materials in learning activities* (systematic analysis of content – components, attributes and relationships; interpretation of content; solving tasks by using visual materials; analysis depth and interpretation of content; fairness of analysis and interpretation of content; consistency of analysis and interpretation of content; value of studied aspects – essentiality, novelty) (Magdaş et al., 2018, p. 281).

3.3. Valorisation of information in picture postcards. A sample of the analysed research

I listed and classified the visual imagery used and I analysed its contents. Based on my work, hereby I would like to propose an analysis model. For relevant results, it is important to use various sources and to combine research methods. In my research about the picture postcards, to complete information from the visual material, printed sources were used where available, or further information on the Internet was searched for. Starting from text and visual imagery, I was able to research two themes included in this subchapter: (a) *Features of the main representations of the urban area that are related to the discourse on development during socialist Romania* and (b) *The case study of Cluj-Napoca.* Because of the available space, I decided to illustrate with picture postcards only the second theme.

(a) ***Features of the main representations of the urban area that are related to the discourse on development during socialist Romania.*** The main territorial development policies during socialist Romania had a considerable impact on the territory and on people's way of living. The policies concerning industrialisation, urbanisation and systematisation are relevant from political and economic perspectives. They were supported by Party ideology and architectural production. Thus the role of propaganda in development and its representations was to re-enforce the main territorial development policies during socialist Romania.

Urban development strategies, social policy, and all spheres of life were influenced by the Romanian Communist Party's ideology (Copilaş, 2015) and thus the new urban identities were constructed by the working people, for the working people, and (re)educating their lifestyles. The social landscape was changing as development meant an obsession with industrialisation, which resulted in forced urbanisation (Copilaş, 2015; Urucu, et al., 1984). People coming from the rural area lived and worked in the growing towns and cities of Romania and such a change asked for new architecture that would order and sanitise the urban area. The forging of the new town and cityscapes was no easy task, because political ideology was to be observed at all costs.

The authoritative ideological discourse was homogenising the architectural and visual production in Romania. Iconic images and the messages behind them were integrated into inhabitants' concepts of identity and national pride and in their structures of expectations (Ilovan et al., 2018a). Devoid of freedom, they were taught what to be proud of, because all of these were part of their lives and products of their labour.

The visual culture of the period was shaped through diverse means. The visual imagery of picture postcards is a source that proves why the socialist ideology continues to shape the inhabitants' perceptions of their cities, as well as their discourse on the differences between now and then, often with a nostalgic touch.

The discourse construction of prosperous socialist Romania was supported by iconic images as those from picture postcards. The encomiastic messages that these representations transmit are just one of the sources that constructed the discourse of the Golden Age when N. Ceauşescu was the supreme ruler of Romania. The legacy of socialism, including its representation stereotypes, is part of contemporary cultural representations of the Romanian urban area. Its ideology is still active in the post-socialist present and it affects social relations: representations of socialist power are part of the urban landscape. They shape people's behaviour, attitudes, they radically influenced their set of values related to societal and individual development, political power, culture, social interaction, their expectations (Ilovan et al., 2016b), and "the way reality is produced" (Brito-Henriques, 2014, p. 321).

Picture postcards reflect the main products of this forced urban development: mass housing, industrial facilities, urban modernisation (hotels and restaurants represented as testimonies of development, welfare and consumption), and the construction and reconstruction of urban centres (e.g. picture postcards where representations and symbols of political power prevailed). These representations offered by picture postcards were part of the Party's discourse on development, they were part of the "Communist project".

Social housing and affordable architecture were given more visibility and brought nearer the civic centres or were now part of them. Still, privileged architecture was crucial in visually representing power and its ideological markers translated from theory into practice. The discursive dominance of such visual ideological markers was "truthfully" rendered by picture postcards' choices of images and urban landscapes.

(b) The case study of Cluj-Napoca. It exemplifies a coherent visual discourse resonating with the propaganda of the socialist period. To demonstrate, I introduced here three picture postcards from our surveyed sample (Fig. 1 and 2), where landscape changes of the urban area of Cluj can be identified.

Picture postcards of the period are a reflection of the intense construction activity; they render the rhythm of modernising Romania. The urban space was radically transformed physically, while the ideological discourse made its way through all possible channels (including visual propaganda) to "help people adapt" to and understand/read "correctly" those rapid transformations.

Ideologically-correct representations of the urban area form the visual discourse of picture postcards were circulated. Of course, the formation of place images was not based on a single source (i.e. picture postcards), but also on newspapers, magazines, school textbooks, TV, etc. and all these contributed to creating a coherent visual discourse.

Public spaces during socialism were shaped, besides buildings, by the presence of memorial edifices, statues, busts, etc., very significant in constructing place memory and representations. However, the main representations in picture postcards focused on the process of systematisation of the urban area and on its results (Fig. 1), on representations of industrial development, on residential areas (blocks of flats as a proof or witness of forced and rapid urbanisation, on administrative buildings) – seats of the Romanian Communist Party powerful administration apparatus, on cultural edifices (Syndical Houses of Culture), museums (of the history of the Romanian Communist Party), commercial areas (e.g. universal stores), etc.

Fig. 1. Urban infrastructure: Gheorgheni Neighbourhood (Source: *Carte Poştală Cluj, Cartierul Ghoergheni, circulată* – see references)

These images of picture postcards are proof of the levelling vision promoted by ideological-driven architecture during socialism and of a coherent visual discourse about nation and development. In the case of Cluj-Napoca, past images and symbols were recirculated, along the new ones, during socialism, legitimising it. For instance, the old (statues with Romanian historical figures), the new (Belvedere Hotel, built in the 1970s) and the political (city council) were displayed in such a postcard, published in the 1980s, with explanations on its backside: "Cluj-Napoca: 1. Statue of Baba Novac, 2. Statue of Michael the Brave, 3. 'Belvedere' Hotel, 4. Headquarters of the County Popular Council". Other picture postcards exhibit prestige buildings in Cluj-Napoca old urban core: one, circulated in 1964, shows "Cluj. Romanian Popular Republic. The University Students' Culture House" and another one, circulated in the 1980s, represents Babeș-Bolyai University. Similarly, The Romanian Opera and Theatre, as well as the Statue of Matei Corvin with St. Michael's Church and the Union Square, and Michael the Brave Square were very often represented in the picture postcards of the socialist period.

However, plenty of picture postcards are images with neighbourhoods with blocks of flats, where the construction process is represented (rather rare) and the neighbourhood after construction (Fig. 2).

These neighbourhoods are the newly introduced elements in the representations of the urban area of Cluj, as compared with the previous period when picture postcards were produced and circulated, too. In the first image below (Fig. 2), is General Dragalina Street and one can see that Belvedere Hotel had not yet been built on the hill behind. The hotel was built in the 1970s. Taking this information into account, we could identify that the postcard was produced in the 1960s, although it had no year mentioned and only the front of the postcard was available on www.okazii.ro (sometimes, on the back, one can find a postal stamp with the delivery date, the author of the picture, the name of the place, etc.). The second image is of Grigorescu Neighbourhood, with the new blocks of flats in Donath Street, in the foreground.

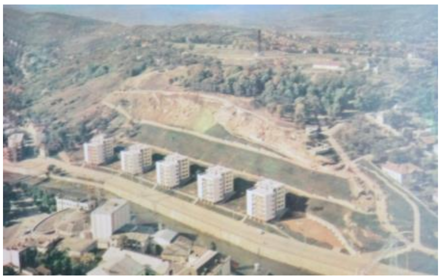


Fig. 2. Standardised appearance of collective housing: (left) View from Cluj, the 1960s; (right) Cluj, 1966. Source: *Carte poștală Cluj, necirculată; Carte poștală Cluj*)

The processes of socialist modernisation and systematisation of Cluj started in the 1960s and also preservation as a strategy for territorial planning may be easily identified in picture postcards documenting in fact the entire development of this city. Picture postcards of Cluj-Napoca after 1989 include *old and new landscape elements* in the same collage, such as Saint Michael Roman Catholic Church (old), Lupa Capitolina (new element in the landscape of the central area, after 1989), The Orthodox Cathedral (old) and the Statue of Avram Iancu (new), The Statue of Matei Corvin (old), Memorandiștilor Monument (new), and The Statue of Michael the Brave (old).

4. Conclusions

Professors and students use visual materials to enable their understanding and learning of scientific geographical contents. In Romania, easy, fast and quite cheap access to Internet lead to increased use of visual materials in e-learning and research. This study is the result of an analysis of my previous research during which I used a website – www.okazii.ro – to obtain the research material (i.e. picture postcards), and of the way I used the respective website in comparison to the available "traditional" sources: libraries, archives, and personal collections. I analysed a selection of the picture postcards representing the urban area of Romania and of Cluj-Napoca hosted by www.okazii.ro and how useful that website and the picture postcards were in representing landscape changes.

Considering the complexity of my research using picture postcards (Ilovan and Maroși, 2018; Ilovan, 2019), I concluded that the commercial website www.okazii.ro was very useful in providing me with rich research material, fast and with no costs.

During the research, I was challenged by the following: many picture postcards had no title and author of the photographs (also because some of those selling the respective postcards did not scan the backside of postcards, where such information could be available, but not necessarily); a difficult process of identifying certain images; the process of classifying the picture postcards considering diverse criteria required solving the challenges mentioned before as well as the researcher' high competence level to be able to assess correctly information from visual imagery.

In addition, researchers/students need very good knowledge (preferably direct one) of the area they research, in order to be able to analyse and interpret correctly the information in picture postcards. Moreover, I recommend very good bibliographical research before searching for picture postcards "to enable correct, in-depth, and coherent analysis and interpretation of the visual materials contents" (Magdaș et al., 2018, p. 483).

A repeated pattern behind the representations of the urban contributed to creating the cultural identity of the urban area and the place-attachment of inhabitants. Representations shaped the way Romanians imagined themselves (besides sources like newspapers, maps, school textbooks, etc.). Therefore, present territorial planning should be informed by such representations and their influence on present spatial perceptions. A very good reason for Geography university students and researchers to be trained in working with representations, especially from picture postcards, which were highly circulated, had multiple layers of meaning, and influenced people in reading urban landscapes.

References

Bahr, T. and Okubo, B. (2013): A New Cloud-based Deployment of Image Analysis Functionality. *GI_Forum 2013: Creating the GISociety*, 243-250.

Brito-Henriques, E. (2014): Visual Tourism and Post-colonialism: Imaginative Geographies of Africa in a Portuguese Travel Magazine. *Journal of Tourism and Cultural Change* 12, 4, 320-334.

Carte poştală Cluj [Picture Postcard of Cluj], https://www.okazii.ro/cpi-b9025-carte-postala-cluj-a191622020, accessed 2018.

Carte poştală Cluj, Cartierul Ghoergheni, circulată [Picture Postcard of Cluj, Gheorgheni Neighbourhood, circulated], https://www.okazii.ro/bnk-cp-cluj-cartierul-gheorghieni-circulata-a198285558, accessed 2018.

Carte poştală Cluj, necirculată [Picture Postcard of Cluj], https://www.okazii.ro/sept15-vedere-carte-postala-cluj-necirculata-a176663874, accessed 2018.

Copilaş, E. (2015): *Naţiunea socialistă. Politica identităţii în Epoca de Aur* [The Socialist Nation. Identity Politics during the Golden Age]. Polirom, Iaşi.

DeSchryver, M. (2017): Using the Web as a Higher Order Thinking Partner: Case Study of an Advanced Learner Creatively Synthesizing Knowledge on the Web. *Journal of Educational Computing Research* 55, 2, 240-271.

Dulamă, M.E. and Ilovan, O.-R. (2016): How Powerful Is Feedforward in University Education? A Case Study in Romanian Geography Education on Increasing Learning Efficiency. *Educational Sciences-Theory & Practice* 16, 3, 827-848.

Dulamă, M.E., Ilovan, O.-R., Ciascai, L. and Maroşi, Z. (2015): E-learning Geography. How Powerful Is Facebook for Geography University Students? In: Vlada, M., Albeanu, G., Adăscăliţei, A. and Popovici, M. (eds.), *Proceedings of the 10th ICVL*, 121-127.

Gratch, J. and Warren, S.J. (2018): Critical CineEthnographic Methods: A New Dimension for Capturing the Experience of Learning in Twenty-First Century Qualitative Research. *Techtrends* 62, 5SI, 473-482.

Ilovan, O.-R. (2019): Visual Imagery and Propaganda during Communist Romania (1948–1989): Picture Postcards as a Tool. *Connections. A Journal for Historians and Area Specialists*, 18.05.2019, <www.connections.clio-online.net/article/id/artikel-4767>

Ilovan, O.-R. and Maroşi, Z. (2018): Markers of Visual Identity: Industrial Sites and Landscapes in Picture Postcards during the Socialist Period of Romania. *Acta Technica Napocensis: Civil Engineering & Architecture* 61, 3, *Special Issue – Intern. Conference - Architecture Technology and the City, Workshop Questions*, 132-151.

Ilovan, O.-R., Dulamă, M.E., Boţan, C.N., Ciascai, L., Fonogea, S.F. and Rus, G.M. (2018a). Meaningful Learning: Case Studies on the Territorial Identity of Historical Urban Centres. In: Chiş, V. and Albulescu, I. (eds.), *5th ERD International Conference, European Proceedings of Social and Behavioural Sciences* 41, 413-421.

Ilovan, O.-R., Dulamă, M.E., Boţan, C.N., Magdaş, I. and Vana, V.M. (2016a): Quality in Geographical Research? Territorial Planning Students' Online Research Methods. In: Chiş, V. and Albulescu, I. (eds.), *4th ERD International Conference, European Proceedings of Social and Behavioural Sciences* 18, 210-216.

Ilovan, O.-R., Jordan, P., Havadi-Nagy, K.X. and Zametter, T. (2016b): Identity Matters for Development: Austrian and Romanian Experiences. *Transylvanian Review* 25, Supplement 1, 261-276.

Ilovan, O.-R., Kosinszki, S.A., Dulamă, M.E. and Marin, M. (2018b): Usefulness of Web Sources in Geography Bibliographical Research and Learning. In: Vlada, M., Albeanu, G. Adăscăliţei, A. and Popovici, M. (eds.), *Proceedings of the 13th ICVL*, 272-277.

Magdaş, I.C., Ilovan, O.-R. and Ursu, C.D. (2018). Visual Materials from Web Sources in Studying Regional Geography Topics. In: Vlada, M., Albeanu, G. Adăscăliţei, A. and Popovici, M. (eds.), *Proceedings of the 13th ICVL*, 278-284.

Osaci-Costache, G. Ilovan, O.-R., Meseșan, F. and Dulamă, M.E. (2015): Google Earth Helping Virtual Learning in the Geographical University Education System in Romania. In: Vlada, M., Albeanu, G., Adăscăliței, A. and Popovici, M. (eds.), *Proceedings of the 10th ICVL*, 114-120.

Petrișor, Al.-I. (2019): The Use and Misuse of Statistics in Research: Theory and Practice. *Romanian Statistical Review* 2, 59-70.

Petrișor, Al.-I. and Petrișor, L.E. (2018): Transitional Dynamics Based Trend Analysis of Land Cover and Use Changes in Romania during 1990-2012. *Present Environment and Sustainable Development* 12, 2, 215-231.

Rose, G. (2012): *Visual Methodologies: An Introduction to Researching with Visual Materials*. Sage, London.

Sanseverino, M.E., Whitney, M.J. and Higgs, E.S. (2016): Exploring Landscape Change in Mountain Environments with the Mountain Legacy Online Image Analysis Toolkit. *Mountain Research and Development* 36, 4SI, 407-416.

Tyner, J., Kimsroy, S. and Sirik, S. (2015): Landscape Photography, Geographic Education, and Nation-Building in Democratic Kampuchea, 1975-1979. *Geographical Review* 105, 4, 566-580.

Urucu, V., Ciangă, N., Cândea, M., Erdeli, G. and Idu, P.D. (1984): Probleme ale sistematizării teritoriului şi localităţilor [Issues of Territorial and Settlement Systematisation]. In: Cucu, V. and Iordan, I. (coord.), *Geografia României – Geografia Umană şi Economică, vol II*. Editura Academiei R.S.R., București, 504-510.

Increasing Generation Z Geography Students' Learning through Didactic Films in University

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Abstract

The aim of this research was to identify improvements and adaptations of the support electronic resources aimed for Generation Z students – the digital natives – in order to help them learn the Didactics of Geography. To achieve this aim, together with students at the Faculty of Geography, Babeş-Bolyai University, in Cluj-Napoca, who attended Level II of the Psychological and Pedagogical Programme, we made a series of didactic films and we created, on Facebook, the closed discussion group titled "Didactic Films". Our objective was that 2nd year students who attended Level I of the same programme learnt to analyse the contents of certain didactic resources photographs, sketches charts, maps, and the geographical globe) together with students from the pre-university system. For an in-depth learning, for each film posted on the discussion group, we associated several questions to identify the used didactic methods, their role in organising the learning process and in increasing learning efficiency.

Keywords: smartphone, digital natives, Geography higher education, Didactics of Geography

1. Introduction and Theoretical Background

In recent years, the rapid speed of advanced technology determined changes in how students learn. The fact that there is a wide variety of applications (web-based applications, mobile applications, movie making tools, assessment tools), as well as the accessibility of smart devices, has facilitated the improvement of courses by educators through the practice of Smart Learning (Amer and Harous, 2017). Videos, films, PowerPoint presentations, the Internet and the World Wide Web are used in Geography teaching and learning (Richter and Van der Westhuizen, 2005) .

There are many studies regarding the use of films in studying Geography in the specialized literature (Dulamă, 1996; Dulamă and Roșcovan, 2007) and in the knowledge of the geographical space (Dulamă, 2004), in the context of developing students' Geography-specific competences in a variety of learning environments (Deac et al., 2019; Ursu, Dulamă and Chiș, 2019). The film and humor were uniquely combined to study the socially constituted and contested nature of space and place (Alderman and Popke, 2002). Students express different opinions on the effects of watching and discussing country films (Xu, 2012). Some studies claim that a short period of time in a video on

History or Geography topics of a large amount of information can have a negative effect on understanding and learning (Arias-Ferrer, Egea-Vivancos and Monroy-Hernandez, 2019). In other studies, it is emphasized that students are currently exposed to a wealth of information and their attention is distracted by gadgets, such as smartphones (Grecu, Deneș and Ipiña, 2013).

In addition, there are studies devoted to the characteristics of digital resources in higher education that focus on changing the design of innovative learning programs (Vlada and Adăscăliţei, 2014). In the higher education, in various fields, film making activities have been implemented and evaluated as teaching methods with an active role in learning (Grecu, Deneș and Ipiña, 2013). More recently, video and digital playback equipment has further enhanced the capability of educators to introduce film into the curriculum (Clemens and Hamakawa, 2010).

Moreover, during the teaching activity in higher education, at the Faculty of Geography, bachelor and master levels, we noticed the students' tendency to frequently use different devices (*smartphone*) to identify, deepen, clarify and exemplify information as well as for online resources (Ilovan et al., 2015; Dulamă, Magdaș and Osaci-Costache, 2015). We found that students own high quality digital skills (Ilovan et al., 2016), that they use ICT for professional purposes (Dulamă, Magdaș, and Osaci-Costache, 2015), and that the smartphone is a tool widely used on site to collect geographic data (Magdaș et al., 2018). To capitalize on this specificity of Geography students, we used the Facebook social media for Geography learning (Dulamă et al., 2015), for space knowledge (Dulamă, Ilovan and Buș, 2016), and for evaluation (Dulamă, Vana and Ilovan, 2016).

During this research, we aimed at identifying ways to optimize and adapt to B.A. and M.A. students of Z generation – "digital natives" – to support electronic resources for course and seminar activities, for frequency education, for low frequency education and for distance learning. In doing this, we considered recent reaseach on the Romanian university students' teaching practice (Catalano and Chiș, 2016), on the benefits of learning through cooperation (Chiș et al., 2019), as well as related to promoting excellence and academic success in general, in higher education (Cuc, 2012, 2019; Manea, 2015; Stan and Manea, 2015). To achieve our goal we organized an experimental activity both at the Faculty of Psychology and Sciences of Education and at the Faculty of Geography, Babeș-Bolyai University of Cluj-Napoca.

2. Material and Method

2.1. Research design. The experimental research was carried out within the project *The capitalization of advanced technologies in support resources for teaching-learning in higher education* held in 2019. We organized three workshops on creating multimedia resources (didactic films), a didactic experiment that used these resources by finally and publicly presenting the results of the project.

2.2. Data Collecting, Procedure and Research Material

Through using the observation method, we collected data on making didactic films. By using the interview method, we found out the opinions about the difficulties that students faced in making these products, about the didactic films and their use during the learning process. We adapted the questions depending on the specifics of each activity. We interviewed the students participating in the films from the Faculty of Geography, Babeș-Bolyai University of Cluj-Napoca and the students who watched these products. We analyzed the answers using the content analysis method. We analyzed multimedia products through visual methods. The research material is represented by the observations on the process of making didactic films, the students' opinions about the process of making these products, about films and their use during the learning process. The processing of the research material took into account recent research in the sciences of education (Magdaș, 2018).

2.3. Participants. In making the didactic films, three students who complete the level II of Psycho-pedagogical Studies Program at Babes-Bolyai University of Cluj-Napoca were involved. In the experimental activity, students from the second year of the Faculty of Geography attending the aforementioned program participated in order to become teachers.

3. Results and Discussions

3.1. Analysis of multimedia resources during the workshops. We made the multimedia products during three workshops of two hours each, held at the Faculty of Psychology and Sciences of Education in the Research, Development and Innovation Unit titled *Work and Organizational Psychology Research Center*, with the participation of professors and researchers of other research units within the BBU, B.A., M.A. and PhD students. During these activities we made several didactic films where the first author demonstrated how Geography students and teachers can use more educational resources (map, photograph, chart, and geographical globe) and teaching methods. During some demonstrations, a student who played the role of the learner was involved. The second author made the films by using a smarphone. All participants were involved in experiential learning.

Each workshop included several stages: filming the demonstration activity; watching the film on smartphones; restoring the film if needed. After each workshop, the films were sent via Wetransfer by the author to the professor who watched them on the laptop and evaluated. During the production of multimedia products, we came to the conclusion that we needed to write the script for each film and to detail what it exposed, what it explained and what the teacher asked, but also what the learner should have answered. Regarding the shooting, during the first workshop we established how the teaching resource should have been set up as well as the angle of which we could achieve the optimal shooting. In Table 1, the films are presented: seven in the first workshop, three in the second and five in the third.

The quantity of information of each film, the duration and the difficulties we faced in disposing the teaching resources in space and the use of smartphone in making the film can be observed. In the third workshop, we noticed the production of shadows because of the gloss of the foil, the sound disturbance by rain drops and the need for a larger space to allow an optimal position of the Earth geographical globe during the demonstration. Regarding the transfer of the films from one person to another, we identified the disadvantage that uploading and downloading took a long time because each film had a large amount of GB.

Table 1. Multimedia products, quantity of information (GB) and position of teaching resources

Workshop	Movie title	Amount of information (GB)	Duration (Minutes)	Position of teaching resource
1	Vegetation floor	262	3.51	correct
	Aquifer layers (film A, film B)	514; 434	7.27; 6.15	correct
	Earth’s revolutionary movement (film A, film B)	552; 480	6.40; 6.50	film A wrong; film B correct
	The meanders of a flowing water	478	2.04	wrong
	Aggregation states of water	536	1.02	wrong
2	Aggregation states of water	59	0.53	correct
	The hydrographic network of Romania	266	3.56	correct
	Major relief units of Romania	71	1.04	correct
3	Crops	531	7.47	correct
	Mountainous relief	539	7.54	correct
	Steamship production in Japan, South Korea and the rest of the world	503	7.22	correct
	Earth’s Rotation	419	6.09	correct
	Earth’s Revolution	641	9.23	correct

3.2. Analysis of multimedia products. To demonstrate the use of teaching resource in learning, we conducted learning activities based on sketches (5 films), maps (2), graphic organizers (1), photos (1), graphics (1), and on the geographical globe (1). In using these resources, we employed "traditional" teacher-centered methods (exposure, explanation, and demonstration), methods based on teacher-student dialogue (conversation), and student-centered methods (exposure) (Table 2). The films have a duration ranging from 0.53 minutes to 7.54 minutes. In terms of films quality, we note that they expose a good clarity and brightness so the smartphone is a device by which the media can achieve good quality products with minimal effort. With regard to the content of the films, we believe that exposure is clear, the rhythm is appropriate, but there are some errors in the oral communication because of the fact that the oral presentation, explanations and conversation are authentic, without previous preparation or a rigidly followed scenario.

Table 2. Multimedia products, teaching resource and methods

Movie title	Teaching resource	Teaching methods
Earth's revolution	sketches	Teacher's oral presentation / explanation
Vegetation floor	sketches	Teacher and student oral presentation
Aquifer layers (film A, film B)	sketches	Teacher-student conversation
The meanders of a flowing water	sketches	Teacher-student conversation
Aggregation states of water	sketches	Student's oral presentation
The hydrographic network of Romania	map	Teacher-student conversation
Major relief units of Romania	map	Teacher-student conversation
Crops	clusters scheme	Teacher's oral presentation / explanation
Mountainous relief	photo	Teacher's oral presentation / explanation
Steamhip production in Japan, South Korea and the rest of the world	graph	Teacher's oral presentation / explanation
Earth's Rotation	geographical globe	Teacher's presentation / explanation / demonstration

3.3. Analysis of experimental teaching activity. To capitalize these films and achieve our purpose, we created a closed discussion group called *Didactic films* on Facebook social media (https://www.facebook.com/groups/2303945323169455/) and invited 52 students from the second year of the Faculty of Geography to be part of the group. Currently, the group has 48 members. We posted nine films and we attached several questions to each. The first seven films posted were viewed by 36-42 members of the group, without expressing their opinions about those products.

In order to help the students to understand the ways of using the teaching resources, we attached the films a few questions, the films being a sort of tutorial. The question regarding all films was: "What was/ were the method(s) used in this film?" To realize the students' degree of involvement through the method used, we asked the question "Who had the greatest contribution in analyzing the sketch / map?"

In this group, we provided students with a table on Bloom's Taxonomy and asked them to specify "At what level of Bloom's taxonomy is this learning activity located?" During the process of decoding the visual representations (maps, photographs, drawings, charts, etc.), the content analysis and interpretation are performed (Dulamă, 1996; Dulamă and Roșcovan, 2007), and these processes are performed according to certain requirements and following certain steps.

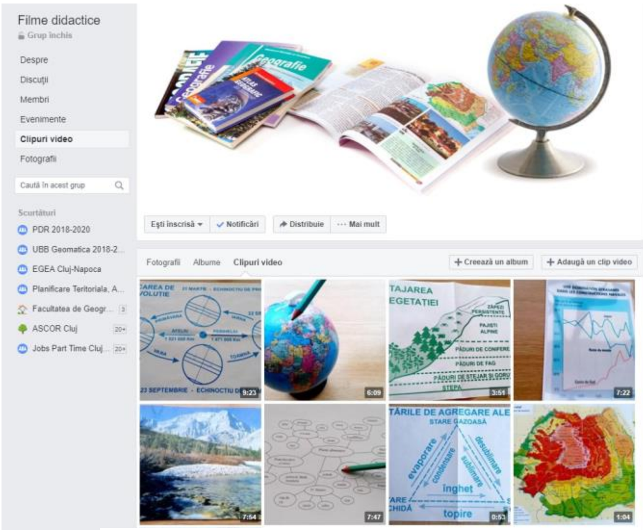

Figure. 1. *Didactic films* discussion group
(https://www.facebook.com/groups/2303945323169455/)

For students to identify the stages and steps that should be covered, we asked the question: "What were the main stages in analyzing this graphic / drawing?" To motivate students, we asked a divergent question "What do you think it means to analyze a photo / map / charts?" The difficulty of using these resources ranges according to the content of the used visual aid. In order for the students to establish this degree of difficulty of the teacher's activity, we asked: "What is the degree of difficulty in analyzing these sketches / maps?"

We also formulated tasks correlated with the specific content of the film: "(1) Look at the map of *the hydrographic network of Romania*. Ask questions about discovering some causes or consequences. (2) Look at the photograph. Ask questions aimed at discovering causes or consequences. (3) What errors have you identified in the graphic organizer? (4) What kind of variations are represented in this graphic? (5) What is the way of representing the statistical data?

For students to understand the role of the use of such visual aids and teaching methods in Geography lessons, we asked to ponder: "What kind of skills does the person develop in analyzing this sketch?" Why is it important for students to learn how to analyze photos?" Since the 2nd year students were at the beginning of the *Didactics of Geography* course and they knew each other too little, being from different specializations, they did not expose themselves by publicly answering these questions posted in the group discussion immediately after posting the didactic films and questions. The task of answering these questions had a higher degree of difficulty compared to their level of teaching skill at that time.

3.4. Presentation analysis of project results. We promoted the project results during two public presentations. One was organized at the Faculty of Geography and one at the Faculty of Psychology and Educational Sciences where the filmmakers of these multimedia products and beneficiaries of project activities, students, professors and researchers from BBU participated in.

4. Conclusions

At present, as a result of advanced technology, Geography teachers and students can easily make films having different contents with the help of smarphone. The transmission, posting and viewing of didactic films is favored by the diversity, existence and continuous development of online applications and easy access to high-performance electronic devices at reasonable prices for student and teacher users. The didactic films made during this project are useful for learning Geography and Didactics of Geography.

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References

Alderman, D.H. and Popke, E.J. (2002): Humor and Film in the Geography Classroom: Learning from Michael Moore's TV Nation. *Journal of Geography* 101(6), 228-239.

Amer, H. and Harous, S. (2017): Smart-Learning Course Transformation for an Introductory Programming Course. *2017 IEEE 17th International Conference on Advanced Learning Technologies (ICALT)*, 463-465.

Arias-Ferrer, L., Egea-Vivancos, Al. and Monroy-Hernandez, F. (2019): Evaluation of Audiovisual Materials for the Teaching of Social Science in Secondary Education. *Revista Fuentes* 21(1), 25-38.

Catalano, C. and Chiș, O. (2016): Comparative Study between Students' Teaching Practice Activities in Hungary and Romania. *4th ERD Conference, European Proceedings of Social and Behavioural Sciences* 18, 74-78.

Chiș, O., Magdaș, I., Dulamă, M.E. and Moldován, K.R. (2019): Learning through Cooperation and Project Method in Pre-School Education in Romania. *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 565-572.

Clemens, B. and Hamakawa, C. (2010): Classroom as Cinema: Using Film to Teach Sustainability. *Academy of Management Learning & Education* 9(3), 561-563.

Cuc, M.C. (2012): Educational Strategies for Training Teachers to Promote Excellence. *8th International Scientific Conference eLearning and Software for Education, Leveraging Technology for Learning* I, 141-145.

Cuc, M.C. (2019): The Relationship between Self-Esteem and Academic Success. *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 36-43.

Deac, A.S., Ilovan, O.-R., Chiș, O. and Dulamă, M.E. (2019): Primary Grades Teachers' Perceptions of Learning Activities in Nature. *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 358-364.

Dulamă, M.E. (1996): *Didactica geografică [Geographic Didactics]*. Clusium, Cluj-Napoca.

Dulamă, M.E. (2014): An Analysis of the Relevance of Some Online Information Sources for E-Learning. Case study: The Geomorphosite „Grădina zmeilor", Romania. In: Vlada M., Albeanu G. and Popovici D.M. (eds.), *Proceedings of the 9th International Conference on Virtual Learning*. Editura Universității, București, 60-69.

Dulamă, M.E. and Roșcovan, S. (2007): *Didactica geografiei [Didactics of Geography]*. BONS OFFICES, Chișinău.

Dulamă, M.E., Ilovan, O.-R. and Roxana-Maria Buș (2016): *Cultural Landscapes and Geography University Students' Learning on Facebook Discussion Groups*. In: Vlada, M. (ed.), *Proceedings of the 11th International Conference on Virtual Learning*. Editura Universității, București, 50-57.

Dulamă, M.E., Ilovan, O.-R., Ciascai, L. and Maroși, Z. (2015): E-learning Geography. How Powerful Is Facebook for Geography University Students? In: Vlada, M. (ed.), *Proceedings of the 10th International Conference on Virtual Learning.* Editura Universității, București, 121-127.

Dulamă, M.E., Magdaș, I. and Osaci-Costache, G. (2015): Study on Geography Students' Internet Use. *Romanian Review of Geographical Education* 1, 45-61

Dulamă, M.E., Vana, V.M. and Ilovan, O.-R. (2016): *Assessing Territorial Planning M.Sc. Students using Facebook*. In: Vlada, M. (ed.), *Proceedings of the 11th International Conference on Virtual Learning*. Editura Universității, București, 66-74.

Filme didactice [Didactic Films], https://www.facebook.com/groups/2303945323169455/

Grecu, V., Deneș, C. and Ipiña, N. (2013): Creative Teaching Methods for Educating Engineers. *Applied Mechanics and Materials*. *Trans Tech Publications* 371, 764-768.

Ilovan, O.-R., Dulamă, M.E., Boțan, C.N., Magdaș, I. and Vana, V.M. (2016b): Quality in Geographical Research? Territorial Planning Students' Online Research Methods. In: Chiș, V. and Albulescu, I. (eds.), *4th ERD Conference, European Proceedings of Social and Behavioural Sciences* 18, 210-216.

Ilovan, O.-R., Dulamă, M.E., Ciascai, L. and Maroși, Z. (2015): Geography University Students' Skills to Research Online Sources. An Empirical Study. In: Vlada, M. (ed.), *Proceedings of the 10th International Conference on Virtual Learning*. Editura Universității, București, 201-134.

Magdaș, I. (2018): *Prezentarea și prelucrarea datelor cercetării în științele educației. Ghid pentru studenți* [Presenting and Processing Research Data in the Sciences of Education. A Students' Guide]. Presa Universitară Clujeană, Cluj-Napoca.

Magdaș, I., Ilovan, O.-R., Dulamă, M.E. and Ursu, C.-D. (2018): Visual Materials from Web Sources in Studying Regional Geography Topics. In: Vlada, M. (ed.), *Proceedings of the 13th International Conference on Virtual Learning*. Editura Universității, București, 278-284.

Manea, A.D. (2015): Lifelong Learning Programs-An Effective Means of Supporting Continuing Education. *4th Intern. Conf. on Adult Education in Universities: Local and Regional Perspectives, Procedia Social and Behavioral Sciences* 142, 454-458.

Richter, B.W., Van der Westhuizen, C.P. (2005): DVD Supportive Training for Geography Teacher Students as an Interim for ICT in Developing Countries. *3rd International Conference on Education and Information Systems: Technologies and Applications* 1, 355-360.

Stan, C. and Manea, A.D. (2015): The Divergent Relationship between Assessment and Self-Assessment in Higher Education. Experimental Results. *3rd ERD Conference, Procedia Social and Behavioral Sciences* 209, 497-502.

Vlada, M. and Adăscăliței, A. (2014): Computers: As Digital Facilities for Scientific Research and As Tools for Enhanced Learning in Higher Education. *eLearning & Software for Education* 2, 537-544.

Xu, H.X. (2012): Undergraduate Students' Perceptions of the Impact of Teaching Strategies: Case Study on an Intercultural Comparison Course in General Education. *5th International Conference of Education, Research and Innovation (ICERI),* 3739-3745.

Using smart board in pre-university education in Romania

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Abstract

In pre-university education in Romania there is an increasing interest in the provision of schools with smart boards, and teachers are preoccupied to use them in didactic activity in order to increase the efficiency of teaching, learning and evaluation. In order to know the teachers' opinions about the use of smart board in the classroom, we applied a questionnaire made in Google Drives. It was completed by 30 teachers teaching various educational subjects at all levels of education. We have collected data about: building competence to use smart board; access to the smart board; frequency of use; the educational disciplines to which it is most commonly used; the typology and weight of the teaching activities in which it is used; ways of using it; effects on learners; the advantages and disadvantages of using it. The results indicate: the predominant use of smart board in urban schools; teachers learn to use it mainly through individual study and discovery learning; various benefits for students and teachers, as well as certain difficulties caused by adaptation to technology.

Keywords: ICT, survey, teachers, digital natives

1. Introduction and Theoretical Approach

The development of information and communication technology (ICT) determined changes in education systems, one of them being the emergence of "smart classes". In order to facilitate and increase the efficiency of the didactic activity, these classess have integrated technological elements, and the smart board is considered to be the important nucleus (Yushendri et al., 2015). Various studies have been conducted worldwide to investigate the use, benefits and difficulties faced by teachers in using smart boards at different disciplines and levels of education. By using smart board technology in math lessons, a high level of student engagement has been maintained and can maintain high levels of student engagement (Min and Siegel, 2011).

Students can learn science, technology and languages through games faster and more durable than other modes (Gursul and Tozmaz, 2010). The use of smart boards facilitates the creation of a more dynamic learning experience in the lesson and increases the enthusiasm of the students (Mun and Abdullah, 2016). Lessons made using smart boards have been clearer and subjects might be able to understand them faster (Smith, Hardman and Higgins, 2006), are more interactive and more effective for both students and teachers (Yushendri et al. al., 2015). Troff and Tirotta (2009) concluded that the effect of smart-boards on students' motivation for mathematical and academic performance is minimal.

In the Romanian education system, the concern for introducing new technologies into education is visible – as well as the focus on interdisciplinarity and on qualitative methods (Ilovan et al., 2016; Scridon and Ilovan, 2015, 2016) – and there is an increasing interest for equipping schools with smart boards, computers, video projectors. In order to increase the efficiency of the training, many teachers are concerned about using new technologies in the classroom activities. In 2013 digital textbooks were introduced, since then many analyses were made, eg. Vlada (2014), Magdaş and Drîngu (2016). Through the smart board the teaching methods was diversified and its quality was improved in Physics courses, the lessons were more attractive, so the students were determined to be more active, they focused their attention better, so this tool was useful for understanding the complexity of physical phenomena, facilitated the development of rational thinking and critical thinking (Buzatu, 2011). It has been studied how teachers can promote interactive learning in Physics by stimulating the use of smart boards and cognitive load theory (Stoica et al., 2011). Smart board has been efficiently used in Biology lessons for observing processes and phenomena in the laboratory, using 3D models and videos existing on use some 3D models and videos existing on the Platform mozaWeb. (Petruța, 2017).

The studies in Romania regarding the use of smart boards mainly focused on analyzing the teaching and learning activity. The purpose of this research is to analyze the teachers' opinions about how and how much they use this tool in the didactic activities, what problems they notice and what are the effects of its use on students.

2. Material and Method

2.1. Data Collecting, Procedure and Research Material

We collected the data through the survey method, through direct observations on the activities and educational means, through discussions with the teachers who use smart boards in the didactic activity. We used a questionnaire in which through 6 items we collected data on participants, and through 9 items, we collected data on the use of smart boards: training in the competence of using smart boards, access to smart boards, frequency of use, disciplines to be used, typology and share of the didactic activities in which they are used uses, modalities of use, the frequency of the effects of the use of smart board on those who learn, the advantages / benefits and the difficulties that the teachers face. The research material was made up of the answers of the teachers offered to the items in the questionnaire, from the information provided by the teachers in discussions with them, from the direct observations on the electronic means and the way of using them in the classroom. The collected data are represented in tables specific to Education Sciences (Magdaş, 2018).

2.2. Participants

The sample of subjects was composed of 30 teachers who use or have used the smart board in the instructional-educational activities. All respondents are qualified as teachers: 46% of them have a Bachelor's degree, 47% have Master's degrees, and 7% have Ph'd diploma. 27% of respondents teach various disciplines in high school, 43% in secondary school, 20% are teachers for primary education, and 10% are kindergarden teachers. Most respondents, 33%, have 5-10 years experience in teaching, 27% have over 20 years. 20% of the respondents have a teaching experience of 5-10 years, 13% of 3-5 years, and 7% have under 3 years old in education. Some respondents have extensive experience in education (28% of them have the second degree in education and 6% of them first degree), and some are teachers at the beginning of their teaching career (14% are beginners; 52% of them have the definitive degree in education). One respondent works in rural areas and 29 in urban schools.

3. Results and Discussions

Training in the competence of using the smart board (Table 1). Most teachers have learned to use smart boards through individual effort. 50% of the teachers claim that they have learned by themselves, intuitively, to use the interactive board in the classroom, 17% of them have documented on the internet about this topic, 10% have found ways to use the interactive board presentation book. We note the interest and availability of the questioned teachers for self-instruction, for the use of ICT in the didactic activity, for professional self-improvement and their ability to transfer the skills of computer use in new contexts. Only 20% of them attended a training course and 3% of the teachers learned from the experience of other colleagues who use the interactive board in the didactic activities. In the specialized literature it is noted that the technological mentoring process is useful in preparing the teachers to integrate the training technology into their teaching (Oigara and Keengwe, 2011).

Table 1. Training in the competence of using the smart board

Modalities of training	% teachers
Learning by direct use of smart board in the classroom	50
In a continuous training course	20
Through documentation on the Internet	17
By studying the presentation book of the smart board	10
By observing the use of smart boards and discussions with other colleagues	3

Access to the smart board. The most of teachers, 83%, said they have a smart board when they need it, whether it is in the class they are working in or in another room. This result is natural because only teachers who use smart boards are questioned. The introduction of technology in Romanian schools represents a significant progress, compared to the previous historical stages (Dulamă et al., 2019).

Frequency of use (Table 2). Almost a third of teachers said they use the smart board daily, which shows that it is a very useful learning activity and that teachers have the availability and competence to use it, and probably that they have smart boards in the classroom. Other teachers say they use it less often. The lower frequency of the use of the smart bord is probably due to the fact that they do not have permanent access to this tool of education, and the movement of students to another classroom requires additional organizational problems.

Table 2. Frequency of using the smart board in didactical activities

Frequency of use	% teachers
Daily	30
2-3 times a month	26
2-3 times per semester	19
2-3 times a week	18
Once a month	7

Use of smart boards according to the educational disciplines. The teachers who teach at the middle school (43%) and at the high school (27%) use the smart board for the disciplines they teach. Teachers working in primary education (20%) and in preschool (10%) were asked in which disciplines they use the interactive board more frequently. In the primary education, the smart board is used more to the disciplines: *Communication in Romanian*, *Mathematics and Environmental Exploration*, *History*. In the preschool education, the interactive table is used more in activities organized within the experiential fields *Language and communication*, *Human and society*, *Sciences*. We note that both in preschool and primary education, the smart board is used in the same fields and disciplines. The explanations for the predominant use of this educational tool to these disciplines is correlated with the large number of hours assigned for certain disciplines or fields (*Language and communication* or *Communication in Romanian*; *Mathematics and*

Environmental Exploration), the high quantity of the exercises realized within them, the need to use visual materials to increase the quality of representations made to children, the existence in the online environment of a large volume of digital materials (movies, tests, worksheets, tutorials, games) with content specific to these disciplines, available for free. The use of smart boards predominantly in certain disciplines is similar to that of other countries where this tool was used to learn communication in Chinese (reading, listening, speaking and writing) (Wang et al., 2019), in English (Giselle Maldonado de Leon et al., 2015) and German (Tanir, 2015), for studying processes in Physics (Buzatu, 2011; Stoica et al., 2011) and Biology (Petruța, 2017), for learning Mathematics (Mun and Abdullah, 2016).

The typology and the share of the didactic activities in which the smart board is used. Half of the respondents said they use the smart board most often in the activities of transmitting new knowledge. 30% of them say they use it in the activities of fixing and systematizing the knowledge, 17% for the training of skills and abilities, and only 3% for lessons of assessment. The fact that the smart board is little used for assessment is explained by the preference of using the worksheets and the printed tests through which the efficiency of organizing the evaluation activity is ensured.

Modalities of use (Table 3). Being an education mean, the smart board can be used for many purposes. In order to determine the most used modalities, we asked the participants to award 1-3 points: Much - 3 points; Medium - 2 points; Little - 1 point to some puposese proposed in the questionaire. The presentation of the video or PPT materials ranks first in the position of the use of the smart board. This tool is widely used for browsing the Internet or for viewing educational software. We notice the preference of teachers to use ready made educational materials (movies, PPT, educational software, etc.), so in these situations, it fulfills the functions of the video projector. The Facebook social network promotes many useful materials for the didactic activity and offers the context of the exchange of experience in the discussion groups (Dulamă et al., 2015; Dulamă et al., 2016). Multimedia activities in digital textbooks (Buzilă et al., 2017; Magdaș et al., Buzilă et al., 2017) can also be used using smart boards. The perception of images is important in forming correct representations of reality (Maroși et al., 2019). The smart board is less used as a support for its own products (schemes or sketches intended to be taken in the notebook, schematic drawings, etc.), so it takes less the functions of blackboard and chalk or whiteboard and marker, probably because in the classrooms there are also such means of education and they retain their initial functions.

Table 3. Modalities of using the smart board in didactical activities

Modalities of use	**Number of respondents**			**Average scores**
	Much (3 p)	Medium (2 p)	Little (1 p)	
Presentation of video materials (movies, animations, PPT presentations)	26	3	1	2.83
Use of educational software	15	11	4	2.36
Navigation on internet	13	5	12	2.03
Writing and drawing	4	17	9	1.83
Making annotations over the given support	5	12	13	1.73
Making sketches (graphic organizers) for lessons	3	15	12	1.70
Saving and printing the sketches made	4	5	21	1.43
Application of grid tests	4	10	16	1.60

Frequency of effects of smart board use on learners (Table 4). One third of the teachers who participated in this study (32%) consider that the most common visible effect due to the use of the interactive board is the fact that the students who are usually “passive” are involved in activities. 22% of the respondents most frequently observed that the students paying more attention during teaching, and 21% of them considered an increasing of the volume of information stored by students in the new contents studied, as a result of the permanent use of the visual support. Fewer teachers consider that the most frequently effect observed in the activity with the students is that they remain concentrated for a longer period of time compared to the traditional lessons (14%). So, although many “passive” students are more attentive and are stimulated to receive the new content transmitted through the smart board, however, there is a risk that their attention will not remain focused for a long time on the contents studied, behavior that is considered specific to the age of preschoolers and small students. 7% of teachers consider that the most common effect they have found is that those who learn more quickly understand the content taught. Probably this effect is more frequent in the disciplines where it is facilitated to understand the content through dynamic or static images, such as Biology, Geography, Astronomy, History. Very few teachers have found that the main effect is that those who learn go out to smart board with pleasure (4%). This result is natural considering that many students dislike to expose themselves by writing or drawing on the board, an aspect noticed in many didactic activities observed in kindergarten and school. We also note the greater difficulty of using the smart board by teachers and students, compared to using black or whiteboard or flipchart.

Table 4. Frequency of effects of smart board use on learners

Observed effects	**Frequency of effects (%)**
Activation of “passive” students	32
Focusing attention during teaching	22
Increasing the volume of information stored in the new contents studied	21
Increasing the duration of focusing attention	14
Faster storage of information	7
Pleasure to write and draw on smart board, at the teacher's request	4

The main advantages of using smart board in instructional-educational activities. In response to an open question, the respondents stated that the main advantages are: “adaptation to the digital generation”, the possibility “to return to previous exercises”, “to capture attention”, facilitates “concepts understanding”. The teachers also assert that the smart board allows to carry out unique learning activities, at the same time involving several analyzers (visual, auditory, olfactory, kinesthetic, etc.) and it is easy to use. In other studies it was pointed out that smart board has advantages as: the use of images and information from the Internet, presentation of information (accuracy, organization in schemes), the possibility of using different materials, which is addressed to several analyzers through which ensures the attractiveness of replacing chalk with special markers (Paragina et al., 2010). In other studies there are positive opinions regarding the use of smart boards: they allow the use of all types of visual materials, they are addressed to all the analyzers (the sense organs), it increases visibility, it saves time, it helps to make pleasant and interesting activities, it facilitates the revision of the subjects, all of which contribute to the efficiency of the learning process (Korkmaz and Cakil, 2013).

The main dysfunctions in the use of smart boards in the educational process. The questioned teachers listed several dysfunctions in the optimal integration of the smart board in the education system in Romania: the lack of interactive boards in all classrooms; the need to schedule the moment of using the smart board, including the space where it is mounted; technical difficulties; purchase of educational software. Other studies also show that teachers have not received materials that can be used on the smart board either from the school where they work or from the Ministry (Somyurek et al., 2009). Other researchers in Romania have identified a number of disadvantages: the high costs and the small number of devices, the mentality of the teachers and the large resources of time needed to train their abilities to work with smart boards, power supply and problems of using the technology (long duration for accessing sources / software, writing problems on the board) (Paragina et al., 2010). Brown (2003) mentions other few disadvantages as: that smart boards are more expensive than white boards, can be easily damaged and that renewal is expensive, some users may have difficulty reaching the upper parts of the smart board. The negative opinions of teachers regarding the use of smart boards are determined by the "lack of knowledge on using these technologies, or their lack of preparation before starting the class" and due the fact that "it is also stated that technical failures can also disrupt the flow of the course"(Korkmaz and Cakil, 2013).

The utility of using smart board in teaching activities. Teachers were asked to give a score from 1 to 5 on a Likert-type scale (one point means a little useful, and 5 points very useful). The average obtained is 4.26 that indicates tthe smart board is considered by the respondents to be very useful in the teaching activities. Half of the 50% of teachers appreciate the smart board is very useful, 46% consider it having an average utility. Only a teacher finds that smart board is a little useful.

4. Conclusions

From the analysis we observed a tendency of the teachers, even those with a great experience in education, towards an adaptation to the new generations and new technologies. Teachers want to learn how to use the smart board in their teaching activities, most of them have learned on their own, intuitively, so they have not fully discovered the functions of using this tool and they do not exploit its full potential. The material resource remains the main dysfunction, these boards are still inaccessible to everyone, especially the rural environment.

It is also observed how those who have a daily smart board, in their own or in each class, tend to use it more often, to integrate such sources into their daily activities, while the teachers who need to make an appointment to use the smart board and avoid using it. However, almost all teachers consider the use of smart board in instructional-educational activities brings a lot of benefits, being aware of the implications it can have on learning. Smart board becomes a support for designing and implementing lessons when used properly and harnessed to its true potential.

References

Brown, S. (2003): *Interactive Whiteboards in education*. TechLearn Briefing, JISC Technologies Centre, Joint Information Systems Committee, UK.

Buzatu, A. (2011): Smart Board The Modality For Increasing The Quality of Physics Lessons. In *Conference proceedings of» eLearning and Software for Education «(eLSE)* (No. 02, pp. 455-458). "Carol I" National Defence University Publishing House.

Buzilă, S.-R., Ciascai, L., Dulamă, M.E., Ilovan, O.-R. & Kosinszki, S.-A. (2017): Interactive Multimedia Learning Activities (IMLA) in a Digital Textbook. In Vlada M., (edits.), *Proceeding of the 12th International Conference on Virtual Learning*, București: Editura Universității, 224-229.

Dulamă, M.E., Ilovan, O.-R. & Buș, R.-M. (2016): Cultural landscapes and Geography university students' learning on Facebook discussion groups. In Vlada M., (edits.), *Proceedings of the 11th International Conference on Virtual Learning*, București: Editura Universității, 50-57.

Dulamă, M.E., Ilovan, O.-R., Bagoly-Simó, P. & Magdaș, I. (2019): Development of the Geographical Education System in Romania, under the Impact of World War II and during the Transition to Communism, *Transylvanian Review*, vol. 24, Supplement no. 2 – under print.

Dulamă, M.E., Ilovan, O.-R., Ciascai, L. & Maroşi, Z. (2015): E-learning Geography. How powerful is Facebook for Geography university students? In Vlada M., (edits.), *Proceeding of the 10th International Conference on Virtual Learning*, București: Editura Universității, 121-127.

Giselle Maldonado de Leon, M., Vela Nava, A. S., & Garza Guzman, M. R. (2015): Impact of the use of the Smart Board Interactive whiteboard as an ICT tool on the English language learning of sixth grade students of a public primary school in Asturias, Spain. *Revista de investigacion educativa de la Escuela de Graduados en Educacion*, *6*(11), 2-8.

Gursul, F. and Tozmaz, G. B. (2010): Which one is smarter? Teacher or board. *Procedia-Social and Behavioral Sciences*, *2*(2), 5731-5737.

Ilovan, O.-R., Scridon, I., Havadi-Nagy, K.X., & Huciu, D. (2016): Tracing the Military Frontier District of Năsăud. Territorial identity and regional development. *Mitteilungen der Osterreichischen Geographischen Gesellschaft, 158*, 215-244.

Korkmaz, O. and Cakil, I. (2013): Teachers' difficulties about using smart boards. *Procedia-Social and Behavioral Sciences, 83*, 595-599.

Magdaș, I. (2018): *Prezentarea și prelucrarea datelor cercetării în științele educației. Ghid pentru studenți*, Presa Universitară Clujeană, ISBN 978-606-37-0420-8, on-line: http://www.editura.ubbcluj.ro/bd/ebooks/pdf/2276.pdf (accessed August 2019).

Magdaș, I., Buzilă, S.-R., Dulamă, M.E., Ilovan, O.-R. & Buzilă, L. (2017): Primary Grades Teachers' Perceptions on a Mathematics and Environmental Exploration Digital Textbook. In Vlada M., (edits.), *Proceeding of the 12th International Conference on Virtual Learning*, University of Bucharest and "L. Blaga" University of Sibiu, București: Editura Universității, 218-223.

Magdaș, I. and Drângu, C. (2016): Primary School Teachers' Opinion on Digital textbooks. *Acta Didactica Napocensia*, Vol. 9, nr. 3, p. 47-54. ISSN: 2065-1430.

Maroși, Z., Adorean, E.-C., Ilovan, O.-R., Gligor, V., Voicu, C.-G., Nicula, A.-S., & Dulamă, M.E. (2019): Inhabitants' Perceptions of the Central Squares and Quality of Life in Cluj-Napoca, Romania. *Mitteilungen der Osterreichischen Geographischen Gesellschaft*- under print.

Min, K. and Siegel, C. (2011): Integration of SMART board technology and effective teaching. *Imanager's Journal on School Educational Technology, 7*(1), 38-47.

Mun, S. H. and Abdullah, A. H. (2016, December): A review of the use of smart boards in education. In *2016 IEEE 8th International Conference on Engineering Education (ICEED)* (pp. 120-125).

Oigara, J. N. and Keengwe, J. (2011): Pre-service teachers and technology integration with SMART boards. *International Journal of Information and Communication Technology Education (IJICTE), 7*(4), 84-92.

Paragină, F., Paragină, S., & Jipa, A. (2010): Interactive whiteboards in Romania. *Procedia-Social and Behavioral Sciences, 2*(2), 4059-4063.

Petruța, G.-P. (2016). Methodological issues concerning the use of smart board within the biology lessons. *7th International Edu World Conference (Edu World)*. European Proceedings of Social and Behavioural Sciences, 23, 978-985.

Scridon, I., & Ilovan, O.-R. (2015): The Zipsers' ethnic identity in Vișeu de Sus/Oberwischau, Romania, in the context of inter-ethnic relationships. *Mitteilungen der Osterreichischen Geographischen Gesellschaft, 157*, 151-168.

Scridon, I., & Ilovan, O.-R. (2016): Approaching the Other in the Zipser community. Identity issues and methodological insights into geographical cross-cultural research. *Transylvanian Review, 25*(1), 55-73.

Smith, F., Hardman, F., & Higgins, S. (2006): The impact of interactive whiteboards on teacher–pupil interaction in the National Literacy and Numeracy Strategies. *British Educational Research Journal*, 32(3), 443-457.

Somyürek, S., Atasoy, B. & Özdemir, S. (2009): Board's IQ: What makes a board smart? *Computers & Education*, 53, 368-374.

Stoica, D., Paragina, F., Paragina, S., Miron, C., & Jipa, A. (2011): The interactive whiteboard and the instructional design in teaching physics. *Procedia-Social and Behavioral Sciences, 15*, 3316-3321.

Tanir, A. (2015): German Language Teaching Academicians' Contentment on the Usage of Smart Board. *Procedia-Social and Behavioral Sciences, 182*, 259-265.

Troff, B. & Tirotta, R. (2009): Interactive whiteboards produce small gains in elementary students' self-reported motivation in mathematics. *Computers & Education*, 54, 379-383.

Vlada, M. (2014): Manuale digitale, o premieră în România – despre confuzii și clarificări. In M. Vlada (edits.), *Lucrările celei de-a XII-a conferințe de învățământ virtual: Virtual Learning – Virtual Reality, Models & Methodologies, Technologies, Software Solutions*, 24-25 octombrie 2014, 37-44. București, Editura Universității din București.

Wang, L.-C.C., Lam, E.T.C, & Chen, Y.-H. (2019): A case study of using the Smart Board as a Chinese learning application by elementary school students. *International Journal of Technology Enhanced Learning, 11*(1), 71-79.

Yushendri, J., Rindani, F., Cristhian, A. A., & Agushinta, R. D. (2015): Design the Smart Board system in ubiquitous computing for teaching and learning process. In *2015 International Conference on Science in Information Technology (ICSITech)*, 89-94AbdullAbdul. IEEE.

Modalities of using the smart board in elearning to *Mathematics and Environmental Exploration*

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Abstract

The purpose of this research is to analyse the efficiency of smart board use in the lessons of Mathematics and Environmental Exploration to the 2nd grade. To achieve the research objectives, we organized a psycho-pedagogical experiment on a sample of 30 students who formed an experimental group and a control group. After applying the initial test to the two groups, in the experimental group we organized a formative intervention during 20 lessons at the unit "Life environments in Romania". In these lessons we used smart board to accomplish more goals and activities: transmitting new knowledge; acquiring skills; knowledge fixation and systematization; showing movies; using the digital manual; annotations over visual support; writing and drawing on the smart board; realizing of graphic organizers and sketches for lessons; using of educational software; computer games; "digital" evaluation. During the formative experiment, we analysed the teaching, learning and evaluation process and student results. To identify the differences between the two groups as a result of the learning activities we used the smart board, we applied a final test. The results indicate benefits (increasing the level of the results in the experimental group, the formation of more accurate and diversified representations), but also some difficulties (great time resources for documentation, design and preparation of activities).

Keywords: ICT, educational software, primary education, educational research, Romania

1. Introduction and Theoretical Approach

The smart board is considered as an important nucleus for increasing the efficiency of the teaching activity in the "intelligent classes" (Yushendri et al., 2015). In various studies, it is considered as a useful teaching tool in learning English (Giselle Maldonado de Leon et al., 2015), German (Tanir, 2015), Chinese (Wang et al., 2019). As a result of the use of smart boards in the didactic activity, the students in an experimental group achieved better performance in moral education compared to those in the control group (Ling et al., 2014).

The smart board was used to diversify the way of teaching Physics, to increase the quality of lessons, to activate students and to focus their attention (Buzatu, 2011), to simulate the interactivity and creative potential of students (Stoica et al., 2011). The smart board facilitated the study of processes and phenomena in physics (Buzatu, 2011) and in biology (Petruța, 2017). During an experiment lasting 4 weeks in a 7th grade, the experimental use of the smart board on the topic "Electricity in our life" helped to obtain better results and to keep the information acquired (Aktas and Aydin, 2016).

Less research has focused on analyzing ways to use the smart board. Through digital games, the speed of learning in science, technology and foreign languages was favored (Gursul and Tozmaz, 2010). On the Internet there are a lot of mathematical games that can be used for learning mathematics, a analysis of these have been made by Magdaș and Răduț (2016). 3D models and videos, their efficiency in the learning of biology has been demonstrated (Petruța, 2017). In an experimental group from a primary school, for students to love math, it was used by using cartoon character on the interactive board which is supported by computer. These students achieved greater success compared to students in a control group (Turan, 2014). Through smart board can be maintained a high level of student engagement throughout the activity, on-task and off-task behaviors in math and science lessons (Min and Siegel, 2011).

The Romanian researchers were concerned to analyze the didactic activities in the pre-university education in which smart boards are used (Buzatu, 2011; Stoica et al., 2011, Petruța, 2017), and the results indicated its effectiveness at the level of teachers and students. Due to the introduction of digital textbooks in Romania for the first time in 2013, there is a need for adequate technical equipment for schools as well as the need to train teachers in using these technical means, including the smart board. However, recent research in geography showed that mixed methods and non-traditional approaches are very efficient for successful research activities in Romania (Ilovan et al., 2016; Scridon & Ilovan, 2015, 2016), but the adaptation to new trends is slow. The perception of the society regarding the introduction of digital textbooks was analyzed by Vlada (2014). Were also analysed teachers' perceptions of a digital textbook at Mathematics and Environmental Exploration (Magdaș and Drîngu, 2016; Magdaș et al., 2017) and the multimedia learning activities of this textbook (Buzilă et al., 2017), as well as the ways of capitalizing the opportunities offered by the Facebook social network in learning (Dulamă et al., 2015; Dulamă et al., 2016).

Although smart boards have been introduced into many classes in the primary cycle, no studies have been conducted on this topic. In this research we will present a psycho-pedagogical experiment in which we analyzed the use of the smart board, the benefits or the problems that determine them.

2. Material and Method

2.1. Procedure, Data Collecting and Research Material

The psycho-pedagogical experiment was organized at the "Spectrum" International Gymnasium School in Cluj-Napoca, Romania, in the 2018-2019 school year. The activities were carried out in the Mathematics and Environmental Exploration discipline (MEE). In the pre-experimental stage we applied an initial test to the experimental group and the control group to determine the volume of knowledge and the level of competence. The items (problems and exercises) of the tests were aimed at establishing the level of four specific competences to this discipline provided in the school syllabus: 1.4. Conducting addings and subtractions, between 0 to 1000, mentally and in writing, using counting and/or grouping whenever necessary; 1.6. The use of mathematical terminology and symbols (sum, total, terms of a sum, subtraction, difference, subtrahend, minuend, product, factors of a product, quotient, dividend, divisor, <,>, =, +, -, ·, :) in solving and/or composing problems; 3.1. Problem solving in investigations, by observing and generalizing some models or regularities in the near environment; 4.2. Formulation of consequences resulting from observing certain relationships, phenomena, simple processes (MEN, 2013).

In the formative experimental stage, we conducted instructive-educational activities involving the smart board, while in the control group it was absent. During 4 weeks we organized 20 lessons in the experimental class, in the thematic unit "Life environments in Romania", in which we used smart boards in various ways (Table 1). In the post-experimental stage we applied a final test to the two groups. We processed the data from the final and initial tests through tables specific to Education Sciences (Magdaş, 2018), analyzed them and compared the results to determine the progress made by the students during this thematic unit. The research material represents the results of the students from the two groups, on the two tests.

2.2. Participants

The sample of subjects consisted of 30 students from the "Spectrum" International Gymnasium School in Cluj-Napoca. The experimental group included 15 students in the second class A, and the control group, 15 students in the second class B. In the experimental class the second author of this article was involved in the research, this being the teacher who designed and organized the didactic activities with the students.

3. Results and Discussions

3.1. The analysis of lessons

In the thematic unit "Life environments in Romania", depending on the subject, we organized four lessons with Environmental Science specific content, 12 lessons with Mathematics content, four lessons with integrated contents from both disciplines. The environmental lessons aimed studying complex ecosystems (forest, puddle, pond), major relief units (Danube Delta) and marine hydrographic units (Black Sea), with a high degree of difficulty in forming correct representations in the primary cycle. (Dulamă et al., 2019; Ilovan et al., 2019). Mathematics lessons are intended for learning multiplication table and to solve problems who involved the multiplication operation. In the lessons with mixed contents, the knowledge about the living environments and about the multiplication operation were recapitulated.

As types, the lessons organized were classified into four categories: 12 lessons for training skills and abilities, five lessons for fixing and systematizing knowledge, two lessons for transmission of new knowledge, and one lesson for assessment. The predominance of the skills training lessons can be explained by the fact that in the training and development of specific skills, the main method is the exercise (Dulamă and Magdaş, 2014) and by the specific of the mathematics, where learning the multiplication table requires a lot of exercise (Magdaş, 2014).

Table 1. Clasiffication of lessons from the thematic unit "Life environments in Romania" by types

Lesson title	**Types of lessons**			
	Transmision of new knowledge	*Training skills and abilities*	*Fixing and systematizing knowledge*	*Assessment*
1. The forest - living environment	✓			
2. The puddle, the lake, the pond – life environment		✓		
3. Repeated adding of equal terms		✓		
4. Danube Delta - living environment		✓		
5. Black Sea - living environment		✓		
6. The multiplication operation	✓			
7. Multiplication. Multiplication properties		✓		
8. Repeated adding of equal terms. The multiplication operation. Properties			✓	
9. The multiplication table with 0 and 1		✓		
10. The multiplication table with 2 and 3		✓		
11. The multiplication table with 4 and 5		✓		

12. The multiplication table with 6 and 7		✓		
13. The multiplication table with 8, 9 and 10		✓		
14. Multiplication table			✓	
15. Problems solved by the multiplication operation		✓		
16. Problems solved by the multiplication operation		✓		
17. Recap: Life environments and Multiplication			✓	
18. Recap: Life environments and Multiplication			✓	
19. Assessment: Life environments and Multiplication				✓
20. We play, correct and learn			✓	
Total	**2**	**12**	**5**	**1**

3.2. The analysis of modalities of using the smart board

In these lessons, we used smart boards in various ways (Table 2): using materials from the digital textbook (70% of the lessons); for writing and drawing with special marker (60%); to make annotations over visual support (55%); for presentation of some video materials (movies, animations, ppst presentations, photographs, schematic drawings) (50%); for drawing sketches for lessons (cluster organizers, Venn diagram) (15%); digital games (15%); for the use of educational software (5%); for digital evaluation (5%). We notice that teachers use materials made by other people on the smart board. The fact that the digital textbook (Mihăescu et al., 2014) was the most frequently used is explained by the fact that it was designed based on the school syllabus with the purpose of being used in lessons, being available on the MEN website (www.manuale.edu.ro) and on CD's. According to the CNEE requirements (2013) the digital textbooks includes several types of multimedia learning activities (static, dynamic, interactive, complex). Many teachers claim to use the MEE textbook frequently, and others at each lesson (Magdaș et al., 2017). The use in half of the lessons of the video materials (movies, animations, photos, schematic drawings, etc.) is explained by the fact that they are available for free on the Internet and can be easily downloaded. The lower frequency of using digital games and educational software is explained by the fact that it is more difficult to find such materials suitable for a specific theme, in Romanian, and some of them have high costs.

Smart boards have been much used for similar activities to the situations in which they used white or black boards (for writing and drawing), but also to make annotations over visual support, which is very valuable because this tool allow to complete or correct the material produced by another person or his own material. Smart board was less used to make sketches for lessons because children have low level of knowledge and less developed skills. The low frequency of digital assessment is explained by the fact that there are few tests or worksheets suitable for the topics covered on the Internet, digital tests or data sheets take a long time and these digital assessment tools are more difficult to apply. For teachers it is easier to make assessment tools in printed format, to make them on their own and to apply them in student classes. Although the smart board allows direct connection to the Internet, this variant of use has not been mentioned by the teachers.

Table 2. Modalities of using the smart board in lessons of the thematic unit
"Life environments in Romania"

Lesson title	Modalities of using the smart board								Number of modalities
	Presentation of video materials	Using digital textbooks	Annotations over visual support	Writing and drawing	Making sketches for lessons	Educational software	Digital games	Digital assessment	
1. The forest - living environment	✓	✓	✓						**3**
2. The puddle, the lake, the pond – life environment	✓	✓	✓						**3**
3. Repeated adding of equal terms				✓	✓				**2**
4. Danube Delta - living environment	✓	✓	✓						**3**
5. Black Sea - living environment	✓	✓	✓						**3**
6. The multiplication operation				✓	✓				**2**
7. Multiplication. Multiplication properties				✓	✓				**2**
8. Repeated adding of equal terms. The multiplication operation. Properties	✓	✓	✓	✓					**4**
9. The multiplication table with 0 and 1	✓	✓	✓	✓					**4**
10. The multiplication table with 2 and 3	✓	✓	✓	✓					**4**
11. The multiplication table with 4 and 5	✓	✓	✓	✓					**4**
12. The multiplication table with 6 and 7	✓	✓	✓	✓					**4**
13. The multiplication table with 8, 9 and 10	✓	✓	✓	✓					**4**
14. Multiplication table						✓			**1**
15. Problems solved by the multiplication operation		✓	✓	✓					**3**
16. Problems solved by the multiplication operation		✓	✓	✓					**3**
17. Recap: Life environments and Multiplication		✓					✓		**1**
18. Recap: Life environments and Multiplication		✓		✓			✓		**3**
19. Assessment: Life environments and Multiplication								✓	**1**
20. We play, correct and learn							✓		**1**
Nr. of activities	**10**	**14**	**11**	**12**	**3**	**1**	**3**	**1**	**55**
Percents of lessons (%)	**50**	**70**	**55**	**60**	**15**	**5**	**15**	**5**	

Within the 20 lessons, smart board was used in 1 to 4 modalities, the average number of modalities used being 2.75. In 35% of lessons the smart board it was used in three different ways, and in 30% of them it was used in 4 different ways (Table 3). Smart board has been used in teaching, learning and assessment of knowledge. The fact that in a lesson we organized at most four activities in which we used smart boards indicates that this educational tool was not used permanently, during the whole lesson.

Table 3. The distribution of lessons according
to the number of modalities of using the smart board

Number (%) of lessons	Number of modalities
7 (35%)	3
6 (30%)	4
4 (20%)	1
3 (15%)	2

3.3. The analysis of students results in tests

In the experimental group, 7 students obtained the qualitative mark *Very good* in both tests, two students registered progress from one test stage to another, obtaining the qualitative mark *Good* in the first test stage, followed by the qualitative mark *Very good* in the second stage of verification, and one obtained the qualitative mark *Good* instead of the qualitative mark *Sufficient* (Table 4). No regression was found in any student in the experimental group. In the control group, the number of students who obtained the qualitative mark *Very good* increased from 5 to 7.

Table 4. The results of the students in the experimental group at the initial test and at the final test

Number of students	**Qualitative marks**	
	Initial test	**Final test**
7	Very Good	Very Good
2	Good	Very Good
3	Good	Good
1	Sufficient	Good
2	Sufficient	Sufficient

Analyzing the results from the initial and final tests (Table 5), we observed a very small difference in terms of school progress between the experimental and the control group. There are students who have remained constant, recording the same rating on both assessments, which is fighting a possible setback due to the use of the interactive table. Two students obtained the qualitative mark *Sufficient* for both the experimental and the control group. The differences are observable for those with qualitative marks *Good* and *Very Good*, where the experimental group has two more students who have obtained maximum rating. This, expressed as a percentage, would mean a school progress of 13.4% for the experimental group, but only part of this percentage is due to the intervention using the interactive table.

Tabel 5. The results of the students to the initial and the final test

Types of group	**Number of students**	**Test**	**Qualitative marks**					
			Very Good		**Good**		**Sufficient**	
			Number of students	**%**	**Number of students**	**%**	**Number of students**	**%**
Experimental Group	15	Initial	7	46,6%	5	33,4%	3	20%
		Final	9	60 %	4	26,6%	2	13,4%
Control group	15	Initial	5	33,4%	6	40%	4	26,6%
		Final	7	46,6%	6	40%	2	13,4%

4. Conclusions

The smart board was a familiar tool for students, which responded to their need and pleasure to use digital devices. The students manipulated the smart board intuitively, without obstacles or difficulties. Because digital materials were quickly deployed on the smart board and addressed to several analyzers (auditory, visual, tactile, kinesthetic), this played an important role in capturing and maintaining attention throughout the activity and in activating the students who manifest, by usually, passivity in learning activities. The students were more attentive during the learning activities in which we used smart boards, compared to other activities. The alternation between the frontal discussions and the traditional activities of writing-reading with multimedia activities in which smart board was used had the beneficial effect of maintaining the involvement of the students in activity / task.

In using the smart board, students were tempted to use it similar to the gadgets they use (smartphone, tablet, electronic watches, electronic pens, etc.), departing from its use for educational purposes, precisely delimited and associated with a certain content. In order to avoid this behavior, in the first activities in which we used smart boards, we established the requirement that this device be used for educational purposes, not as a relaxation tool through the excessive use of electronic games, by drawing, by accessing web sources.

With the increase in the frequency of use of smart boards in lessons, the risk of reducing students' interest in this tool has increased. Even though the smart board is a digital tool suitable for digital natives, it was necessary to change frequently the modalities of using and the materials used to introduce novelty elements into the activity that stimulate the curiosity of the students.

The use of smart board had an effect on all students. The students who obtained very good results in the initial test remained constant, retaining their interest for learning, the interactive board satisfying their need for knowledge and processing of the contents. Students with good or less good results at the initial test remained constant or progressed. The fact that the information was provided, with the help of smart board in forms that involved several analyzers, including the visual stimulus provided by the bright colors of the smart board, increased the duration of the students' attention focus. The presentation of the content in different forms and modalities on the smart board (movies, animations, forographies, schematic drawings, games, etc.) has increased the weight of the aspects perceived and represented by the students who have different learning styles. By choosing the most suitable digital materials for a topic, we have increased the accessibility and understanding of the contents and the transition from concrete to abstract.

Smart board quality has been an important factor in the effective conduct of lessons. In the first activities we used a Smart BOARD SB480, which presented difficulties in design and touch function. The technical problems (failures, delayed response) determined the consumption of time resources for solving them, to the detriment of the proposed didactic activities, as well as the disconnection of the students from the learning situation. The problems were solved by replacing the smart board with a new version, a Multi-Touch Interactive Panel, which did not require a design, had a good image quality and the reception of touch so that the time was fully allocated to the didactic activities in the lessons.

At the end of the research, we consider that the smart board is a suitable tool for the students in Romania who are eager to transform the spaces in which they learn in “smart classes” and which is involved in the educational use of any instrument that is close to the digital area. The efficiency of using smart board in the teaching activity depends much on the quality of this product, on the motivation and competence of the teachers (digital, in their speciality, didactic, psycho-pedagogical) in its use.

References

Aktas, S. and Aydin, A. (2016): The effect of the smart board usage in science and technology lessons. *Eurasian Journal of Educational Research, 16*(64), 125-138.

Buzatu, A. (2011): Smart Board The Modality For Increasing The Quality of Physics Lessons. In *Conference proceedings of» eLearning and Software for Education «(eLSE)* (No. 02, pp. 455-458). ”Carol I” National Defence University Publishing House.

Buzilă, S.-R.**,** Ciascai, L., Dulamă, M.E., Ilovan, O.-R. & Kosinszki, S.-A. (2017): Interactive Multimedia Learning Activities (IMLA) in a Digital Textbook. In Vlada M., (edits.), *Proceeding of the 12th International Conference on Virtual Learning*, București: Editura Universității, 224-229.

Centrul Naţional de Evaluare și Examinare (CNEE) (2013): *Specificații tehnice pentru editarea manualelor școlare destinate claselor I si a II-a,* on line at: https://media.hotnews.ro/media_server1/document-2013-11-13-16017743-0-caiet-sarcini-manual-imprimat-digital.pdf [accessed Aug. 2019].

Dulamă, M. E. and Magdaș, I. (2014): Analysis of the Competences and Contents of "Mathematics and Environmental Exploration" Subject Syllabus for Preparatory Grade. *Acta Didactica Napocensia, 7,* 2, 11-24.

Dulamă, M.E., Ilovan, O.-R. & Buș, R.-M. (2016)**:** Cultural landscapes and Geography university students' learning on Facebook discussion groups. In Vlada M., (edits.), *Proceedings of the 11th International Conference on Virtual Learning*, București: Editura Universității, 50-57.

Dulamă, M.E., Ilovan, O.-R., Ciascai, L. & Maroşi, Z. (2015)**:** E-learning Geography. How powerful is Facebook for Geography university students? In Vlada M., (edits.), *Proceeding of the 10th International Conference on Virtual Learning*, București: Editura Universității, 121-127.

Giselle Maldonado de Leon, M., Vela Nava, A. S., & Garza Guzman, M. R. (2015): Impact of the use of the Smart Board Interactive whiteboard as an ICT tool on the English language learning of sixth grade students of a public primary school in Asturias, Spain. *Revista de investigacion educativa de la Escuela de Graduados en Educacion*, *6*(11), 2-8.

Gursul, F., and Tozmaz, G. B. (2010): Which one is smarter? Teacher or board. *Procedia-Social and Behavioral Sciences*, *2*(2), 5731-5737.

Ilovan, O.-R., Scridon, I., Havadi-Nagy, K.X., & Huciu, D. (2016): Tracing the Military Frontier District of Năsăud. Territorial identity and regional development. *Mitteilungen der Osterreichischen Geographischen Gesellschaft, 158,* 215-244.

Ling, L. W., Ahmad, W. F. W., & Singh, T. K. R. (2014): Effects of the smart board on students' achievement in moral education. In *2014 International Conference on Computer and Information Sciences (ICCOINS)* (pp. 1-6). IEEE.

Magdaș, I. (2014): *Didactica matematicii pentru învăţământul primar şi preşcolar: actualitate şi perspective*. Second edition, Cluj-Napoca, Presa Universitară Clujeană.

Magdaș, I. (2018): *Prezentarea și prelucrarea datelor cercetării în științele educației. Ghid pentru studenți*, Presa Universitară Clujeană, ISBN 978-606-37-0420-8, on-line: http://www.editura.ubbcluj.ro/bd/ebooks/pdf/2276.pdf (accessed August 2019).

Magdaș, I., Buzilă, S.-R., Dulamă, M.E., Ilovan, O.-R. & Buzilă, L. (2017): Primary Grades Teachers' Perceptions on a Mathematics and Environmental Exploration Digital Textbook. In Vlada M., (edits.), *Proceeding of the 12th International Conference on Virtual Learning*, University of Bucharest and "L. Blaga" University of Sibiu, București: Editura Universității, 218-223.

Magdaș, I. and Drângu, C. (2016): Primary School Teachers' Opinion on Digital textbooks. *Acta Didactica Napocensia*, Vol. 9, nr. 3, p. 47-54. ISSN: 2065-1430.

Magdaş, I. and Răduţ-Taciu, R. (2016): A Didactical Analysis of Math Online Games for Primary Education. In Vlada M., (edits.), *Proceeding of the 11th International Conference on Virtual Learning,* p. 175-181, Ed. Universității din București.

Mihăescu, M., Pacearcă, Ș., Dulman, A., Alexe, C., Brebenel, O. & Ionescu, C. (2014): *Matematică şi explorarea mediului. Manual pentru clasa a II-a.* Editura Intuitext, București.

Min, K. and Siegel, C. (2011): Integration of SMART board technology and effective teaching. *Imanager's Journal on School Educational Technology*, *7*(1), 38-47.

Ministerul Educației Naționale (MEN) (2013): *Programa şcolară pentru disciplina Matematică şi explorarea mediului, clasa a II-a.* Bucharest.

Ministerul Educației Naționale (MEN) (2014): *Digital Textbooks*. www.manuale.edu..ro, accessed Aug. 2017).

Petruța, G.-P. (2016): Methodological issues concerning the use of smart board within the biology lessons. In *7th International Edu World Conference (Edu World)*. European Proceedings of Social and Behavioural Sciences, 23, 978-985.

Scridon, I., & Ilovan, O.-R. (2015): The Zipsers' ethnic identity in Vișeu de Sus/Oberwischau, Romania, in the context of inter-ethnic relationships. *Mitteilungen der Osterreichischen Geographischen Gesellschaft, 157*, 151-168.

Scridon, I., & Ilovan, O.-R. (2016): Approaching the Other in the Zipser community. Identity issues and methodological insights into geographical cross-cultural research. *Transylvanian Review, 25*(1), 55-73.

Stoica, D., Paragina, F., Paragina, S., Miron, C. & Jipa, A. (2011): The interactive whiteboard and the instructional design in teaching physics. *Procedia-Social and Behavioral Sciences*, *15,* 3316-3321.

Tanir, A. (2015): German Language Teaching Academicians' Contentment on the Usage of Smart Board. *Procedia-Social and Behavioral Sciences, 182,* 259-265.

Turan, B. (2014): Smart board in mathematics education, the use of cartoon characters impact on student success. *Procedia-Social and Behavioral Sciences*, *143*, 809-815.

Vlada, M. (2014): Manuale digitale, o premieră în România – despre confuzii şi clarificări. In M. Vlada (edits.), *Lucrările celei de-a XII-a conferinţe de învăţământ virtual: Virtual Learning – Virtual Reality, Models & Methodologies, Technologies, Software Solutions*, 24-25 octombrie 2014, 37-44. Bucureşti, Editura Universităţii din Bucureşti.

Wang, L.-C.C., Lam, E.T.C & Chen, Y.-H. (2019): A case study of using the Smart Board as a Chinese learning application by elementary school students. *International Journal of Technology Enhanced Learning*, *11*(1), 71-79.

Yushendri, J., Rindani, F., Cristhian, A. A. & Agushinta, R. D. (2015): Design the Smart Board system in ubiquitous computing for teaching and learning process. In *2015 International Conference on Science in Information Technology (ICSITech)* (pp. 89-94). IEEE.

The role and effectiveness of digital products in instruction at Mathematics and Environmental Exploration

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Abstract

In this paper we studied the opinions of one hundred teachers from Sălaj county regarding the role of educational software and PowerPoint presentations in Mathematics and Environmental Exploration lessons in the preparatory class and their efficiency. Data was gathered through the survey method. The survey was made in Google Forms on Google Drive and contains 2 open questions and 14 Likert scale questions. We have collected data on several aspects: the typology of used digital materials; frequency of use; the progress made by students; positive aspects and identified negative aspects of using digital educational materials. Some conclusions have been reached: the regular use of digital educational materials determines the increase in the mathematics interest of students in the preparatory class; through the use of diversified educational digital materials, children are stimulated for cognitive training by solving various tasks, which leads to their performance improvement; the use of digital didactic materials is effective in transmitting new knowledge, enhancing learned skills, and transferring information between different areas of knowledge.

Keywords: ICT, educational software, PowerPoint presentations, primary education, survey, teachers, Romania

1. Introduction and Theoretical Approach

Currently, there is a growing interest for the integration of information and communication technologies (ICT) in the learning and teaching activity (Hwa, 2018), and the application of technology as a training support has been appreciated as an effective learning method (Pritami and Muhimmah, 2018). Due to their ability to provide a virtual environment in which knowledge can be effectively acquired, multimedia objects play an important role in the activity carried out in the classroom by students (Hwa, 2018). Students in primary school use gadgets such as smartphone, tablet (Pritami and Muhimmah, 2018), digital camera, smart watches, pencils and electronic pens, interactive games and more. Researchers are aware of the risk that the use of these gadgets by children can have a negative impact on their achievements at school, as they may become lazy and less useful (Pritami and Muhimmah, 2018).

The use of educational software in the educational process offers many advantages, but it can generate a frustrating experience for teachers and students without experience in using it (Zaldívar-Colado et al., 2017). Research shows that teachers do not have the equipment to properly integrate technology (Öksüz et al., 2009). In the decision to use educational software in teaching, teachers are influenced by several factors: the effort required, personal innovativeness, perceived ease of use, perceived usefulness, previous technical training and pleasure in helping others (altruism). (Lambić, 2014).

There are many studies in the literature on the use of digital games and PowerPoint presentations in mathematics learning, and less on the use of educational software and other applications. Currently, children learn many things from the games (Chizary and Farhangi, 2017). Digital game-based learning has been more effective in primary school children in gaining mathematics knowledge than traditional learning (Hwa, 2018). Video games have helped to achieve better results in mathematics for students in the 12^{th} grade, compared to those in the classrooms where traditional methods have been used (Tokac et al., 2019). Educational games are effective tools for influencing motivation, for improving understanding of complex problems and learning mathematics (Chizary and Farhangi, 2017), in developing creative thinking (Wang, 2018). In primary education, various games have been used experimentally to improve some knowledge of arithmetic and skills (Brezovszky et al., 2019), to increase their degree of activation and to develop counting skills (Pritami and Muhimmah, 2018), thinking logical (Wang, 2018), a positive attitude towards learning mathematical concepts and practicing mathematical thinking skills in an attractive way (Hwa, 2018). A didactical analysis of the mathematical online games for primary education have been made by Magdaș and Răduț (2016). In order to satisfy the need of children to learn specific concepts through a multi-sensory approach to education, in a mathematical game about angles, several sensory modalities (movement, sound, image) have been harnessed (Volta, Alborno, Gori and Volpe, 2018).

PowerPoint software is a commonly used tool for creating and using electronic presentations (Stacy and Thiel, 2017). In a meta-analysis of PowerPoint studies, compared to traditional education, it was concluded that, on average, there are no differences in student learning (Baker et al., 2018). Some postgraduate students found PowerPoint interesting at the beginning of the lecture, but boring and tiring later, and others were happy. The efficient use of PowerPoint in the classroom is influenced by the construction and management of PowerPoint, by the subject's knowledge and by the teacher's teaching skills (Abdelrahman et al., 2013). The subject's knowledge and interaction proved highly useful for all those invoved in research and related activity types (i.e. education) (Ilovan et al., 2016; Scridon and Ilovan, 2015, 2016). Through hyperlinks, PowerPoint presentations can change the learning activity in which the participant plays a passive role in an activity in which he has an active role (Stacy and Thiel, 2017). Visual means are important in forming spatial representations (Maroşi et al., 2019; Dulamă et al. 2019).

Various electronic devices and multimedia products are used in Romanian education, and some of them are presented in didactics books (eg. Magdaș, 2014) but opinions about them are different. In this research we will analyze the opinions of teachers from Sălaj county regarding the role and efficiency of educational software and PowerPoint presentations in *Mathematics and Environmental Exploration (MEE)* lessons, in the preparatory class.

2. Material and Method

2.1. Data Collecting, Procedure and Research Material

We collected the research data using the survey method. The tool used was a questionnaire completed in Google Forms on Google Drive. Through 6 items we collected data about participants, and through 14 questions with Likert scales and 2 open questions, about the digital materials used: typology; frequency of use; the progress made by the students; positive and negative aspects identified in their use. The research material was represented by the answers / options / choices of the teachers to the items in the questionnaire and from the information obtained from direct discussions with the teachers. The collected data are represented in tables specific to Education Sciences (Magdaș, 2018).

2.2. Participants

The sample of subjects was made up of 100 teachers from Sălaj County. 4% of the teachers graduated from the Pedagogical high school, 67% have a Bachelor's degree, 28% have a master's degree, 1% have a Ph'd diploma. Most teachers, 41%, are between the ages of 40-49, 27% are 35-39 years old. The percent of respondents with age under 35 is lower (20-24 years - 8%; 25-29 years - 1%; 30-34 years - 4%), as well as those over 50 years (50-59 years - 14 %; over 60 years - 3%). Regarding teaching experience in education, most of the respondents, 37%, have 20-30 years, and 31% have 11-20 years. Under 5 years of teaching experience are 9% of respondents, between 6-10 years are 15% while over 31 years of teaching experience are 8%. 59% of the teachers have the first degree, 14% have the second degree, 22% have the definitive degree, and only 5% are beginners withouth a teaching degree. 62 teachers work in urban areas and 38% in rural areas. Only 6% of the respondents are male. Studies, degrees and teaching experience of the respondents indicate the experience necessary for their answers and opinions to be considered as relevant.

3. Results and Discussions

The use of digital educational materials in the cycle of fundamental acquisitions and in the MEE lessons in the preparatory class. Table 1 shows that teachers mostly use PowerPoint presentations and movies, which can be short documentaries or animations. From discussions, it turns out that their frequent use is determined by the easiness of: making the presentation, accessing presentations and films in the online environment and their using in the classroom. More than half of teachers claim to use educational software. Their lower using is due to the costs of many of these software, the restrictions on their use, the need for the existence / installation of certain programs or applications, as well as the adequacy of electronic devices. 58% of teachers state they use materials from digital textbooks in the fundamental acquisition cycle. The digital textbooks were introduced in 2013 since then many analyses were made, eg. Vlada (2014), Magdaș and Drîngu (2016). Teachers certainly use them at MEE lessons, but this option was not offered in the applied questionnaire.

Table 1. The use of digital educational materials in the cycle of fundamental acquisitions and in the MEE lessons in the preparatory class

Types of digital materials	**in the cycle of fundamental acquisitions**	**in the MEE lessons in the preparatory class**
	% teachers	**% teachers**
PowerPoint presentations	83	79
Movies	80	82
Educational software	58	55
Materials from digital textbooks	58	0
Other materials	2	0

Frequency of use. One third of the teachers claim that they use PowerPoint presentations and educational softewarers in the MEE lessons in the preparatory class 2 times a week (33%) and 31% of the teachers use them 2-3 times a month (Table 2). Although in Romania there are digital textbooks since 2013 (Magdaș et al., 2017; Buzilă et al., 2017) and 79.9% of the schools in primary and secondary education, respectively 71.8% of the rural schools had internet access in the 2016-2017 school year (INS, 2018), only 29% of teachers say they use daily PowerPoint presentations and educational softwares, 7% of teachers use such digital materials very rarely, once a month or 2-3 times per semester. Based on the discussions with the teachers, we consider that the daily or high frequency use of digital materials is conditioned, first of all, by the permanent access to devices in the class of students, by the existence of the digital materials adapted to the studied contents and by the digital competence of the teachers.

Table 2. Frequency of use of PowerPoint presentations and educational software in MEE lessons in the preparatory class

Frequency of use	% teachers
Twice a week	33
2-3 times a month	31
Daily	29
Once a month	4
2-3 times per semester	3

Frequency of using PowerPoint presentations by source of origin. Table 3 shows that 52% of teachers use the most commonly used PowerPoint presentations taken from the Internet. On average, 53% of them use PowerPoint presentations made by themself, and 48% PowerPoint presentations received from their colleagues. Although it is possible that the presentations received can also be downloaded from the Internet, it is relevant that the teachers share materials they discover in various sources and use them in the activity with the students. The discussion groups made up of teachers in the Facebook social network offer a lot of information and materials that can be used for educational purposes (Dulamă et al., 2015; Dulamă et al., 2016).

Table 3. Frequency of using PowerPoint presentations by source of origin

The source of PowerPoint presentations	% teachers		
	Rarely	Medium	Frequent
Made by myself	26	53	21
Received from colleagues	44	48	8
Retrieved from the Internet	9	39	52

The utility of using PowerPoint presentations and educational software in MEE lessons in the preparatory class. Teachers were asked to express their opinion on the usefulness of these materials. Table 4 shows that almost a half of teachers, think that PowerPoint presentations and educational softewarers are very useful. 36% of them consider them very useful, while 16%, average useful. Only 2% of teachers consider them a little and not at all useful.

Table 4. The utility of using PowerPoint presentations and educational software in MEE lessons in the preparatory class

	Level of utility					Mean
	Not at all (1 pst.)	A little (2 pt.s)	Average (3 pts.)	Much (4 pts.)	Very much (5 pts.)	
Nr. of respondents	1	1	16	47	36	**4.26**

Progress made by students as a result of using PowerPoint presentations and educational softeware. By a regular use of these digital materials in the MEE lessons in the preparatory class, 65% of the respondents say that the students' results have made significant progress, 30% of the respondents think that the students have made little progress, 3% of the respondents say that they do not know what progress has been made, and 2% say they have not noticed any progress in the students' results (Table 5).

Table 5. Progress made by students as a result of using PowerPoint presentations and educational softeware in MEE lessons in the preparatory class

Frequency of use	% teachers
Significant progress	65
Little progress	30
No progress	2
I do not know	3

The level of students' involvement in the MEE lessons in which digital educational materials are used. 76% of the respondents stated that the students get very involved (36%) and much (40%) in lessons as a result of using such materials. 22% of the respondents consider that the students are involved on average, while 2% of the respondents say that the students are little involved (Table 6).

Table 6. The level of students' involvement in the MEE lessons in which digital educational materials are used

The level of students' involvement in the MEE lessons	**% teachers**
Very much	36
Much	40
Average	22
A little	2

Positive aspects regarding the use of digital educational materials. The teachers provided a wide variety of opinions (Table 7) as a response to an open question. 33% of them consider that the lessons are more attractive for students. More teachers believe that these materials bring more benefits in the process of preparing students for learning, thus they increase the students' interest in the activity, stimulate their curiosity, facilitate their attention, increase the motivation of the students. They play an important role in focusing attention by providing variety of stimuli and providing opportunities for diversifying learning situations. The use of these digital materials during learning is valuable because through them you can ensure efficiency in transmitting new knowledge, receiving and understanding easier, faster and better contents, increasing the efficiency in solving problems, in consolidating the learned skills and in achieving the transfer of information between the different fields of knowledge. The use of digital materials is effective not only in teaching lessons but also in knowledge consolidation or assessment. On an emotional level, teachers positively believe that these digital materials are well-liked by children and that they enjoy participating in the MEE lessons in which they are used. By using in mathematics lessons digital educational materials, teaching content becomes interesting, increases the degree of interactivity, and involvement of students in the lesson and student performance.

Table 7. Positive aspects regarding the use of digital educational materials

Responses	**% of responses**
Attractive, captivating lessons, teaching becomes interesting	34
Increases students' interest in the activity	21
Active involvement of students in the activity	22
Stimulate the students' curiosity	17
The attention of the students is easier captured	14
Facilitates an easier learning / storage of information	14
Interactive lessons / Interactive character	10
Easier / quicker / better understanding of content	12
Increases student motivation	9
Diversity of learning situations	5
Increases school performance of students	5
Students take pleasure in the lesson	3
Students are more receptive	3
It contributes to the development of logical thinking	3
Deepening knowledge	2
It solves problems much easier	2
Increased interest in mathematical discipline	1

The activities like to children	1
Provides variety of stimuli	1
It grows efficiently in the transmission of new knowledge, in the consolidation of the learned skills and in the transfer of information between the different fields of knowledge.	1
Develops voluntary attention	1

Negative aspects regarding the use of digital educational materials. Among the opinions expressed by the respondent (Table 8), the poor endowment of schools with IT equipment and digital educational materials is the main negative aspect found by the respondents. Also many teachers consider that using digital materials it is time consuming, probably also for the preparation of the equipment, as well as the technical limitations. Many teachers working with the simultaneous classes consider that digital materials cause some disturbance of the activity in the class. Other important negative aspects considered are: it takes a long time for their preparation or design and the existence on the market of a small number of educational software and that they are expensive. During the activity, the teachers noticed that the use of too animated digital materials distracts attention from the task, their failure to adapt to the topic causes disinterest, that the students get tired faster, and their excessive use causes boring. Some teachers express the opinion that the use of digital educational materials affects students' writing, reading and oral communication. Some teachers have the opinion that digital materials request the visual sense, they limit the imagination of the children, they cause a precarious emotional development and create a state of dependence. There are also teachers who believe that there are no negative aspects as long as these materials are correctly chosen and used rationally.

Table 8. Negative aspects regarding the use of digital educational materials

Responses	**% of responses**
Poor endowment of schools with IT equipment and digital educational materials	16
Consuming time in their use in lessons	12
Technical limitations	9
Some disturbance of activity when teaching simultaneously	6
It takes a long time for their preparation	6
There is few educational software on the market	5
Not all students can be involved if the materials are numerous	4
Students get tired faster	4
Excessive use causes boredom	4
The high price of educational software	3
It affects the reading of the students	3
If they are too busy, they distract from the task	2
Affects student writing	1
Poor emotional development	1
Affects oral expression	1
Unadapted to the theme lead to disinterest	1
Students are required visually	1
Creates a state of addiction	1
Limiting imagination	1
Lack of training courses for teachers	1
No negative aspects were identified	6

4. Conclusions

At the end of the study in which we analyzed the opinion of the teachers regarding the use of digital educational materials in the MEE lessons in the preparatory class, we found that the teachers used the most movies, PowerPoint presentations and educational software. Nearly two-thirds of teachers use these digital materials at least a few times a week. More than half of the teachers regularly use PowerPoint presentations taken from the Internet, and only one fifth of them regularly use PowerPoint presentations done by themselves, and only one-tenth taken from their colleagues. Respondents consider digital materials very useful in training. Two thirds of the teachers observed a significant progress of the pupils 'performances following the use of digital materials, respectively a significant increase of the students' involvement in the lesson. The most important positive aspect was identified by one third of the respondents as the attractiveness of the lessons, while the negative aspects are not well crystallized, the teachers have different opinions, the most frequent being the lack of endowments, and the fact that these lessons are time consuming.

Some conclusions have been reached: the regular use of digital educational materials determines the increase in the mathematics interest of students in the preparatory class; through the use of diversified educational digital materials, children are stimulated for cognitive training by solving various tasks, which leads to their performance improvement; the use of digital didactic materials is effective in transmitting new knowledge, enhancing learned skills, and transferring information between different areas of knowledge.

References

Abdelrahman, L. A. M., Attaran, M. & Hai-Leng, C. (2013): What does PowerPoint mean to you? A Phenomenological Study. *Procedia-Social and Behavioral Sciences*, *103*, 1319-1326.

Brezovszky, B., McMullen, J., Veermans, K., Hannula-Sormunen, M. M., Rodríguez-Aflecht, G., Pongsakdi, N. & Lehtinen, E. (2019): Effects of a mathematics game-based learning environment on primary school students' adaptive number knowledge. *Computers & Education*, *128*, 63-74.

Buzilă, S.-R., Ciascai, L., Dulamă, M.E., Ilovan, O.-R. & Kosinszki, S.-A. (2017): Interactive Multimedia Learning Activities (IMLA) in a Digital Textbook. In Vlada M., (edits.), *Proceeding of the 12th International Conference on Virtual Learning*, București: Editura Universității, pp. 224-229.

Chizary, F. and Farhangi, A. (2017): Efficiency of Educational Games on Mathematics Learning of Students at Second Grade of Primary School. *Journal of History Culture and Art Research*, *6*(1), 232-240.

Dulamă, M.E., Ilovan, O.-R. & Buș, R.-M. (2016): Cultural landscapes and Geography university students' learning on Facebook discussion groups. In Vlada M., (edits.), *Proceedings of the 11th International Conference on Virtual Learning*, București: Editura Universității, 50-57.

Dulamă, M.E., Ilovan, O.-R., Bagoly-Simó, P., Magdaș, I. (2019): Development of the Geographical Education System in Romania, under the Impact of World War II and during the Transition to Communism, *Transylvanian Review*, vol. 24, Supplement no. 2 – under print.

Dulamă, M.E., Ilovan, O.-R., Ciascai, L. & Maroși, Z. (2015): E-learning Geography. How powerful is Facebook for Geography university students? In Vlada M., (edits.), *Proceeding of the 10th International Conference on Virtual Learning*, București: Editura Universității, 121-127.

Hwa, S. P. (2018): Pedagogical Change in Mathematics Learning: Harnessing the Power of Digital Game-Based Learning. *Journal of Educational Technology & Society*, *21*(4), 259-276.

Ilovan, O.-R., Scridon, I., Havadi-Nagy, K.X., & Huciu, D. (2016): Tracing the Military Frontier District of Năsăud. Territorial identity and regional development. *Mitteilungen der Osterreichischen Geographischen Gesellschaft, 158*, 215-244.

Institutul național de Statistică (INS). (2018). *Sistemul educațional în România. Date sintetice. Anul școlar 2016-2017*. Online at: http://www.insse.ro/cms/sites/default/files/field/publicatii/sistemul_educational_in_romania_2016_2017.pdf (accessed August 2019).

Lambić, D. (2014): Factors influencing future teachers' adoption of educational software use in classroom. *Croatian Journal of Education*, *16*(3), 815-846.

Magdaș, I. (2014): *Didactica matematicii pentru învăţământul primar şi preşcolar: actualitate şi perspective*. Second edition, Cluj-Napoca, Presa Universitară Clujeană.

Magdaș, I. (2018): *Prezentarea și prelucrarea datelor cercetării în științele educației. Ghid pentru studenți*, Presa Universitară Clujeană, ISBN 978-606-37-0420-8, on-line: http://www.editura.ubbcluj.ro/bd/ebooks/pdf/2276.pdf (accessed Aug. 2019).

Magdaș, I., Buzilă, S.-R., Dulamă, M.E., Ilovan, O.-R. & Buzilă, L. (2017): *Primary Grades Teachers' Perceptions on a Mathematics and Environmental Exploration Digital Textbook*. In Vlada M., (edits.), *Proceeding of the 12th International Conference on Virtual Learning*, University of Bucharest and "L. Blaga" University of Sibiu, București: Editura Universității, pp. 218-223.

Magdaș, I. and Drângu, C. (2016): Primary School Teachers' Opinion on Digital textbooks. *Acta Didactica Napocensia*, Vol. 9, nr. 3, p. 47-54. ISSN: 2065-1430.

Magdaş, I. and Răduț-Taciu, R. (2016): A Didactical Analysis of Math Online Games for Primary Education. In Vlada M., (edits.), *Proceeding of the 11th International Conference on Virtual Learning*, p. 175-181, Ed. Universităţii din Bucureşti.

Maroși, Z., Adorean, E.-C., Ilovan, O.-R., Gligor, V., Voicu, C.-G., Nicula, A.-S., & Dulamă, M.E. (2019): Inhabitants' Perceptions of the Central Squares and Quality of Life in Cluj-Napoca, Romania. *Mitteilungen der Osterreichischen Geographischen Gesellschaft*- under print.

Öksüz, C., Uça, S., & Genç, G. (2009): Designing multimedia videocases to improve mathematics teaching with technology: "technology integration into mathematics education" project. *Procedia-Social and Behavioral Sciences*, *1*(1), 489-494.

Pritami, F. A. and Muhimmah, I. (2018, February): Digital Game Based Learning using Augmented Reality for Mathematics Learning. In *Proceedings of the 2018 7th International Conference on Software and Computer Applications*, 254-258. ACM.

Scridon, I. and Ilovan, O.-R. (2015): The Zipsers' ethnic identity in Vișeu de Sus/Oberwischau, Romania, in the context of inter-ethnic relationships. *Mitteilungen der Osterreichischen Geographischen Gesellschaft, 157*, 151-168.

Scridon, I. and Ilovan, O.-R. (2016): Approaching the Other in the Zipser community. Identity issues and methodological insights into geographical cross-cultural research. *Transylvanian Review, 25*(1), 55-73.

Stacy, G. S. and Thiel, S. G. (2017): Use of Hyperlinks in PowerPoint Presentations as an Educational Tool. *Academic radiology*, *24*(10), 1318-1324.

Tokac, U., Novak, E., & Thompson, C. G. (2019): Effects of game-based learning on students' mathematics achievement: A meta-analysis. *Journal of Computer Assisted Learning*, *35*(3), 407-420.

Vlada, M. (2014): Manuale digitale, o premieră în România – despre confuzii şi clarificări. In M. Vlada (edits.), *Lucrările celei de-a XII-a conferinţe de învăţământ virtual: Virtual Learning – Virtual Reality, Models & Methodologies, Technologies, Software Solutions,* 24-25 octombrie 2014, 37-44. Bucureşti, Editura Universităţii din Bucureşti.

Volta, E., Alborno, P., Gori, M., & Volpe, G. (2018, August): Designing a Multisensory Social Serious-Game for Primary School Mathematics Learning. In *2018 IEEE Games, Entertainment, Media Conference (GEM)* (pp. 1-9). IEEE.

Wang, L. (2018, September): Design and implementation of four arithmetic operations learning games in primary mathematics based on cocos2d-js. In *2018 3rd International Conference on Mechanical, Control and Computer Engineering (ICMCCE)* (pp. 595-598). IEEE.

Zaldívar-Colado, A., Alvarado-Vázquez, R. I., & Rubio-Patrón, D. E. (2017): Evaluation of using mathematics educational software for the learning of first-year primary school students. *Education sciences*, *7*(4), 79.

Online Apps, Web Sources and Electronic Devices: Learning through Discovery about Valea Ierii [Iara Valley]

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Abstract

Geography university students and their professors do often research of certain unknown places in a direct manner. At present, the Internet offers very many sources that may be used in research and there are plenty of applications that enable us learn about the terrestrial space. During this research, we used the method of learning through discovery, and Google Maps and Google Street View for obtaining information as well as for assessing the one from other web sources. We were able to establish the degree to which we found the answers for a specific case study: a primary exploration of Valea Ierii Commune. We used the Internet facilities for researching the territory of this commune. For in-depth knowledge of this area, we realised field research in which we compared the information from web sources with the ones obtained through direct observation of the research area. In addition, we realised a series of measurements, we discussed with the inhabitants and specialists working in the respective commune and we eventually confronted our conclusions with the ones of several experts and with the ones in specialty studies. Finally, we identified the benefits and the drawbacks of geographical research using the present Information and Communication Technology.

Keywords: Web sources, smartphone, digital natives, Geography university education

1. Introduction and Theoretical Background

Students in the field of Geography as well as their professors always search the Internet resources for data and information about unknown places, spaces and regions, aiming at using this information in various purposes: scientific research, touristic and personal curiosity, and to develop their general knowledge (Dulamă, Magdaș and Osaci-Costache, 2015). These online sources are supporting both long-life learning (Manea, 2015) and Geography specific competences (Ursu, Dulamă and Chiș, 2019; Deac et al., 2019). Nowadays, Internet provides multiple sources (scientific papers, books, websites and webpages, newspaper articles and shared materials via various channels as Youtube, Instagram, Pinterest, etc.) that could be used in research approaches, thus enhancing the knowledge on various worldwide spaces and places (Google Earth, Google Maps, Google Street View, etc.). Students also can access different sources in line with their needs and interests, in studying a particular geographic place (Osaci-Costache et al., 2014). Since some data and information in the virtual environment could be erroneous, the intervention of the trainer in students' learning is required, to assist students' activity and to turn them into "reflexive students", in discerning what is right or wrong (Cinque, 2013). Consequently, students should learn "to filter, to select, to accept and to reject the wrong data provided" by the Internet (Eco, 2007).

Research capturing data and information for different academic analyses from online resources required a high degree of attention, as well as a certain capacity of synthesis (Cernat, 2017). The analysts of various information backgrounds pay special attention to data trustworthiness, to its conclusiveness and completeness (Nițu, 2011). Regarding, information selection and its academic capitalisation, Popa (2015) proposed four relevant criteria: credibility, objectivity, accuracy and relevance.

Geography students consider frequently that online information does not have scientific credit if it is not assigned to an author or if it does not include relevant citations and references. Furthermore, without any scientific structure, reference, date of updated material and with colloquial texts instead of academic writings, these resources remain doubtful and with no scientific value (Ilovan et al., 2015).

Concerning the texts provided by online resources, the students consider it is mandatory to include correct and relevant information. Furthermore, they have to be stated concisely, with logical approach according to the contemporary academic requirements. In addition, they have to be expressed correctly, through adequate scientific discourse (Dulamă, 2014). Turning to figurative materials as maps and charts, frequently used in Geography learning, students often unveil their difficulties in selecting the appropriate and correct materials, while in using of various images and photos there were recorded multiple cases when students used visual images with no geographic substance that often did not express the objective spatial reality. In addition, students used often wrong pictures and images, with confusing contents on different investigated places and spaces (Magdaș et al., 2018).

Learning through discovery is based on a certain activity of investigation developed by a person or a group. Very often this activity is connected closely to problem-based learning, searching for multiple alternatives in finding the best solution in researching, reconstructing and rediscovering the scientific truths and the real methods through which these realities had been discovered (Dulamă, 2008). This is a means frequently used by all those interested in learning and research activities (Catalano and Chiș, 2016; Chiș et al., 2019), irrespective of being teenagers or adults, seeking for enhancing their knowledge through heuristic approaches, for identifying actively and solving diverse geographical problems (Dulamă, 1996; Cuc, 2012). This research investigates the ways in which learning through discovery using online resources was done, in researching the region of Valea Ierii.

2. Material and Method

2.1. Data Collecting, Procedure and Research Material

The data of this study were collected through the interview method. The items and questions were adjusted to each online application, web source and electronic device used in this study. The research sample included all students involved in a fieldtrip research activity that took place in 2019, affiliated to the Faculty of Geography, Babeș-Bolyai University, Cluj-Napoca. The research material is made of the interviewees' answers to the set questions addressed by the trainers and of the web sources content. The latter was investigated through the content analysis method. Motion pictures, figures, images and other visual imagery were approached through the lens of diverse visual methods. A guide on processing these data for educational purposes was used (Magdaș, 2018).

2.2. Participants. This research is based on four students with different levels of approaches (B.A., M.A. degree and two Ph.D. candidates) and four professors.

3. Results and Discussions

3.1. Discovering places through online apps

In order to achieve knowledge about different places (landscapes, landforms, rivers, vegetation, local anthropic planning, etc.), the students experienced multiple online apps: *Google Earth, Google Maps, Google Street View, România Map, etc.*

Through the lens of ***Google Maps App*** (https://www.google.com/maps/), students became familiar with the local territorial issues of the investigated commune (Valea Ierii) as well as with its surrounding areas. There are visible the following: the main communication axes, the buildings, the land use forms and aspects concerning some particularities of the relief and surface waters. Regarding communication axes, their design, links and connections could be observed, as well as their density and typology (national roadways, county roads, forest alleys and un-modernised paths). In addition, some transport routes could be viewed as for instance some indicatives: 107N and 107J. The main axis along which the main buildings of the commune are placed is the county roadway 107J providing to the settlement hearth the form of a linear rural habitat with the following route: Cerc village (the end of the route) - Valea Ierii - Valea Ierii Touristic Complex, Plopi village, and Muntele Rece village. The road assigned with the code 107N extends from Băișoara to Valea Ierii village, in a contact area to the road assigned with 107J indicative.

Several buildings with different functionalities are visible: administrative buildings (the Mayor's Office), commercial buildings (Universal Store, a bar), and accommodation units (Cabane de lux, Carla Pension, Lara & Mara Pension; Valea Ierii Touristic Complex, Children Chalet Caps and Ama, Poiana lui Mircea, Ocol Silvic Valea Ierii chalets). These names inserted in the online maps are a strength, while the absence of some geographical names of other places remains a major weakness, as it is the case of the local school, the village church, the Red Cross sanitary bases, etc.). On the other hand, some names are present partially, thus requiring a lot of supplementary documentation. The application allows the visualization of the main rural features of the village: household size, their density and the placement within the rural hearth, as well as the houses placement within the rural households. It is important the representation of the local land use forms, since the application allows for differentiating the main types of vegetation: meadows and pastures, hardwood forests, coniferous forests and mixt forests, young bushes, etc. Clear areas are visible indicating their position and sizes, the vegetation densities, the sizes of vegetal species and the size of places with certain uses. Concerning the relief and landforms, the main particularities of the valleys are visible: their aspect, length and size. Alluvial fans are also visible as it is the case of the one threatening Lara & Mara Pension. Within the commune area, the sinuous way of the Iara River is obvious together with its confluences and affluent rivers. The absence of the latter's names remains a disadvantage of this online application for Regional Geography learning.

România Map (https://satellites.pro/Romania_map) provides a clearer representation of Romanian space in comparison with Google Maps, especially when the zoom is on. On the contrary, the absence of the names of geographic features remains a disadvantage in using this application for Geography learning.

Google Street View from Google Maps is an online system with a 360° view of the streets. The programme was launched in 2007 and started with 2008. It can be accessed via Google Earth. It was largely extended in 2010, in eight Romanian cities, including some major national roads. Since 2013, it covered all the Romanian space. Then relevant features of this programme have been updated in 2019 with information from other important communication networks (Google Street View, https://ro.wikipedia. org/wiki/Google_Street_View). Through the *Instant Google*

Street View programme (https://www.instantstreetview.com/), going on the 107N road from Băișoara to Valea Ierii, the research area was tracked, thus allowing a correct representation of the commune. Even though some updated images are not available, the captures were helpful during the first contact with the terrain geographic features.

The main strength of the area is that the village is a commune residency, with most of its constructions being placed along the road. Through the above-mentioned application, the students investigated the main constructions and vegetation. Since these approaches were quite facile, it was very difficult to identify the main species of the vegetation from this area. In some areas, where the road is not bordered by trees, the analysis of Iara meadow was possible through this application, with students investigating its length and its land use particularities. On the other hand, some major and important locations, even though not visible in an interactive manner in Street View, include attached images thus providing a global perspective of detailed geographic points in the investigated area of Iara Valley (Fig. 1). The application also allowed both parallel and perpendicular images captures (Fig. 2), thus providing an in-depth knowledge of the places, as well as a better representation of these observed areas and places.

Similarly, ***Google Earth*** (https://earth.google.com/web) provides a good representation as it is the case of Google Maps, noticing that this application simplifies the observation of the local landforms (interfluves, slopes and meadows). Its disadvantage is the absence of geographical names or geographical names are seldom mentioned. On the other hand, it seems that terrain tilt is not in line with the terrain reality.

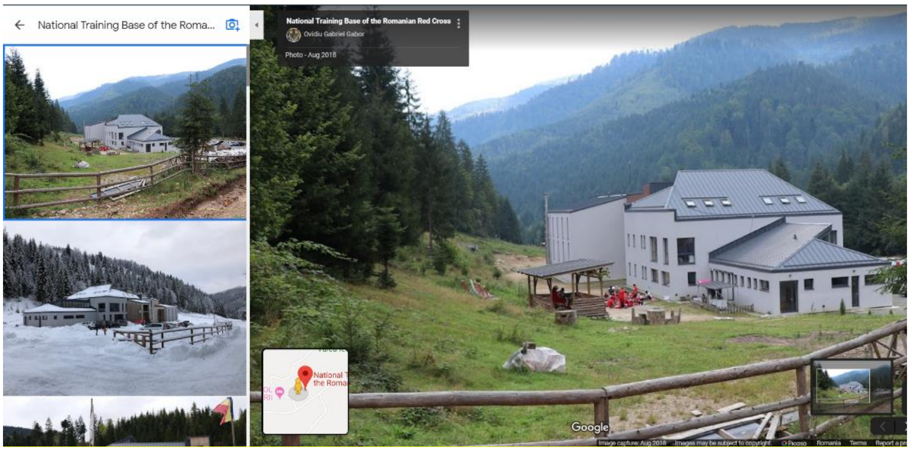

Fig. 1. The national volunteers training point
for Intervention in Case of Emergencies (ISU), Valea Ierii (2019)

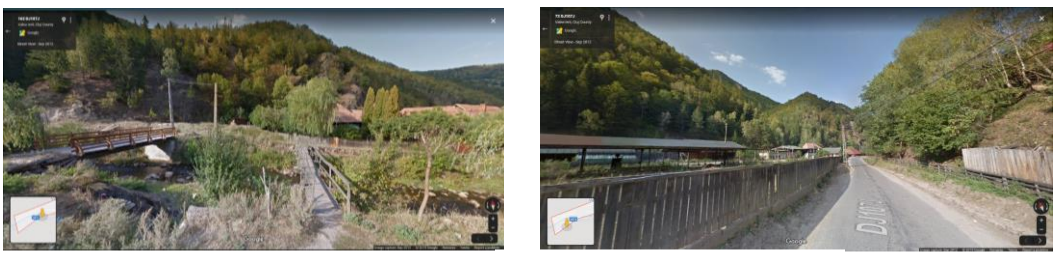

Fig. 2. Images from Valea Ierii (*Google Street View*, screenshots,
https://www.instantstreetview.com/)

Table 1. Advantages and disadvantages of learning through discovery using online apps on Valea Ierii

Applications	Advantages	Disadvantages
Google Maps	- Different axes of communication are visible with some of them assigned to an indicative. - Constructions and buildings (their location, placement and density) are visible, with some of them having names and functionalities mentioned. - Vegetation is visible, as well as its typology and local distribution. - The river courses and some aspects of fluvial landforms are visible.	- The absence of some important buildings. - The roads quality is not visible. - The relief tilt is not visible. - Locating the relief forms is difficult. - Using Zoom in, clarity is lost.
Google Earth	- Similar advantages to Google Maps - It provides a 3D image of the relief and other visible features.	- It is difficult to perceive the real tilt of the relief.
Instant Google Street View	- It allows a good perception of the roads and vicinities (vegetation, landforms, buildings, real estate, etc.).	- The representations of places are outdated (2013) - Comparisons with maps are difficult to make.

3.2. Discovering information about places using web sources

Google, as an Internet search engine, is the most preferred by students (Dulamă, Magdaș and Osaci-Costache, 2015) because it has the advantage to provide quickly information from a data basis including billions of websites (Google, https://ro.wikipedia.org/ wiki/Google). Using *Valea Ierii* as a search keyword, after 0.51 seconds, 159,000 results returned with different contents about the pensions, local videos and photos, documentaries, news, real estate information, weather information, services, and so on. Students have to filter adequate content in line with their research purpose, related to geographical knowledge. The first source where information was anticipated to be present is *Comuna Valea Ierii, Cluj* (https://ro.wikipedia. org/wiki/Comuna_Valea_Ierii,_Cluj). There are provided different and disparate information (locality name, location, history, demography and population, politics and administration, cultural issues, touristic resources, protected areas, and several references). As a source with an unknown author in a free encyclopaedia, the content has to be verified and validated using certain trustful sources.

The official site of Valea Ierii Mayor's Office (https://www.primariavaleaierii.ro/) is provided by the Internet on the 19th position, in 2019 being actually under construction. In the section of General Information, a mix of data is presented, being correct, wrong or confusing. For instance, the commune location in the Gilău Mountains, the confusion between soil and sub-soils. Consequently, these data have to be improved by a geographer. Within the tourism section, the information is grouped in three categories: touristic information, accommodation and touristic objectives. Regarding the first three links, it appears *Touristic Information Center of Valea Ierii* (in progress), *Tourism,* with general data and touristic routes with no other details, and *Natural Protected Areas*.

The unknown authors of the online texts appreciate both the value and attractiveness of the landscape, as well as the need of forest preservation on the slopes. In addition, they appreciate the haunting background. Accordingly, this area was declared as site of community interest in 2007. Since 1994, the County Council of Cluj have declared three natural protected areas of county interest (Bondureasa, Iara Valley and Șoimului Valley) with all being situated within Valea Ierii Commune administrative territory. In this regard, both economic and recreational activities that could harm this area through pollution were been prohibited. In the above-mentioned website, relevant information concerning some further development projects is to be found, as for instance interventions in the running water supply, the development of the volunteering service for emergency situations, as well as some in-progress projects, such as the development of sports infrastructure through the construction of a new stadium, the creation of a touristic centre and the rehabilitation of the road between Cerc and Vârful Dobrin.

ROSCI 0263 *Valea Ierii, Cluj, România* (http://valeaieriinatura2000.ro/) is on the 21st position in the results hierarchy provided by Google. On the first page, three logos appear: of the European Union, of the Romanian Government, and of Structural Funds 2014-2020, all these illustrating that the website is an official one, entitled *The Management Plan Implementation for the Natural Area Valea Ierii ROSCI 0263 Code SMIS 103698*. The beneficiary, S.C. EPMC Consulting S.R.L., became the main custodian of this area back in 2016, based on a contract with the Romanian National Agency for Environmental Protection. It has a team with 80 experts with multidisciplinary training.

EPMC states its continuous interest for biodiversity protection. The protected area as part of Gilău-Muntele Mare Mountains from the Apuseni Mountains occupies 6,289 ha within the communes Valea Ierii (33%) and Băișoara (12%), both of them situated in Cluj County. These data are on many websites, but none indicates the correct data. In the general information section, the data about the location of the protected area is incomplete and the correspondence with the map is very difficult to make. Under the title *Characteristics*, some information about the relief, climate, geology and soils are provided. All these are incomplete, with a low relevance level. Information is randomised and superficial, situation indicating that this data have been set without scientific rigour and designed by unspecialised persons. Considering the species and natural habitats only, several are presented in pictures. The seven habitats are presented summarily, without any localisation and their design is not based on a unitary and coherent data presentation plan. Furthermore, the pictures seem to be not entirely relevant.

Table 2. Protected habitats in Valea Ierii area

Habitat	Problematic issues
6520 Mountain meadows	- The picture illustrates not only meadows, but also forest. - Alongside the meadows, pastures appear.
9110 Beech forest of *Luzulo-Fagetum* type	- It uses the name of the species in Latin, without mentioning the popular names. - The picture does not show the beech forests, but mixt forests.
9130 Beech forests of *Asperulo-Fagetum* type	- In the foreground of the picture, appear coniferous forests.
9170 Hornbeam and oak tree forests *Galio-Carpinetum*	- In the bottom part of the mountains actually sessile is present (*Quercus petraea*), which composes a particular section, not the oak (*Quercus robur*), but both of them are from *Quercus* family.
91E0 Alluvial forests *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, *Alnion incanae, Salicion albae*)	
91V0 Dacian forests of beech (*SymphytoFagion*)	- The picture shows spruce forests.
9410 Acid forests of *Picea abies* (*Vaccinio-Piceetea*), from mountain areas.	- A contradiction appears: in the text, a connection with a tilt land is made, while in the picture appears a smooth area.

In the Communities and Events section, no communities appear even though they have an important role in biodiversity preservation. Only two events are mentioned, without any dates, such as The Fest of Băișoara Days and the Festival of Traditional Food from Valea Ierii. Both these events promote the local traditions, customs and culture of this area. A supplemental search unveils that the sixth edition of the latter fest was organised on the 17th of May 2018, involving 27 schools from 15 counties. In addition, the County Centre for Traditional Cultural Preservation of Cluj, the County School Inspectorate, the Primary School from Valea Ierii and the Mayor's Office of Valea Ierii were also involved in this event (https://turdanews.net/articole/rural/54848-festivalul-bunatatilor-traditionale-de-la-valea-ierii.html).

In the Administration section, *the Management Plan and the Regulation of the sit with community importance ROSCI0263 Valea Ierii* are presented. The first document includes much relevant data and information for the commune, but its extension on 687 pages and the landscape pages make the document very difficult to be read and understand. In addition, because of this, the tables are difficult to read and maps are difficult to be investigated. It is quite difficult to handle the document since it is scanned and taking data from it represents a difficult approach. Only a strong motivation could determine readers to analyse this plan. In order to make the data easier to read a synthesis of data would we preferred, in a .pdf format.

In order to make the document more credible, it is important that the authors of these texts to assume these writings considering that the document is financially supported by the budgets of the E.U. Funds. In the document, it is stated that data have been required from various actors and specialists of diverse backgrounds, but their identities are not disclosed. The document includes plenty of correct data provided by various sources, but many of these are old and outdated, thus being less relevant for this area. In addition, other data are referring to Romania. The name of Valea Ierii appears only in two sources.

The document includes 94 maps in a landscape format. Their quality and the connection between their contents and legends, as well as the absence of the geographical names of the local features make these representations problematic in the current research on the territory.

Article 44 states that the scientific research in this area is developed only with the custodian acceptance, "supporting scientific research in this sit thus actively participating with personal and logistics to the research activities." According to this document, the scientific findings and results are offered to the custodian in order to improve the management and the administration in this area. It is important to note that we discussed with the field agent mentioned in the document regarding the future capitalisation of the developed research based on Valea Ierii.

3.3. Identifying scientific works on Valea Ierii using Internet resources

In order to identify relevant scientific works about Valea Ierii, students appeal to Google Academic and Google Scholar. Since 2004, these search channels provide a relevant list of publications with integral texts or complete references of the main publications. In 0.04 seconds, it provided approximately 372 results for the keyword Valea Ierii. Of these, 17 publications included the keywords in the title (six Geology articles, four Biology papers, three focused on environment and two on Hydrology, one on tourism and one concerning the climate). Five papers are available in full-text, with students being able to identify other references in their final reference lists. Data and information about Valea Ierii were also available in other sources focused on large Romanian areas. The selection of data from these latter sources is often difficult, thus claiming for hard work and extended time resources. Furthermore, specialised competencies are required in this regard in order to develop quality research work.

Worldcat (https://www.worldcat.org/) provides ten sources for the period 1952-2011: six books, three maps, and one article. This small number of references on Valea Ierii included in the above-mentioned catalogue composed by countless collections from 72,000 libraries, from over 170 countries, is supported by the rationale that Romanian libraries have not managed yet to provide all their titles to this international database. However, we consider Worldcat as an excellent documentation source in order to investigate a particular topic. "Lucian Blaga" Central

University Library from Cluj-Napoca (https://www.bcucluj.ro/), the most accessible library for the students of Babeş-Bolyai University, provides only two sources about Valea Ierii. An in-depth search via Internet reveals 22 sources with Valea Ierii, of which eight are Geology articles, seven works focused on Biology and environment, four sources dedicated to Hydrology, and one paper for each of following fields: Tourism, Climate and Toponimy.

3.4. Learning through discovery using smartphones

During in-field documentation, students often make use of electronic devices to find out information about aspects of nature and environment. Developing research in Valea Ierii, students used smartphones and several free available apps provided by the online environment. Plantnet app was free downloaded from PlayStore and it was used to identify the major features of the plants. The students took pictures of plant parts (leaves, flowers, fruits, etc.), with those photos being compared with pictures taken by other individuals. Results indicated many versions presented in line with the ways in which the picture fitted to the images of the unknown plant. The application provided the official names of the species both in Latin and in popular terms of English. The application does not allow the complete identification of all worldwide species; therefore, many species of Romania, many of them being endemic species, are not identifiable. Or, there are cases when the app identifies the plant gender (*Quercus*, in Valea Ierii), and not the species (*Quercus petraea)*. The user has the possibility to add in the album the plant name, its image, thus serving as a further model to be compared by other users.

A second application used in the field-trip research by the students is *Altimeter*. It measures the altitude in meters or in feet, recording the maximum and minimum altitudes during the entire research route and establishes the latitude and longitude, the speed, and the temperature in Celsius degrees. On the main interface of the application, a map is shown with the correct users' location and for orientation, a compass is also shown. Useful applications are also all those used for rocks identification, but they are not freely available. *Smart Geology-Mineral Guide* Application provides a full list of minerals with each having a brief description (chemical formulae, an image, colour, etc.). Also in this application, a mineral classification exists with particular samples.

The app includes a dictionary of geologic terms and the geologic time scale, so useful in field research where the usage of large posters is very difficult to handle. For a preliminarily identification of an unknown rock, in the frame of this app, a section entitled Detect Hand-Specimen is very helpful. Based on some particular questions about colour, form, hardness, etc., the application tries to find out the name of the rock, unveiling many results with different fitting degrees. Using images and the minerals properties provided by the returned results, users have the possibility to identify approximately the type of the unknown rock. It is important to note that the usage of this application in the field-trip research required both phone signal and good Internet connection.

4. Conclusion

Within the online environment and Internet resources, we identified a reduced number of references about Valea Ierii, but the Internet provides a plenty of studies concerning other geographical topics. In order to find out the most appropriate sources, it is required that both trainers and students have specialised competencies focused on online documentation. They should systematically search the information and data using adequate search channels, in line with their research purposes. In addition, the best sources and resources remain the scientific websites that include scientific work such as articles, books, scientific reports, etc. During information selection, the main problem students face with is that of wrong information and uncertain data frequently included in so many websites. This reality could lead to a false perception that such data is correct.

In order to filter correct information, it is required that students create their own knowledge that could be then compared to the online data from various internet resources. Other relevant issues identified during this paper, focused on the online research, are the randomised search for diverse data and the usage of some sources for the public.

Regarding the online resources and electronic devices used in geographical research and in learning through discovery in geography, both of them are highly useful. Their ongoing development and updating provide new opportunities for geographers. Considering these, this paper calls for further in-depth research on these topics, opening new avenues for future approaches of the online instruction in the field of Regional Geography.

References

Biblioteca Centrală Universitară "Lucian Blaga" din Cluj-Napoca ["Lucian Blaga" University Central Library, Cluj-Napoca], https://www.bcucluj.ro/.

Catalano, C. and Chiș, O. (2016): Comparative Study between Students' Teaching Practice Activities in Hungary and Romania. *4th ERD Conference, European Proceedings of Social and Behavioural Sciences* 18, 74-78.

Cernat, M. (2017): OSINT – *cine, ce, unde, când, cum?* [who, what, where, when, how?], https://intelligence.sri.ro/osint-cine-ce-unde-cand-cum/ (accessed 12 July 2019).

Chiș, O., Magdaș, I., Dulamă, M.E. and Moldován, K.R. (2019): Learning through Cooperation and Project Method in Pre-School Education in Romania. *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 565-572.

Cinque, M. (2013): "Lo studente riflessivo": l'uso di dispositivi mobili tra formazione on-the job e PLN (Personal Learning Network). *Form@re - Open Journal per la formazione in rete* 11, 73, 38-50, http://www.fupress.net/index.php/formare/article/view/12554/11890 (accessed 17 May 2014).

Comuna Valea Ierii, Cluj [Valea Ierii Commune, Cluj], https://ro.wikipedia.org/wiki/Comuna_Valea_Ierii,_Cluj (accessed 20 April 2019).

Cuc, M.C. (2012): Educational Strategies for Training Teachers to Promote Excellence. *8th International Scientific Conference eLearning and Software for Education, Leveraging Technology for Learning* I, 141-145.

Deac, A.S., Ilovan, O.-R., Chiș, O. and Dulamă, M.E. (2019): Primary Grades Teachers' Perceptions of Learning Activities in Nature. *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 358-364.

Dulamă, M.E. (1996): *Didactica geografică [Geographical Didactics]*. Clusium, Cluj-Napoca.

Dulamă, M.E. (2008): *Metodologie didactică [Didactic Methodology]*. Clusium, Cluj-Napoca.

Dulamă, M.E. (2014): An Analysis of the Relevance of Some Online Information Sources for E-Learning. Case study: The Geomorphosite "Grădina Zmeilor", Romania. In: Vlada, M., Albeanu, G. and Popovici, D.M. (eds.), *Proceedings of the 9th International Conference on Virtual Learning*. Editura Universității, București, 60-69.

Dulamă, M.E., Magdaș, I. and Osaci-Costache, G. (2015): Study on Geography Students' Internet Use. *Romanian Review of Geographical Education* 1, 45-61.

Eco, U. (2007): A che serve il professore? http://espresso.repubblica.it/opinioni/la-bustina-di-minerva/2007/04/17/news/a-che-serve-il-professore-1.3250 (accessed 17 May 2014).

Festivalul Bunătăților Tradiționale de la Valea Ierii [The Festival of Traditional Food from Valea Ierii], https://turdanews.net/articole/rural/54848-festivalul-bunatatilor-traditionale-de-la-valea-ierii.html

Google Earth, https://earth.google.com/web

Google maps, https://www.google.com/maps/

Google Street View, https://ro.wikipedia.org/wiki/Google_Street_View

Google, https://ro.wikipedia.org/wiki/Google

Ilovan, O.-R., Dulamă, M.E., Ciascai, L. and Maroși, Z. (2015): Geography University Students' Skills to Research Online Sources. An Empirical Study. In: Vlada, M., Albeanu, G. and Popovici, D.M. (eds.), *Proceedings of the 10th International Conference on Virtual Learning*. Editura Universității, București, 201-134.

Instant Google Street View, https://www.instantstreetview.com/

Magdaș, I. (2018): *Prezentarea și prelucrarea datelor cercetării în științele educației. Ghid pentru studenți* [Presenting and Processing Research Data in the Sciences of Education. A Students' Guide]. Presa Universitară Clujeană, Cluj-Napoca.

Magdaș, I., Ilovan, O.-R., Dulamă, M.E. and Ursu, C.-D. (2018): Visual Materials from Web Sources in Studying Regional Geography Topics. In: Vlada, M., Albeanu, G. and Popovici, D.M. (eds.), *Proceedings of the 13th International Conference on Virtual Learning*. Editura Universității, București, 278-284.

Manea, A.D. (2015): Lifelong Learning Programs-An Effective Means of Supporting Continuing Education. *4th International Conference on Adult Education in Universities: Local and Regional Perspectives, Procedia Social and Behavioral Sciences* 142, 454-458.

Nițu, I. (coord.) (2011): *Ghidul analistului de informații. Compendiu pentru analiştii debutanţi [Guide for the Information Analyst. Compedium for Beginners]*. București: Editura Academiei Naționale de Informații „Mihai Viteazul", https://www.academia.edu/12137574/Ghidul_analistului_de_intelligence (accessed 12 July 2019).

Osaci-Costache, G., Cocoș, O. and Cocoș, A. (2014): Online Cartographic Materials for Geographical Higher Education: Opportunity or Threat? In: Vlada, M. (ed.), *Proceedings of the 9th International Conference on Virtual Learning ICVL*. Editura Universității, București, 218-224.

Popa, I. (2015): Metoda scenariilor în analiza informațiilor de securitate națională. Studiu teoretic-aplicativ [Using Scenario Building Method for National Security Intelligence Analysis. Theoretical and Practical Study]. In: Marian, C., Ivan, A. and Basarabă, A. (eds.), *Globalizare. Identitate. Securitate [Globalization. Identity. Security]*, 157-178. Cluj-Napoca: CA Publishing. https://www.academia.edu/9793046/Metoda_scenariilor_%C3%AEn_analiza_informa%C8%9Biilor_de_securitate_na%C8%9Bional%C4%83._Studiu_teoretic-aplicativ_Using_Scenerio_Building_Method_for_National_Security_Intelligence_Analysis._Theoretical_and_practical_Study_ (accessed 12 July 2019).

Primăria Valea Ierii, județul Cluj [Valea Ierii Mayor's Office, Cluj County], https://www.primariavaleaierii.ro/

România map, https://satellites.pro/Romania_map

The national volunteers training point for Intervention in Case of Emergencies (ISU), Valea Ierii (2019), https://www.google.ro/maps/place/Baza+Nationala+de+Pregatire+a+Crucii+Rosii+Romane/@46.6042202,23.2801534,3a,75y,90t/data=!3m8!1e2!3m6!1sAF1QipMtJvAzLyf0Z6FTGdiZJ-KLAGSPzNKer2WoQjl-!2e10!3e12!6shttps:%2F%2Flh5.googleusercontent.com%2Fp%2FAF1QipMtJvAzLyf0Z6FTGdiZJ-KLAGSPzNKer2WoQjl-%3Dw129-h86-k-no!7i6000!8i4000!4m12!1m6!3m5!1s0x4749229395e0afd9:0xe556ae61fca02462!2sBaza+Nationala+de+Pregatire+a+Crucii+Rosii+Romane!8m2!3d46.6042202!4d23.2801534!3m4!1s0x4749229395e0afd9:0xe556ae61fca02462!8m2!3d46.6042202!4d23.2801534?hl=ro (accessed 15 May 2019).

Ursu, C.-D., Dulamă, M.E. and Chiș, O. (2019): The Competences to Explore, Present and Represent the Urban Space**.** *6th ERD Conference, European Proceedings of Social and Behavioural Sciences* LXIII, 349-357.

Valea Ierii. Proiect cofinanțat din Fondul European de Dezvoltare Regională prin Programul Operațional Infrastructură Mare 2014-2020 [Valea Ierii. Project co-financed by the European Regional Development Fund through the Operational Programme for Big Infrastructure 2014-2020], http://valeaieriinatura2000.ro/ (accessed 12 April 2019).

Worldcat, https://www.worldcat.org/

Using Tracker as Augmented Reality Tool in Teaching Physics

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Abstract

Tracker is one of the applications that has been extensively used in the last years at all levels of teaching physics. The software has an optical tracking system based on Java and a flexible data tool analysis, specially designed for physics experimental activities. These capabilities recommend Tracker as a typical AR – augmented reality tool. The main advantage of Tracker is the possibility to make, merely without costs, accurate measurements in experiments where the same data can be obtained only using expensive experimental setups, like data acquisition interfaces with appropriate sensors and dedicated software and drivers, usually recommended for AR applications. The paper presents an example of creative use of Tracker, in which the very simple experimental learning task of measuring the elastic constant of a spring may be performed costless with good results, adapting the classical experimental procedure to the requirements of Tracker software. Because the simplicity of the method, the use of Tracker allows more time for in-depth approach of the elastic deformation applications, like real spring and the phenomenon of oscillations.

Keywords: experimental methods, elastic constant of a spring. Tracker software, augmented reality, physics education.

1 Introduction

Tracker is a free application designated for use in experimental physics classes. It is intended as a video analysis and modeling tool built on the Open Source Physics (OSP) Java framework, developed in the Open Source Project ("About OSP," n.d.). The main Tracker version together with past developments of Tracker and a large repository of documentation and examples covering different domains of experimental physics topics are available on the Tracker website (Brown, 2016). The main Tracker feature is based on the optical recognition tracking system which allows recordings of the followed object (x, y) position versus time and the time **-** plot of about 23 other calculated parameters such as velocity, acceleration etc. Tracker includes special effect filters, calibration tools and a quite accurate and flexible data analysis module. It is designed to be used in introductory college physics labs and lectures.

The new trend in the experimental approach of physics curricula emphasizes the use of the ICT (Information Communication Technology) tools in learning and teaching physics. The concepts of virtual reality (VR) and augmented reality (AR) are used in order to clarify the didactic aspects of in-class using of ICT tools in physics. With its characteristics and way of use, Tracker can be included in the AR category of tools. The educational valence of using Tracker was emphasized in conjunction with the development of students' conceptual thinking (Hockicko et al, 2015) as a solution for making physics more attractive for the pupils. A lot of publications present approaches of teaching different physics and science themes by means of Tracker (Claessens, 2017; Avradinis et al, 2000).

The general use of AR tools in physics implies the overlay of the measured data on the digital representation of the real world. The real data acquisition is usually performed by dedicated sensors connected to data boards driven by specific software. This solution is quite expensive, due to the fact that the software can drive only the producer's hardware solution *i.e.* LabVIEW. A cheap but reliable solution is to use computer resources to extract data from recorded representations of reality. In this case, we can mention Sound Forge or other sound file analyzers and also Tracker software for movie and picture analysis.

The challenge of students' and physics teachers' creativity in using the ICT tools concerns the effort to adapt the experimental procedures, in order to fit the ways the data are collected. This point represents the main subject of the manuscript. The simplest classic way to find out the elastic constant of a spring is to plot the dependence between the elongation of the spring and the value of the deforming force. The experiment requires measurements of the length using a ruler and measurements of the respective force.

The second method is to measure the period of small oscillations of a body attached to the spring. Both experiments may be performed by using Tracker and adapting the experimental procedure. The advantage of using Tracker is the increased precision of the measurements and the possibilities offered by the optical tracking to perform an in-depth analysis of the phenomenon by taking into account the missed aspects of the reality (when using the well-known model of the elastic spring).

2 Theoretical model

Two methods are mainly employed in high school physics in order to experimentally find out the elastic constant (k) of a spring. The first technique (the static one) is the direct use of the expression of the elastic force:

[1] $\vec{F} = -k \cdot \vec{r}$

The experimental setup consists in a vertically suspended spring of elastic constant k. The value of the elastic force is proportional to the weight of the known masses attached at the free end of the spring. For each value of the known values of the mass, *i.e.* the weight of the attached body, the elongation of the spring can be measured. Using relation [1] the value k can be easily determined and the elastic force is given by:

[2] $m(n) \cdot g = -k \cdot \left[y(n) - l_0 \right]$

and

[3] $m(n) = m_s + m_0 \cdot n$

where m_s is the mass of the spring, $m_0 = 0{,}01kg$ is the value of one attached mass and n $n \in \{0, 1, 2, 3, 4\}$ the number of added masses, g is the gravitational acceleration, k is the elastic constant of the spring, l_0 - the length of the non-stressed spring, coordinate $y(n)$ is the distance from the suspension point of the spring to its end; the absolute value $y(0)$ is the length of the spring deformed by its own weight.

The relations [2] and [3] can be rewritten as a linear function of the suspended body *y* and the number of attached masses *n* as follows:

[4] $y(n) = -\frac{m_0 \cdot g}{k} \cdot n + l_0 - \frac{m_s \cdot g}{k}$

From the regression line, parameters of the curve from relation [4] can be determined and then the value of *k* will be found.

The second method consists in using the harmonic solution for the movement equation of a body suspended by a spring.

[5] $\ddot{y} - \frac{k}{m} \cdot y = 0$

Its solution is:

[6] $y(t) = A \cdot \sin(B \cdot t + C)$

where A is the amplitude of the oscillation, $B = \omega = \sqrt{\frac{k}{m}}$ is the pulsation and C the initial phase. The value of k can be easily determined by using an appropriate experimental data tool for fitting the relation [6] with the measured experimental data y and t.

3 Experimental Model Adapted for Tracker

For both methods, we used the Tracker capability to automatically extract position y of the object versus time t in the tracking process.

The experimental device illustrated in Fig. 1 simply consists in a spring, vertically suspended on a support. Identical masses m_0 were attached one by one to the free end of the spring.

In order to perform the static experiment, pictures were taken for the equilibrium position of the system and for each mass attached to the spring. The total mass was then

[7] $m(n) = m_0 \cdot n, \ n \in \{0,1,2,3,4\}$

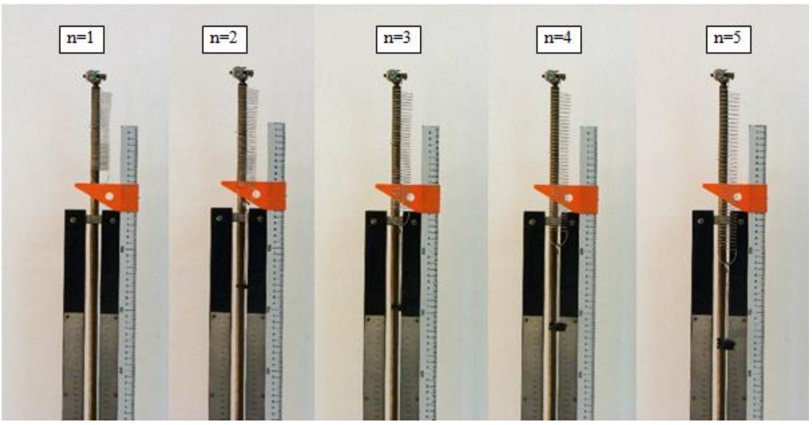

Figure 1. Pictures of the equilibrium position for each number n of attached masses

The photos in Fig. 1 were imported in Tracker and the result was a movie with 5 frames.

By choosing the frame rate of 1 FPS, the number of the attached masses n formally is represented in Tracker data analysis by time variable t. Thus, relation [4] becomes:

[9] $y(t) = -\frac{m_0 \cdot g}{k} \cdot t + l_0 - \frac{m_s \cdot g}{k}$

The recorded data were auto fitted in the Data tool module of Tracker and plotted in Figure 2.

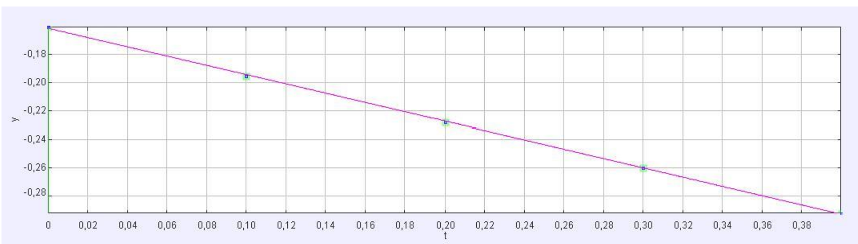

Figure 2. The fitting line of plotted data

The auto - fitting function found by Tracker is

[10] $y(t) = 0,0034 \cdot t + 0,1613$

Root Mean Square deviation = $8,253 \cdot 10^{-4}$

By identifying the coefficients of equation [9] with the values of the coefficients from the fitting function [10] and employing the identity $t \equiv n$ the value of the elastic constant of the spring can be obtained.

[11] $k = (2,9863 \pm 0,0003) N/m$

In the above determinations, we used the mass $m_0 = 0,01 Kg$ and we considered $g = 9,81 m/s^2$.

The second method, which can be entitled the cinematic method, is given by the theoretical relation [6], where the mass attached on the spring was set to execute small oscillations. The main experimental precaution was to assure that the displacement *r* from the gravitational equilibrium position of the system is smaller than the deformation produced by the attached mass. The oscillations of the three different masses were recorded with a camera. Each movie was loaded and analyzed with Tracker. The Tracker's data tool was then used to automatically fit the plotted data.

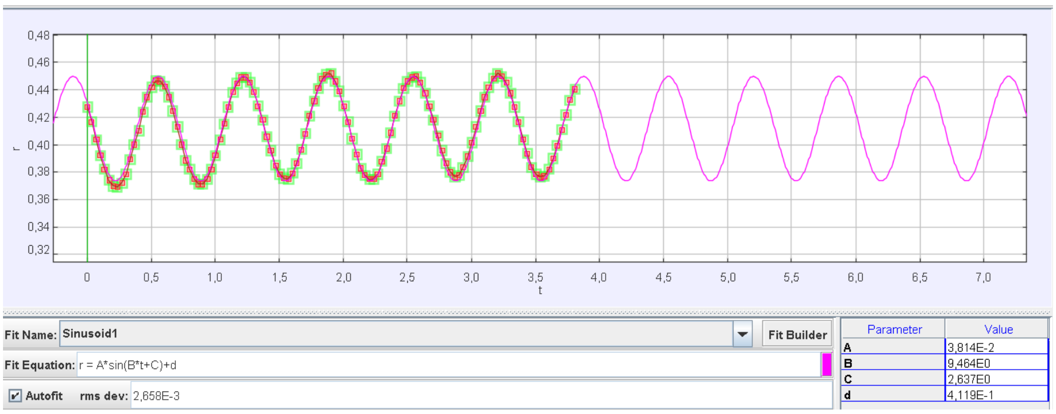

Figure 3. Screen capture of Tracker Data tool auto fit window for an oscillator with mass 0,03 Kg.

Assuming an estimated relative error for the coefficient B of 10%, the value of the elastic constant obtained via the second method was:

[12] $k = (2,7400 \pm 0,5000) N/m$

The value in [12] is in good concordance with the value in [11] and, furthermore, with the value of the elastic constant indicated by the spring manufacturer.

4 Conclusions

Recent studies have shown that using computer simulations and, particularly, virtual experiments highly contribute to improving learning science concepts and developing students' knowledge (Pantazi et al, 2019; Grigore et al, 2017; Mihalache, Berlic 2018; Marciuc and Miron 2018; Bleotu et al, 2019).

By its optical tracking capability and using real experiment movies, in order to extract quite accurate experimental data, Tracker can be considered a suitable AR tool for performing experimental tasks in teaching and learning physics.

The two experimental approaches in measuring the elastic constant of a spring presented in this paper are one of the most frequent used in-class, by employing the physics laboratory instruments. We consider that the approach presented in this paper exclusively by using Tracker can be a challenge for any physics teacher's creativity in order to explore new ways of using AR tools in teaching physics (*i.e.* to adapt the experimental methodology in concordance to an AR tool such as Tracker).

Concerning the experimental method and the processing experimental data, it may be noticed that the obtained values of k are in very good agreement. Furthermore, the precision of the cinematic method is improved, due to the significant increase in number of experimental values which allows for obtaining a better fitting process result.

In conclusion, Tracker is a free Open Source application and, additionally, with some Java programming knowledge, it can be adjusted for specific experimental needs. Tracker is mainly suitable for tracking the movement of bodies, but, in a creative way, it can be used to adapt traditional methods to the tracker specificity of collecting data and furthermore to analyze other phenomena in physics (de Jesus et al, 2018; de Jesus and Sasaki, 2018; Eadkhong et al, 2012; Leme and Oliveira, 2017; Vozdecky et al, 2014) such as from electricity, magnetism (Aguilar-Marín et al, 2018; Bonanno et al, 2015; Carlos et al, 2012; Onorato et al, 2012) or even astronomy (Belloni, et al, 2013).

References

Journal Articles:

Aguilar-Marin, P., Chavez-Bacilio, M., Jauregui-Rosas, S. (2018) Using analog instruments in Tracker video-based experiments to understand the phenomena of electricity and magnetism in physics education. *European Journal of Physics 39*, 3, 035204.

Belloni, M., Wolfgang, C. and and Brown, D. (2013) Teaching astronomy using Tracker. *The Physics Teacher 51*, 3, 149–151.

Bleotu, P., Mihai, L. and Sporea, D. (2019) Setup for quantum cascade lasers characterisation using the Labview programming environment. *Romanian Reports in Physics 71*, 1, 901.

Bonanno, A., Bozzo, G., Camarca, M. and Sapia, P. (2015) An innovative experiment on superconductivity, based on video analysis and non-expensive data acquisition. *European Journal of Physics 36*, 4, 045010.

Carlos, J., Mendoza, R., Mora, C., Aguilar, N. Á. (2012) Implications for teaching college physics in the development of creativity. *Latin-American Journal of Physics Education 6*, 1, 175-178.

Claessens, T. (2017) Analyzing virtual physics simulations with Tracker. *The Physics Teacher 55*, 9, 558–560.

de Jesus, V. L. B. and Sasaki, D. G. G. (2018) A simple experiment to determine the moments of inertia of the fidget spinner by video analysis. *The Physics Teacher 56*, 9, 639–642.

de Jesus, V. L. B., Haubrichs, C., de Oliveira, A. L., Sasaki, D. G. G. (2018) A low-cost experiment to visualise the Fourier series: Video analysis of a real plucked coiled spring. *European Journal of Physics 39*, 2, 025704.

Eadkhong, T., Rajsadorn, R., Jannual, P. and Danworaphong, S. (2012) Rotational dynamics with Tracker. *European Journal of Physics 33*, 3, 615–622.

Grigore, I., Miron, C. and Barna, E. S. (2017) Exploring Excel spreadsheets to simulate the projectile motion in the gravitational field, *Romanian Reports in Physics 69*, 1, 901.

Hockicko, P., Kristak, L. and Nemec, M. (2015). Development of students' conceptual thinking by means of video analysis and interactive simulations at technical universities. *European Journal of Engineering Education 40*, 2, 145–166.

Leme, J. C. and Oliveira, A. (2017) Pendulum underwater – An approach for quantifying viscosity. *The Physics Teacher 55*, 9, 555–557.

Marciuc, D. and Miron, C. (2018) Understanding multiple reflections in two plane mirrors by building computer simulations. *Romanian Reports in Physics 70*, 3, 902.

Mihalache, B. and Berlic, C. (2018) Using Excel spreadsheets to study the vibrating string behavior. *Romanian Reports in Physics 70*, 2, 901.

Onorato, P., Mascheretti, P. and Deambrosis, A. (2012) Investigating the magnetic interaction with Geomag and Tracker Video Analysis: Static equilibrium and anharmonic dynamics. *European Journal of Physics 33*, 2, 385–395.

Pantazi, D., Dinu, S., Voinea, S. (2019) The Smart Aquaponics Greenhouse – an Interdisciplinary Educational Laboratory. *Romanian Reports in Physics 71*, 3, 902.

Vozdecky, L., Bartos, J. and Musilova, J. (2014) Rolling friction-models and experiment. An undergraduate student project. *European Journal of Physics*, *35*, 5, 055004.

Conference Proceedings:

Avradinis, N., Vosinakis, S., ; Panayiotopoulos, T. (2000). Using Virtual Reality Techniques for the Simulation of Physics Experiments. *4th Systemics, Cybernetics and Informatics International Conference, SCI*

Internet Sources:

About OSP. (n.d.). Retrieved May 17, 2019, from https://www.compadre.org/osp/webdocs/about.cfm

Brown, D. (2016). Tracker - Video Analysis and Modeling Tool (Version 4.92). http://physlets.org/tracker/. *Open Source Physics*. Retrieved from https://physlets.org/tracker/

The premises of the digitization policies of the European Union: transposition approaches in the educational system of the Republic of Moldova

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Abstract

This article comes with a descriptive analysis of the political initiatives of digitization of the European Union in an operational and functional context of implementation in the reality of the Republic of Moldova in the field of education and training. The presentation of the implementation of educational experiences, which are currently taking place in the Republic of Moldova, is centered on the basic ideas of the article in which the author thinks that: in particular, digital education is essential for the regional, but also global development of the IT industry, and in general, digital education will ensure the proper and constructive insertion of children and adults in the social and economic life of the era of the fifth industrial revolution.

Keywords: digitization, policies, technological revolution, skills

1 Introduction

EU policies related to digital transformation, regardless of whether they have a narrower coverage, such as those dedicated to the business environment, or a broader one, such as those with a broad social destination area, are always launched, with the major aim of support the formation and development of human capital today, so that tomorrow it will be capable of a complete, adequate and constructive integration in the digitized society, pronounced characterized by the signs of the V^{-th} technological revolution.

2 About the V^{-th} technological revolution in notional and descriptive terms

Although currently there are researchers, from several scientific fields, who are concerned about both the concept and the characteristics and impact of the V^{-th} technological revolution, general idea of it is not precisely defined.

The origin of the concept of the V-th technological revolution, obviously, derives from the general notion of a technological revolution. In particular, under the technological revolution, we mean a period when one or more technologies are replaced by another technology in a short time. It is an era of accelerated technological progress, characterized by new innovations whose rapid application and diffusion cause a sudden change in society. Traditionally, from an epistemological point of view, researchers, representatives of different fields of research, refer to various stages of technological development in their work. Totally on the surface is the information regarding the context of identification of the technological revolutions. Classical and representative, in this sense, is the classification made by Šmihula, D. (Šmihula Daniel, 2011).

According to the scientist, technological revolutions happened in the following way: (1.) The financial-agricultural revolution (1600-1740); (2.) The Industrial Revolution (1780-1840); (3.) The technical revolution or the second industrial revolution (1870-1920); (4.) The scientific-technical revolution (1940-1970); (5.) The information and telecommunications revolution, also known as the Digital Revolution or the third industrial revolution (1975 - present).

The V-th technological revolution is characterized by the transition from mechanical and electronic technology to analog mechatronics and digital electronics. Schoenherr (E. Schoenherr, Steven 2004) argues that the initial stage of the given path took place, from the late 1950s to the late 1970s. During those 20 years, there have been extensive innovations and implementations determined by the process of adoption and proliferation of digital computers and digital recording, which continues to this day. The technological essence of this revolution consisted in the mass production and widespread use of the digital logic, transistors and integrated circuits, as well as technologies derived from the listed innovations, including computers, microprocessors, mobile and cellular devices, digital tablets, Internet and Web Technologies (Roy Debjani, 2014). Another author (Irena Bojanova, 2014) considers that the respective technological innovations have transposed the technique, which traditionally occupies a certain niche "[...] in a production and business environment". The common intention of the Council of Europe, of the EU member states, but also other states of the world is to create a favorable, constructive and functional legislative environment, which will ensure a decent life for all citizens (normally, "[…] without distinction of any kind, such as race, colour, sex, language, religion, political or other opinion, etc.") (United Nations, General Assembly, 1948), by including them in the labor market deeply marked by social attributes, economic, technological, etc. of the digital age.

3 EU policies related to the V-th technological revolution

Over the last decade, in the viewfinder of the high authorities of the European Union, there are a series of policies and legislative initiatives which development and implementation supports the preparation of the population for the challenges of following the technological intense digital transfer from the science and research in in all areas of human activity. Thus, with the approval of the new long-term budget, targeting the years 2021-2027, the EU formulates the modernized version of cohesion policy and approves the investment policy in a way that tends to form "A smarter Europe, through innovation, digitalization, economic transformation and support of small and medium-sized enterprises and a Europe connected with strategic transport and digital networks " (The European Commission, 2018). In the same document, the EU pleads a more personalized approach to regional development in which have been introduced "[...] new criteria" [ibidem] (such as, youth unemployment, low level of education) […]", for the more adequate analysis and reflection of the real regional situation.

On January 17, 2018 Brussels (The European Commission, 2018a) launches an information sheet on certain initiatives in the field of education and training, specifying the trends dictated by the digitized social reality in all aspects of human-technology interaction. Thus, its are:

I. The recommendation of the Council of Europe (The European Commission, 2012), on key competences for lifelong learning, where together with reading and writing skills or language learning are reviewed as being of paramount importance and digital skills.

II. In an other project (The European Commission, 2018a) is stipulated that the EU commission "[...] will also develop reference materials and tools in cooperation with the Member States, such as open online courses and Masses (MOOCs), assessment tools, networks including eTwinning, the world's largest network of teachers and the Electronic Platform for Adult Learning in Europe (EPALE) ".

III. This document also comes with the recommendation to EU Member States to apply education, training and learning focused on acquiring skills, where digital competence is passed as the core competence and for which an updated definition is stipulated that "[…] digital skills that include programming, cyber security and issues related to digital citizenship [ibidem]".

IV. Coming up with an action plan regarding digital education, the EU is trying to help people, institutions and education systems adapt to changes in the "digital universe". The plan is intended to be implemented in partnership with Member States and stakeholders by the end of 2020 in the context of the 2020 Education and Training (ET 2020) process [ibidem].

Relevant to the given document is the fact that it has three key objectives, as follows: **O 1:** better use of digital technologies for teaching and learning; **O 2:** developing the digital skills needed to live and work in an era of rapid digital developments; **O 3:** Higher quality education through better data analysis and forecasting.

V. The authors of the given legislative initiative are committed to working with the regional to ensure **the constructive insertion of girls in the activity of acquiring and training digital skills**. This experinece (Burlacu and Irimiciuc, 2018) "[…] would form serious premises to help ensure female students' participation in STEM studies and careers".

In this context, the EU commission (The European Commission, 2018a) **encourages the organization of more programming courses for girls** in the context of the EU Week of Programming initiative [ibidem].

VI. Because there is a clear difference in the digital domain in different countries: the European Commission guarantees **the modernization of the high-speed broadband in schools** through its active and direct involvement in the field [ibidem].

VII. EU Commission proposes to develop and implement a framework for digital certified qualifications, a mechanism which, according to the promoters of the idea, offers "[...] new ways to increase credibility and transparency of qualifications and to protect against falsification of documents" [ibidem].

VIII. Being interested in digitizing society on several dimensions, the EU is also concerned about the maximum avoidance and / or definitive removal of those risks that arise when students interact with technologies. In this sense, there are ongoing actions that tend to protect and make available to students the digital educational and training tools they need.

IX. At the level of the non-legislative decision of the EU Commission, it was decided that the EU Member States should be assisted in the implementation of digital education and ICT application fields in education. The cooperation between the EU commission and the EU member states, but also the ones that sign pre-accession agreements with the EU, will be done through the financing of Erasmus + programs in the post-2020 period, in order to ensure the cross-border mobility of a more imposing number of people: students, trainees, teachers, etc.

X. These initiatives obtain EU funding to increase the number of young people who will finish their studies and acquire skills that make them more competitive in the labor market. Obviously, in this context, it is the intention of the EU commission **to reduce the drop-out rates**, along with **improving the possibilities offered by vocational and tertiary education**. Thus, in order to achieve the objective set for the period 2014-2020, the EU has allocated over EUR 39 billion.

Equally significant, The European Parliament. (2018), in the context of digitization, but also of improving the educational and formative impact of digitization on the population (students, students, adults in continuous training, older people interested in the formation of digital and / or technological skills, etc.), there are other documents. In particular, it is worth mentioning the EUROPEAN PARLIAMENT RESOLUTION PROPOSAL on digitizing for development: reducing poverty through technology. The importance of the document is especially important because the authors of this document express their wish to support digitization in developing countries as well. The project is initiated to reduce the digital divide between different countries, between different socio-economic sectors of different countries and / or between the representatives of the different population groups of the countries for which the technical and financial assistance is intended.

4 The vision and actions of the Republic of Moldova on digitization

4.1 Legislative approaches

Among the number of countries that benefit directly and indirectly from the scientific, legislative, but also financial support from the EU, as well as from donors from other countries (USA, UK, Sweden, Liechtenstein, Estonia, North Korea, etc.), is the Republic Moldova, which is trying to comply with the educational and digital standards recommended by the EU. Noteworthy for the analysis of the political strategies and initiatives presented in the current material is the document with the generic “CONCEPT NOTE on the vision of the National Development Strategy“ Moldova 2030 ””, (Government of the Republic of Moldova 2017), which comes with numerous references to the essential opportunities offered by the "[...] global economy of knowledge based on technology [...]", these being achievable through "modernizing the curriculum in all educational cycles". In this context, the argument being raised, that "a new educational model is needed to prepare students and students for the demands and challenges of the information and innovation era" and "the rapid development of technologies, digitization, automation, and machine learning will radically change the place of traditional work "and" students, labor force and entire economies, taking into account the level of globalization, will compete for the best education, jobs, and economic growth" [ibidem].

Being in a permanent search for opportunities for continuous training of teachers who tend to train on certain dimensions that will determine their future involvement in the digital education of students, training and developing certain skills of interaction with innovative technologies, etc. The Republic of Moldova is attracting investments for human capital not only from the EU but also from other states of the world, with representatives of the academic world whose tangency. As an example, the collaboration with the academic community from Jeju Province (South Korea) can be brought in, starting with 2015, already in the 5th edition, organizing short-term local training for teachers in the Republic of Moldova, but also lasting 2 weeks and 1 month in South Korea to train students on: e-Learning; Implementation of algorithms in graphic-interactive programming environments; programming with Micro:bit and its use in the educational process; Robot programming, etc. The courses are organized according to the **Memorandum of Understanding on cooperation in the field of Information and Communication Technologies**, signed between the Ministry of Education, Culture and Research of the Republic of Moldova and the Ministry of Education and the Special Government Office for Education of the Jeju Province of the Republic of Korea.

4.2 Actions in the field of Robotics

In recent years, the interest in robotics and technology has been constant in the Republic of Moldova. Here, in the context of formal education, activities related to LEGO integration are recommended by the national curriculum (Ministry of Education of the Republic of Moldova, 2015) in the school discipline of Robotics. Currently, in the Republic of Moldova, we have schools in which the Technological Education lessons have been integrated the module of Digital and Robotic Education. As methods of working at the Robotic hours of the teacher are recommended for use "Regardless of the level and cycle of education [...]" some "[...] active-participatory learning" methods [ibidem], such as: educational games with robots (in the primary classes), exploration by robots of simulated working environments (in the secondary classes) and / or robot competitions (in the high school classes). In the Republic of Moldova LEGO WeDo 2.0 sets are used predominantly for Robotics lessons in the primary school. These sets are revealed to be didactic resources meant to initiate the young age school's students in the technologies of programming and control, using Robotics.

4.3 The STEAM actions

In the context of integrating digital education into the pre-university level of education in the Republic of Moldova, there is more and more talk about the integrated approach to learning through the STEAM concept.

In Moldova, the idea of promoting the STEAM concept belongs to USAID and UK Aid Moldova, the National Association of ICT Companies in collaboration with several partner institutions, including the Technical University of Moldova, and from 2018 and the State Pedagogical University " Ion Creanga". The authors of the initiative are, as in Romania, organizers, and hosts of national competitions and events related to the educational programs FIRST LEGO League, FIRST LEGO League Junior, which in the promoters' view are also considered application activities with an inter- and multi-disciplinary approach, as STEAM type.

In the autochthonous version, from the Republic of Moldova, the general approach of the STEAM concept is achievable through teaching-learning activities, which are organized/carried out in open training spaces, transformer rooms, environments/spaces where teachers and students experience teaching scenarios, In the during of didactical process are used innovative technologies, such as state-of-the-art digital equipment, robotics sets educational, tablets, sensors, various programming environments, digital tools for training creativity and implementing activities aimed at developing digital & soft skills, etc. Nowadays, the perception of specialists on digital education has gone much further than the classical and traditional vision that was reduced to studying Computer Science and ICT in school at the level of interaction with the computer and with some generic applications (very rarely with some educational software). Digital education both in the research environment, but already in the social environment, tends to go beyond just using the computer. Across the world, digital education is penetrated (but also the traditional teaching-learning process, with resources and / or strategies) by technologies as Robotics, Coding, Micro::Bit, Arduino, Adafruit, Raspberry Pie, etc. There are voices, which already have many followers who support the implementation of these types of devices in Digital Education, the study of Computer Science and ICT. Moreover, these three areas being component elements, but also catalyzing factors of successful inter-, multi-, cross-disciplinary learning, can ensure the interconnections between several school objects and/or academic disciplines that are in the same or the same. different curricular areas. For example: studying physics and/or chemistry and/or mathematics and/or modern languages, etc.

4.4 "Clasa viitorului" - The "Future Classroom Lab" project

An ambitious project that in itself combines many digital and didactic technologies. In the Republic of Moldova, the project is implemented within the framework of a public-private partnership (PPP) between the Government of the Republic of Moldova, the Competitiveness Project from Moldova funded by USAID, the Government of Sweden and Uk Aid, and the Orange Moldova Foundation. The project implementation partners are "Ion Creangă" State Pedagogical University, Tiraspol State University, and the Center of University Information.

The central idea of the project is based on the prototype that has existed for a certain time in the EU countries, named the "Future Classroom Lab". The implementation of the concept of classrooms of this type is related to the development of the teaching-learning activities in conditions other than the formal ones limited by the environment of a traditional study hall to the extended non-formal spaces of "transformer" type. The new classrooms designed and developed according to this idea are equipped with different work areas and suitable furniture which, being of a modular type, are flexible enough to accommodate simultaneously, but also autonomously both different activities: as a field of study, teaching methods to be applied in the classroom, school and / or academic contents proposed for research and implementation, as well as the integration within the classroom of various techniques and technologies as facilitative tools of the teaching-learning-innovative evaluation process. Developers, donors, promoters and already project members are adept of the teaching-learning methodologies and strategies focused on active-participatory teaching activities, such as: Learning by doing; Learning through play; Discovery Learning (DL); Experiential Learning (EL); Problem Based Learning (PBL), etc.

Initially, the pilot project "Future Classroom Lab" in the Republic of Moldova was launched in 2017 in 11 institutions of general education, by renovating the spaces and equipping them with digital technologies and equipment useful for the study process. Actually, project has expanded the number of members from 11 pre-university educational institutions to 31. New members of the project are trained to implement in class the digital and technological equipment specific to fifth-grade education. technological revolution: Arduino, Micro::Bit, Adafruit, Raspberry Pie, etc. The pieces of training are organized by teams of experts invited by the project developers in the country and abroad (Estonia, Finland, Belgium, etc.), but also by the more active members of the project co-opted within the teaching staff of the pilot education institutions from the start edition of the project from 2017.

5 Conclusions

MOTTO:
I like to limit myself to infinite things.
(Valeriu Butulescu)

The scientific and financial resources, as well as those of the legislative and political framework of the digitization initiatives launched by the EU, described in this paper, create premises with an area of beneficial and tangible actions for the population of the Republic of Moldova. These best practices can be implemented in the local educational system, creating a long-term model of pedagogical and social success, similar to those in the Nordic countries, such as Estonia and Finland. The implementation of the possibilities (materialized in methodologies, technologies, and equipment) currently offered by the numerous educational projects that are being implemented today in the Republic of Moldova is recommended and carried out within several school objects from different curricular areas, then just Computer Science and ICT- community.

The teachers involved in the operation of the equipment show so much creativity that they even exceed the expectations of the developers who have launched the devices listed above. Thus, in our opinion, in the Republic of Moldova, there is created a community made up of educational institutions, teachers, researchers, students, parents involved in the school life of its children, students and voluntary teachers from several universities and IT companies, etc. from our country. The community members, besides the fact that they are dealing with the integrated implementation of innovative teachers, also create and disseminate to the colleagues in the country new and unusual experiences of teaching-learning-evaluation assisted by the digital technologies of tomorrow.

By the way, tomorrow is a future so close that if we continue to ignore it, it will surprise us very soon, creating a totally inopportune situation for those who believe only in the potential of traditional school and learning and, from on the contrary, indulging in those who will be able to capitalize on those studied and explored until then only in a school and / or academic setting, already in a new reality, either daily or professional.

References

Journal Articles:

Bojanova, I. (2014): The Digital Revolution: What's on the Horizon? *IT Professional* 16 (1):8-12. January 2014. Available: shorturl.at/foIJO, accesed 2019.

Debjani, R. (2014): Cinema in the Age of Digital Revolution. *International Journal of Interdisciplinary and Multidisciplinary Studies (IJIMS)*, 2014, Vol 1, No.4, 107 -111. ISSN: 2348 – 0343. Available: shorturl.at/jpFJW, accesed 2019.

Šmihula, D. (2011): Long waves of technological innovations, *Studia politica Slovaca*, 2/2011, Bratislava, ISSN 1337-8163, pp. 50-69. Available: shorturl.at/vxAM3, accesed 2019.

Conference Proceedings:

Burlacu, N. and Irimiciuc, S. D. (2018): Validarea conceptului STE(A)M din perspectiva modelelor ecosistemice de învăţare. In: *Proceedings of The 15th National Conference of Virtual Learning*, Bucharest, România, 26-27 October, Publishing house of the University of Bucharest, pp. 120-126. 362 p. ISSN 1842-4708.

Internet Sources:

E. Schoenherr, S. (2004): *The Digital Revolution.* Available: shorturl.at/mtL04, accesed 2019.

Government of the Republic of Moldova. (2017): *CONCEPT NOTE regarding the vision of the National Development Strategy "Moldova 2030".* Available: shorturl.at/aftvV, accesed 2019.

Ministry of Education of the Republic of Moldova. (2015): *The curriculum for the optional Robotics discipline.* Chişinău. 61 p. Available: shorturl.at/lvJUW, accesed 2019.

The European Commission. (2012): *The European Qualifications Framework for Lifelong Learning.* Available: shorturl.at/izFV7, accesed 2019.

The European Commission. (2018*): A new cohesion policy.* Available: shorturl.at/yBELV, accesed 2019.

The European Commission. (2018a): Fact Sheet. *Education and training initiatives.* Available: shorturl.at/pV057, accesed 2019.

The European Parliament. (2018): *MOTION FOR A EUROPEAN PARLIAMENT RESOLUTION on digitalisation for development: reducing poverty through technology.* Available: shorturl.at/gh019, accesed 2019.

United Nations, General Assembly. (1948): *Universal Declaration of Human Rights.* Paris, 10 December 1948. Available: shorturl.at/ENS16, accesed 2019.

Implementation of a Document Camera as an Information Tool for Obtaining Optical Characteristics of Food Products

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Abstract

The Document-camera as an easily accessible additional device to an interactive presentation system can be used not only in its core function as a visualization tool but also as a device used in the analysis of food and technical products.The aim of the article is to offer a model of an accessible system for obtaining and processing spectral and hyperspectral data, which is also suitable for training in this field.The experimental setup consists of a personal computer with software for obtaining and processing images in the visible and near infrared ranges of the spectrum.The two-dimensional pseudo-images depicted at different wavelengths can be used to examine the composition of the product. With the document-camera can be obtained hypercubes of food products to be used for the training purposes. The comparative analysis using synthetic and real data showed that the developed document-camera model is approaching opportunities for research-confirmed spectrophotometers, with the advantage that with its accessibility it can be applied in the training activity in training for working with a specialized laboratory which is not publicly available. An accessible document-camera model is proposed, for obtaining and processing spectral and hyperspectral data, which is appropriate and can also be used as a learning tool in this area.

Keywords: Document-camera, Color chart, Spectral analysis, Dairy products.

1 Introduction

Spectral and hyperspectral data obtaining on object characteristics requires specialized equipment that is not widely available and costly in its nature.Such technical devices are available mainly in specialized scientific laboratories.The training of students, technicians to work with these tools requires the use of available technical tools by which hyperspectral data can be obtained and processed(Pu et al., 2017).

The document-camera as an easy-to-access modern technical training tool is used not only in its core function of visualizing the educational content but also as a tool for analyzing food and technical products (Osadcha et al., 2017).

In recent years, scientific papers and reports have been published on use of web cameras as document-cameras.Webcams are also used to build technical measurement systems for spectral analysis, image recognition and analysis (Sahu et al., 2018).

One of the reasons for the widespread use of webcams as document-cameras and for the implementation of measurement systems is that the majority of the earth's population (around 80%) lives in developing countries where laboratory equipment, such as spectrophotometers, is not as the purchase and maintenance of such devices is unbearable for them.On the other hand, mobile phones and webcams are available in these countries, and modern models have some capabilities to be used in data analysis (Van-Horn, 2005;Szűcs et al., 2017).

The processing and analysis of data from visual images, spectral and hyperspectral characteristics of food and industrial products includes methods for reducing the amount of data, retrieving features, classifying and creating predictive models for product properties and properties obtained from data from its optical characteristics.

Contribution: Few published results areavailable in literature of use of web cameras and document-cameras to obtain spectral and hyperspectral data, as well as their application in training on technical toolsfor hyperspectral analysis.

The aim of the article is to offer an model of an accessible system for obtaining and processing spectral and hyperspectral data, which is also suitable for training in this field.

The article is structured in the following order: the first stage is a review of the available technical solutions, related to the development of optic-based presentational tools.

Their advantages and disadvantages are outlined and the unresolved problems of the existing devices are defined; the second stage presents the software and hardware tools with which the developed device has been implemented and tested; in the third step a test was performed with synthetic and real data; the fourth stage involves a comparison of the results obtained with the solutions known from the available literature; Finally conclusions are formulated.

2 Related works

A number of developments are presented on the Internet relating to the use of the more common and more affordable web-cameras and iPad for visualization of educational content – features which are basically designed document-cameras.In scientific publicationsand Internet forums and blogs, lecturers share their experience in using web cameras and iPadas document-cameras, mainly for visualizing the educational content.

Kunev et al.(2010)offer a variant of a night vision system operating in the 780-1000nm spectral range, characterized by high efficiency and low investment.It can be used extensively in signal-security equipment and for scientific purposes.The principle of operation of the system allows to use different emitters and receivers.The system can be implemented with a mobile phone for receiver, with autonomous power supply.The advantages of this option are easy mobility and compactness.The experiments found that the system provides high quality images at distances from 0.1-0.5m to 5-7m, and the quality of the images received depends on the power of the emitter.

Studies related to the solution of this problem are available. PASCO, Wireless spectrometer PS-2600 (https://www.pasco.com) presents an commercial optical drive – wireless spectrophotometer that can visualize the spectral characteristics of objects, absorption intensity on the screen of a tablet, mobile phone or through a projector on an interactive whiteboard. The disadvantage of the discussed device is that it is intended primarily for teaching chemistry and the software, although it is distributed free of charge has a limited set of features and can not be modified to the needs of different users.

Also related to size measurement is the publication of other researchers (Onac et al., 2016). The paper explores the influence of a 293W power field and an ultrasound treatment with a power of 0.5 W/cm^2 on the sprouting of basil seeds.The authors have preferred the use of a high resolution document-camera.Dimensions for seed measurement are set by a measurement line placed next to the object.

For the creation of document-cameras using a web camera (or iPad) and spectrophotometers, the above-mentioned developments use both standard and nonstandard tools such as camera stands, night stand, as well as proprietary elements and devices made with 3D printers.Authors (Oh et al., 2016; Bruder, 2018) recommend the use of high-resolution HD cameras as they approach capacities to document-cameras used in practice.

The disadvantage of the available development of presentation devices operating on an optical principle is that few use spectral characteristics in the visible range of the spectrum, as well as visual images and spectral characteristics in the near infrared region (NIR).In an accessible way they can facilitate analysis of food products during a presentation in front of the audience, in the study of artificial intelligence systems and intelligent sensors and systems.

According to Damyanov (2006) the practical implementation of technical presentation tools does not require the use of all possible methods and tools for the creation of the equipment, but the efficiency criteria that are formed from the point of view of the needs of the end user are of central importance. This principle has been used to construct the proposed document-camera model operating in the visible and near-infrared range of the spectrum.

3 Material and methods

An experimental stand. The experimental setup shown in Figure 1 consists of a personal computer with software for obtaining and processing images in the visible and near infrared ranges of the spectrum.

The two used video cameras are installed in weatherproof housing with protection class IP54. The capture distance is adjusted by a movable stand. The personal computer has Intel Core I5 processor, with 6 GB RAM. The software was developed on GNU Octave 4.2.2.

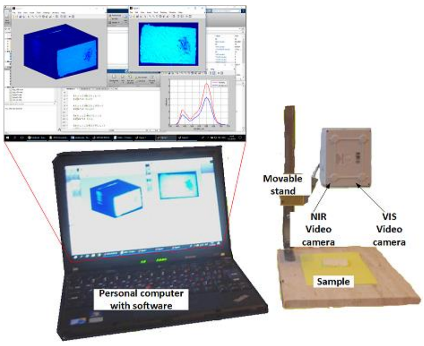

Fig. 1. Experimental setup – general view

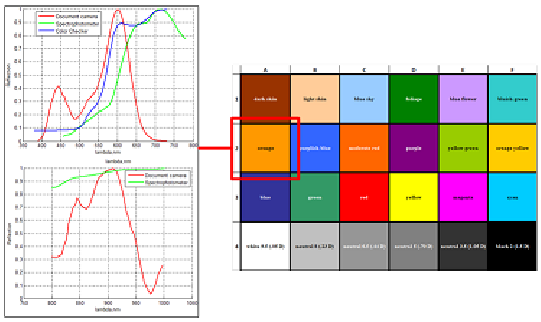

Fig. 2. VIS and NIR spectral characteristics of a Color Chart element

Converting color components into reflectance spectra. Conversion of values from XYZ and LMS models into reflectance spectra in the VIS and NIR ranges in the bands 390-730nm and 800-1000nm is conducted by mathematical dependencies, with the transformation possible in both directions of equality (Glasner, 1989). The matrixes used to convert color components to spectrum are available in (Glasner, 1989). for the VIS range and in (Vilaseca et al., 2004) for NIR. According to those literature sources, the conversion is:

To reduce the amount of data of the spectral characteristics, latent variables and principal components are used. The assessment of the performance of the classifiers used and made by a general classification error (Mladenov et al., 2015).

The principal component analysis creates an orthogonal coordinate system where the axes are arranged according to the dispersion in the original data to which the relevant principal component and the dispersions and the dispersion in the principal values refer

The simple variant of PCA have some disadvantages if data is highly overlapped.

Test of the developed device. Two tests were conducted– with synthetic and real data.

As a synthetic data, a Danes Picta Color chart BST11 (Danes Picta inc.) with 24 color fields is used.The real data are spectral characteristics of white brined cheese and yellow cheese in a storage period, measured by NirQuest 512 and USB 2000 spectrophotometers (Ocean Optics inc.).

A comparative analysis of optical devices and reference was made by Mahalanobis distance, defined by:

[1] $$d_{st}{}^2 = (x_s - y_t)C^{-1}(x_s - y_t)'$$

where C is a covariance matrix; x and y are vectors compared.

For the classification discriminant analysis with three separating functions - quadratic, diagonal-quadratic and Mahalanobis is used (Mladenov et al., 2015).

A discriminant function Z, or a canonical vector, create a linear combination of discriminating (independent) variables, such that:

[2] $$Z = b_1x_1 + b_2x_2 \dots b_nx_n + a$$

where the b's are discriminant coefficients, the x's are discriminating variables, and a is a constant.

4 Results and discussion

Test of the developed device with synthetic data. Spectral characteristics were obtained with spectrophotometers operating in the visible (VIS) and near infrared (NIR) range of the spectrum and with the presented document-camera.

The spectral characteristics obtained are close to those presented by the manufacturer in the visible spectral range.Comparison in the near infrared range utilized spectral characteristics obtained with the developed document-camera and NIRQuest512 spectrophotometer as the reference chart manufacturer did not provide such data.

A comparative analysis of optical devices was made - a spectrophotometer operating in the visible area, a spectrophotometer in the near infrared and the developed document camera.The spectral characteristics are compared to the reference chart.The spectrophotometer and the reference chart, document the camera with the chart, and between the two devices are compared.The comparative analysis shows that the spectrophotometer operating in the visible range of the spectrum is close in performance to the reference chart.The document-camera is moving away from the standard, but its spectral characteristics are close to those of the spectrophotometer.A similar result is also found in the near-infrared range where the document-camera characteristics close to those of the spectrophotometer.

Test of the developed device with real data. A test of the developed device was carried out with samples of white brined cheese and yellow cheese during the storage period. After 5-7 days of storage, digital images are captured in the visible and near infrared spectral range.The resulting images are presented as spectral characteristics in the two areas of the spectrum.

The amount of data of these spectral characteristics is reduced by latent variables.There is severability of object areas, as between those obtained with a spectrophotometer, and a document camera.This separation will be proven in the next stages of the work.

Discriminant analysis with three non-linear separating functions was used.It can be seen that a better separation between the object areas is obtained using a quadratic and diagonal-quadratic discriminant function.When using data from a document, the camera generates a general classification error of 2% to 30%.The results using a spectrophotometer are from 0% to 35% general classification error.

The specified classifier and discriminant functions are used in the analysis of data obtained in the near infrared spectrum. General classification error when using a document-camera reaches 2 to 5%, and from spectrophotometer data it is from 0 to 29%, depending on the separation function used.As with the use of spectral characteristics in the visible area of the spectrum here, using a Mahalanobis separating function, larger error values of up to 29% are obtained.

Obtaining hyperspectral images. The functions for converting RGB components into a spectrum were used to obtain a hyperspectral cube of samples of white brined cheese.

Figure 3 shows the resulting hyperspectral image of cheese on day 5 of storage.Two pixels are indicated with a healthy and infected area of the hyperspectral cube and the spectral characteristics for these pixels.The two-dimensional pseudo-images depicted at different wavelengths can be used to examine the composition of the product. From the figure, it can be seen that with the document-camera can obtain hypercubes of food products to be used for the training purposes.

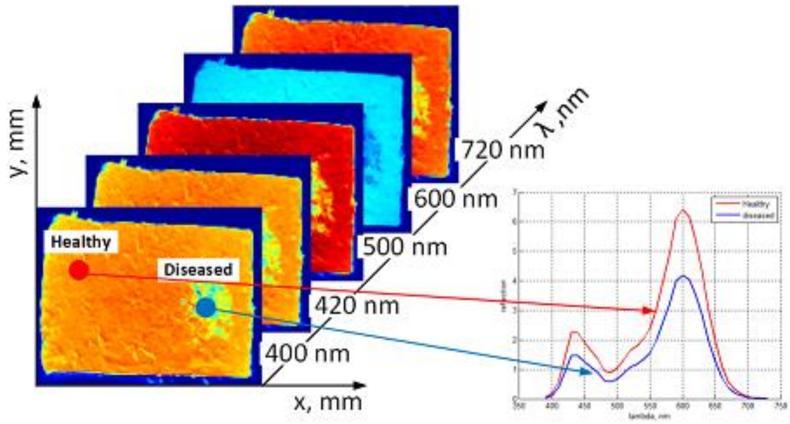

Fig. 3. Hyperspectral cube of white brined cheese in the range of 390-730nm

Conclusion

The proposed document-camera model allows adaptation to the needs of individual users, as additional software can be added to its software.

A few available items with low cost have been used to build the unit.

The comparative analysis using synthetic and real data showed that the developed document-camera model is approaching opportunities for research-confirmed spectrophotometers, with the advantage that with its accessibility it can be applied in the training activity in training for working with a specialized laboratory which is not publicly available.

Using the presented document-camera model in the learning process can improve its quality but only when students are active participants rather than passive observers of what is visible on the screen.

Funding

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References

Bruder, P. (2018): Document cameras in the classroom, http://www.njea.org/news-andpublications/njea-review/december-2011/document-camera (available on 10.01.2018).

Damyanov, Ch. (2006): Non-destructive quality evaluation in automatic sorting systems of food products, UFT, Plovdiv. (in Bulgarian)

Glassner, A. (1989): How to derive a spectrum from an RGB triplet. IEEE *Computer Graphics and Applications*, 9, 4, 95-99.

Kunev, A., Uzunov, D, Dimov, V. (2010): Variant of mobile night vision system.In *Proceedings of the scientific student session – SSS'10,* Ruse, Bulgaria, 14-17 (in Bulgarian).

Mladenov, M, Penchev, S, Deyanov, M. (2015): Complex assessment of food products quality using analysis of visual images, spectrophotometric and hyperspectral characteristics. *International Journal of Engineering and Innovative Technology (IJEIT),* 4, 12, 23-32.

Oh, S, Brown, M, Pollefeys, M, Kim, S. (2016): Do It Yourself Hyperspectral Imaging with Everyday Digital Cameras.In *Proceedings Computer of Vision and Pattern Recognition (CVPR)*, 2016 IEEE Conference on 27-30 June, 2461-2469.

Onac, I, Singureanu, V, Moldovan, G, Ungur, R. (2016): High frequency pulsatile electromagnetic fields and ultrasound pulsatile fields impact on germination dynamic of ocimum basilicum L. and O. basilicum var. purpurascens benth observed with Open source software. *Not Bot Horti Agrobo*, 44, 1, 41-47.

Osadcha, K., Chemerys, H. (2017): Formation of computer science bachelor's graphic competency while studying the prototification of soft interfaces. *Information technologies and learning tools*, 67, 5, 104-120.

Pu, Y, Sun, D-W, Riccioli, C, Buccheri, M, Grassi, M, Cattaneo, T, Gowen, A. (2017): Calibration transfer from micro NIR spectrometer to hyperspectral imaging: a case study on predicting soluble solids content of bananito fruit (Musa acuminata). *Food Analytical Methods*, 11, 4, 1021-1033.

Sahu, A, Swain, G, Babu, E. (2018): Digital image steganography using bit flipping. *Cybernetics and information technologies*, 18, 1, 69-80.

Szűcs, G, Papp, D. (2017): Content-Based Image Retrieval for Multiple Objects Search. *Cybernetics and information technologies*, 17, 1, 106-118.

Van-Horn, R. (2005): A do-it-yourself document camera, spyware, and Firefox. *Phi Delta Kappa*, 86, 487-551.

Vilaseca, M, Pujol, J, Arjona, M, Martínez-Verdú, F. (2004): Color visualization system for near-infrared multispectral images. In *Proceedings of The Second European Conference on Colour Graphics, Imaging and Vision CGIV*, 431-436

Application of Mobile Devices in The Training of Aromatic Products Analysisfrom Essential Oil Plants

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Abstract

In the present work an analysis is made of the possibility of measuring the color of aromatic products of the white oregano essential oil using the cell phone camera. An analysis of the color change of essential oils and white oregano extracts obtained from wild plants was made directly after drying. A comparative analysis was made between cell phone camera and spectrophotometer measurements. The results show that the use of digital camera images on a cell phone is a practical method for quantitative color determination in laboratory conditions when conducting practical exercises on analysis of aromatic products from essential oil plants.

Keywords: Mobile phone camera, essential oils, extracts, white oregano, color measurement

1 Introduction

According to a study by Batista et al. (2014), lecturers make use of mobile devices to provide training through mobile applications, video sharing, virtual learning environments, while students use these devices to a greater extent for access to social networks.

The use of mobile devices such as phones and tablets also has some drawbacks related to the physical activity of learners, both in primary and secondary schools and in colleges and universities (Lepp et al., 2013, Chartrand, 2016, Zagalaz-Sánchez et al. ., 2019).

Despite some of their drawbacks, mobile devices find application in learning. In social, legal, and humanities, they are widely used (Verdú et al., 2019). Few are the applications of these devices in the technical sciences. In this area, the application of mobile devices for practical exercises is still the subject of research. This is due to the specifics of practical exercises in the field of technical sciences, as specialized equipment and trained personnel are required to work with it as well as its maintenance.

In practical exercises related to the analysis of aromatic products from essential oil plants such as essential oils and extracts, mobile devices can be used to analyze their color. These exercises include color determination, color difference determination, measurement with different technical means.

The quantitative determination of the color of essential oils and extracts from essential oil plants is necessary when comparing these products, depending on the type of cultivation, comparison between different species, their yield properties from different parts of plants (Kendal et al., 2013).

To accomplish this task, preliminary analyzes are required for the compliance of the measurements made with the camera on a mobile phone and those from the reference measurement. The absence of such an analysis would lead to an increase in measurement errors in the application of these methods in practical color analyzes of products obtained from essential oil plants. This analysis is the goal of the current work.

2 Material and methods

Raw material. Wild white oregano (*Origanum heracleoticum* L.), harvested in blooming phase from the southern slopes of the Eastern Rhodopes (360m altitude), the region of Ivaylovgrad, Haskovo, Bulgaria at the end of July 2017 and at the same period in 2018. The dried overhead part of the plant has been investigated. The raw material is dried at room temperature without direct sunlight until moisture content reaches less than 10%.

*Essential oil.*10g of the dried herba, leaves or inflorescences of *Origanumheracleoticum* L.were distilled by hydrodistillation for a period of about 1h using Clevenger-type apparatus. The oil was dried over anhydrous sodium sulphate to remove traces of moisture and stored in a vial inside a refrigerator at 4°C until use.

Extracts. Prior to extraction, the raw material was milled in a laboratory mill. Solvent - ethyl alcohol (chemically pure for analysis) at a concentration of 70%. The extraction was carried out as a stationary process at 60 °C for 6 hours with two hydromodules - 1:8 and 1:10. After filtration, the resulting micelles were used to obtain color digital images and spectral absorption characteristics.

To obtain color component values from color digital images, an Apple iPhone S6 mobile phone video sensor (Apple Inc.) was used.

The color setting is made with a color scale with 24 color chart Danes Picta Color chart BST11 (Danes-Picta, Praha, Czech Republic).

The homogeneous illumination of the captured scene is obtained with a light source developed in the faculty of Technics and technologies Yambol, Bulgaria. It consists of a dome part in which white LEDs with maximum intensity of light emitted at 450nm are mounted. The control of the power of light is realized with the LED controller Ultralux RFD8 (ET Boryana-Saba Hristova, Dryanovo, Bulgaria). The lighting system is powered by a constant voltage pulse source with nominal output voltage and current U=12V, I=1,5A.

As a reference measurement, spectral absorption of liquid substances - essential oils and extracts is used. For this purpose a UV-VIS spectrophotometer HALO SB-10 (Dynamica Scientific Ltd.) was used.

According to the methodology presented in (Bain, 2009), the absorbance of the samples at wavelengths 420, 520 and 620 nm was measured. A conversion to Lab color model has been done.

The color components of the RGB color model (RGB [0 255]), obtained by mobile phone camera were converted to Lab (L [0 100], a [-86.18 98.23], b [-107.86 94.47]) with online converting tool Convert Rgb to Lab (colormine.org).

The total color difference ΔE between the control sample and those with the addition of basil (additive) is determined by equation [1], where with index “c” are color components, defined by spectrophotometer and with “a” are color components, measured by smartphone.

[1] $$\Delta E = \sqrt{(L_c - L_a)^2 + (a_c - a_a)^2 + (b_c - b_a)^2}$$

The conversion functions applied to the 10° observer (Stiles and Burch 10o, RGB (1959)) and illumination D65 (average daylight with UV component (6500K)).

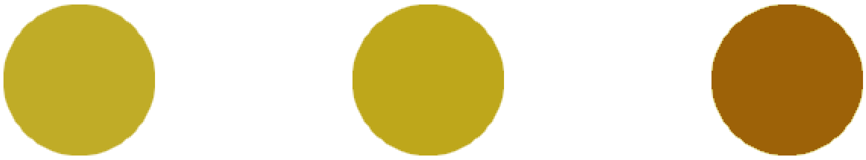
All data were processed at a level of significance of α = 0,05.

3 Results and discussion

An analysis of the color change of essential oils and white oregano extracts obtained from wild plants was made directly after drying.

From the resulting color digital images, the areas with essential oil from the glass vessels were separated and their color components analyzed.

Figure 1 shows the colors of essential oils of white oregano harvest 2017 obtained by measurement with a spectrophotometer. Table 1 presents their values. It can be seen that the oils of whole blade and inflorescence are similar in color, whereas the oil of the leaf oil is visibly different and darker.



a) herb b) inflorescence c) leaves

Figure 1. Color of essential oils determined by spectrophotometer – general view

Table 1. Color components of samples determined by spectrophotometer

Measurement	Absorption, AU			**RGB**			**Lab**		
Sample	**420 nm**	**520 nm**	**620 nm**	**R**	**G**	**B**	**L**	**a**	**b**
Herb	2,532	1,230	1,792	192	172	39	70,1	-6,55	65,07
Inflorescence	2,485	1,094	1,726	190	167	27	68,37	-4,98	66,87
Leaves	1,861	0,697	1,528	157	98	8	46,94	17,42	52,78

Figure 2 shows the colors of white oregano essential oils determined by cell phone camera measurements and their values in Table 2. The color values are similar to that of spectrophotometer measurements. The color of the essential oil of herb and inflorescence is similar, whereas the leaves are darker.

a) herb b) inflorescence c) leaves

Figure 2. General view of essential oil color determined by cell phone camera

Table 2. Color components of samples determined with a cell phone camera

Measurement	**RGB**			**Lab**		
Sample	**R**	**G**	**B**	**L**	**a**	**b**
Herb	192,4	150,64	12,40	64,41	4,55	66,72
Inflorescence	189,04	160,04	21,64	66,55	-1,86	66,51
Leaves	142,99	73,31	29,79	39,14	26,16	37,83

Figure 3 shows the colors of white oregano extracts obtained by spectrophotometer. It can be seen that using a 1:10 hydromodule results in a darker and dense color.

a) 2017 harvest year, hydromodule 1:8 b) 2017 harvest year, hydromodule 1:10 c) 2018 harvest year, hydromodule 1:8 d) 2018 harvest year, hydromodule 1:10

Figure 3. General color view of extracts determined by spectrophotometer

Table 3 gives the measured absorbance values in the three wavelengths of 420, 520 and 620 nm. According to the presented methodology they have been transformed into three color models RGB and Lab. In the RGB model, high values of R and G components are observed and lower than the B color component.

Table 3. Absorption units (AU) and color components of the samples

Measurement	Absorption, AU			RGB			Lab		
Sample	**420 nm**	**520 nm**	**620 nm**	**R**	**G**	**B**	**L**	**a**	**b**
2017 1:8	3,000	3,000	2,049	200	249	82	91,97	-38,34	71,67
2017 1:10	3,000	1,624	0,883	142	174	108	67,36	-22,69	30,37
2018 1:8	3,000	2,646	1,431	163	212	97	79,46	-34,29	51,06
2018 1:10	3,000	1,607	0,741	127	160	111	62,34	-20,80	21,94
2017 and 2018 – harvest year; 1:8 and 1:10 –dilution (hydromodule)									

Figure 4 shows color digital images of extracts of dried white oregano from different harvest years in different hydromodules obtained with a cell phone camera.

It is seen that the colors are much darker and tend to dark-brown in combination with a dark green color.

a) 2017 harvest year, hydromodule 1:8 b) 2017 harvest year, hydromodule 1:10 c) 2018 harvest year, hydromodule 1:8 d) 2018 harvest year, hydromodule 1:10

Figure 4. General color view of extracts determined by cell phone camera

Table 4 lists the color components of the RGB and Lab color models. It can be seen that, compared to the spectrophotometric measurement, the colors are much lower (over 100) for RGB components, which is also apparent in the extracts images.

Table 4. Descriptive statistics of color components
from RGB and Lab color models

Measurement	**RGB**			**Lab**		
Sample	**R**	**G**	**B**	**L**	**a**	**b**
2017 1:8	81,01	63,53	45,45	28,27	4,72	13,95
2017 1:10	86,34	58,74	30,34	27,27	8,71	22,24
2018 1:8	69,85	56,25	46,05	24,79	4,21	8,63
2018 1:10	89,62	62,62	43,46	29,02	9,16	16,41
2017 and 2018 – harvest year; 1:8 and 1:10 – dilution (hydromodule)						

Figure 5 shows results in determining the color difference between the colors obtained with the spectrophotometer and those with the cell phone camera. It can be seen that when measuring an ethereal oil color, results are obtained with an acceptable color difference (Sharma, 2003).

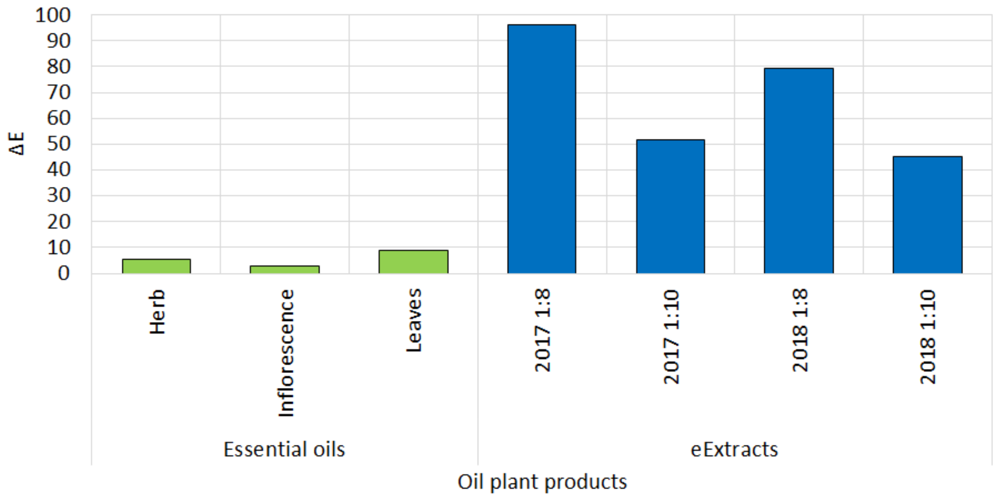


Figure 5. Color difference ΔE between measurements
2017 and 2018 – harvest year; 1:8 and 1:10 – dilution (hydromodule)

The results obtained confirm that of Kendal et al. (2013), where the authors point out that when measuring color with a camera on a mobile phone, results are produced with a greater error than digital cameras. This is observed when measuring the color of white oregano extracts.

Conclusion

The present work has shown the possibility of measuring the color of aromatic products from the white oregano essential oil plant.

The analysis of digital images obtained with a cell phone camera is a practical method for color quantification in laboratory conditions when conducting practical exercises on the analysis of aromatic products from essential oil plants.

Using the mobile phone in the learning process can improve its quality, when students are active participants rather than passive observers.

Research will be continued with an assessment full spectrum application of white oregano essential oil images, obtained by cell phone camera.

Acknowledgements

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References

Bain G. (2009). Wine Color Analysis using the Evolution Array UV-Visible Spectrophotometer. *Thermo Scientific*, Application Note: 51852.

Batista, S., Barcelos, G. (2014): Considerations on the use of mobile phones in educational context. *International journal on new trends in education and their implications*, 5,1, a1, 1-10.

Chartrand, R. (2016): Advantages and disadvantages of using mobile devices in a university language classroom. *Bulletin of the Institute of Foreign Language Education Kurume University*, 23, 1-13.

Dobreva, K. (2005): Nutritional and Medicinal Properties of Spices. *Trakia Journal of Sciences*, 3, 3, 198-200 (in Bulgarian).

Gábor, K. Péter, E. (2015): Implementation of mobile phones in education. *Research in pedagogy*, 5, 1, 98-108.

Kendal, D., Hauser, C., Garrard, G., Jellinek, S., Giljohann, K., Moore, J. (2013): Quantifying plant colour and colour difference as perceived by humans using digital images. *PLoS ONE*, 8, 8, e72296, 1-11.

Lepp, A., Barkley, J., Sanders, G., Rebold, M., Gates, P. (2013): The relationship between cell phone use, physical and sedentary activity, and cardiorespiratory fitness in a sample of U.S. college students. *International Journal of Behavioral Nutrition and Physical Activity*, 10, 79, 1-9.

Nedeva, V., Dineva, S., (2013): Design and development of efficient e-learning courses. *Proceedings of the 11th International conference on virtual learning* (ICVL), Romania, 108-115.

Sharma, G. (2003):*Digital Color Imaging Handbook* (1.7.2 ed.). CRC Press.Taylor & Francis, London.

Shivacheva, G., Nedeva, V. (2016): Methods for Teaching Programming Using Virtual Laboratory. *Proceedings of the 8th International conference on virtual learning* (ICVL), 92-98.

Verdú, A., Pando, A., Llamas, M. (2019): A framework for visual art education in mobile devices. *Revista de Educación a Distancia*, 59, a7, 1-25. (in Spanish)

Zagalaz-Sánchez, M., Cachón-Zagalaz, J., Sánchez-Zafra, M., Lara-Sánchez, A. (2019): Mini review of the use of the mobile phone and its repercussion in the deficit of physical activity. *Frontiers in Psychology*, 10, a1307, 1-6.

Application of a document camera as a technique which makes training attractive

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Abstract

Measuring of geometric dimensions of eggs is important in terms of their incubation, packaging, transport, and sorting. The use of video cameras in contactless determination of both geometric dimensions and the mass and volume of eggs has been the subject of research in recent years. In the process of training of zoo engineers and specialists in the field of poultry farming, it is necessary to introduce lectures and practical exercises related to the use of such contactless methods to the training of engineers in this field. A comparative analysis has been made of the possibility of using document cameras for measuring basic egg sizes. It has been found that high-end consumer class document cameras can be used for contactless measurement of egg sizes because they results obtained are close to those obtained with using calipers. The usage ofweb camerasfor measuring egg sizes is inappropriate because measurements are error-prone up to 20%. Such cameras could be suitable for learning and demonstration purposes

Keywords: Document camera, a comparative analysis, hen eggs, quail eggs, image processing

1 Introduction

Document cameras are devices which are additional technical tools for interactive presentation systems and have proved to be effectively used not only as visualizingtools and replacing old overhead projectors. At the recent stage of science and technology development, applications have beenworked out, mainly related to their software management. Havingsuch advanced functionalities, document cameras are applied in object recognition, color measurement, plant seeds development tracking (Baycheva et al., 2016; Onak et al., 2016).

Available publications related to machine parts visualization and automatic measurement of their dimensions can be found (Georgiev et al., 2013).

Size measurement is not only related to machine parts. This process is also needed in the analysis of products of plant and animal origin. Leaf sizes, animal eye area, and egg sizes can be measured as well.

Geometric dimensions of eggs measurement are important from the point of view of their incubation, packaging, transportation, and sorting (Lukanov et al., 2014, Titova et al., 2015, Stoddard et al., 2017). In recent years, studies have been conducted (Alikhanov et al., 2015; Mladenov et al., 2015; Alikhanov et al., 2018) for the use of video cameras in contactless determination of both geometric dimensions and eggs' mass and volume.

In the process of poultry farming zooengineers' and specialists' training, it is necessary to introduce lectures and practical exercises related to the use of these contactless methods aiming engineers' professional development in this field.

Document cameras, as an affordable, widespread and low-cost technical tool, has the potential to be used for training in poultry farming when measuring the geometric dimensions of eggs.

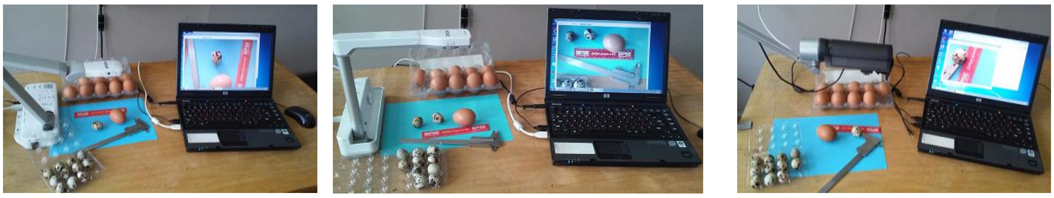
The aim of this report is to make a comparative analysis of the possible usage of various types of document cameras in determining the basic sizes of eggs.

2 Material and methods

For the purposes of this work, three document cameras were used: DC1-Epson DC 11 (Epson America, Inc.); DC2-Epson DC 06 (Epson America, Inc.); DC3-webcam GTC 903.

Webcam was used due to the fact that in recent years, developments related to the application of web cameras, mobile phones and tablets as document cameras have been reported (Baycheva et al., 2016, Zlatev, 2016).

Figure 1 shows document camera test patterns used.



a) Epson DC 11 b) Epson DC 06 c) GTC 903

Figure 1. Document cameras used

30 hen eggs (Poultry Farm Yambol, Drajevo, Bulgaria) and 30 Japanese quail eggs (Agricultural producer Atanas Simeonov, Yambol, Bulgaria) were used. The chicken eggs were shot at a distance of 20 cm and quail eggs were shot at a distance of 6.5 cm. LED diode with 6400K white LEDs is used. Color digital images with 640x480 pixel resolution were captured.

As a reference, a caliper was used with an accuracy of 0.05mm.

Table 1 gives the reference measurement results for large axis, small axis and eggs weight.

Table 1. Egg reference measurement results

Eggs	Dimension	Mean	SD	CV	min	max
Hen eggs	**D, mm**	58,43	2,02	0,03	55,20	62,80
	d, mm	45,22	0,75	0,02	43,70	46,40
	m, g	67,62	2,46	0,04	63,64	71,82
Quail eggs	**D, mm**	31,53	2,12	0,07	27,00	33,85
	d, mm	24,78	1,11	0,04	23,00	26,80
	m, g	10,40	1,64	0,16	7,31	13,02
Mean-arithmetic mean; SD-standard deviation; CV-coefficient of variation; min-minimum value; max-maximum value; D-long axis; d-short axis						

The basic geometric dimensions of the eggs were determined by Vividia Ablescope (Vividia Technologies USA). Figure 2 shows a screenshot of the program used. A setting of 10 mm was made. A caliper was used for calibration.

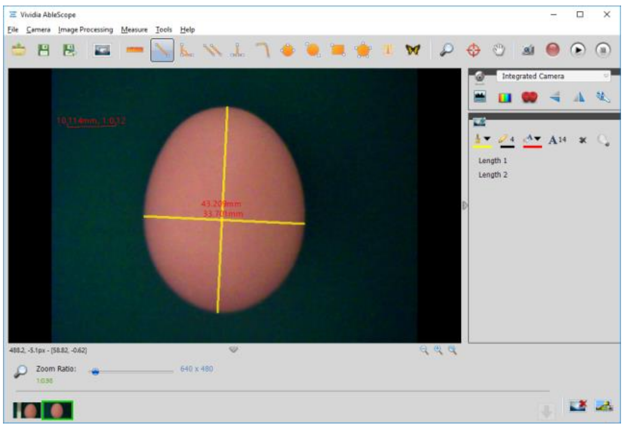


Figure 2. Work screen of Vividia Ablescope software

The criteria for evaluating results of the measurements using the technical means used in the available literature show that an informative indicator is a p-level between different measurements (Zlatev et al., 2014). Sullivan et al. (2012) proves that p-value is not a sufficient benchmark for the performance of measuring devices. The R-correlation coefficient, R^2-regression coefficient and p-value similarity level were used in this material. Table 2 gives the meanings of these criteria according to (Sullivan et al., 2012).

Table 2. Criteria for Document Camera Measurement

Criteria	**Range**	**Effect size**	**Comment**
Coefficient of correlation R	-1 to 1	Small ±0,2 Medium ±0,5 Large ±0,8	Measures the degree of linear relationship between measurements
Coefficient of regression R^2	0 to 1	Small 0,04 Medium 0,25 Large 0,64	Proportion of variance in one variable explained by the other
p-value	If p-value is <=αthen the data is Significant and if p-value is >αthen the data is highly significant		

All calculations have been made at a level of significance α = 0.05.

3 Results and discussion

A comparative analysis of three document cameras measurements of hen and quail eggs has been made. The results obtained are compared with those measured with a caliper.

Table 3 shows the results of three document cameras eggs measurements. It can be seen that the measured eggs are similar in size, with a small standard deviation and a coefficient of variation of 1-3% for hen eggs and higher values of 4-7% for quail eggs.

Table 3. Measurement of eggs with document cameras

Eggs	Document camera	Descriptive statistics / Dimension	**mean**	**SD**	**CV**	**min**	**max**
Hen eggs	**DC1**	**D, mm**	54.00	1.33	0.02	51.21	56.26
		d, mm	44.09	0.64	0.01	43.12	45.11
	DC2	**D, mm**	54.26	1.10	0.02	52.14	56.08
		d, mm	46.54	0.44	0.01	45.66	47.09
	DC3	**D, mm**	54.49	1.55	0.03	51.98	57.64
		d, mm	46.53	0.55	0.01	45.50	47.54
Quail eggs	**DC1**	**D, mm**	31.28	2.08	0.07	26.80	33.65
		d, mm	24.40	0.91	0.04	22.80	25.85
	DC2	**D, mm**	30.96	2.08	0.07	26.48	33.33
		d, mm	24.08	0.91	0.04	22.48	25.53
	DC3	**D, mm**	30.84	2.08	0.07	26.36	33.21
		d, mm	23.96	0.91	0.04	22.36	25.41
Mean-arithmetic mean; SD-standard deviation; CV-coefficient of variation; min-minimum value; max-maximum value; D-long axis; d-short axis; DC1-Epson DC 11; DC2-Epron DC9; DC3-GTC903							

Table 4 shows the results of a comparative analysis between caliper measurements and those made with document cameras for hen eggs. It can be seen that the first two document cameras have high correlation coefficients as well as a regression coefficient. The significance level p = 0 indicates that there is no significant difference between caliper measurements and those with document cameras DC1 and DC2. Less precise results were obtained when measuring with DC3 web-camera. The data obtained are close to the ones measured with caliper, but regarding the ones for the large axis of the eggs the results are similar to the ones measured with DC1, but they differ significantly from those obtained with DC2.

Table 4. Results for hen eggs

		C-DC1	C-DC2	C-DC3	DC1-DC2	DC1-DC3	DC2-DC3
R	**D, mm**	0.95	0.96	0.54	0.97	0.54	0.62
	d, mm	0.90	0.89	0.62	0.81	0.34	0.81
R^2	**D, mm**	0.91	0.92	0.29	0.94	0.29	0.38
	d, mm	0.81	0.79	0.38	0.66	0.12	0.66
p-value	**D, mm**	0.00	0.00	0.00	0.03	0.15	0.29
	d, mm	0.00	0.00	0.00	0.00	0.00	0.48
D-long axis; d-short axis; C-caliper; DC1-Epson DC 11; DC2-Epron DC9; DC3-GTC903							

Table 5 shows the results from the comparative analysis of large and small axis of quail eggs. The results obtained correspond to those obtained for hen eggs. The DC1 and DC2 camera measurements are similar to those obtained with a caliper as well as between the two document cameras themselves. In this case, the data for DC3 are less precise compared to those measured with a caliper, as with the other two document cameras.

Table 5. Results for quail eggs

		C-DC1	C-DC2	C-DC3	DC1-DC2	DC1-DC3	DC2-DC3
R	**D, mm**	0.95	0.92	0.52	0.95	0.54	0.62
	d, mm	0.91	0.88	0.64	0.79	0.34	0.77
R^2	**D, mm**	0.91	0.84	0.27	0.90	0.29	0.38
	d, mm	0.83	0.77	0.41	0.63	0.12	0.60
p-value	**D, mm**	0.00	0.00	0.00	0.05	0.12	0.24
	d, mm	0.00	0.00	0.00	0.00	0.00	0.58
D-long axis; d-short axis; C-caliper; DC1-Epson DC 11; DC2-Epron DC9; DC3-GTC903							

The results obtained confirm those reported by Waranusast et al. (2016), where the authors point out that hen eggs size can be estimated with an accuracy up to 96.9%. Results obtained with DC1 and DC2 cameras are similar to each other.

Conclusion

Based on the results obtained, the authors consider that:

- ✓ Document high-grade consumer cameras can be used for contactless measurement of eggs, because they produce results close to those of a caliper;
- ✓ It has been found out that the usage of web cameras for measuring egg sizes is inappropriate because the measurements show error rates up to 20%. Such cameras could be suitable for learning and demonstration purposes only.

References

Alikhanov, D., Penchev, S., Georgieva, Ts., Moldajanov, A., Shynybaj, Z., Daskalov, P. (2015): Indirect Method for Egg Weight Measurement Using Image Processing. International Journal of Emerging Technology and Advanced Engineering IJETAE, 5, 11, 30-34.

Alikhanov, J., Penchev, S., Georgieva, Ts., Moldazhanov, A., Shynybay, Zh., Daskalov, P. (2018): An indirect approach for egg weight sorting using image processing. Journal of Food Measurement and Characterization, 12, 1, 87-93.

Baycheva, S., Zlatev, Z., Dimitrova, A. (2016): Investigating the possibilities of document cameras for quality assessment of foodstuffs by measuring of color, ICVL 2016, The 11th International Conference on Virtual Learning 2016, 204-208.

Georgiev, G., Zlatev, Z. (2013): Comparative Analysis in the Measurement of Geometric Parameters of Machine Parts. ICTTE International Conference on Technics, Technologies and Education, Faculty of Technics and Technologies, Trakia University, October 30-31, 2013, 49-56(in Bulgarian)

Lukanov, H., Genchev, A., Dimov, D., Penchev,,I. (2014): Quality characteristics of eggs obtained from crosses between Shindelar and line B and D of Rodailland. Poultry farming, 4, 4-8. (in Bulgarian)

Mladenov, M., Penchev, S., Deyanov, M. (2015): Complex assessment of food products quality using analysis of visual images, spectrophotometric and hyperspectral characteristics. International Journal of Engineering and Innovative Technology (IJEIT), 4, 12, 23-32.

Onac, I., Singureanu, V., Moldovan, G., Ungur, R. (2016): High frequency pulsatile electromagnetic fields and ultrasound pulsatile fields impact on germination dynamic of *Ocimum basilicum* L. and *O. basilicum* var. purpurascens benth observed with Open source software. Not Bot Horti Agrobo, 44, 1, 2016, 41-47.

Stoddard, M., Yong, E., Akkaynak, D., Sheard, C., Tobias, J., Mahadevan, L. (2017): Avian egg shape: Form, function and evolution. Science, 356, 1249-1254.

Sullivan G., R. Feinn (2012): Using effect size – or why the p-value is not enough. Editorial in Journal of Graduate Medical Education, September 2012, 279-282.

Torniova,B., Paskaleva, T. (2015): Innovative technologies in the training of medical specialists. Management and education, XI, 3, 66-71

Waranusast, R., Intayod, P., Makhod, D. (2016): Egg Size Classification on Android Mobile Devices Using Image Processing and Machine Learning. 2016 Fifth ICT International Student Project Conference (ICT-ISPC)Nakhon Pathom, Thailandon, 2016, 170-173.

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. ICVL 2016, The 11th International Conference on Virtual Learning 2016, 209-213.

Zlatev, Z., Ribarski, S., Mladenov, M. (2014): Automatic measurement of Loin eye area with computer vision system. Agricultural science and technology, 6, 2, 224-227.

Titova, T., Nachev, V., Damyanov, Ch. (2015): Non-destructive diagnosis of food products using neural-genetic algorithm. International Journal of Reasoning-based Intelligent Systems, 7, 1/2, 55-61.

Application of a Document Camera for Vine Leaves Color Measurement

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Abstract

This report presents some applications and in the use of e-learning systems, and accessories. The application of active teaching methods and use of information technologies with interactive tools, providing active involvement of the students in training, leads to considerable interest and improvement in the quality of teaching and learning.After conversion from RGB 12 color components are obtained in HSV, Lab and LCH color models. Selection of informative color components was made by Fisher discriminant ratio function. For classification a discriminant analysis was used. The assessment of the classifier was made by general classification error.The research can be continued by conducting a survey among learners to assess the effectiveness of using this methodology and document camera with which each learner can work individually.

Keywords: Document camera, vine leaves, color measurement

Introduction

A chance to show and study is the possibility to put genuine items or photos in front of a document camera. Vine leaves can be graphically handled as a 2D image so as to measure their colors (Pehlivanova et al., 2011; Georgieva et al., 2015). The instructor can ascertain the quantity of pixels in every one of these interims and change the splendor of the picture to access its surface. Different surfaces have diverse coefficients of reflection. The manager of the framework can grow it, permitting logical research for students (Nedeva et al., 2013; Stoykova, 2014). Likewise, they can introduce programs on the personal computer for a visual framework. The Workforce of Methods and innovations have built up a logical undertaking for incorporating that visual framework with a specialist for programmed conclusion of diseases of plants, in light of shading changes by the subsystem visual discernment in the vineyards.

This paper can be put away as a piece of an introduction or as a video record utilizing the proper devices, distributed through the University e-learning system, and, along these lines, utilized amid classes or self-instructional meetings for students. The above alternatives can be utilized to help the innovative readiness of students on the course “Mechanical Technology in Agriculture”.

All the above choices are related with the use of document camera, and they can give help to assistance for engineering technological training at universities.

The aim of this paper is to access the possibility of using document camera as color measurement device and its implementation for vine leaves diseases identification.

Material and methods

To obtain the color characteristics of vine leaves, an Epson DC-11 (Epson America, Inc.) document camera, with 5MP video sensor and diode light was used.Three different types of leaves are studied – healthy leaves (H), diseased with powdery mildew (PM) and Grape phylloxera (GP).Figure 1 presents the document camera used and some of the samples. Infestation on vine leaves is visible and clearly distinguishable.

a) Document camera	b) Vine leaves diseases

Figure 1. Measuring vine leaves color with a document camera

After conversion from RGB 12 color components are obtained in HSV, Lab and LCH color models (Kirilova et al., 2009). Selection of informative color components was made by Fisher discriminant ratio function. For classification a discriminant analysis was used (Mladenov et al., 2015). The assessment of the classifier was made by general classification error (Zlatev et al., 2017).

All calculations are made at a level of significance α=0,05.

Results and discussion

Mean value, standard deviation, and coefficient of variation for color characteristics of the four color models are determined.Discriminant analysis was used. The results were compared with those from other authors.

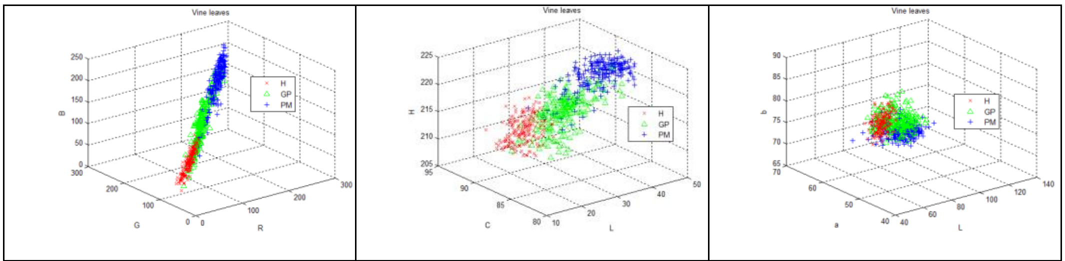
Table 1 provides descriptive statistics of color components for healthy and diseased vine leaves.It can be seen that the resulting color components have close averages and a coefficient of variation below 30%.

Table 1. Descriptive statistics of color components for healthy and diseased vine leaves

Color model \ Vine leaves			H	GP	PM	Color model \ Vine leaves			H	GP	PM
RGB	R	mean	82,13	136,74	200,30	Lab	L	mean	61,09	81,55	102,72
		SD	15,61	29,29	29,44			SD	4,76	11,55	11,49
		CV	0,19	0,21	0,15			CV	0,08	0,14	0,11
	G	mean	123,89	162,70	201,10		a	mean	51,99	55,88	62,51
		SD	8,42	22,64	23,14			SD	2,23	2,54	2,34
		CV	0,07	0,14	0,12			CV	0,04	0,05	0,04
	B	mean	56,51	107,16	176,42		b	mean	79,86	77,14	70,43
		SD	18,79	32,85	30,30			SD	2,89	3,24	2,31
		CV	0,33	0,31	0,17			CV	0,04	0,04	0,03
HSV	H	mean	0,27	0,24	0,17	LCH	L	mean	23,96	31,98	40,28
		SD	0,01	0,03	0,05			SD	1,87	4,53	4,51
		CV	0,05	0,11	0,30			CV	0,08	0,14	0,11
	S	mean	0,55	0,36	0,14		C	mean	90,04	88,34	87,25
		SD	0,13	0,13	0,07			SD	1,08	1,21	1,24

		CV	0,24	0,35	0,47			CV	0,01	0,01	0,01
	V	mean	0,49	0,64	0,80		H	mean	212,35	215,19	221,32
		SD	0,03	0,09	0,10			SD	2,22	2,56	2,00
		CV	0,07	0,14	0,12			CV	0,01	0,01	0,01
H-healthy leaves; PM-diseased with powdery mildew; GP-Grape phylloxera											

Figure 2 shows the distribution of color components for vine leaves.It can be seen that, for the data's distinctness inwithin a given class, indicate that better results are obtained in the research basedof the color. This is an expected result becausethe main part of the studied properties related to the vine leaves diseases are visible properties that can be analyzed in the visiblespectrum of reflected light.

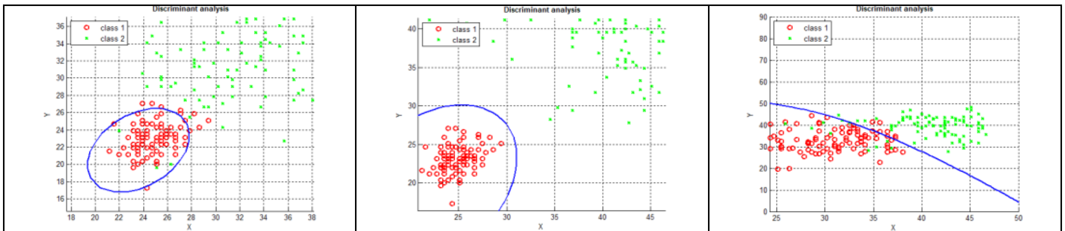


a) RGB | b) LCH | c) Lab

Figure 2. Color models for vine leaves

A Fisher discriminant ratio was used to form a feature space for informative color components. After the assessment, three color components were selected – G (RGB), L (LCH) and H (HSV).

Figure 3 shows examples of nonlinear discriminant analysis by L (LCH) color component.All classes of data are overlapping.This overlap is reflected through the general classification error.



a) H-GP, e=8% | b) H-PM, e=0% | c) GP-PM, e=9%

Figure 3. Nonlinear discriminant analysis

Table 2presents results from a general classification error evaluation using a nonlinear discriminant analysis.Small values of the general error are obtained using L (LCH) color component, wheree=0-9%. Using a non-linear discriminant analysis and the other two color components H (HSV) and G (RGB), the general error of more than 10% is obtained.

Table 2. Results of a general classification error

Color component	Separation function	H-GP	H-PM	GP-PM
G (RGB)	Q	3%	0%	11%
	DQ	3%	0%	12%
	M	6%	0%	12%
L (LCH)	Q	3%	0%	9%

	DQ	3%	0%	9%
	M	8%	0%	9%
H (HSV)	Q	11%	1%	12%
	DQ	13%	1%	12%
	M	21%	1%	10%
H-healthy leaves; PM-diseased with powdery mildew; GP-Grape phylloxera; Q-quadratic; DQ-diagonal-quadratic; M-Mahalanobis				

The results obtained confirm the findings from Zlatev (2016) that additional devices to interactive presentation systems, and in particular document cameras, can be used for both visualization and teaching aids using object recognition techniques on the surface of organic products.Document camera features can be expanded using softwaretools. Such an opportunity is suggested by Oh et al. (2016) using document cameras for hyper-spectral analysis. The results obtained herein can be used in the preparation of images for hyper-spectral analysis.

Conclusion

The high level of visualization that the teacher achieves through interactive white boards and document cameras enables preparation of the learning content in the most appropriate way for students with visual-kinetic style of learning. More importantly, the interactivity leads to their active participation during the classes.document cameras, can be used for The visualization and teaching aids can be achievedusing object recognition techniques on the surface of diseased vine leaves.

The research can be continued by conducting a survey among learners to assess the effectiveness of using this methodology and document camera with which each learner can work individually.

References

Georgieva, K., Stoykova, V., Ivanova, N., Dimova, E. (2015): Application of information technologies and interactive tools for improving educational quality. In *CBU International conference on innovation, technology transfer and education*, March 25-27, 2015, Prague, Czech Republic, 468-474

Kirilova, E., Daskalov, P., Tsonev, R., Draganova, Ts. (2009): Statistical characteristics of digital images of healthy and infected with the Fusarium corn seed. *Trakia Journal of Sciences*, 7, 2, 161-167. (in Bulgarian)

Mladenov, M., Penchev, S., Deyanov, M. (2015): Complex assessment of food products quality using analysis of visual images, spectrophotometric and hyperspectral characteristics. *International Journal of Engineering and Innovative Technology* (IJEIT), 4, 12, 23-32

Nedeva, V., Dineva, S., (2013): Design and development of efficient e-learning courses. In *International conference of virtual learning,* ICVL 2013, Romania, 108-115.

Oh, S, Brown, M, Pollefeys, M, Kim, S. (2016): Do It Yourself Hyperspectral Imaging with Everyday Digital Cameras. In *Proceedings Computer of Vision and Pattern Recognition* (CVPR), 2016 IEEE Conference on 27-30 June, 2461-2469.

Pehlivanova, M., Ducheva, Z. (2011): Training in a virtual learning environment in the theoretical module - a factor for development of "responsible" driver. In *International Conference on Virtual Learning,* ICVL 2011, Romania, 275-280.

Stoykova, V. (2014): Evaluation of the application of interactive presentation systems in higher education. *Applied Researches in Technics, Technologies and Education* ARTTE, 2, 3, 286-300

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. In *International conference of virtual learning,* ICVL 2016, Romania, 209-213

Zlatev, Z., Baycheva, S. (2017): Application of optical device in methodology for teaching analysis of essential oils. In *International conference of virtual learning,* ICVL Romania, 124-129

Application of Geometric Elements in Fabric Design Training

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Abstract

This report analyzes the possible implementation of computer-generated geometric elements in the textile design training. A review of the available solutions in this area is proposed. A survey was conducted among students on the acceptability of computer-generated geometric elements. Some basic concepts, their application and their role in the online whiteboard exercise are explored. These tools are important from the point of view of modern design training methods.

Keywords: Virtual Learning Systems, Computer Generated Forms, Geometrical Elements

1 Introduction

The training in the field of textile design is carried out through curricula, providing the necessary fundamental, general engineering, special engineering and specialized training, which corresponds to the degree of development of contemporary theory and practice in the field. This is one of the main prerequisites for the effectiveness of this training (Elnashar et al., 2017).

The introduction of modern methods, which are available in the scientific literature, makes the training current and following the modern tendencies in the textile design.

Methods for a mathematical description of geometric elements are a topical issue covered in contemporary scientific publications. Magnetic curves are used to generate aesthetic objects and floral ornaments (Xu et al., 2009; Anton, 2016). Some authors suggest using fractal geometry to describe drawings on bed covers (Bales, 2012). On the other hand, the use of geometric shapes involves the use of the Fibonacci circle and numbers as well as the golden section in garment design (Kazlacheva, 2017; Kazlacheva, 2018). Figures obtained through the Fibonacci numbers allow more varied color work and can be used as a framework for additional geometric constructions.

The use of algorithms and computer programs to generate geometric elements would facilitate their creation and, on the other hand, facilitate their introduction as an element of interactive learning systems (Stoykova, 2015, Shivacheva et al., 2016, Zlatev, 2016).

From the analysis of current research it can be summarized that it is necessary to analyze the possibilities for integration and adaptation of computer generated geometric forms in textile design training.

2. Material and methods

Fibonacci numbers sequence have been used (Kazlacheva, 2019), which is defined by the formula and program description, with a pseudo code shown in Figure 1. The algorithms for generating a circle, astroid and triangle are examined.

The circle module is obtained by converting the coordinates of the circle points from a polar to a rectangular coordinate system. The same algorithm is used in the astroid, but the coordinates obtained are raised to the third degree, resulting in the reversal of the half-arcs of the circle. The triangle module is obtained by drawing triangles, with their starting points following the coordinates obtained from the Fibonacci numbers.

$F_1=0$, $F_2=1$, $F_n=F_{n-1}+F_{n-2}$
fibf(1) = 1;
fibf(2) = 1;
n=3
while(fibf(n-1)+fibf(n-2)<1000)
fibf(n)=fibf(n-1)+fibf(n-2);
n=n+1;
end
	fi1=0:360-180
	for i=1:length(r)
	xx2=x1(i)+rn(i).*cos(fi1*t)
	yy2=y1(i)+rn(i).*sin(fi1*t)
	fill(xx2,yy2,c2)
	axis equal
	end
		fi1=0:360-180
		for i=1:length(r)
		xx2=x1(i)+rn(i).*cos(fi1*t).^3
		yy2=y1(i)+rn(i).*sin(fi1*t).^3
		fill(xx2,yy2,c2)
		axis equal
		end
			g=0.6
			for i=1:length(x)
			fill([x(i) x(i)+r(i)*g x(i)+r(i)*g/2 x(i)],[y(i) y(i) y(i)+r(i)*g y(i)],c1)
			end

a) Fibonacci sequence	b) half circle	c) half astroid	d) triangle

Figure 1. A pseudocode used for computer programs

The survey was conducted on-line. Google Forms (Google Inc.) has been used to create the survey. This is a free Google application that is used to create an online forms or tests that can be completed on the Internet. The results are obtained in real time on-line. To use, a Google or gmail account with an access password is required.

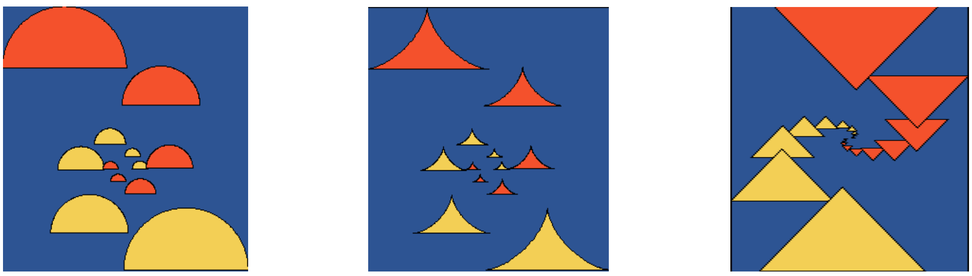
The study was conducted at the faculty "Technics and Technologies" - Yambol, Thrakia University – Stara Zagora, Bulgaria. A total of 70 students were interviewed. They are chosen randomly regardless of the course of study and gender. All respondents are aware of the purpose of the survey and the purpose of using the data received.

The purpose of the study is to find out which modules are liked by the students and would be appropriate to increase their interest and activity during the classroom activities.

An online training system Ziteboard (Ziteboard, 2019) was used. This is a lightweight whiteboard website suitable for mobile work.

3 Results and discussion

The variants presented in Figure 2 are motifs that can be directly used in textile design. In order to increase the modular diversity and ease of designing the right, their shape is transformed on the basis of radial symmetry used in various geometric combinations and shapes - a circle, astroid, triangle.



a) Half circle b) Half astroid c) Triangle

Figure 2. Computer generated modules

The results of the survey related to the selection of computer-generated modules are shown in Figure 3. As can be seen from this figure, the largest percentage of respondents have chosen the astroid module. This is an expected result because this module is complex and contains both the shape of the triangle and the arcs of the circle in the corresponding two quadrants but opposite.

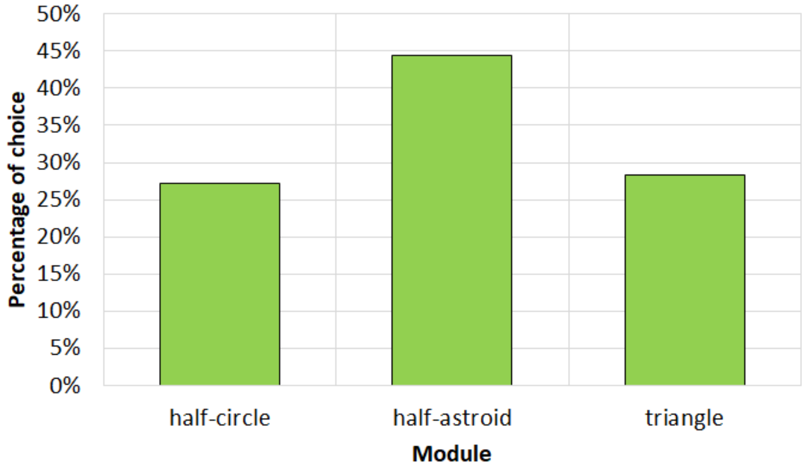
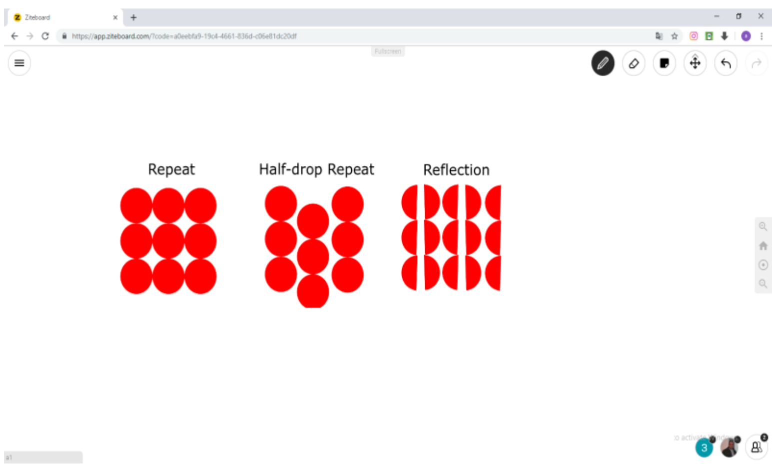


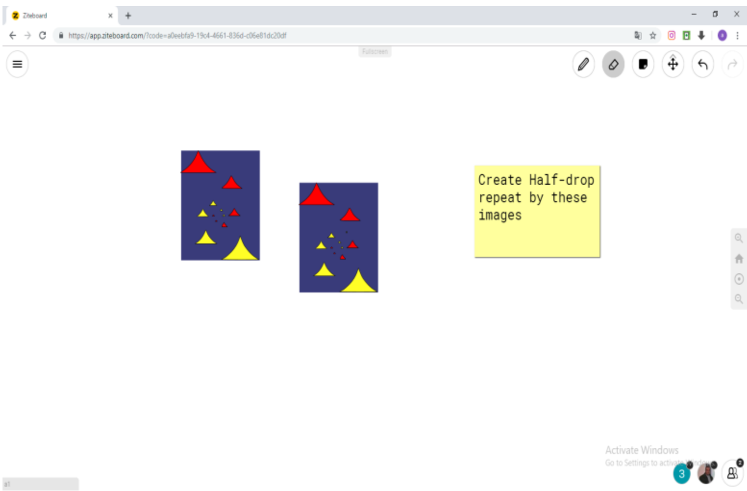
Figure 3. Results from a survey

The use of computer-generated forms for online learning is presented in Figure 4. The work spaces of the lecturer and the student are shown. The lecturer shows the types of repeat and visualizes their performance. After clicking on the selected student's profile, he receives the audible alert and performs the assigned task. In this case, the task for the student is to draw pattern using the computer generated motif on the screen of the online whiteboard.

When performing the tasks of the students, the lecturer can put notes on the white field of the online whiteboard for the purpose of guiding the implementation of the tasks assigned to the students.After running the tasks from the context menu, the desktop whiteboard can be stored and used in the training course available in the university's e-learning system.



a) Work place of the lecturer



b) Work place of the student

Figure 4. Using ZiteBoard for online education

The motifs generated by the proposed algorithms can be directly used to create patterns. For this purpose, they need to be downloaded as image files from the e-learning system. Then to be uploaded in the online whiteboard environment.

With the help of the Internet-based “Ziteboard” software, student work can be shared using their mobile devices – phones, tablets, laptops included in the current session initiated by the lecturer. Students and lecturers can make comments and notes on the presented image, or perform operational control in real time. The lecturer has the opportunity to control the work of the students.

Conclusion

Programming tools for the implementation of the proposed methods and procedures for generating geometric shapes and their application in the textile design training are adapted.

Contemporary technical tools of training, tailored to the preferences and peculiarities of the students of the digital generation, help to increase the interest and activity of the students, bring dynamics, flexibility and high level of visualization in the training process.

The use of an online whiteboard during the lectures helps to better illustrate the presentation of the materials and the consistency in the design of textile fabrics and, in general, supports the specialized training of students.

Acknowledgements

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References

Anton, L. (2016): Computer-generated Floral Ornament Based on Magnetic Curves. Available at: https://medium.com/@tokudu/computer-generated-floral-ornament-based-on-magnetic-curves-d77a3f206893, accesed 2019.

Bales, J. (2012): Creating Again and Again: Fractal Patterns and Process in Improvisational African-American Quilts. *Critical Interventions*, 9/10, 63:83.

Elnashar, E., Zlatev, Z., Boneva, P. (2017): Education in the professional field "Design": A comparative analysis of Egyptian and European experience in this study area of higher education. *International Journal of Advanced Educational Research*, 2, 2, 5:9.

Kazlacheva, Z. (2017): An investigation of application of the golden ratio and Fibonaccisequence in fashion design and pattern making. Proceedings of *17th World Textile Conference AUTEX 2017- Textiles - Shaping the Future*, IOP Conf. Series: Materials Science and Engineering, 254, 1:6

Kazlacheva, Z. (2018): Fibonacci Circle in Fashion Design. *Latest Trends in Textile and Fashion Designing*, 1, 3, 56-57.

Kazlacheva, Z. (2019). Pattern design of twisted draperies with decorative and constructive function. *Applied Researches in Technics, Technologies and Education* (ARTTE), 7, 1, 1-9.

Shivacheva, G., Nedeva, V. (2016): Methods for Teaching Programming Using Virtual Laboratory. Proceedings of the *11th International conference on virtual learning* (ICVL), 92-98.

Stoykova, V. (2015): Interactive environments for training in the higher education. Proceedings of *International Conference on e-Learning, e-Learning'15*, Berlin, Germany, 268-273.

Xu, L., Mould, D. (2009): Magnetic Curves: Curvature-Controlled Aesthetic Curves Using Magnetic Fields. *Computational Aesthetics in Graphics, Visualization, and Imaging*, 1-8.

Ziteboard, Online Whiteboard with Realtime Collaboration. Available at: https://ziteboard.com/, accesed 2019.

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. Proceedings of *11th International Conference on Virtual Learning 2016* (ICVL), 209-213.

Application of A Traffic Light System for Public Transport Vehicle Drivers Training

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Abstract

The present work analyzes the possibility of application a traffic light system for the training of drivers of public transport vehicles. A component of a graphical user interface is developedfor driver assistance system with aim to improve passenger comfort. The results obtained can be used for evaluation and guidance to improve the style of driving, which leads to improvement of the parameters of the transport process.

Keywords: traffic light system, graphical user interface, travel comfort

1 Introduction

For the passenger, the performance indicator is the quality of the transport service. This is a factor that is closely related to the parameters of the transport process. The interests of the carrier are related to the efficient use of vehicles (Karapetkov et al., 2003; Pehlivanova et al., 2014).

Carlson et al. (Karlsson et al., 2010) are conducting a study of the transport system in the city of Gothenburg, Sweden and a line of intra-urban bus transport. From preliminary analysis studies by the Swedish National Transport Agency. The authors found that, as a result of a survey conducted by the agency mentioned above, three of the main indicators of comfortable public transport travel - the temperature in the bus, reliable and accessible information and, last but not least, the way of driving the driver.

The results of the study in Sofia Municipality (Tsvetkova, 2017) and in Sweden, consumers categorically with more than 86% of the total number of respondents, indicate that they would pay a higher price for the service if this would support measures to improve comfort on a trip.

According to Shivacheva (2011), the purpose of the professional activity of the trainer, the trainers of drivers, is concretely shaped in the formation and development of the personality of safe drivers as road users. This objective is very broad and includes the overall personality of the vehicle driver for public transport and is realized through the formation of a knowledge system, practical habits for safe and comfortable driving behavior of the vehicle.

In recent years, a traffic light system has been used to assess the effectiveness of the work of the workplace (Baycheva et al., 2016; Jain, 2016; Shivacheva et al., 2016, Zlatev, 2016) It is necessary to analyze the possibility of applying this type of system to the training of drivers of public transport vehicles, which is the purpose of this report.

2 Methodology

The Traffic Light System (TLS) is used in various production areas to indicate the state of production machinery (Goldnfiber, 2015), an assessment of the work of textile workers (Islama et al., 2013).

Traffic light system has proven to be an effective inspection tool for reducing production defects.This system is more effective than other quality tools due to its visual communication. The use of this system increases the level of diligence of workers in production (Jain, 2016).

The traffic light system works on a similar principle as traffic lights placed at urban junctions. Like the transport system, it includes three levels - green, yellow and red. For example, when using a traffic light system in production, each worker is characterized by a map. Green is for good quality, yellow is for warning, and red means stopping production due to poor quality.

Mladenov (2015) suggests that such a system be used to indicate the quality of food products. Through the traffic light system and application of a mobile device, using various sensors on the mobile phone, the user is warned of the quality of the product he chooses

In the available literature and in the features of existing travel comfort systems, no evidence has been found of using a traffic light system to alert the driver of the degree of comfort it provides to travelers by driving the vehicle.Such a system would be suitable to guide the driver while driving, as well as using a behavioral recording system, to use it to analyze and improve his style of driving.

The present work proposes the use of a traffic light system to indicate the degree of discomfort of travelers in a public transport vehicle. Table 1 lists the three colors and their importance for traveling comfort.

Table 1. Application of a traffic light system

Color	*Meaning*	*Description*
Green	Comfortable	The trip is pleasant for the traveler
Yellow	Non-comfortable	It is necessary to reduce the influence of factors affecting passengers's discomfort when maneuvering
Red	Extremely non-comfortable	It is necessary for the driver to take action to improve the comfort of travel, as it causes great discomfort to the traveler

On this basis, a graphical user interface element is comprised of an instrument and driver assistant type system that will guide it to improve travel comfort (Figure 1).

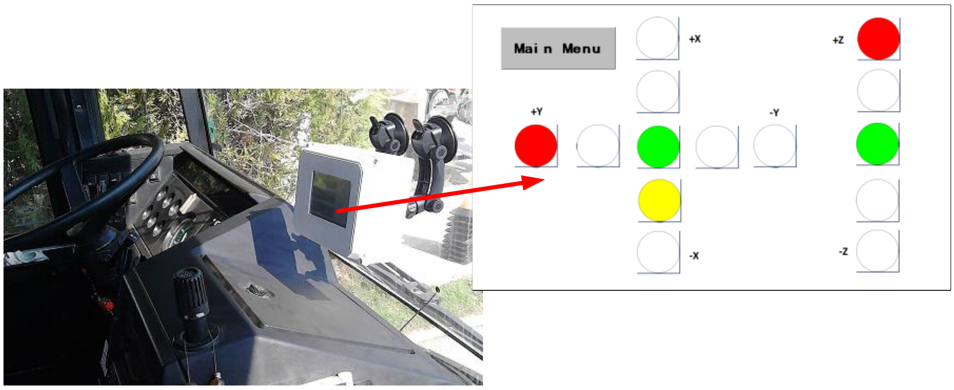


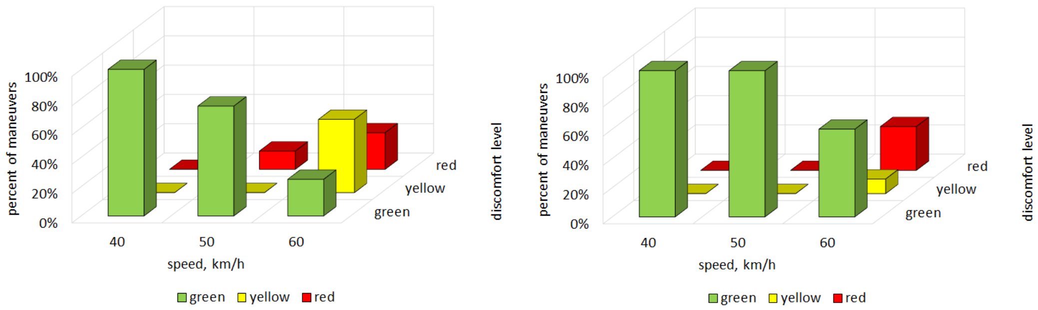
Figure 1. Graphical user interface element for driver assistant system

The program implementation of such a "traffic light" system requires determination of limits for discomfort. When defining these limits, it is necessary to use a model describing the relationship between measured linear and angular accelerations as well as X, Y and Z axis acceleration limits.

3 Results and discussion

An analysis has been made of the possibility of applying a traffic light system to assess the driver in the course of linear and non-linear maneuvers of the vehicle. The analysis includes indications for driving the vehicle at different speeds and the degree of discomfort. These results can be used to improve the driving style and, as a further benefit, to reduce the harmful emissions resulting from the efficient use of the car (Karlsson et al., 2010).

Figure 2 shows results of driver evaluation in linear and nonlinear maneuvers with the vehicle. It can be seen that the maneuvers with a linear motion of 40km/h have the lowest degree of discomfort. In these maneuvers filled with 60km/h, readings were obtained, mainly in the yellow zone. The greatest share of high levels of discomfort was obtained by performing maneuvers with a rectilinear motion of 60 km/h.



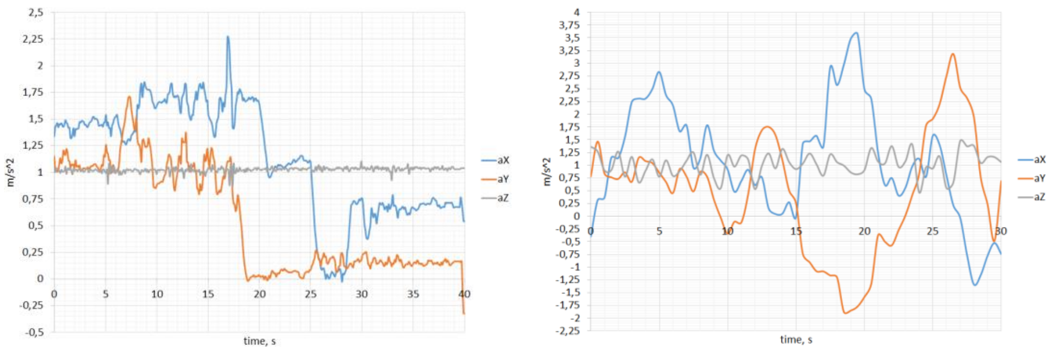
a) Linear maneuvers b) Non-linear maneuvers

Figure 2. Driver evaluation through a traffic light system

The performance of maneuvers with non-linear motion shows that the greatest percentage of them have a low degree of discomfort for travelers. As with both linear and in-motion maneuvers of the vehicle and the performance of non-linear motion, their performance at the highest speed of 60km/h leads to increased discomfort for travelers.

The basic system allows the X, Y, and Z axis acceleration to be recorded on an SD card. Through this record, an analysis of the acceleration change can be made in performing different maneuvers.

Figure 3 shows acceleration graphs, measured by the acceleration sensor, of the driver assist device, at speeds of 60 km/h. It can be seen that in the maneuvers the acceleration is over 1m/s^2, which, as shown in the previous figure, leads to an increase in the discomfort in the traveling.



a) Linear maneuver b) Non-linear maneuver

Figure 3. Graphics of acceleration for linear and non-linear maneuvers

4 Conclusion

In the present work, an analysis has been made of the possibility of using a traffic light system for the training of public transport vehicle drivers. The results obtained show that the developed graphical user interface to a driver assistant system can be used to evaluate and guide the driver, that will improve its style of driving. The results obtained improve the parameters of the transport process, which covers the interest of the transport carrier related to the efficient use of the vehicles and hence the reduction of the fuel consumption and the environmentally harmful emissions.

References

Baycheva, S., Zlatev, Z., Dimitrova, A. (2016): Investigating the possibilities of document cameras for quality assessment of foodstuffs by measuring of color. ICVL 2016, The 11th International Conference on Virtual Learning 2016, 204-208.

Goldnfiber (2015): An overview of Traffic Light System, http://www.goldnfiber.com, accessed 2019.

Islama, M., Rahmanb, S. (2013): Enhancing lean supply chain through traffic light quality management system. Management Science Letters, vol. 3, pp.867-878.

Jain, L. (2016): *System implementation. Thesis, Department of Fashion Technology*. National Institute of Fashion Technology, Mumbai.

Karapetkov, S., Genova, P., Uzunov, H., Kalicin,G. (2003): Loss of vehicle stability in a corner. Machine Mechanics, 46. (in Bulgarian)

Karlsson, J., Larlsson, E. (2010): *Passengers' Valuation of Quality in Public Transport with Focus on Comfort*. Thesis, Chalmers University of Technology, Göteborg, Sweden.

Mladenov, M. (2015): *Complex assessment of the quality of food products by analysis of visual images, spectrophotometric and hyperspectral characteristics*. Monograph. University Publishing Center of Rousse University "A. Kanchev ", Rousse, Bulgaria. (in Bulgarian)

Pehlivanova, M., Ducheva, Z. (2014): Training in a virtual learning environment in the theoretical module - a factor for development of "responsible" driver. ICVL 2014, The 6th International Conference on Virtual Learning 2014, 274-279.

Shivacheva, G., Nedeva, V. (2016): Methods for Teaching Programming Using Virtual Laboratory. ICVL 2016, The 11th International Conference on Virtual Learning 2016, 92-98.

Shivacheva, I. (2011): The professional activity of the teacher training the driver of motor vehicles. *In Proceedings of Scientific conference – Traffic safety*, Yambol, Bulgaria, 58-63. (in Bulgarian)

Tsvetkova, S. (2017): Improvement of the Quality of Passenger Transport in Sofia through the Implementation of Intelligent Transport Systems. *Ikonomiceski i Sotsialni Alternativi*, 4, 29-42.

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. ICVL 2016, The 11th International Conference on Virtual Learning 2016, 209-213.

Challenges to Designing Tests to E-Evaluate the Theoretical Training of Students in Pedagogical Disciplines

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Abstract

The paper examines the challenges of designing tests to e-evaluate the theoretical training of students in pedagogical disciplines. The motives for choosing certain types of electronic didactic tests are analysed; the difficulties and limitations in their creation depending on the nature of the curriculum, the type of questions (tasks) and the components of competence assessed. E-evaluation is realized through the e-learning platform Moodle. The results of this form of control and comparative analysis are presented according to the type of questions (tasks).Finally, conclusions are drawn on the applicability and effectiveness of this type of examination in the theoretical training of pedagogical specialists.

Keywords: theoretical pedagogical training, e-test, e-evaluation, challenges

1. Introduction

E-learning and forms of e-test control and evaluation are an integral part of and need for the learning process, including the higher education system. They have their undisputed and proven advantages, confirmed in educational practice and author' positions (Shivacheva, Dineva, Pehlivanova, Dzhambazov, Peneva, Keremedchiev, Terzieva, Todorova, Kademova-Katzarova, Popescu, Toma ... and many others). For some of the higher education areas and professional fields e-learning and e-evaluation are more relevant, while for others are accompanied by the need to overcome certain difficulties related to the nature of the learning content.It is primarily narrative and descriptive.„The nature of pedagogical topics and competences requires by future teachers … to justify, interpret, defend and motivate their position, form and develop their ability to express themselves and persuade as part of the professionally significant qualities of the educator. Such competencies are hardly captured by test forms of verification“ (Shivacheva, 2016, p.14-15). From this point of view, constructing didactic e-tests in pedagogical disciplines is a process of overcoming a number of challenges.

2. Methodology of the research

2.1. Object and subject of the research

The *object* of the study is the process of controlling and evaluating the theoretical preparation of students in pedagogical disciplines.

The *subject* of the study is an analysis of the challenges and the possibilities of the constructed and used tests for e-control and e-assessment of the competences of the students of Theory of upbringing and Andragogy.

2.2. Aim of the research

The *purpose* of the study is to draw (outline):

- the challenges in designing e-tests to control and assess the competencies of students in pedagogical disciplines;
- and the possibilities to overcome them.

2.3. Methods and tools of the research

The main *methods* in the present study are the e-tests of Theory of upbringing and Andragogy for the control and evaluation of the students' knowledge.The Moodle e-learning platform, which is being applied at the Thracian University - Stara Zagora, is used in this process.It provides a variety of options for the lecturer for:

- developing the design of the tests according to the specific learning content;
- generating, storing and analysing the results.

Another used research method is a didactic analysis of the constructed e-tests from a point of view of the aims of training in the pedagogical disciplines Theory of upbringing and Andragogy - scope of the learning content, realized functions of the tests, achieved educational aims.

The resources for statistical analysis of the Moodle e-learning platform are also used in the study, to determine the degree of difficulty of the questions in the tests and random answers.

2.4. Contingent

The contingent of the study is498 students fromthe 1styear of all specialties from the nomenclature of the Faculty of Education of Thrakia University - Stara Zagora, Bulgaria (Preschool and Primary School Pedagogy - 252, Primary School Educationwith a Foreign Language - 39, Social Pedagogy - 71, Special Pedagogy - 47, Pedagogy of Information Technology Education - 29) and 60 students from the 3rdyear of Social Pedagogy, full-timeand part-time training;Bachelor’s Degree Programme, for the 2017/2018 and 2018/2019 school year. In the framework of the present study, their knowledge and competences in the educational disciplines Theory of upbringing and Andragogy have been checked and evaluated by e-testing.

2.5. Criteria and indicators

The main criteria of the study are the challenges in designing e-evaluation tests. They concentrate on achieving:

- optimal scope of the learning content;
- the requisite degree of difficulty of e-tests;
- high degree of realization of:
  - diagnostic (possibility for in-depth knowledge verification);
  - training;
  - and developmental function of the test in e-testing of students.

3. Results of the survey - Analysis of the tests

The objectivity of the proposed tests, the success of the students and the intensification of the control through them is commented in another publication (Shivacheva, 2017).These characteristics can be considered as achieved and will not be discussed here.

The present analysis covers diagnosis and argumentation of the possibility of the e-tests, constructed and used in the training, to overcome the challenges posed by the nature of the educational content of the pedagogical disciplines.

3.1. Scope of Learning Content - Types of questions

One of the challenges to compiling e-tests in pedagogical disciplines is to enable the test to cover an optimal volume of learning content (full-time course content).At the same time, the number of questions and the duration of work on the e-test should be in line with psychological and hygiene standards.

Multiple-choice questions were used in the tests:

- with 1 correct answer;
- with more than one correct answer.

All true answers have equal weight in the question according to their number.

Questions with one correct answer.Questions with one true answer in both tests are relatively small: Theory of upbringing - 13 of 86; Andragogy - 6 of 46.

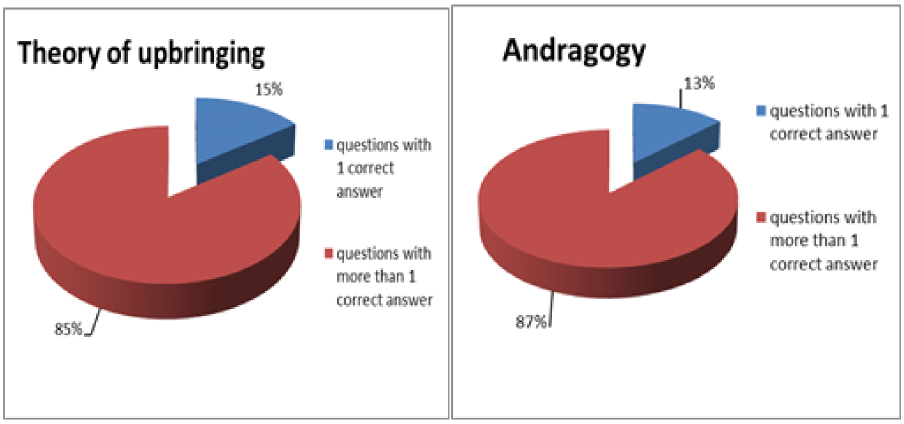

*Figure 1.*Correlation between questions with 1 correct answer and questions with more than one correct answer in e-tests

This type of questions requires exact answers. No punitive weight for wrong answers. Their content focuses on questions about:

- a certain period in the development of a particular pedagogical science (Pedagogy, Andragogy);
- differentiation between specific pedagogical sciences (Pedagogy and Andragogy);
- definition of a specific component of pedagogical science (subject, subject);
- definition of a specific pedagogical process (distance learning, e-learning);
- differentiation between specific pedagogical processes (distance learning and e-learning);
- definition of components of pedagogical processes (aim of the teaching profession);
- identifying and designating the types of a particular pedagogical phenomenon (driving forces of development, training certification);
- linking a real pedagogical situation to the relevant educational processes, etc.

There are more restrictions on these questions related to:

- checking primarily on memory productivity;
- reproductive thinking;
- higher risk of misleading and error (where the student does not get any points on this question) due to rushing, tension or too close formulations of different in meaning answers;
- impossibility of self-productive formulation of own ideas;
- limiting the creative expression of the forming professional-pedagogical competencies. Such opportunities, however, students have in a number of other forms throughout the semester.
- low level of verification of the mastering and use of the scientific dictionary and terminology (thesaurus), etc.

Questions with more than one correct answer.This kind of questions is related to broad-based answers. They require students:

- to have a broader and deeper knowledge of the learning content;
- to understand the meaning of pedagogical phenomena and proposed answers;

- to have the skills to critically analyze and differentiate pedagogical phenomena and suggested answers, etc.

These questions focus on discovering and pointing out:

- types of a specific component of pedagogical science (functions);
- the characteristics of a particular pedagogical phenomenon (development, acceleration, unevenness, developmental jump, communication, pedagogical communication, pedagogical environment);
- the components of a particular pedagogical phenomenon (pedagogical communication, pedagogical environment);
- types of a particular pedagogical phenomenon (development, communication);
- the characteristics of a particular pedagogical process (upbringing, self- upbringing);
- correlation between pedagogical processes (upbringing and self- upbringing, distance learning and e-learning);
- differentiation between pedagogical processes (upbringing and self- upbringing);
- the characteristics of a particular component of the educational process (aim, stages, peculiarities, principles, forms, methods, types);
- types of specific component of the education process (principles, forms, methods);
- the structure of a particular component of the educational process (forms, methods);
- the characteristics of a specific component of the andragogical process (adult learner, stages, methods, assessment);
- the structure of a specific component of the andragogical process (adult education system);
- thetypes of a specific component of the andragogical process (principles, functions, tasks, motives, advantages, barriers, evaluation, certification), etc.

There are no questions in this group where all answers are true.

Limitations on questions with more than one true answer are analogous to the limitations for questions with 1 true answer.By contrast, in case of error, the student would retain some part of the evaluation of the question depending on the number of correct answers given.

The summarized presentation of the nature of the questions in the two e-tests confirms that they cover all the learning content of the courses.Although the personally generated tests contain 12 questions about Theory of Upbringing and 10 questions about Andragogy, they are generated from a rich base (bank) of questions organized in clusters (categories) - 12 clusters with 86 questions of Theory of Upbringing, 10 clusters with 46 questions about Andragogy.These sets of questions allow including all of the learning content.The challenge for the author of didactic e-tests is to show creativity in selecting the highlights in the content, selecting types of questions and answers depending on the content, determining the number of answers to each question depending on the content, to formulate the questions and the suggested answers.This is the most difficult but also the most important task and part of the e-test design.

3.2. Providing the necessary degree of difficulty of the e-tests

Necessary degree of difficulty of didactic tests (and every question in them) is within the range of 40% to 70%.The established degree of difficulty of the two e-tests and each of the questions in them is within the norm - from 40% to 70%.This fact confirms that the e-tests constructed overcome the challenge associated withthe nature of educational content in pedagogical disciplines:

- descriptive character;
- an extremely thin line in their formulation between elementarily and a very high degree of complexity of questions (Shivacheva, 2017, 166).

Ensuring the necessary degree of difficulty of e-tests is achieved by:

- how to construct the questions:
  - for questions with one true answer, the prepositional answers are more than two;
  - number of responses to each question;
  - the wording of the answers:
    - have close nuances;
    - require knowledge of content but also consideration;
    - different formulations of response with identical meaning are proposed. Their multivariate increases the degree of complexity of the issue;
- developing a methodology for evaluating responses:
  - the weight of any correct answer;
  - the weight of each wrong answer for both types of questions.

3.3. Реализиране на дидактическите функции на е-теста

Another challenge in constructing e-control and e-evaluation tests is to ensure that they can achieve a high degree of their didactic functions:

- diagnostic;
- training;
- and developmental.

Diagnostic function (possibility for in-depth knowledge verification).The solution of the proposed e-tests provides an opportunity for diagnosing the degree of the formed competence of the students in the courses studied.The reasons for this are:

- including questions from all learning content in the automatically generated personal version of e-tests;
- the random choice of the questions and the prepositional answers in the personal version.Surveys conducted among students by T. Pehlivanova confirm that so constructed e-tests motivate students for real training on the course, rejecting the possibilities of fraud or reliance on chance (Pehlivanova, 2018).Thus, the assessment is with greater degree of accuracy and objectivity;
- the reduced number of questions (12/10) allows the e-tests to be solved within 10-15 minutes, which is optimal in terms of the complexity of questions, the psychological norms of sustainability of attention and the phases of working capacity;
- the mechanism of forming the weight of each answer to the questions;
- questions with more than one true answer require a penalty for wrong answers.This prevents the formal marking of all the answers, thus are choosing all the correct answers.Under this option, the got assessment would be maximum but not objective.The punitive weight of the wrong answers is less than the weight of the correct answers in order not to get a negative value and thus the evaluation of such questions has a very strong effect (and ultimately non-objective) on the final evaluation.the feedback (report and evaluation immediately after completion of the e-test) for the results of the e-tests for the students and the lecturer allows the subjects in the training (student and lecturer) to diagnose the level and the nature of competence (Shivacheva, 2017).

Training function.The training function of the e-tests consists in the possibility for students to supplement, expand, correct, summarize their knowledge and competences during the test (solving the test), develop skills for applying the knowledge in real pedagogical situations (the tests are included similar questions) rather than just getting some assessment.Suggested answers to the structure of each question (especially questions with more than one correct answer) allow them to complement, expand and summarize their knowledge by reasonably assessing each response.Especially important role in the realization of this function is the final report as feedback.It is generated immediately after completing the e-test.Students have enough time to get acquainted with their results on any question - correct, wrong, partially correct, nature and cause of mistakes, search for reasons for different answers, analyze in depth, and so on.Thus, the final report allows in fullness to realize all aspects of the training function, regardless of the nature of the learning content.

*Developmental*function.The developmental function is an essential aspect of the didactic tests.It focuses not on the momentary results of the control, but on their durability, personal significance and improvement in perspective.This function can be realized if the positive test results are not the result of a random, formal or accidental response.Despite the complexity of designing test questions in pedagogical disciplines, statistical data show that:

- for most of the questions (87%) there is no records of a random response;
- only for about 13% of the questions were found random responses at 6.67% -20% of the attempts made for the concrete question. These are just answers to questions with a correct answer.

These data are proof that the proposed e-tests have a number of advantages that inspire the realization of their developing function.Despite the challenges of the nature of learning content, the two e-tests provide:

- development of analytical skills;
- developing logical thinking;
- speed of thinking, given the limited time;
- the punitive burden of wrong answers provokes students to work carefully, thoroughly and critically, to consider and appraise each proposed answer;
- self-command and self-control;
- self-criticism
- and many other intellectual qualities and skills.

Conclusions

The proposed data and analysis of the didactic e-tests in Theory of upbringing and Andragogy prove that the way of their construction provides for overcoming the challenges related to the nature of the educational content of the pedagogical disciplines:

- provision the optimal scope of the learning content;
- provision the necessary degree of difficulty to e-tests;
- provision a high degree of realization of the diagnostic, training and developing function of the test in e-evaluation of the students.

In conclusion, it can be categorically argued that the didactic e-tests are suitable for the control and evaluation of the theoretical preparation of the students in the pedagogical disciplines.They not only correspond to the global technological trends and preferences of the digital generation of students but can be constructed to meet the content challenges and to meet the didactic requirements.From the creative intentions of the author depends the metamorphosis of the challenges to them in advantages.

References

Dineva S. (2018): Teacher’s feedback using Moodleand blend learning. In *Proceedings of 13th International Conference on Virtual Learning VIRTUAL LEARNING - VIRTUAL REALITY*, Buchrest University Press, Buchrest, 87-91.

Dzhambazov, V., Peneva, J., Keremedchiev,D. (2018):Student’s readiness for e-learning. In*ProceedingsofXI National Conference "Education and Research in the Information Society”*, Plovdiv: Association "Development of the Information Society" Sofia,196-203.

Keremedchiev,D., Peneva, J. (2017): Comparison of online and traditional in class exams in computer science courses.In*ProceedingsofX National Conference "Education and Research in the Information Society "*, Plovdiv: Association "Development of the Information Society" Sofia, 69-77.

Pehlivanova, T. I., Kanchev, K.T. (2019): Number of questions for creating online quizzes. *Applied Researches in Technics, Technologies and Education*, 7, 1, 58-63.

Popescu, D., Toma, A. (2018): Creating online evaluation system using new technologies. In *Proceedings of the 13th International Conference on Virtual Learning VIRTUAL LEARNING - VIRTUAL REALITY*. Bucharest University Press, Bucharest, 197-204.

Shivacheva, I. (2016): E-learning as supporting technology in the pedagogical preparation. *Innovation and entrepreneurship*, 4, 2, 3-16.

Shivacheva-Pineda, I. N. (2017):Options for e-evaluation of the theoretical training of students of pedagogical disciplines. In *Proceedings of the 12th International Conference on Virtual Learning VIRTUAL LEARNING - VIRTUAL REALITY*. Bucharest University Press, Bucharest, 165-169.

Terzieva, V., Todorova, K., Kademova-Katzarova,P.(2017): Technology in help of personalised education.In*ProceedingsofX National Conference "Education and Research in the Information Society "*, Plovdiv: Association "Development of the Information Society" Sofia, 60-68.

Method for Automated Generation of Test Questions in Moodle

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Abstract

The interest in electronic tests for assessment of the students' knowledge is increasing continuously. The reason for this is their many advantages. However, they have some disadvantages. Part of the problems that appears in evaluating with electronic tests are the mechanical memorization of the correct answers and the possibility for cheating. The development of the modern digital technologies and devices facilitates the leakage and access to the test questions and gives the ability to the students to learn only them, rather than the learning content.

Method for automated generation of test questions which reduces the impact of these disadvantages is proposed in this article.Based on the proposed method, a plugin for Moodie has been developed, which allows the creation of a new type of questions called „Multivariate Multiple Choice Questions".

This article presents results of a study of the opinion of former and current students on issues related to the evaluation with e-tests. Two experiments were also conducted during the evaluation of students from Trakia University – Stara Zagora, Bulgaria. The results prove the applicability of the developed method.

Keywords:e-learning, e-tests, Testing, Moodleplugins, Multiple Choice Questions.

1. Introduction

With the entry into higher education of new forms of training such as electronic learning, distance learning, etc. the interest in using e-tests for assessment of the students' knowledges has increased a lot.

Assessment with e-tests has many advantages over the other forms of assessment. It allows testing at the same time of large groups, avoiding subjectivism, saving time, enabling immediate receipt and generalization of the results, etc. However, it also has some major disadvantages, such as possibility for cheating by using the computer to access unallowed help materials; unauthorized access to examination tests; difficulties in creating tests that check the entire amount of knowledge, possibility of interrupting the exam for technical reasons etc.

The development of modern technologies expands the abilities of dishonest students to use these disadvantages.

In the article is proposed a method and a solution has been developed that can help reduce cheating and the use of unallowed help materials when evaluating by electronic tests.

When creating the tests, Muddle and other e-Learning systems offer built-in methods to prevent cheating such as shuffling optional answers, shuffling the questions for different learners, choosing a random question from a category, and getting different tests for each learner, setting a time limits for solving the test, limiting the IP address from which the test can be solved and others.

The aim of the article is to justify and present a method for automated generation of test questions and plugin for Moodle, allowing the creation of a new type of questions that are a variety of multiple choice questions. The method allows an easy and quick automated way to increase the total number of questions in the bank and makes it difficult for students to memorize the correct answers and use unallowed help materials during the evaluation.

2.Problem Formulation

In order to establish whether there are problems related to cheating when evaluating by electronic tests, a survey has been conducted covering 54 former and current students who graduated or trained in technical, computer, economic and other specialties at different universities in Bulgaria, in the cities Sofia, Yambol, Plovdiv and others. The age of the respondents is up to 40 years because the questions are mostly related to digital training methods, and it is supposed that the older ones have completed their education before their wide entry into practice. (Pehlivanova and Kanchev, 2019).

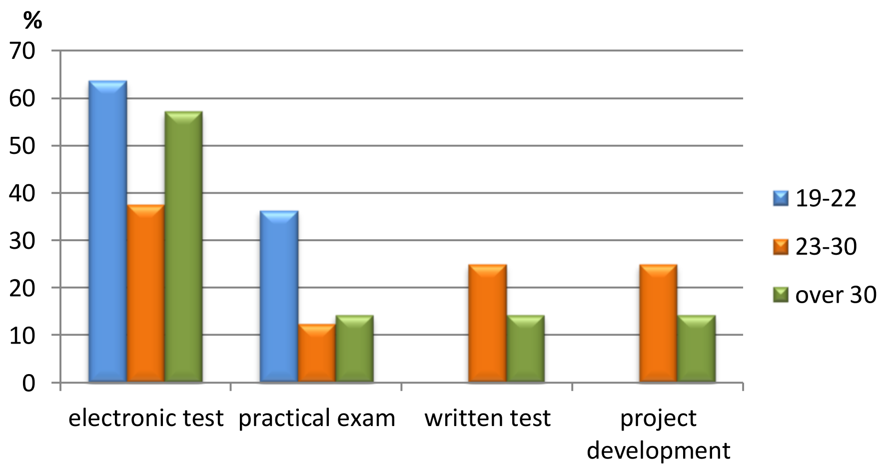

Figure 1. Percentage of Respondents which Have Indicated the Respective Type of Exam as Easiest

Respondents were asked to rank the different types of evaluation according to the difficulty. 53.8% of respondents said that the electronic test is the easiest exam. It should be noted that this opinion does not apply to the tests as a whole, but specifically to the electronic tests. 73.1% of respondents consider the electronic test is easier than the paper test.

The distribution of the answers received for that which of the different types of exams is easiest for them is shown in Figure 1. The results are divided into 3 age groups. As expected, the preference for electronic tests from the youngest respondents who have the best knowledge of modern IT is the highest. The classical exam, which consists of developing topics with or without oral interview, was not mentioned by any student.

One reason for this result is that by working on the computer, the student has easier access to additional unallowed electronic materials. Another reason is that despite the efforts of the examiners, after several evaluations with the same question bank, students are already familiar with the biggest part of the questions. In the study (Pehlivanova and Kanchev, 2019) 40% of respondents answered that during preparation for e-tests, at least once they had a full or partial set of questions from which the test was formed (without the teacher's permission); 16% had materials in half or most of the subjects.

In this case, during the exam, some students try to mechanically recognize the questions by keyword used in both the formulation of the questions and the formulation of the answers. With a bank of several hundred questions, recognition can hardly be done from paper help materials or photographs. Typically, computer files are used in which all questions are saved. Usually they are sorted in alphabetical order and the question is easily reached by the first words. Also it is possible to find it using the "find" command available in all modern text and data editors.

The study presented in (Pehlivanova and Kanchev, 2019) found that if the total number of questions in the question bank is greater than 600, 34.6% of the students considered that they do not have time to transcribe the correct answers and that they cannot mechanically memorize the correct answers, even if they know the questions before the exam. For a total number greater than 1000, this applies to all tested. This number encourages learners to direct their efforts to learn the learning content, not to look for ways to "take the exam".

Since the creation of such bank with questions requires serious time and effort from the examiners side, we have decided to offer an automated method for increasing the number of questions in the bank by creating a plugin in the e-learning system Moodle. It allows from one question in the question bank to be formulated variety of test tasks.

The reason why this system is chosen is that Moodle is an open-source e-learning system and it is applied in almost all Bulgarian universities, including those of the authors of the article. In Moodle, system administrators can easily integrate external system applications or create their own plugins to enhance its functionality.

3. Description of the Method

The proposed method is based on the fact that if the formulation of the question or answer changes, it becomes unrecognizable by incompetent students.

The same question can easily be formulated in 2, 3 or more ways that are equally true, but they sound completely different. This method is applicable to questions of type: Multiple choice; Short answer; Comparison; Numeric; Computing; Truth / False. Adding a different wording to the answers to the multiple choice questions, a test task can be set in many different variants. This makes it practically impossible to memorize the questions mechanically, to get help from colleagues, to collect all test questions or to copy the correct answer from a colleague.

If the different versions of the text are introduced into the questions bank as different records then when creating tests by generating random questions from a category, there is an opportunity a single student to receive two practically identical questions in a test. This can be avoided by appropriately grouping the questions in the bank and appropriately arranging the questions in the test by using the possibility of asking a random question from a group. However, when creating banks with questions and the questionnaires, serious effort is needed as manual grouping is required.

To avoid these difficulties, a plugin for Moodle has been developed (Pehlivanova and Kanchev, 2019). Through it a new type of question is being created called „Multivariate Multiple Choice question“. In the text field of the questions, in the special format described below, the different formulation of the questions is entered. In the field where the text of the answers is entered, the same format is used. The system generates a random combination of question and answers.

The online documentation for the Moodle e-learning system has been explored to develop the plugin (Moodle Developer Documentation, 2018; Moodle Documentation, 2018). The programming language used in Moodle is PHP. That’s why the same technology is used for the development of the plugin. (Welling and Thomson, 2004; Zandstra, 2013).

The study conducted in the official directory with plugins for Moodle shows that such plugin, which allows generation of multiple choice questions with different wordings of the questions and answers, does not currently exist. (Moodle Plugins, 2019). There are a total of 54 plugins available in the directory (to February 15, 2019) for creating new types of questions. Most of them are aimed at facilitating the creation of questions from specific scientific fields such as chemistry, geography, mathematics, and programming. Plugins have been developed to generate random numerical values for each student. There are ones that are a variety of standard multiple choice questions, but differ from them by way of evaluation, and so on.

Now there is an opportunity for many variants of the same question as part of the standard Moodle release in the computing questions (computing, simple computing and closed computing). In creating the question, it is possible to randomly generate a number of combinations of values within a predefined range.

4. Results

The plugin developed allows the creation of new type questions called „Multivariate Multiple Choice question“. It is similar to the "Multiple choice with one true answer" type, but it allows to set different variants of the questions and answers texts.

The choice of the type of questions is made from the standard view for adding question in Moodle. Since the format for entering the text of questions and answers is specific, a detailed explanation is written. It contains:

- *What opportunities this type of question has;*
- *For what purpose they are used;*
- *What is the format of the text input;*
- *How the system generates different questions.*

Selecting a question of this type opens a standard screen to create a new question. The question input screen does not differ in any way from ordinary „Multiple Choice question“. Again, the lecturer has the opportunity to add as much as he wants answers, and define which one is correct. It is possible to add a shuffle of answers at the lecturer's request as well as a numbering of the answers.

To create a question or answer that can take more than one form, the text of the question should match the following format, popular among web developers who use it to generate larger volumes of text content for the same topic.

Text outside of curly brackets "{}" is not interpreted in a special way, and when a test is run it is displayed directly to the student undergoing the test.

Text in "{}" is interpreted as a word combination, of which exactly one particular word combination should be chosen for the text of the question (or answer). In the group, the word combinations are separated by the symbol "|" (pipe).

When generating a question during a test, for each group is selected exactly one random word combination to include in the text of the question (or answer) and visualize to the student. In the initial generation of the question and the answers to it, each selected word combination is recorded in the student's current attempt session, together with the ordering of the answers (if the lecturer chooses it to be different for each student) and with the answer given at the moment (if any). So every student who receives the question will get a different variation. The number of variations depends on the number of groups and their richness. For one question examining the same knowledge in students, we can get a total *N* variation of the question [1].

[1] $N = \prod_{i=1}^{m} n_i$,

where n_i is the number of word combinations in the i -th group;

m - number of groups.

During a test attempt, the question retains its appearance, and in a new attempt by the same student the question will be generated in a new variation.

Next example illustrates how the examiner enters the text of the questions and answers in the system and possible variations.

Text of the question:

{Specify the unit of measure that| Which of the following measurement units| Mark the measuring unit that| Select the unit of measure that} {is used| is appropriate| is applicable} for measuring the quantity{electrical voltage| electrical potential| electromotive force}.

Text of the answers:

Answer 1: {Watt | Kilowatt | Ampere}
Answer 2: {Volt | Kilovolt | Millivolt}
Answer 3: {Joule | Coulomb}
Answer 4: {Kilowatt-hour | Ampere-hour}

In this way, the question can get 36 different formulations.

Together with the different wording of the answers, we reach a total of 1296 variations of the same task.

In the example above, in addition to the formulations, the knowledges that are being verified are also changed. In each attempt, one of the three electrical quantities electrical voltage, electric potential, electromotive force is selected. Joining them in a single question is possible, since the correct answer is the same regardless of the randomly chosen electrical quantity.

The student sees the question as a simple multiple choices question and does not understand that it has many possible forms.

When the student finishes the test, he sees the question and the feedback field. The variant of the question is the same as the one displayed during the test.

To verify the applicability of the proposed method, we conducted the following experiment.

For the subject "Design of lighting systems", studied in FTT-Yambol, the evaluation is done by electronic tests. We created a bank with questions that consists of 320 questions grouped into 15 categories. Students got permission to solve a large number of sample tests in their home preparation. 20 questions were selected from all categories that were modified by the proposed method - different wording of the questions, different wording of the correct answer (where possible) and various wrong answers.

Students were asked to solve a first test consisting of the twenty modified questions. Then each of them solves another test consisting of 20 questions randomly generated from the bank with unchanged questions (one or two from each category).

There was a visible difference in the scores of the two tests. For 80% of tested, Test 2 had a higher score. The average score of Test 1 was 3.27, and of Test 2 - 4.18. The difference in the scores obtained from the two tests was 0.91. To prove that the differences obtained were due to the new way of formulating the questions and not the influence of random factors, we applied a statistical criterion (Stoimenova, 2000).

We checked the hypothesis that the results of test 1 have lower average. The Student's t-test was used with significancelevel $\alpha = 0{,}05$. *We calculatedt-value* $t = 2{,}1669$. *This value is greater than the critical value of criterion* t_{cr} *at a significance level* $\alpha = 0{,}05$. *This gives reason to assume with 95% probability that the differences in assessments are due to the modification of the questions, not to the random factors.*

These conclusions were confirmed by another experiment. It was held with students from FTT - Yambol, studying the discipline "Lighting and installation equipment". Two sets of questions were developed. The first group A consists of 300 questions in 19 categories that students solved in their preparation. The other group B includes 100 questions from all categories, modified by the *methodology described. During the exam the students solved two tests with 20 questions. The first included questions from group B and the second from group A, randomly generated for each student, containing questions of all categories. In the first test each student received an unknown question called "new".*

In solving the first test, students were informed that it includes "new" questions and those that they have solved, but formulated differently, called "familiar" questions. They were asked to note in a standard form for each question whether this is a "new" or "familiar" question.

Again, there was a significant difference in the scores of the two tests. About 83% of tested Test 2 had a higher score. The average score from test 1 was 3.56, and from test 2 - 4.39. Again, we checked the hypothesis that Test 1 scores were with lower average using a Student's t-test with level of significance $\alpha = 0.05$. The results obtained confirmed that the differences in assessments were due to the change in the questions and not the random factors, with a probability of 95%.

Classifying questions as "new" and "familiar" showed the following results. All students recognized as "new" much larger number than actually are "new". The minimum number of questions wrongly identified as "new" is 5. The largest percentage of students surveyed, 23.8% wrongly referred 9 questions as "new". Over 50% of the total number of modified questions were recognized as "new". The distribution of the results is shown in Figure 2.

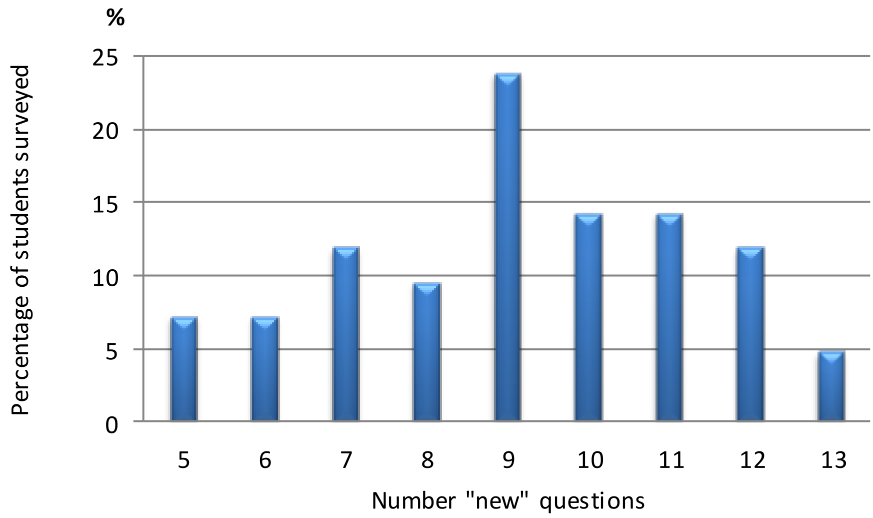

Figure 2. Number of Questions Wrongly Identified as "New"

The analysis of these results shows that, using the proposed method and the developed plugin, the examiners who create tests can automatically increase the total number of questions in the question bank. This will reduce the mechanical memorization of correct answers and the possibilities for cheating.

The proposed method is most appropriate when evaluating in technical and mathematical disciplines. It can also be applied to humanitarian disciplines, taking into account their specifics described in (Shivacheva-Pineda, 2017).

Testing the developed plugin in the training and assessment of students is forthcoming. The effectiveness of its implementation will be assessed.

Conclusions

Method for automated generation of test questions which increases the total number of questions in the questions bank about creating tests is proposed.

Plugin for Moodle has been developed, which allows the creation of a new type of questions called „Multivariate Multiple Choice Questions".

The proposed method and plugin reduce the attempts of some students to mechanically memorize the questions and correct answers and make it difficult to use unallowed help materials when evaluating by electronic tests.

It was found that after applying the proposed method, over 50% of the questions are recognized by students as "new" questions.

In the next stage, the developed plug-in will be tested and will be assessed the effectiveness of its implementation.

References

Moodle Developer Documentation:
https://docs.moodle.org/dev/Question_types, accessed 2018

Moodle Developer Documentation:
https://docs.moodle.org/dev/Question_API, accessed 2018

Moodle Documentation:
http://www.collinsharper.com/documentation/moodle/index.html, accessed 2018

Moodle Plugins: https://moodle.org/plugins/, accessed 2019

Pehlivanova, T. I. and Kanchev, K.T. (2019) Number of questions for creating online quizzes, *Applied Researches in Technics, Technologies and Education7,* 1, 58-63

Pehlivanova, T. I. and Kanchev, K.T. (2018): Plugin for creating a new type of questions in moodle. In *Proceedings of The 5th International Conference on Technics, Technologies and Education,* Trakia University, Stara Zagora, Faculty of Technics and Technologies, Yambol, 179-186

Shivacheva-Pineda, I. N. (2017): Options for e-evaluation of the theoretical training of students of pedagogical disciplines. In *Proceedings ofthe 12th International Conference on Virtual Learning VIRTUAL LEARNING - VIRTUAL REALITY,* Bucharest University Press, Bucharest, 165-169.

Stoimenova, E. A. (2000):*Measuring properties of the tests*.New Bulgarian University, Sofia, Bulgaria.

Welling L. and Thomson L. (2004):*Development of web projects with PHP and MySQL.*Softpres, Sofia, Bulgaria.

Zandstra M. (2013):*PHP Objects, Patterns, and Practice*. Apress, New York, USA.

The importance of visualization in e-learning courses

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Abstract

Good E-courses always should contain visuals. All types of visuals are important and help researchers and learners to achieve their goals. Applying visualizations to tough topics benefits both teachers and students, helping them to cope with difficult new matter, as well as leading to profounder understanding. If we support students by implementing visual learning materials their performance are risen. The results of our practices on different subjects demonstrated that students achieved better performance on exams, when visuals methods are used during learning process.

Keywords: E-courses; E-Learning; Visualization.

1 Introduction

The use of visualization techniques in learning process is not new approach; it has been used in maps and drawings for thousands of years (Klerk *et al*, 2013). The visualization gives opportunity difficult topics to be simplifying, and easily to be comprehended and adopt by learners (Kamy, 2018). Currently, educators can use enormous different types of visualizations such as images, slideshows, gifs, graphics, photos, illustrations, charts, maps, diagrams, videos and etc. Graphic interfaces and videos are gradually replacing text-based courses (Gutierrez, 2014). On the web, there are many on-line interactive sources and visualization software's that can generate animation or graphics. All types of visualizations can be applied in e-learning courses with a proper and available learning management system (LMS). Nevertheless, videos are being used as major learning tools and trend in the IT best practice training industry (Samuel, 2018).

According to Veřmiřovský (2010) visualization today is an integral part of education at all types of schools that associated with cognitive activities. Of course visuals cannot replace the spoken words, but carry advantages into the learning process by attracting listeners; reducing the burden of teachers; attending the concentration on the essence of content; and facilitating the acceptance of given information (Veřmiřovský, 2010; Gutierrez, 2014; Kamy, 2018). The combination of audio and visuals add life to perceptions and make e-Learning engaging and effective (Samuel, 2018).

Visualization on the Internet became inevitable, where information is presented in various forms exclusively visual experience (Veřmiřovský, 2010). The significance of visualization in learning can be definite through the often used expression "seeing is believes" or "a picture is worth a thousand words" (Hariharan, 2014). The visuals can be given in different ways: pictograms, diagrams, scientific images illustrations, drawings, photographs, graphics or media. All noticed approaches gave benefits when are used in e-courses, blend or distant education. The reason of their positive effect on learning process can be described as stick in long term memory, transmitted faster messages, improve comprehension, and motivate learners (Gutierrez, 2014).

The majority of teachers and students had positive perceptions of using visuals (Ghulam *et al*, 2015). Images, pictures and videos have a better and more lasting impression on the brain than only words, and that is precisely the reason of using those tools in e-Learning (Hariharan, 2014).

2 The power of visualization

During visualization, learners store information in their long-term memory (Kamy, 2018). Visuals create a quicker and stronger impact on brain than words, the images are stored in iconic memory that acts as a visual sensory memory register, and after that are deposited in long-term memory (Mylavarapu, 2016). According to Hariharan (2014), visualization means clarity, recall by association and the impact lasts for a longer time. The internal visual association is an interdisciplinary effort to understand and learn, as an effort to define the relevant knowledge, skills and competencies that are required for the acquisition of trivial and other skills for successful learning process. The key to understand different perceptions of reality (Veřmiřovský, 2010). The researchers found that the recall of information from spoken lecture after three days is only 10-20%; of written information 10%; but of visual performance is about 65% (Active Learning, 2012). Visualization helps learners to make sense out of the content and draws the direct attention (Veřmiřovský, 2010; Gutierrez, 2014; Kamy, 2018).

Visualization does not replace spoken words but can reinforce the information by (Veřmiřovský, 2010):

- ✓ *increase the concentration and attention of listeners on the essence of the content;*
- ✓ *attract listeners;*
- ✓ *reduce the burden of teachers;*
- ✓ *help in the orientation of the audience;*
- ✓ *facilitate the understanding of presented information;*
- ✓ *access to the substance of presented content;*
- ✓ *deepening and extension of the spoken word;*
- ✓ *supported remembering of the presented contents; encourage the growth opinion on the presented content.*

There is no doubt that technical devices applying during study process have a great impact on human informative system. It has been revealed that 1% of what is learned is from the sense of taste. Just only 1,5% of what is learned is from the sense of touch. Approximately 3,5% of what is learned is from the logic of smell. About 11% of what is learned is from the logic of hearing; and 83% of what is learned is from the sense of sight (Cuban, 2001).

3 Learning styles and success in education

There are four types of learners and interconnections between them (see Fig. 1), but around 65% of people are visual learners (Jukes *et al*, 2010; Mylavarapu, 2016; Kamy, 2018).

The most widely accepted model of learning styles is called the VARK model (fig. 1), which stands for visual, aural/auditory, reading/writing, and kinesthetic. In brief:

Visual (spacial) **-** learners learn best by seeing;
Auditory (aural) **-** learners learn best by hearing;
Reading/writing learners **-** learn best by reading and writing;
Kinesthetic (physical) learners **-** learn best by moving and doing.

According to another theory that takes the basics of the VARK model, called memletics, there are also some additional learning styles. This theory adds in a few different categories:

Verbal learners **-** learn best by speaking;
Logical (mathematical) learners **-** learn best by using logic and reasoning;
Social (interpersonal) learners **-** learn best in groups;
Solitary (intrapersonal) learners - learn best alone.

Ordinary, people have one dominant learning style, but most people are a combination of many. No matter what face of education you're coming from, a learning style just explain a student's preferred way of learning that may changes over time (Becton, 2019).

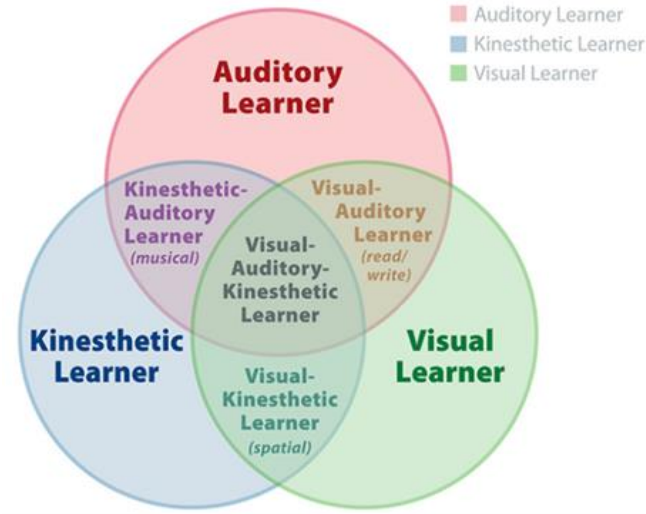

Figure 1. Types of learning styles (image credit: J.Dragonfly, Flickr; Becton, 2019)

People generally remember: about 10% of what they read; 20% of what they hear; 30% of what they see; 50% of what they hear and see; 70% of what they say; and 90% of what they say as they do a thing (Cuban, 2001). Approximately the same magnitudes has been found in other research that people remember 10% of what they hear; 20% of what they read; and 80% of what they see or do (Mylavarapu, 2016).

The reason why the visualization has so big power on learning is shown on Fig. 2.

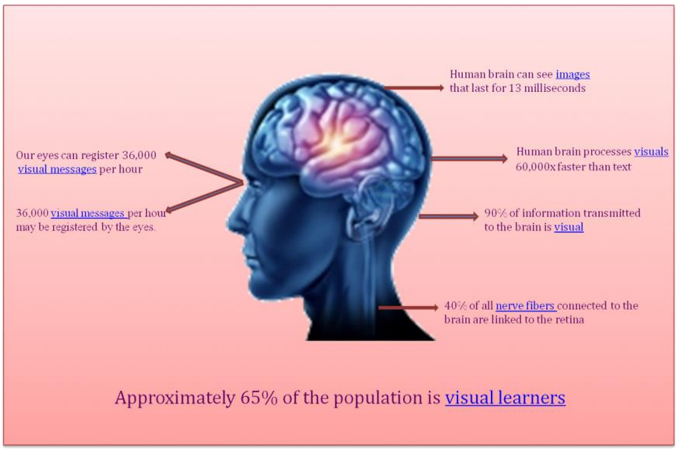

Figure 2. The Power of Visualization (Mylavarapu, 2016)

Visualization has a great impact on a learner's understanding in comparison just content with text. Visualization improves the comprehension and learning is enhancing up to 400% (Gutierrez, 2014; Hariharan, 2014). Visuals help complex patterns easier to be perceived and understand (Vallano, 2012). The human brain processes visual information much faster than plain text (Becton, 2019). The 90% of information transmitted to the brain is visual and visuals are processed 60,000X faster in the brain than text (Gutierrez, 2014; Mylavarapu, 2016). Visual stimuli and emotional response are related, for they are situated on the same place in the brain, visual memory is encoded in medial temporal lobe of the brain where emotions are processed, and, as it is well known emotional reactions influence on retention of information. That is why text combined with visuals recalls better and for longer periods (Mylavarapu, 2016).

Around 40% of learners respond better to visual information than only to text (Gutierrez, 2014), so visuals stimulate thinking and improves learning environment in the classroom (Ghulam *et al*, 2015), attract and motivate student's learning. Nevertheless, a fine equilibrium need to be maintained between visuals and no visual information (Mylavarapu, 2016).

4 Visualizations in e-courses in FTT-Yambol

On the fig.3 is presented manual instruction for the laboratory task of students, training in the microbiology course. All parts of the methodic are demonstrated in parallels with the instructions, which are given on the website in a regular text format.

The vast majority of learners in any given classroom are no longer auditory or text-based learners, they think graphically and are, therefore, either visual or visual kinesthetic learners (fig.1), reinforced by multimedia. During visualization, the brain is being trained for actual performance (Adams, 2009). Therefore, we notice that after using video manuals as instruction, helps students to be more confident of well prepared and that they acquired adequate knowledge about the task, even they fill themselves as already trained and ready to exercise.

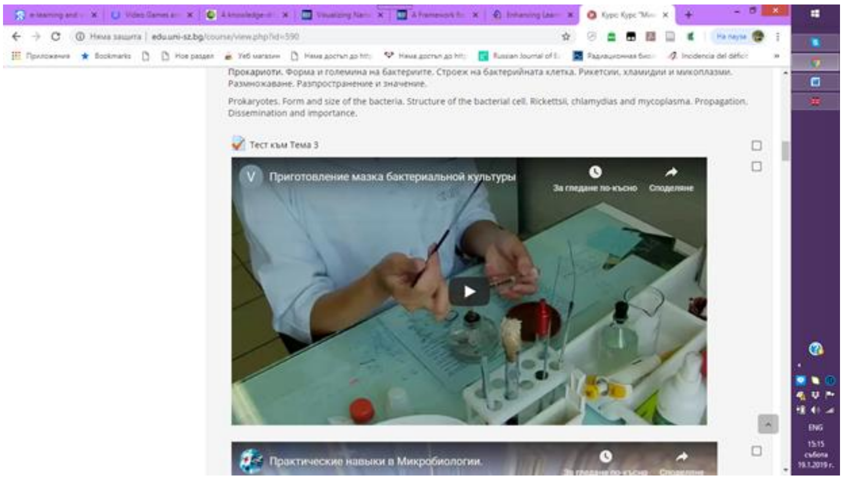

Figure 3. Visual instruction in microbiology e-course in FTT – Yambol

In the field of biochemistry and microbiology, photos and videos help a lot to express the biological structures and their functions. There no doubt learners connect quickly to the image of the microscope or videos than to the text definition (Mylavarapu, 2016).

Another way to stimulate learning of students is to give them task to create their own presentation on given topic. The basis for creation of PowerPoint e-learning presentations is to analyze the content and structure of study topic, search for an external text and visual information and form of visualization. That kind of study in mentioned as an active way of learning during lessons and outside (Veřmiřovský, 2010). Visuals arouse the interest of learners and help the teachers the complex concepts easily to be explained (Ghulam *et al*, 2015). Commonly difficult topics cannot be explain and learn without graphics, schemes, photos or diagrams.

Today most educational organizations used blend learning and the teaching resources are placed on web. The interactive visualization tools implemented in LMS definitely improve the learning and teaching process (Ghulam *et al*, 2015; Kuosa *et al*, 2016). The information about students' communication, collaboration, and participation in online courses is very useful to the teacher and that is his feedback helping to understand the weak and strong points of lessons. Most LMS that offer online courses draw simple graphs about each student's elementary actions, nevertheless many plug-ins for LMS are developed in order to grip and emit more detailed and selected information, because that is worth it (Kuosa *et al*, 2016).

5 Conclusion

By implementing video manuals, students came to the classroom with better confident that they have enough knowledge about and with impression that had been already trained, ready for exercises. The experience of applying visual data in created e-courses confirm that this approach is effective, draw attention of students and improve their learning, as well as enhance the motivation to study.

Applying videos or any types of visualizations to difficult topics always helps both teachers and students to cope with the new information.

Acknowledgement

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References

Books:

Jukes I., T. McCain, Crockett L., (2010): Understanding the digital generation: Teaching and learning in the new digital landscape. Book by Ian Jukes, Ted McCain, & Lee Crockett. Review by Douglas Smith. Thousand Oaks, CA: Corwin Press (SAGE), 152 pp.

Klerk, J. K. Verbert, E. Duval (2013): Enhancing Learning with Visualization Techniques. Handbook of Research on Educational Communications and Technology Springer, New York, NY, USA, 2013. pp 791-807.

Roberts R., (2010): The Digital Generation and Web 2.0: E-Learning Concern or Media Myth? Source Title: Handbook of Research on Practices and Outcomes in E-Learning: Issues and Trends. p. 23. 2010. DOI: 10.4018/978-1-60566-788-1.ch006.

Journal Articles:

Ghulam *et al*, (2015): Impact of Visual Aids in Enhancing the Learning Process Case Research: District Dera Ghazi Khan. Journal of Education and Practice. www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online).Vol.6, No.19, 226-233. 2015.

Kuosa K., D. Distante, A. Tervakari, L. Cerulo, A. Fernández, J. Koro, M. Kailanto, (2016): Interactive Visualization Tools to Improve Learning and Teaching in Online Learning Environments. January 2016. International Journal of Distance Education Technologies 14(1):1-21. DOI: 10.4018/IJDET.2016010101.

Internet Sources:

Active Learning, (2012): http://changingminds.org/explanations/learning/ active learning. htm 2012.

Adams A.J. (2009): Seeing Is Believing: The Power of Visualization. https://www. psychologytoday.com/us/blog/flourish/200912/seeing-is-believing-the-power-visualization.

Becton L., (2019): Discover Your Learning Style - *Comprehensive Guide on Different Learning Styles*. https://www.educationcorner.com/learning-styles.html.

Cuban, L., (2001): Computers in the Classroom, Cambridge, M.A. Harvard University Press. Retrieved from http://www.webpages. uidaho.edu/mbolin/akerele-afolable.htm.

Gutierrez K., (2014): Studies Confirm the Power of Visuals in eLearning. https://www. shiftelearning.com/blog/bid/350326/studies-confirm-the-power-of-visuals-in-elearning. 08. July 2014.

Hariharan S., (2014): Visualization – An Important Factor in E-learning. https://blog. commlabindia.com/elearning-design/visualization-in-elearning-courses March 26 2014.

Kamy A., (2018): Using the Power of Visualization in eLearning. https://blog.crozdesk. com/visualization-in-learning/11.April 2018.

Mylavarapu L., (2016): The Power Visualization Adds to E-learning. https://blog. commlabindia.com/elearning-design/power-of-visualization-in-elearning.

Samuel J., (2018): All About Developing Video-based Learning https://blog.commlabindia.com/learning-design/video-based-learning-infographics April 01 2018.

Vallano E., (2012): How data visualization promotes eLearning through effective story telling https://www.mindjet.com/blog/2012/02/how-data-visualization-promotes-elearning-through-effective-story-telling/.

Veřmiřovský J., (2010): The importance of visualization in education, http://weinoe.us. edu.pl/sites/weinoe.us.edu.pl/files/36 the importance_of_visualisation.pdf p.453-463.

Digital Generation and Visualization in E-Learning

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Abstract

In the new ages we are faced with the internet or digital generation that are a digital native grown up and acquires innovative and adequate methods to be put in practice for working and training them. The paper is based on the training in the subjects "Programming and Use of Computers", "Food Contaminants", "Microbiology", "Biochemistry" and "Ecology", for students of Bachelor's and Master's degree in the period from 2016 to 2018 school years. The age analyses reveal that students undergoing FTT training are mainly from Y and Z generation. The report analyzes the effectiveness and the opportunity of unlimited on-line visual resources to educate well our generation and the putting into practice of those approaches in Faculty of Technics and Technology – Yambol. There is no doubt that the e-courses give opening a study subject to be presented in depth, logically and thought-provoking way. Many studies showed that new generation students prefer blend learning instead of traditional one, and that they don't like reading of books, instead of that they favor a learning in active manner combining all types of possible information resources applying in their activity. Most of all of course they like chat, video games or movies, as well as any kind of visualization. Therefor applying visualizations to tough topics ever benefits both teachers and students to attain deep understanding and to manage with the novel information. If we support students by implementing video manuals and they watch it before lessons or exercises, they came to the schoolroom with better confident that already have some training. The results of our practice and investigation displayed that students achieved better performance on exams when visuals methods drawing their attention are used during learning process, and that they are more motivated to attend lectures, like discussions, as well as actively to cooperate with the lecturers

Keywords: Digital Generation; E-Learning; Visualization; Python Tutor; Programming

1 Introduction

The revolutions in ICTs technologies have transformed deeply people relationship, their social behavior, collaboration and communication, market of knowledge and the knowledge itself. The knowledge and access to and acquisition of knowledge are changing, as well as the ways in which we work with others. In this digital society, a new generation has emerged: the digital natives (Cornu, 2011).

The student's generation nowadays is a digital native that grown up with enormous internet information and communication technologies. Hence, the ways of receiving and acquiring information have been completely transformed, so the teaching approach needs also to be attuned. The children of digital generations prerequisite for situations in which many simultaneous multimedia inputs are joint and they thrive in them (Roberts, 2010). They experience a world through computers, internet, and social online sites like a Facebook, Twitter, Google, iPhone's, iPad's (Jukes *et al*, 2010). Usually, by interacting with other individuals humans learn (Rago, 2014), but today young pupils prefer to interact through social networking sites and around 30% of them have a blog in the web, and 62% have a profile on internet (Curtis, 2009).

Young people favor to expose them, to be active and collaborate using newest technology and visualization. Therefore, the way of teaching should be completely altered in order to meet those challenges and to response to the new requests.

Based on well-developed VLE of Trakia University – Stara Zagora (http://edu.uni-sz.bg/?lang=en) and successful practice of blend learning in FTT – Yambol, we analyzed how visualization influences on student's motivation and performance. In the scope of interest were subjects "Programming and Use of Computers", "Food Contaminants", "Microbiology", "Biochemistry" and "Ecology", Bachelor's and Master's degree in the period from 2016 to 2018 school years.

2 Analysis of recent studies and publications

The quick development and implementation of new digital technology in everyday life, brings specific characteristic to the new generation that are continuously changing following execution of novel technics, economic and social transformations that comes in cycle of four instead of 16 year and gives birth to micro-generations, with new concerns, new motivations and new challenges in all aspects of their live (Morin, 2016).

According to Morin (2016), the first micro-generation, also called Echo-Boomers (1989-1994), or first digital natives GenY, were born with the establishment of Web, and grew up with the new technology from the cradle. They belong to the passage zone from one generation to another, and those young people now 22 - 27 years old, exhibit completely different personal motivations, with demonstration of high pragmatism and commercial spirit. Echo-Boomers have great social consciousness, appreciate businesses and organizations, like to demonstrate a commitment at this level, but anyway they are much more closely to the next Gen Z digital generation (Morin, 2015).

For the next digital generation - Net Generation, or often called Gen Z, born between 1998-1994, the web tools are as essential as air and water, and they request to use it at work. They are known as hyper-connected 'selfie' generation, attached to smart phones as if they had become extensions of their personalities (Morin, 2016). Now with ages between 17-21 years became the first sub-group of generation Z that enters the labor market. They know nothing else, but these tools to interconnect and learn, and this young cyber – generation is driven by tremendous curiosity, and favor companies that will exploit this and enable them to achieve it through their work (Morin, 2015).

The sub-group of generation Z (1998/2002), is named Rainbow Generation, for them is crucial to be treated as individuals. They like learning process and see everyone as equals, regardless of nationality or gender orientation (Morin, 2015).

The Post-Millennial Generation Z – 2002/2006, or young mobile generation, have grown up with social networks and mobile technologies, developing an instinct for collaboration and cooperation with the community. Their learning was done through social networks and mobile and they already show more awareness of the environmental and social problems in the world. Hence, when become on the labor market in 2018 probably they will seek more of a coach or mentor position than to be a traditional leader (Morin, 2015).

The last Gen Z - Silent Generation is born 2006/2010, and now is coming digital "Gen C"– "Confluence Marketing at the Era of Connected Consumers" (Morin, 2016; 2015).

All that micro-generations are different from each other, but commonly digital learners are comfortable when are doing several things at once, prefer multitask and parallel processing, receive information quickly by processing pictures, sounds, and color from multiple multimedia sources and other. The digital natives are more experience-minded, than ownership-minded, hence they need to use data in an extremely novel way or an extremely useful way, and if that is no happen for them it is waste of time (Carey, 2018).

Digital generation undoubtedly prefers video instead or before text, they randomly accessed to hyperlinked multimedia information, and usually net at the same time with many others, learning "just in time" (Morin, 2016; 2015).

4 The Results and Discussion

In the age analysis of students undergoing FTT training, it was found that the majority of students were from Y and Z generation (Fig.1).

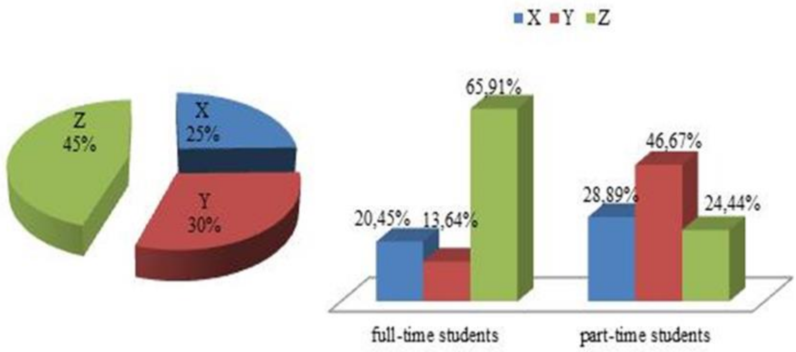

Figure 1. Distribution of the students according to their belonging to a certain digital generation in FTT-Yambol

This imposes the style of teaching and the way in which the information is presented to be conforming and adapted to the peculiarities of perception of these two generations. Digital natives have a different way of concentrating and being attentive, they are "multitasking" - performing several tasks in parallel mood at the same time, or moving from one task to another (Cornu, 2011).

The peculiarity of those two generations that we can use in learning is non-linear visual thinking, in which case we focus on the visualization in the e-learning. Another peculiarity is the speed and multi-channel in the perception of information, which unfortunately reduces the possibilities for continuous concentration and attention. For this reason the using in an addition - video, images, infographics, visual simulations and other types of visualizations in order to keep student's engagement and to give them timely access to a variety of information sources is an essential for the learning process, and for student success. "E-learning environment providing rich opportunities for using multimedia, which allows for a greater degree of acquiring knowledge. Visibility and interactivity of the multimedia attract and hold the interest of students" (Pehlivanova, T. I., 2015).

Various studies have established that the millennial generation prefers watching videos over reading manuals and documents (Samuel, 2018). Hence, to be in response to the new ages we added in our online courses video in some topics of study (fig.2).

Students of FTT-Yambol learning "Food contaminants" and "Ecology" often have a task to demonstrate novel scientific information on the different topics of that field. Usually, they choose a theme on the beginning of semester and created their own PowerPoint presentation or present video-clip. After their presentations the auditory actively discuss the subject and they receive additional mark to the final exam assessment.

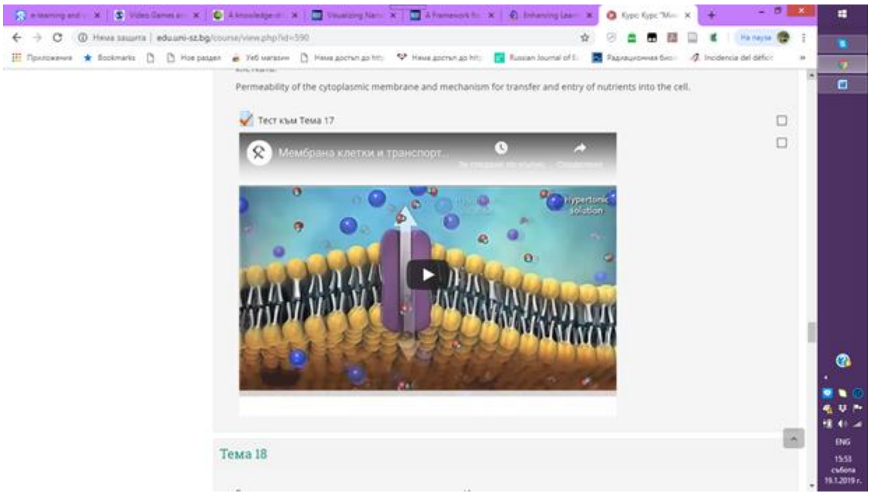

Figure 2. Membrane structure and its permeability,
Biochemistry e-course, FTT – Yambol

The active method of subject learning can take variety forms carried out by suitably awarded learning tasks. The starting point for each representation is to search on the web, obtaining textual information, selection of images and video clips or creating visuals. By using video clips together with visualization with own images and simulations, the process of learning is stimulated (Veřmiřovský, 2010).

Each subject in the e-learning allows the use of different types of visualizations (Fig.3, Visualization of Symmetric Arrays in Java).

In Programming and Using the Computers and Object Oriented Programming subjects, we use visualization in C ++ and Java program languages. The visualization is part of e-books in the e-learning system of Trakia University - Stara Zagora, which is common to all faculties, based on Moodle.

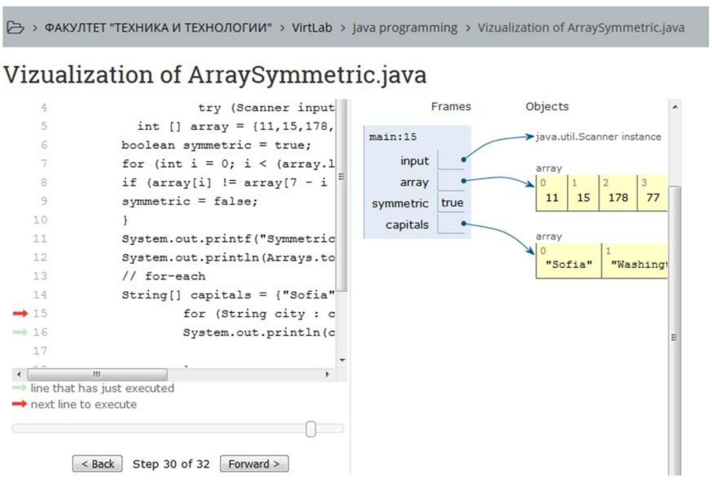

Figure 3. Visualization of symmetric arrays in Java, FTT - Yambol

Similarly, the programming tasks that are offered to students to use during their preparation seem similar. They are fundamentals for learning algorithms and the basics of programming. The creation of these visualizations was used Python tutor also http://pythontutor.com/ (Guo, 2015). In the eDuTrU for the Programming and Using the computers and Object Oriented Programming have been selected programs to visualize algorithms of programs written in C ++ and Java. But Python Tutor can also be used to program Python, JavaScript and Ruby. The visualization of the code represents the data in four panels: Left panel - for the program code; a two-part right panel - Print output - for the result that is printed on the screen during execution; Stack and Heap - Shows the visualization of the changes that occur with the memory stack variables and the dynamic memory of the computer.

Visualization allows students to track the execution of the program code step-by-step, with the possibility of multiple executions; returning to the previous step, tracking the changes occurring in Steak and Heap of memory during the implementation. This is better seen in Fig.4, when working with arrays and can see the variables in the memory and the arrays are visualized during execution.

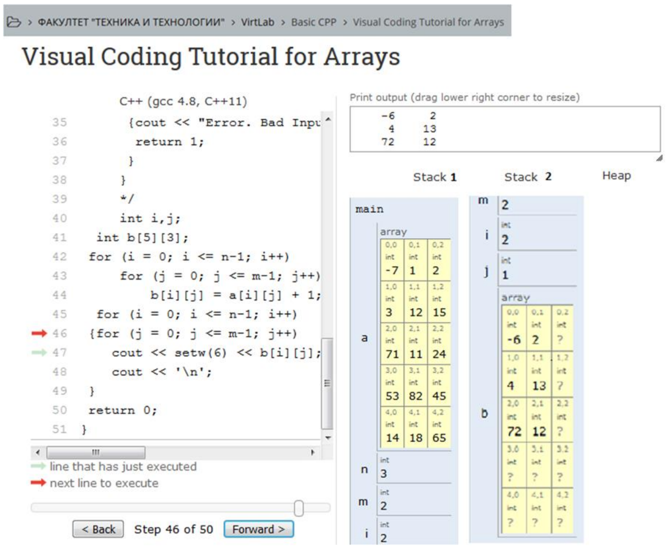

Figure 4. Stack Memory's Visualization in the code implementation for the Arrays, FTT - Yambol.

Visualization for teaching Program languages is very important and "helps people overcome a fundamental barrier to learning programming: understanding what happens as the computer runs each line of code" (Guo, 2015). Another important opportunity to use programming visualization is the ability to use the http://pythontutor.com/ website to independently create the program code and its subsequent visualization. During these processes, students can work with other colleagues, search for online help from other users, comment on executed code, edit multiple times, and more.

The visualization is a part of all scientific fields, for instance, engineering, biology and microbiology, statistics and etc., as a recognized thinking view of facts and associated with the application of rules clarity. Visualizations are related with virtual reality and simulations, which are technically possible, but in education unfortunately are still with restricted use. Nevertheless, the visualization is an essential part of education at all types of schools in different forms from full-time education after distance learning (Veřmiřovský, 2010).

Visualization has become a strong asset in academia and some universities created Visual Understanding Environment (VUE) for managing and integrating digital resources in support of teaching, learning and research. VUE provides a flexible visual environment for structuring, presenting, and sharing digital information. Through on-line available technology and web tools, which are easy to understand and operate, anyone can enter data and create a personal visualization of it, so everyone can benefit from making intricate patterns (Vallano, 2012). Perhaps, that is a good idea for the new projects, which will support distant learning.

According to Morin (2015), following Massive Open Online Courses and distance education, vocational training and digital learning will attest great tasks for organizations.

5 Conclusions and prospects for further research

In the pending years, digital generations will become more involved in the social transformation of educational institutions, and will start practical amendments that best meet their necessities, learning styles and curiosity. The results showed that students are performed better when the innovative visuals methods drawing their attention are used, they are more motivated for the learning process, ready for discussion, and actively collaborate with the lecturers.

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References

Books:

Bernard Cornu (2011): *Digital Natives: How Do They Learn? How to Teach Them?* Published by the UNESCO Institute for Information Technologies in Education. ISSN 2221-8378.

Jukes I, et al., (2010): Understanding the digital generation: Teaching and learning in the new digital landscape. Book by Ian Jukes, Ted McCain, & Lee Crockett. Review by Douglas Smith. Thousand Oaks, CA: Corwin Press (SAGE), 152 pp.

Roberts R., (2010): The Digital Generation and Web 2.0: E-Learning Concern or Media Myth? Source Title: Handbook of Research on Practices and Outcomes in E-Learning: Issues and Trends. p. 23. 2010. DOI: 10.4018/978-1-60566-788-1.ch006.

Journal Articles**:**

Ghulam *et al*, (2015): Impact of Visual Aids in Enhancing the Learning Process Case Research: District Dera Ghazi Khan. Journal of Education and Practice. www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online).Vol.6, No.19, 226-233. 2015.

Pehlivanova, T. I. (2015) Methods for intensification of the training in technical subjects. Applied Researches in Technics, Technologies and Education 3, 4, 344-349

Internet Sources:

Carey G., 2018. Inside The Mind Of A Digital Native. https://www.cmo.com/ interviews /articles/2018/7/10/ cmocom-interview-gemma-milne-cofounder-sciencedisrupt.html#gs.5whl0z

Curtis P., 2009. Internet generation leave parents behind. *The Guardian*. https://www. theguardian.com/media /2009/jan/19/internet-generation-parents. Mon 19 Jan 2009.

Guo, Philip, http://pythontutor.com/ Python Tutor 2015.

Morin R., 2015. 10 Ways That Generation C Impact Us. https://curatti.com/generation-c-center-social-transformations/. 2015.

Morin R., 2015. Generation C – The Emergence of Micro-Generations. https://curatti. com/generation-c-evolution-micro-generation/

Morin R., 2016. The many faces of digital generation. https://curatti.com/digital-generation/

Rago R., 2014. Emotion on the Brain. http://sites.tufts.edu/emotiononthebrain /2014/ 10/ 24/vision-and-emotion/.

Samuel J., 2018. All About Developing Video-based Learning https://blog.commlabindia. com/elearning-design/video-based-learning-infographics April 01 2018.

Vallano E., 2012. How data visualization promotes eLearning through effective story telling https://www.mindjet.com/blog/2012/02/how-data-visualization-promotes-elearning-through-effective-story-telling/.

Veřmiřovský J., 2010. The importance of visualization in education, http://weinoe.us. edu.pl/sites/weinoe.us.edu.pl/files/36 the importance_of_visualisation.pdf p.453-463.

Readiness and Attitudes for Self-Development of Students' Digital Competences/Self-Assessment of Students from FTT - Yambol /

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Abstract

Continuously growing competition between companies not only in Europe but also globally, their desire to develop depend both - on innovation and effective use of ICT, but also on the quality of training of the workforce. The initiatives and European Union policies are aimed at improving digital skills and lifelong learning in the frame of Employment policies of the EU. Undisputed is the fact that the development of the digital competence of engineers is a key moment in their preparation. The report examines the integrative nature of digital competences. The input level of the digital competences of the students, who are preparing at the Faculty of Technics and Technology - Yambol, is analyzed. An attempt has been made to track their attitudes and readiness to develop their digital competences not only in the course of learning but also in the aspect of lifelong learning.

Keywords: digital competence, improve digital competences, self-development, information and data literacy, communication and collaboration, digital content creation, safety, problem solving

1 Introduction

The entry of the digital and other technologies in all spheres of production and everyday life inevitably changes the nature of work in the digital economy. This raises the need for new competencies and new ways for working of those, who succeed in the job market. The new demands posed on the workforce and its competencies put the need for high-level digital competencies at the forefront so that the employee can fit in the work environment and fulfil her/his professional duties. Increasingly, digital competencies are becoming key components, which enhance the competitiveness of a company. Globally, the introduction of digital technologies in the manufacturing process, service, education, etc changes the requirements for the engineering personnel in several aspects:

• Decreasing the search for jobs, related to recurring operations, and making more professional tasks automated (McKinsey, 2017, 2018; Frey et al 2017), increasing the productivity by automating workflows using technologies, based on artificial intelligence.

• Shortening the life cycle of professions and specialties, job renewal as a result of the introduction of innovative technologies, the emergence of new professions and professional roles (Arntz et al 2016; He et al, 2018; McKinsey, 2017b).

• Transformation of the competency profile of specialists, due to changing the tools, which also lead to increasing the requirements for the adaptability of workers and their "flexible skills," performing tasks of a high order, such as searching for non-standard solutions, developing methodologies and the ability to implement flexible career trajectories, and having a higher degree of emotional intelligence;

• Increased demand for professionals with higher level of digital competence, especially in areas such as artificial intelligence, analysis of large databases, virtual reality architecture, the

Internet of Things and of Everything, robotics, etc., or with digital dexterity and leveraging new technology for higher business results (Gartner, 2018).

Digital competence is a concept describing technology related habits. In World Economic Forum (2016) analysis, according to the Human Capital Development Index, 21-22% of all enterprises and 66% of the large ones in the European Union need or have completed additional staff training. The inertia of the training and education of engineers and the dynamic development of the technologies have led to a growing shortage of staff and under-trained personnel to teach the new specialist in the sphere of digital technology. With the increasing speed of data exchange and the penetration of information technology into the economy and life, the question of the level of digital competence not only of the population as a whole, but also of the engineering staff in particular (as trained by the Faculty of Technics and Technology (FTT) - Yambol) and their willingness to constantly improve their digital competences during their professional development is raised. Therefore, one of the goals of the study is to determine the degree of students' readiness to integrate themselves into the labour market as well prepared for work in the field of digital technologies and their attitudes to constantly develop their competence due to the exponential development of technology and its application in the work of engineers.

2 Theoretical Statement of the Problem

The digital transformation of the companies and the increasing competition between the employees create the necessitates for a fast improvement in the workers' knowledge and competence. This calls for a transformation in educational models aimed at developing lifelong learning skills and creating learning content that meets the requirements of the employers (Global Education Futures Report 2018). The omni-training (training using all possible channels of communication), social training, adaptive training, mentoring, project-based training, "self-learning" organizations, etc can be seen as a current trend in the field of education. When analysing the digital competencies, a distinction should be made between the basic and the high-level skills which are part of the professional functions of professionals, working in the digital environment and are related to the application of innovative methods and techniques (Cedefop 2016; OECD, 2016)).

In the context of digitalization, mastering digital competences at a high level is relevant to engineers, as they are an integral part of the range of competencies required by employers. To be successful in the labour market, workers must possess an amalgam of hard and soft skills as well as specialized digital competencies. In this amalgam, we can include groups of competencies such as:

- Professional competencies: In-depth understanding of the professional field; knowledge in related professional fields - the so-called "T-shaped specialist";
- Social, managerial competencies: Emotional intelligence; Teamwork; Readiness for lifelong learning; Adaptability during conditions of uncertainty; Successfully solving tasks, limited by time; Project management skills.
- Digital competencies: “digital dexterity”; work with big data tools; visualization tools, basics of cybersecurity; systematic thinking; understanding the opportunities and risks associated with the application of new technologies.

What has been said so far confirms the need for digital competencies for students - future engineers. In this context, it is important to clarify the concept of digital competence.

Recognized as one of the 8 key competences for lifelong learning in the European Key Skills Framework (2006), digital competence has been the focus of many European Commission documents. It is seen as a 21st-century competence for citizens to actively participate in the economy and life, as a transversal key competence that allows the acquisition of other key competences. A broad interpretation of digital competence includes confident, critical and creative use of ICT to achieve work-related goals, employability, learning, leisure, inclusion and / or participation in society. Perceived as "claim and right". (OECD, 2001), as a 'life/basic skill' (Bawden, 2001), the digital competences of employees help them fully and actively engage in the social and economic life (Ducheva, Nedeva, 2018). In a European Commission report was found that "the lack or insufficiency of digital skills in many adults (48% of Europeans aged 16-74 do not have or have low ICT skills) impedes productivity and innovation capacity in the workplace and limits their participation in society". (EC, 2013). It also emphasizes that digital competence is not directly linked to "being born in the digital age" - it is acquired through formal, non-formal and informal learning and the learner's efforts. (EC, 2013). Distributed in 5 areas and 21 sub-competencies that characterize skills and attitudes in terms of necessary knowledge. DigComp was developed by the Joint Research Center (JRC) of the European Commission as a scientific project based on consultation with, and active input from, a wide range of stakeholders and policymakers from industry, education, and training, employment, social partners, etc. ICT The DigComp 2.0 framework is reported. for Citizens are developed and acquired different dimensions - for professionals and teachers. The aspiration of the academic staff at the Faculty of Technics and Engineering - Yambol, is not only to shape the students, future engineers and teachers as professionals but also to develop their lifelong learning attitudes. This is achieved by providing opportunities for individual educational trajectories by choosing a package of courses in accordance with their abilities, interests and future professional plans. The development of the educational documentation takes into account the needs of the labour market and the users of the staff while maintaining constant communication with them, the implementation of activities under a program for student internships, etc. Students who are prepared for career success in today's contexts are aware of the need for continuous self-improvement in the professional field and in terms of acquired digital competences. Engineers' readiness for professional activity is linked to their professional competence and can be seen as a reflexive focus on the profession, a willingness for professional and personal self-improvement, self-realization and self-development (Ломакина, Коржуев, 2010). It is this readiness for self-development of digital competences that is the problem which is explored in the article. It is also associated with the preparation of mobile, market-oriented professionals who are inclined to self-improve. The changes in the different fields of life and economy are constantly modifying the social requirement for the preparation of engineers in terms of content, forms of translation, ways of organizing the activity, advanced competencies for working in the digital environment. In these circumstances, the problem of prolonged education, which is being transformed into lifelong learning, is particularly relevant because of the desire of professionals to meet the 'standard of conformity' of the rapidly changing realities. In addition, in modern production, tasks are being solved, not by using templates, but by making use of innovatively and creatively. (Ломакина et al, 2011)

A person who has realized the need for self-improvement consciously and purposefully manages his development, guided by subjective goals and interests. In this sense, the continuous updating of digital competences is connected with the awareness of the personality, the understanding of the motives and results of the activity, of the future professional and career development. Self-development in each area can be defined as an intellectual, volitional emotional-moral process that intertwines and creates a complex image of self-improvement. (Селевко, 2008) At the level of self-esteem and self-determination, self-affirmation is related to the desire of the person to be the best in the profession, to be confident in his abilities, to achieve maximum results.

3 Study Design

In an earlier article, the author considered the conceptual and practical reasons for conducting the digital competency study among the FTT students (Ducheva et al, 2018).

In the same article, it is justified that during the development of the conceptual model of the study, the spectrum of the components of digital competences are reflected not only by the European documents but also by the needs and requirements of the labour market for the preparation of engineering personnel, new approaches, and paradigms in higher education and the views of the author. The overall study aims to determine the extent to which FTT training develops the digital competence of future engineers, what factors influence the development and attitudes to improve this type of competence.

The questionnaire is based on the European Digital Competence Reference Framework, the curricula of the various specialties and the digital competencies that it seeks to develop in them through its teaching in the Faculty. The questionnaire underwent adaptation and verification, selecting the correct specialized terminology, choosing the form and design of the questionnaire, which was conducted with the students online. The questions (15 in number) were conditionally divided into seven sections, with links. The article analyses the answers to the questions related to the students' plans for professional realization, their readiness to enter the labour market, as well as their attitudes towards developing their digital competences.

4 The Results and Discussion

The study at this stage was conducted with 285 students from 1-4 years of bachelor's degree, full-time and part-time education, as well as part of the students studying in master's programs of FTT. For the purpose of this study, only the results obtained from the bachelor degree will be analyzed. In this research the majority of respondents were male (68.42%), which is explained by the engineering focus of preparation. In data processing, the students were divided into groups depending on their belonging to a particular digital generation (McCrindle, 2006.). This is intended to test which digital generation has greater aspirations and ambitions to develop and enrich their digital competencies. The age composition of the surveyed students shows that more than half belong to Generation Y, with almost equal shares the representatives of generations X and Z and less than 1% are students of the baby boom generation. It can be said that the students are representatives of 4 generations, each of them having specific cultural and communication characteristics and attitude towards working in digital environment. Adapting to the digital, Generation X meets digital technology for the first time in its adolescence, and is often viewed as their consumer, but also as a bridge between the older and younger generations. The digital natives of the Y and Z generations live entirely in digital technologies, with them the transformation of communication processes and systems begins. Generation Z can be called multi-modal - it communicates with the involvement of different cognition channels, and this must be taken into account by both – lecturers and employers (McCrindle, 2006). The logical question is: adapters to digital technologies (X) or digital natives (Y and Z) are more likely and more readily would constantly updating their digital competences? The bigger part of the students study part-time (53.11%) , which explains the fact that the majority of the respondents are over the age of 23. and belong to Generations X and Y. This gives grounds to assume that students - respondents have the necessary social experience, most of them work and can judge what features must have in order to succeed in the labour market. It is supposed that they have already faced the need to continuously improve themselves, including to develop, their digital competences.

In order to understand the extent to which students have the attitude and need to develop their digital competencies, we asked the question "How well can you handle each of these tasks?". Based on the DigComp framework, activities were related to 5 domains: information and data literacy, communication and collaboration, digital content creation (we have taken into consideration the specifics of the preparation that students receive in different specialties), safety, problem solving. Respondents had the opportunity to choose 1 of the answers, namely: “I know how and I can to do it”, “I can learn how to do it”, and “I don't think I can do it”.

In the area of *information literacy*, most students appreciate that they know and can cope with finding information from the Internet. With almost equal result is the creation and editing of documents, followed by searching, finding and servicing files and directories on the computer. Most of the students, regardless of generation, have expressed the view that they would direct their efforts to learn how to create databases. This shows that future engineers are aware that the creation of databases and data warehouse is a perspective area, which is especially relevant today. They express their intention to make the effort and time to keep up with the innovations and to be successful in their professional realization.

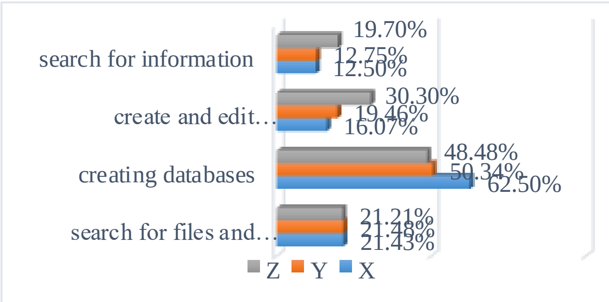

Fig. 1. Willingness of the students to improve digital competences in Information and data literacy

Undoubtedly, students successfully use the new information and communication technologies to interact and work together not only with students and lecturers, but also in the profession and for personal contacts. In their work with students, the majority of academic staff in the faculty not only create courses and tests in e-learning, but also set up group projects for them, where learners use chat, video-conferencing, etc. while observing netiquette. The fact that a considerable number of respondents stated that they could not add text, images and video to their online profile was a puzzler. However, almost half have stated their willingness to perfect their competencies for *communication and collaboration* when needed due to the continuous development of technology.

Regardless of their specialty and to which digital generation they belong, the majority of the students say that they successfully develop multimedia products (X - 57.14%, Y - 61.74% and Z - 72.73%). Although, in many subjects, lecturers assign to the students individual or group projects, the results of which they have to present in the form of a finished product as a presentation, there are also students who want to improve their skills *to create Digital content*, with the largest share are the X-Generation students. They probably account for the differences in their preparation and the preparation of their colleagues from younger generations, who have acquired basic knowledge in creating audio and video presentations in secondary education.

When presenting various products and preparing analyses, the use of tables and graphs is indisputably necessary. Therefore, students not only successfully accomplish this task, but would also learn new techniques and techniques for this purpose. Within this competency group, the majority of students focusing their attention on learning the latest about how to create and edit web pages, and write code and create macros. This can be explained by two complementary statements. On the one hand, students recognize that every company that wants to market itself and claim its presence in the public domain must have a

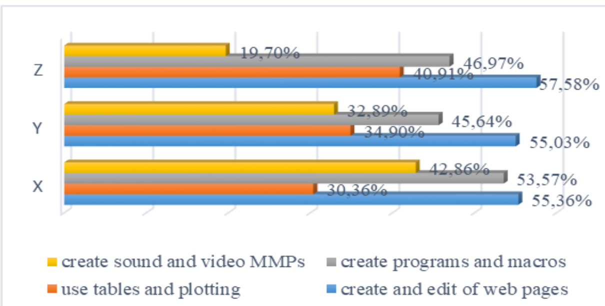

Fig. 2. Willingness of students to develop their digital competences in content creation

website that is constantly renewed and updated. On the other hand, mostly students in the Automation and Computer Systems major study subjects that give them the necessary preparation to cope with these tasks. Due to the specifics of their preparation, students from other specialties in the faculty may study these subjects as electives. This indicates that when updating curricula it have to take into account the need and willingness of the students to develop their digital competences in the field of programming and be more competitive in the labour market.

In the area of *safety*, most of the students are prepared to protect their devices and data from intrusion. At the same time, approximately one-third of the students from all generations realize that in order to keep up with new opportunities to prevent various attacks by detractors, they need to constantly update their skills.

Problem solving

In the group of *problem solving competencies*, they are conditionally divided into: solving technical problems, using digital technologies creatively and identifying gaps in digital competencies. When solving technical problems, such as changing the parameters of a computer in order to improve its performance or troubleshoot and set up a computer network, The shares of students who say they know how to handle this task are almost equal to those, who would learn to do it when needed. With regard to the second subgroup, as students are trained in engineering majors, they study technical documentation and, depending on the specialty, receive basic skills in working with AutoCad, SolidWorks, MS Visio or more. Nevertheless, they would enrich their digital competencies to work with other programs and digital technologies to create and edit drawings and design of fabrics and clothing, depending on their needs in the profession. In terms of identifying gaps in digital competencies, we can assume that students actually evaluate their competencies and clearly state in which directions they would improve.

5 Conclusions

From the research and analysis, the following trend can be outlined:

In the area of Information and data literacy, Communication and collaboration and Safety, students feel confident in their competencies and confidently say that they can cope with the tasks assigned in these areas. An exception is the creation of databases - to acquire such competencies would be directed their self-preparation, since they realize that they have not received sufficient training in this field (this is especially true for Generation X).

In the other 2 areas - Digital content creation and Problem solving regardless of generation, students would strive continuously to develop their competences and they are confident that can learn to cope independently after self-study.

This research has once again proved that digital competence is both a requirement and a right of citizens, and in particular of engineering personnel, to be able to integrate into today's society and be successful in the profession. Students from FTT realize that in order to keep pace with technological change, they must be prepared to constantly improve their digital competences in various fields.

Taking into account the guidelines in European Union policies and labour market requirements, the Faculty analyses the repertoire of competences that students acquire and defines the learning objectives, ensuring integration of technology into the learning process. In the development and updating of curricula, the efforts of the academic staff are aimed at improving the digital competences and lifelong learning of future engineers in order to meet the employers' requirements for the preparation of the workforce.

References

Arntz, M., T. Gregory and U. Zierahn (2016), "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis", OECD Social, Employment and Migration Working Papers, No. 189, OECD Publishing, Paris. http://dx.doi.org/10.1787/5jlz9h56dvq7-en

Bawden, D. (2001). Information and digital literacies: a review of concepts. *Journal of documentation*, 57(2), pp. 218–259.

He D., Guo M., Zhou J., Guo V., (2018). The Impact of Artificial Intelligence (AI) on the Financial Job Market., Boston Consulting Group, http://image-src.bcg.com/Images/BCG-CDRF-The-Impact-of-AI-on-the-Financial-Job-Market_Mar%202018_ENG_tcm9-187843.pdf (accesed 2019)

Cedefop (2016). Digitalisation and Digital Skill Gaps in the EU Workforce. http://www.cedefop.europa.eu/files/esj_insight_9_digital_skills_final.pdf (accesed 2019)

Ducheva Zl., Nedeva V., From ICT Skills to Digital Competence for Academic Needs in Trakia University – Stara Zagora, In *International Conference on Technics, Technologies and Education,* Faculty of Technics and Technology - Yambol 2018, https://sites.google.com/a/trakia-uni.bg/ictte-2018/http://uni-sz.bg/truni5/wp-content/uploads/ftt/file/ICCTE%202018.pdf

Frey C.B., Osborne M.A. (2017). The Future Of Employment: How Susceptible are Jobs to Computerisation?, *Technological Forecasting and Social Change*. 2017. No. 114., https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

Gartner (2018). 4 Steps to Develop Digital Dexterity in Your Workplace. https://www.gartner.com/binaries/content/assets/events/keywords/digital-workplace/pcce13/4_steps-infographics-3.pdf (accesed 2019)

Global Education Futures Report (2018). Образование для сложного общества. https://drive.google.com/file/d/0B9ZvF6mQ5FMbSTFKVmhodU5rNTNiTXpUZ2QwZktiR0pzSmJR/view (accesed 2019)

McCrindle M., *Word Up: A lexicon of Generations Y & Z: A guide to communicating with them.* Baulkham Hills Business Centre, (accesed 2019) http://www.libraries.vic.gov.au/downloads/Public_Libraries_Unit/newgenerationsatwork.pdf

McKinsey (2017a). *A Future That Works: Automation, Employment and Productivity*. https://www.mckinsey.com/~/media/mckinsey/featured%20insights/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works-Executive-summary.ashx (accesed 2019)

McKinsey (2017b). *Jobs Lost, Jobs Gained: What the Future of Work Will Mean for Jobs, Skills, and Wages*. https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages (accesed 2019)

McKinsey (2018). *Notes from the AI frontier: Modeling the Impact of AI on the World Economy.* https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/Notes%20from%20the%20frontier%20Modeling%20the%20impact%20of%20AI%20on%20the%20world%20economy/MGI-Notes-from-the-AI-frontier-Modelingthe-impact-of-AI-on-the-world-economy-September-2018.ashx (accesed 2019)

OECD (2016). Skills for a Digital World. http://www.oecd.org/els/emp/Skillsfor-a-Digital-World.pdf (accesed 2019)

Seriously Cool. Marketing and communicating with diverse generations.Australia: The ABC of XYZ, 2007, p. 20. Available from: https://www.slideshare.net/markmccrindle/seriously-cool-marketing-and-communicating-with-diverse-generations (accessed August 2019)

Ломакина Т. Ю., Коржуев А. В.,Современные подходы к самообразованию педагога, *Образование через всю жизнь: непрерывное образование в интересах устойчивого развития* (2010), https://cyberleninka.ru/article/n/sovremennye-podhody-k-samoobrazovaniyu-pedagoga

Селевко Г. К. (2008) *Энциклопедия образовательных технологий.* В 2 т. Т. 1. livelib.ru: https://www.livelib.ru/author/17848/top-g-k-selevko

The Use of MOODLE in the Discipline “Chemistry of Natural Compounds”

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Abstract

The course in the subject "Chemistry of Natural Compounds" is aimed at acquainting the students of Food Technology at the Faculty of Technics and Technology – Yambol, Bulgaria with the main classes of natural organic compounds. The four short thematic blocks aim to pass on the basic knowledge needed to work with regular expressions. The texts are brief because, on the one hand, it is a demonstration course, and on the other hand, in asynchronous learning, the attention of students is difficult to focus on a topic for a longer time. For this reason, the division of content into four short modules was chosen as the most appropriate, followed by a knowledge test. The course on "Chemistry of Natural Compounds" can be used both separately and as a complement to lectures and exercises.

Keywords: Mobile phone camera, essential oils, extracts, white oregano, color measurement

1 Introduction

Information is an essential part of knowledge and information technology enables us to be systematized, stored, processed and used while maintaining its attractiveness. Knowledge is seen as a strategic resource in the information society, and learning as a strategic process(Sandeva et al., 2018).

Today people are different, they have direct access to digital technologies in every aspect of their lives and it is quite natural that this has a huge impact on their behavior and their way of thinking. As far as the education system is concerned, new technologies provide much more opportunities and, at the same time, much more challenges for teachers are increasing.

Web-based training and its synonym, "e-learning", are among the most frequently mentioned words in academic circles in recent years. These concepts are associated with new training methods that are supposedly more effective than traditional ones and allow learners the freedom to decide when, where, and at what pace to study(Shivacheva et al., 2016; Dineva et al., 2018).

The term e-learning, which has become widely popular with its English version of e-learning, refers to interactive learning that uses computers or communication technologies as a means of teaching. This is not just about replacing a teacher with a computer: electronic technologies are intertwined throughout the learning process - in the preparation, presentation of information and knowledge verification. However, the lecturer remains the leading figure that structures and prepares learning content. The idea of e-learning is not to supplant live contact but to be combined with other teaching methods to increase the efficiency of the learning process.

E-learning environments (ELEs) are an entirely type of technology in education. In general, they provide a set of teaching and learning tools designed to support the learning process through the use of computers and the Internet. These environments are available online and rely on internet technologies for their existence(Nedeva et al., 2013; Zlatev, 2016). The basic principles on which each ELE is based are:

- Transfer the curriculum into thematic blocks in the learning environment;
- Supporting online learning by providing access to different learning resources, targeting students and evaluating results;

- Track the activities of students in the online system;
- Help from the lecturer;
- Help from other learners;
- Active communication between participants.

Moodle is an open source e-learning environment that is quite similar to the core commercial products. Moodle is a software package for developing Internet-based education courses and websites. This is an evolving project that supports the idea of a transition to learning based on the theory of social constructivism. This theory refers to the idea that one is actively constructing knowledge through his environment so far, rather than accepting it simply by listening and reading(Stoykova, 2014; Dimitrova, 2018).

The aim of the present work is to develop a course on Natural Compound Chemistry using the tools of MOODLE.

2 Exposure

The course in the subject "Chemistry of Natural Compounds" is aimed at acquainting the students of Food Technology at the Faculty of Technics and Technology - Yambol, Bulgaria with the main classes of natural organic compounds. At the beginning of the course, as shown in Figure 1, a link to a forum, course annotation, video conference connection was introduced.

Natural organic compounds are main components of the diet: proteins, carbohydrates, lipids, dyes, vitamins, nucleic acids and others.

The knowledge of chemistry and the structure of natural compounds are important for students of Food Technology for the following reasons:

- They are acquainted with the structure and properties of the main structural units of nutrients such as: amino acids - proteins, carbohydrates, fatty acids, etc .;
- The basic chemical and biochemical laws that occur during the technological processing of the raw materials and their storage are studied;
- Basic chemical methods for modifications in the production of certain food products and their preparation for analysis are explained.

Unlike many other e-learning environments, Moodle has a solid pedagogical rationale behind it. Here, he relies heavily on the theory of social constructivism and contains several basic concepts:

- Constructivism: people actively construct new knowledge in the process of communicating with the environment. Everything we read, we see, we hear, and we feel is comparing with our previous knowledge to form new ones. Knowledge is strengthened if it is used successfully in a broader social context. Man is not just an empty vessel where passively accumulate knowledge; they can not be transmitted simply by reading or listening;
- Constructivism: learning is particularly effective when constructing something that others can experience. For example, you can read this page several times and forget it, but when you try to explain it to someone with your own words, you will understand the content much better. That's why people keep notes on lectures even then never read them;
- Social constructivism: translates the above-mentioned ideas into a social context, into a social group where a small group of people create a common culture with common artifacts and common meanings. When immersed in such an atmosphere, one learns all the time how to be part of this culture.

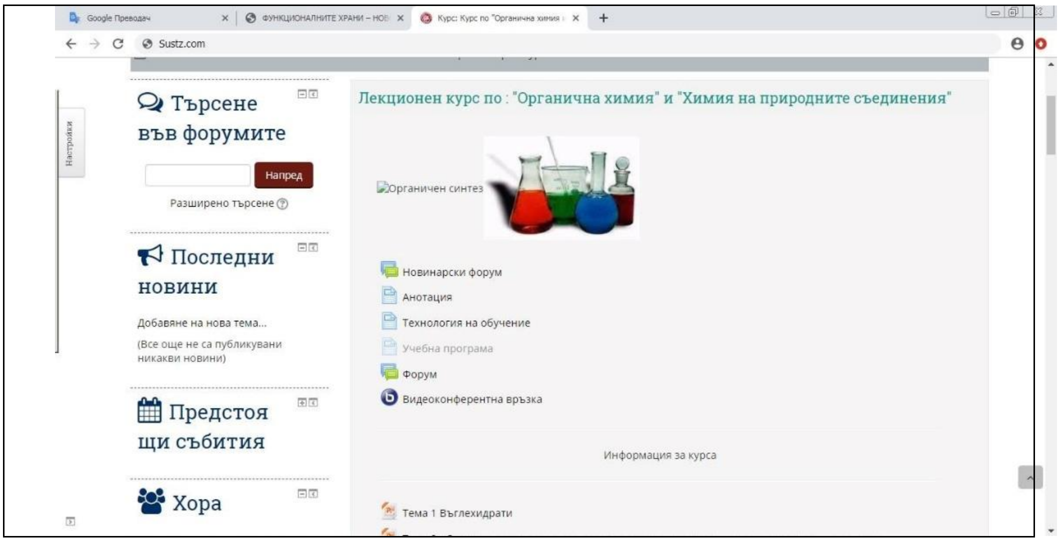

Figure 1. Introduction part of the course “Chemistry of Natural Compounds”

In terms of pedagogical orientation, the exemplary course "Processing of textual information with regular expressions" is divided into two parts:

Lesson content: The four short thematic blocks (Figure 2) aim to summarize the basic knowledge needed to work with regular expressions. The texts are brief because, on the one hand, it is a demonstration course, and on the other hand, in asynchronous learning, the attention of students is difficult to focus on a topic for a longer time. For this reason, the division of content into four short modules was chosen as the most appropriate, followed by a knowledge test.

The reading and understanding of the information in the modules is sufficient to solve the test and to use real text processing programs.

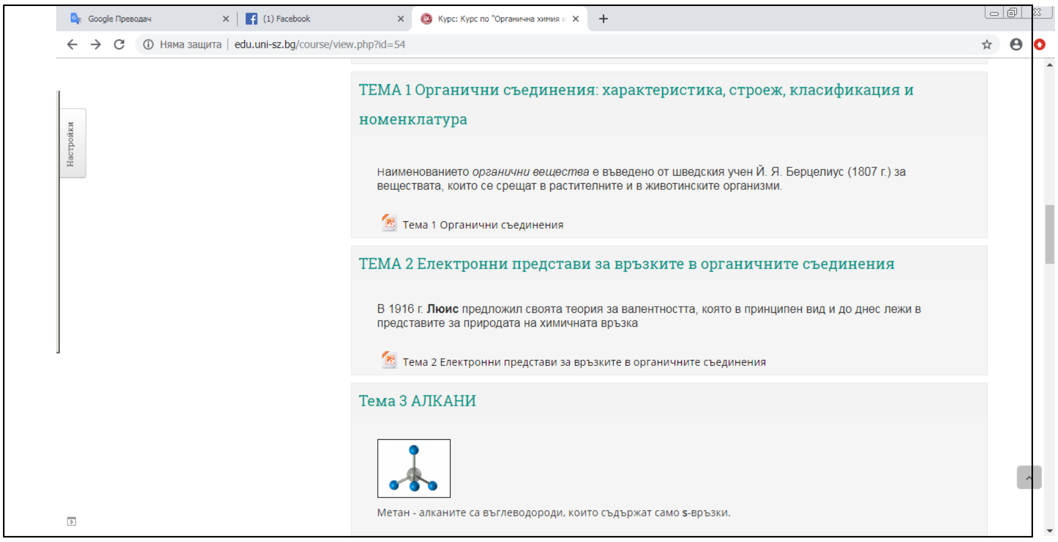

*Figure 2.*Content of the course “Chemistry of Natural Compounds”

Test and additional resources: The test aims to verify through actual examples (other than those considered in the modules) the level of utilization of the presented information. As well as the information in the lesson, the test is short and aims at quick, but comprehensive knowledge checking, and logical thinking is required to solve some tasks. The main purpose of the test is to be pleasant and non-stressing. Successful resolution also implies the practical use of any of the provided word processing programs with regular expressions.

The course develops maximum transparency - the latest site changes as well as registered users are clearly visible to everyone. Students have the maximum system permissions for reading, editing and writing (on forums) on the site. This concept is particularly important for creating a sense of community that is neglected in many other learning environments. The ability to express your own opinion and to communicate with other learners, whether they are teachers, students or administrators, is Moodle's basic concept.

However, it needs to be made clear that the creation of fully web-based training courses is still very complicated, not as technical as the infrastructure.

Currently, most of the resources in e-learning environments are used by students as a supplement to regular classes. This, in itself, is a bad practice, because it does not lose living contact with teachers and fellow students. This is, in fact, the mixed learning model where regular lectures are combined with web-based courses.

3 Conclusion

This is the idea of creating a Moodle course - developing a course that can be used on its own and as a complement to lectures and exercises. The truth is that neither Moodle nor most of the commercial systems are fully tailored to create and maintain a training course to be visited online.

In addition to the regular curriculum, Moodle certainly has a lot to offer. Its main features are that it is free, easy to adapt, as it is open source, it is already localized in Bulgarian and is easy to install and maintain. Indeed, it is not intended to manage a full faculty or university, but a bachelor or master level program can be used very successfully both to develop fully web-based courses and blended learning to complement regular lectures and exercises.

References

Dimitrova, T. (2018): *The Role of Information and Communication Technologies in Music Education to Boost the Motivation for Learning Romani Children*. Thesis, Sofia University “St. Kliment Ohridski”, Department for Information and Teacher improvement. (in Bulgarian)

Dineva, S., Nedeva, V., Ducheva, Z. (2018): Improving the quality of study assessment. Proceedings of the *13th International conference on virtual learning* (ICVL), 106-111.

Nedeva, V., Dineva, S., (2013): Design and development of efficient e-learning courses. Proceedings of the 11th International conference on virtual learning (ICVL), Romania, 108-115.

Sandeva, V., Despot, K., Zlatev, Z. (2018): Education influence of artistic elements and principles on the street network. Proceedings of the *13th International conference on virtual learning* (ICVL), 119-123.

Shivacheva, G., Nedeva, V. (2016): Methods for Teaching Programming Using Virtual Laboratory. Proceedings of the *11th International conference on virtual learning* (ICVL), 92-98.

Stoykova, V. (2014): Evaluation of the application of interactive presentation systems in higher education. *Applied Researches in Technics, Technologies and Education(ARTTE)*, 2, 3, 286-300.

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. Proceedings of 11th International Conference on Virtual Learning 2016 (ICVL), 209-213.

Improve critical thinking skills for students of FTT – Yambol

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Abstract

Critical thinking is an important skill, especially in the digital century, when a huge amount of information bomb the young, every day, through the web net. The aim of the paper is to describe and introduce the main qualities of critical thinking. We present also how the abilities of well-developed VLE help for the successful growth of students. The good practices that we use to boost critical thinking are discussed. We try to develop critical thinking and logical reasoning skills. These are our main goals in teaching programming. Programming is a complex process where the programmer very often uses most of their time to planning the individual pieces that will come together to make the system works. In the paper, we analyze different strategies that we apply to improve critical thinking: training strategies; strategies for ongoing knowledge testing; evaluation strategies. Each of these aims to develop critical thinking along with mastering programming languages. Implemented strategies in programming training produce positive results, allowing students to grow professionally.

Keywords: e-learning, critical thinking, good practices

1 Introduction

Programming training is part of the curriculum of most of the specialties at Faculty of Technics and Technologies (FTT) - Yambol. Professional programming skills require a variety of skills, including critical thinking is the greatest assets. Critical thinking training is not like learning a programming language. Instead, critical thinking is a soft skill that is cultivated over time, not just by learning about concepts and listening to lessons. Learning to develop critical thinking and logical reasoning skills are our main goals in teaching programming. Programming is an enough complex process where the programmer very often uses most of their time to planning out the individual pieces that will come together to make the system works.

Thinking critically comprise many traits, but one of the most important quality is thinking independently, which is much more of just thinking clearly or rationally (Wabisabi Learning, 2019). Critical thinking is the ability to analyze and evaluate information (Duron et al, 2006). In the last decade, more and more students are conducting academic research on-line, so for them, it is essential to have well developed critical thinking (Browne *et al*, 2000).

We need then an "ability to analyze and evaluate information", to "raise vital questions and problems, formulate them clearly, gather and assess relevant information, use abstract ideas, think open-mindedly, and communicate effectively with others" (Duron, Limbach, & Waugh, 2006, p. 160).

The aim of the paper is to present the abilities of well-developed VLE of Trakia University – Stara Zagora (http://edu.uni-sz.bg/?lang=en) and the good practices for strategies that are applied for successful development of critical thinking of learners.

2 The base of critical thinking

The critical thinking skill is crucial for the decision-making process and for gaining constructive results, the reason is hidden its nature (fig.1).

Figure 1. The stages of the decision making process of critical thinkers

People who think critically are classified as instinctual problem solvers (Skills You Need, 2017). The important peculiarity of a critical thinking is to clarify the goals and then to start decision making process, based on a different possibilities. On the fig.1 are summarized the main stages of a decision making process, when the critical thinking is applied (Skills You Need, 2017). When receive information to ask yourself: "*Who said it?*" – is it matter to you; did you know that person; is it person in a position of authority or power. The next question that will follow: "*What did they say?*" – is it all the facts or opinions and what they left out. After that to clarify "*Where did they say it?*" - in a public or in private place; is the other people have the same chance to respond and provide an alternative account to. The important question is: "*When did they say it?*" - before, during, or after an important event. "*Why did they say it?*" – to see the reasoning behind their opinion; may be trying to make someone look good or bad. And last but not least: "*How did they say it?*" - happy or sad, angry or indifferent; write it or say it; could you understand what was said.

The characteristics typical for critical thinkers included (Skills You Need, 2017):

- ✓ *Curiosity* – the critical thinkers are lifelong learners, which have broad interests and curiosity about the world and people, with a philosophical understanding and appreciation for a diversity of cultures, beliefs, and opinions of a great critical thinkers.
- ✓ *Compassion* – that means no judgment and segregation during a decision making process, combining an emotional, instinctual and intellectual sides of the action.
- ✓ *Awareness* – the critical thinkers desire constructive outcomes by not accepting anything at face value, appreciating facts hiding in everything, asking questions (fig.1), and exploring all sides of an issue.
- ✓ *Decisiveness* - directly linked to the quick and decisive action, instead of not making any decision at all; to move things forward rather than backward or postponing; thinking critically means to weigh all options, put aside fear and making decisions with confidence, even when the information is not all that are need it.
- ✓ *Honesty* - resides at the core in any sense, and it is very important especially for critical thinking. Moral integrity, ethical consideration, global citizenship practices, a strong desire for harmony and fulfilment are all part of effective critical thinking. Critical thinkers are aware, accepting of themselves as they are of others.

- ✓ *Willingness* - open-mindedly, constantly improving, learning from their own personal mistakes and shortcomings, and excelling; challenging the status-quo when the need arises; listening actively rather than simply waiting for their turn to talk;
- ✓ *Creativity* - effective critical thinkers are also largely creative thinkers, usually in the collaborative modern workforce. Creativity has indisputably defined itself as a requisite skill for having. For instance, get creative with products and how they are advertised, means thrive in the global marketplace.
- ✓ *Perseverance* - staying on task, not give up until a solution is formulated, a process is determined, or a decision is reached; critical thinkers tend to model by default; an especially useful quality not only to have but to be able to encourage in a team-working environment.
- ✓ *Objectivity* – not to be affected by external or internal influences, such as burst of emotions; base on the facts that included all points of view and concern; to appears mature and rational; full acceptance and consideration of possibilities;
- ✓ *Reflective capacity* - a critical thinkers accepted their mistakes, learn, internalize, and move on to the next challenge.

The person with well-developed critical thinking easy understand links between ideas, appraise arguments, identify errors and irregularities, determine the importance and relevance of arguments, approach problems (Skills You Need, 2017).

3 Good teaching practices to encourage critical thinking

Good teaching practices are summarized and explains in a 5-step process for boosting critical thinking (Agoos 2019; fig.2). On the first stage – *formulate question.* After knowing for what you are looking for – *gather information.* Check the reliability of information – *apply the information*. Hence, followed comparing of your point of view with the other or – *explore other points of view.* On the end of that process comes – *consider the implications (*fig.2*).*

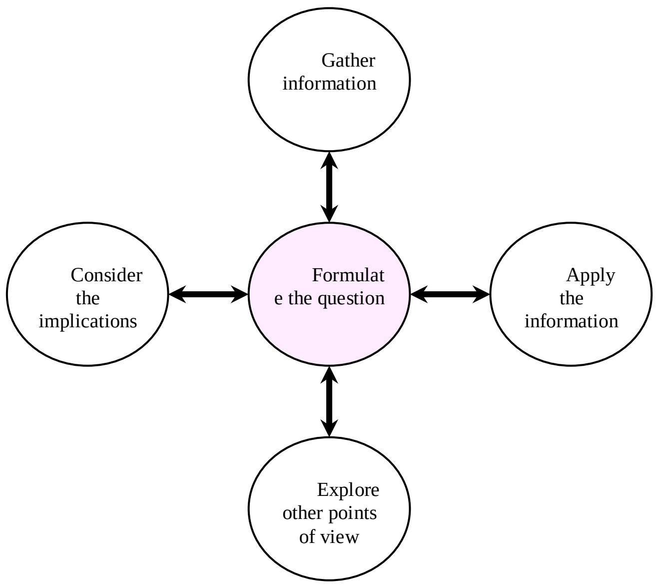

Figure 2. Boosting critical thinking (Agoos, 2019)

Another lessons model for enhance critical thinking, also in 5-step framework is given on fig.3. The process can be applied in almost any teaching or training situation, and effectively move learners toward critical thinking (Duron *et al*, 2006).

The 12 solid strategies, discussed on the blog web page of Wabisabi Learning (2019), for teaching critical thinking skills are:

- *Begin with a question* - it should be a quest for knowledge and problem-solving; encourage brainstorming; have an open discussions with students; write down possible answers on a chalkboard or student answers;
- *Create a foundation* – no one can think critically without proper information. So related data which ensures that recall facts pertinent to the topic at the beginning of any lesson. These may stem from things like: *reading assignments and other homework; previous lessons or exercises; a video or text;*
- *Consult the classics* – the classical information is always the most reliable and the best basis to launch for exploring great thinking.
- *Creating a country* - maybe a tremendous project-based learning scenario about learning. In the process, students can learn history, geography, politics, and more.
- *Use information fluency* - mastering proper information is crucial, it's about how to dig through knowledge to catch the most useful and suitable facts for solving a problem.
- *Utilize peer groups* - digital natives thrive in environments involving teamwork and collaboration, their peers are an excellent source of information, questions, and problem-solving techniques.

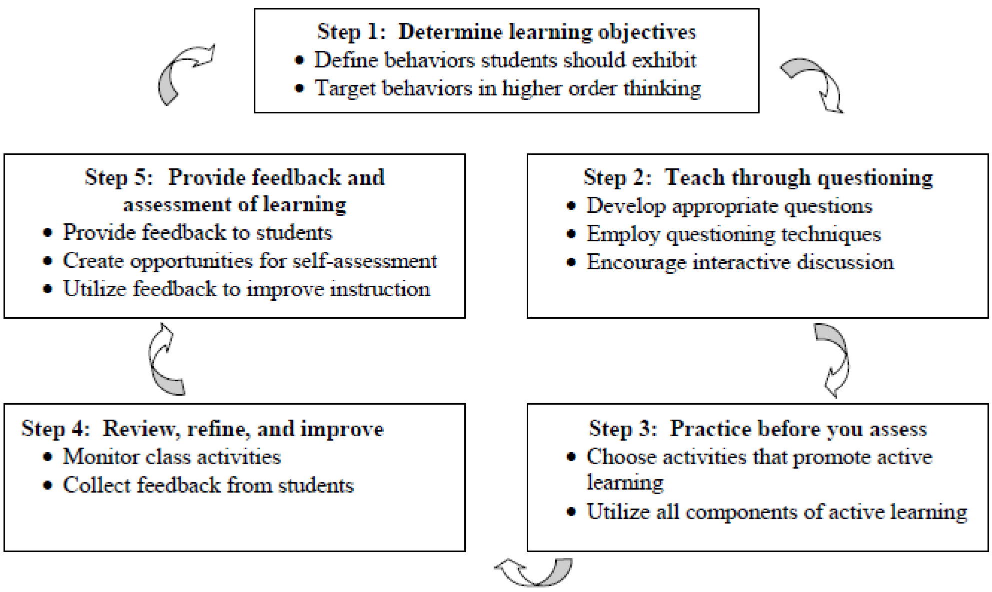

Figure 3. 5-step model to move students toward critical thinking

- *Try one sentence* – that is exercise: form groups of 8-10 students, instruct each student to write one sentence shapes a topic on a piece of paper. The student then passes the paper to the next student who adds their understanding of the next step in a single sentence. So, students learn to apply their knowledge and logic to explaining themselves as clearly as possible.

- *Problem-solving* – specifying a precise problem is the best path for exercise critical thinking. Leave the goal or “answer” open-ended for the broadest possible approach. This is the essence of asking essential questions requiring the discovery and synthesis of knowledge through critical thinking.
- *Return to role playing* - Role-playing has always been an excellent method for exercising critical thinking. It’s why actors do tireless research for their roles as it involves inhabiting another persona and its characteristics. Becoming someone else calls upon stretching both your analytical and creative mind. Pair students up and have them research a conflict involving an interaction between two famous historical figures. Then lead them to decide which character they each choose to play. They’ll each have different points of view in this conflict. Have them discuss it until they can mutually explain the other’s point of view. Their final challenge will be to each suggest a compromise.
- *Speaking with sketch* - it is challenging to communicate without words and very effectively especially for visual learners. Nevertheless, converting thoughts to picture inspires critical thinking and manage learners to think using a different mental skill set.
- *Prioritize it* - every subject offers opportunities for critical thinking, and should be apply always in your lessons; check to understand and discusse; accept the critical thinking as a culture rather than just an activity.
- *Change misconceptions* - critical thinking involves concentration and intensive work. Apart from correcting errors or assumptions, offer more vibrant lessons, more in-depth investigation, and better lifelong learning.

4 Developing critical thinking in FTT-Yambol

Students of FTT-Yambol have opportunity to demonstrate novel scientific information on the different topics, as well as to take course project or chore. Usually, a topic is chosen from the beginning of the semester and cover the subject area of study. After their performance, in front of auditory, usually followed a discussion, and on the end assessment from their classmates. During that discussions students learn how to present and defend their opinion, appreciating other viewpoints. Active learning makes the course more enjoyable and most importantly cause students to think critically (Duron *et al*, 2006).

Another way of developing that skill is including the students in scientific projects also. As a part of scientific projects, students learn to measure, obtain data, analyze and extrapolate the results. As a crucial part of critical thinking is the confidence to analyse, see the connections between ideas, appreciating other viewpoints and opinions (Wabisabi Learning, 2019).

During programming training, we apply different strategies to improve critical thinking: training strategies; strategies for ongoing knowledge testing; evaluation strategies. Each of these aims to develop critical thinking along with mastering programming languages.

Training strategies. The purpose of training strategies is to engage students in active learning, not to be taught only mechanically to memorize the material taught. The basic theoretical concepts in the field of programming are an exception. They have the opportunity to ask their questions during the lectures. The teacher, in turn, asks questions that arouse their attention and engages their thinking, incl. stimulating critical thinking. Students should not take the learning material for granted, but should consciously participate in the training. To this end, the Flipped Classroom approach is also applied. The major design principles of this flipped instructional approach were: self- and co-regulated, recorded small-group discussions without the presence of the instructor; flipped role of the instructor and students; and the use of video-chat technology, video camera, and Dropbox, to enable learning. This particular instructor experimented with radical student-directed learning with the instructor absent. Students were given prompts and role-playing scenarios that guided the small-group discussions, which students then had to edit and record for the instructor [M. Jenkins, R.Bokosmaty, 2017].

A strategy for ongoing knowledge testing. The purpose of these strategies is to encourage critical thinking by questioning the process of thinking through effective techniques for preparing questions or guiding the process of thinking.

Tests with questions that require not only memorization but also the application of critical thinking skills. In this case, they are required to read the program code and answer correctly and precisely what the result would be if the compiler were executed. “An automated method is proposed to increase the number of questions in the bank by creating a plugin in the Moodle” by our colleagues. This plugin “has been developed to create a new type of test questions called Multiple Choice Multivariant Questions. By using it, an automatic increase in the total number of questions in the bank is achieved. The goal is to reduce some students' attempts to mechanically memorize questions and correct answers, and to hinder the use of unregulated help materials” [Pehlivanova, T. I., Kanchev, K.T., 2018a, 2018b].

Discuss the questions for which there are at least the correct answers and propose a new wording of the questions when testing this Quiz. This is an approach that aims to stimulate critical thinking and activate creative thinking to refresh questions that more than 90% of students have not answered.

Programming questions, part of a programming task. The newest type of questions we apply in programming training require code to be written directly into the browser, among which it is executed on a sandbox server and the student receives points. Under the "All or nothing" option, they are not eligible for a second attempt. There is an option that takes 10% to 20% or more of the points on the subject when performing multiple attempts. Tests can also be solved in adaptive mode, in which feedback is displayed if the answer is incorrect. The code verification is prepared by the case test teacher with case test inputs and outputs, some of which are visible to students, but there are others that are hidden. These types of questions are called the CodeRunner type and are provided in the Moodle virtual learning environment by installing the CodeRunner plugin.

Evaluation strategies. We apply peer-reviewing in specific disciplines. Assessing the work of their colleagues as well as participating in team projects also greatly enhances students' critical thinking skills. This is practiced in the subject of Multimedia for Web-Based E-Learning, where students design their own site and work on a specific topic collectively as activities in the virtual learning environment: audio, video, animation, vocabulary and others.

But knowing the learning goals is not enough when assessing for learning. Students must be aware also of the criteria for assessment, the standards they are aiming for. That means that apart for knowing the expected behaviors they should recognize the expected level of achievement of performance. As a result of this students become more autonomous and capable of assessing themselves or/and even other students (Fink, 2003; Hernández, 2010).

5 Conclusions

Students effectively involved in the learning process, by cooperation in the projects, seminar discussions, course assignment or presentations develop proper self-assessment, confidence, and critical thinking. Implemented strategies in programming training produce positive results, allowing students to grow professionally. The acquired skills are useful not only in their direct activity but also in real life. Critical thinking enables them to screen out false news and not spread it. They might consider trusting the high popularity of some individuals, even politically active ones when they have little evidence of their qualities. Possessing critical thinking, students can sift through scientific and pseudo-scientific facts.

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6 References

Journal Articles:

Browne M. N., K. E. Freeman, and Carrie L. 2000. Williamson. The importance of critical thinking for student use of the internet. https://go.galegroup.com/ps/ anonymous?id=GALE%7CA66760560&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=01463934&p=AONE&sw=w

Duron R., B. Limbach and W. Waugh, 2006. Critical Thinking Framework for Any Discipline. International Journal of Teaching and Learning in Higher Education. ISSN 1812-9129. http://www.isetl.org/ijtlhe/ 2006, Volume 17, Number 2, 160-166.

Pehlivanova, T. I. and Kanchev, K.T. (2018a) Number of questions for creating online quizzes, Applied Researches in Technics, Technologies and Education 7, 1, 58-63

Conference Proceedings:

M. Jenkins, R.Bokosmaty, M.Brown, C.Browne, Q.Gao, J.Hanson, and K.Kupatadze, K., Enhancing the design and analysis of flipped learning strategies. Teaching & Learning Inquiry, 5(1), pp.1-12, 2017.

Pehlivanova, T. I. and Kanchev, K.T. (2018b): Plugin for creating a new type of questions in moodle. In Proceedings of The 5th International Conference on Technics, Technologies and Education, Trakia University, Stara Zagora, Faculty of Engineering and Technologies, Yambol, 179-186

Internet Sources:

Agoos S., 2019. 5 tips to improve your critical thinking - https://ed.ted.com/lessons/5-tips-to-improve-your-critical-thinking-samantha-agoos 2019

SkillsYou Need (2017) https://www.skillsyouneed.com/ips/barriers-communication.html

Wabisabi Learning (2019) 12 solid strategies for teaching critical thinking skills https://www.wabisabilearning.com/blog/teaching-critical-thinking-skills May 06, 2019

Watanabe-Crockett L., 2019. The one critical thinking and problem solving process everyone needs. https://www.wabisabilearning.com/blog/critical-thinking-problem-solving-process April 10, 2019

Technical Reports:

Fink, L. (2003). A self-directed guide to designing courses for significant learning. University of Oklahoma, 1-35.

Application of Color Analysis in Bread-Technology Training

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Abstract

The work suggested the use of a scanner as a technical presentation and measurement learning tool. The advantage of using a scanner for color measurement compared to a document camera is supported by an analysis of the similarity of colors obtained with a standard colorimeter. The scanner can be used when conducting classroom exercises in bread and bakery technology. Using the proposed equipment can be solved pedagogical tasks related to the integration of knowledge from the field of technical sciences and information technologies, as well as the formation of research skills for work with measuring equipment.

Keywords: Bread technologies, Cookies, Color analysis

1 Introduction

The properties of bread and bakery products depend on the quality of the raw materials as well as on the proper conduct of the individual stages of the technological process and on the purposeful use of additives of different origins which influence their properties and quality (Chonova et al., 2012).

Among the indicators of quality, the color is of special importance because it is viewed with great criticism by consumers. Among other indicators such as shape, size, general appearance, color is often a criterion when choosing a product, whether it is accepted or rejected (Papadakis et al., 2000; Kumar, 2017; Zlatev et al., 2019).

Apart from improving the technology and improving and preserving the quality of bread and bakery products, modern scientific research is related to increasing their biological value by including biologically active substances that reduce their energy value and give them healing, prophylactic and dietary properties (Stankova et al., 2018).

Laboratory analyzes of grain, bread and bakery products, such as ash content, fat content, sugars, are included in bakery technology curriculum at Razgrad Branch, Rousse University, Bulgaria. In addition to these analyzes, the color of the bread and bakery products is also measured. The measurement is realized with a specialized colorimeter. The disadvantage of this method of measurement is that only partial data are obtained on the surface of the product.

In recent years, there has been interest in the use of interactive learning tools such as document cameras (Dineva et al., 2011; Baycheva et al., 2016) in the analysis of food products. A common disadvantage when using a document camera is the impact of side lighting on the quality of the image you receive. Scanners have an advantage over them that they are less affected by side light. They can be used in the analysis of surface characteristics of sliced bread and biscuits (Bosakova-Ardenska et al., 2018; Nakov et al., 2018).

The purpose of the report is to investigate the potential for using a scanner to determine the color of bakery products that can be used for education.

2 Material and methods

An analysis of the possibility to measure the color of cookies using a scanner has been done.Cookies were produced according to AACC Approved Method 10-50D (AACC

10-50D) prepared in a laboratory at the University of Ruse “Angel Kanchev” – branch Razgrad (Bulgaria). from composite flours containing plain white and einkorn flour in ratios S1-100:0, S2-70:30, S3-50:50, S4-30:70 and S5-0:100 respectively.

Cookies images are obtained with scanning device EPSON Perfection® V500 Photo (Epson America, Inc.).

Colorimetric measurements are made withChroma Meter CR-400 (Konica Minolta, Tokyo, Japan).

Figure 1 represents general view of the cookies obtained.

a) S1 b) S2 c) S3 d) S4 e) S5

Figure 1. Cookies with einkorn – general view

The components of the RGB color model (RGB [0255]) were converted to Lab (L [0 100], and [-86,18 98,23], b [-107,86 94,47]) using the online Convert Rgb to Lab conversion tool (colormine.org). The chroma (C) and hue (h) values of the LCh color model (Sawaya, 2019) are defined by:

[1] $$C = \sqrt{a + b} h^o = atan\left(\frac{b}{a}\right)$$

YI-index of the yellow and white WI index were determined according to the method of Ghodke et al. (2007):

[2] $$YI = \frac{142,86b}{L} \qquad WI = 100 - \sqrt{(100 - L)^2 + a^2 + b^2}$$

The yellow and white indices are defined in the standard (ASTM E313). The Yellow Index (YI) is a value determined by colorimetric or spectrophotometric product data that describes the color change of the sample from transparent or white to yellow. This test is most commonly used to assess product color changes caused by real or simulated external influences.

Measurements are made in three replicates. Data is processed at a level of significance α = 0,05. The data are presented by descriptive statistics (DS), their mean values, standard deviation (SD) and coefficient of variation (CV).

The comparison for the similarity of the color components and indexes is done by three criteria - correlation, level of significance (calculated in MS Excel spreadsheet software) and Fischer distance.

Fisher discriminant ratio (FDR) is determined by:

[3] $$d_{st} = \frac{(\bar{x} - \bar{y})^2}{{SD_x}^2 + {SD_y}^2}$$

3 Results and discussion

An analysis of the measurements of cookies with a colorimeter and those obtained from color digital images from a scanner is made. The results obtained are compared with three methods for detecting color similarity. It is proposed to use the results obtained for the realization of contemporary pedagogical goals and tasks in the field of technology training of bakery products.

Table 1 gives results of measuring the color of cookies with a colorimeter.

Table 1. Color components and indexes of cookies by colorimeter data

Sample	Color / DS	L	a	b	C	h, rad	YI	WI
S1	mean	68,30	-2,70	18,90	4,02	-1,43	39,53	62,99
	SD	3,66	0,58	0,67	1,43	0,02	3,17	3,24
	CV	0,05	-0,21	0,04	0,35	-0,02	0,08	0,05
S2	mean	51,70	5,90	25,80	5,63	1,35	71,29	44,92
	SD	2,78	0,94	0,73	1,39	0,02	3,35	5,71
	CV	0,05	0,16	0,03	0,25	0,02	0,05	0,13
S3	mean	50,70	6,40	26,40	5,73	1,33	74,39	43,71
	SD	2,35	1,32	1,14	1,61	0,01	0,99	3,93
	CV	0,05	0,21	0,04	0,28	0,01	0,01	0,09
S4	mean	47,60	8,60	25,90	5,87	1,25	77,73	40,92
	SD	2,02	0,41	1,11	1,78	0,02	3,62	4,59
	CV	0,04	0,05	0,04	0,30	0,02	0,05	0,11
S5	mean	45,70	9,00	27,60	6,05	1,26	86,28	38,43
	SD	2,06	2,80	1,88	1,56	0,04	4,25	8,12
	CV	0,05	0,31	0,07	0,26	0,03	0,05	0,21

It can be seen that as the amount of spelled meal increases, the L (Lab) color component values decrease, indicating that their color becomes darker. The color of the cookies is from yellow to red to brick-red. The yellow index increases while the white index decreases.

The results obtained after analysis of color digital images from a scanner are presented in Table 2. As with the colorimeter measurements, the values of the L (Lab) color component decrease. There is an alteration of the other two components of the model from yellow to red to a darker color. The yellow index increases and the white index decreases. This trend is also seen in the preview of cookies. In sample S1 of 100% wheat flour, the color tends to white. As the amount of einkorn flour increases, it is getting darker.

Table 2. Color components and indexes of cookies by scanner data

Sample	Color / DS	L	a	b	C	h, rad	YI	WI
S1	mean	77,33	-0,09	22,40	22,40	0,00	1,15	77,32
	SD	3,94	0,54	1,61	1,61	0,01	0,19	3,93
	CV	0,05	-6,38	0,07	0,07	-6,75	0,17	0,05
S2	mean	58,21	5,79	26,50	27,15	0,10	14,48	57,39
	SD	5,69	0,93	1,41	1,39	0,02	3,35	5,71
	CV	0,10	0,16	0,05	0,05	0,23	0,23	0,10
S3	mean	53,47	6,42	27,75	28,50	0,12	17,25	52,57
	SD	3,23	1,00	1,37	1,43	0,02	3,17	3,24
	CV	0,06	0,16	0,05	0,05	0,18	0,18	0,06
S4	mean	49,85	6,86	25,99	26,90	0,14	19,89	48,90
	SD	4,61	0,92	1,75	1,78	0,02	3,62	4,59
	CV	0,09	0,13	0,07	0,07	0,18	0,18	0,09
S5	mean	47,38	6,28	23,65	24,48	0,13	19,10	46,62
	SD	4,04	0,88	1,48	1,56	0,02	3,25	4,00
	CV	0,09	0,14	0,06	0,06	0,17	0,17	0,09

Figure 2 shows results for the change of the color indexes YI and WI depending on the percentage of einkorn flour.

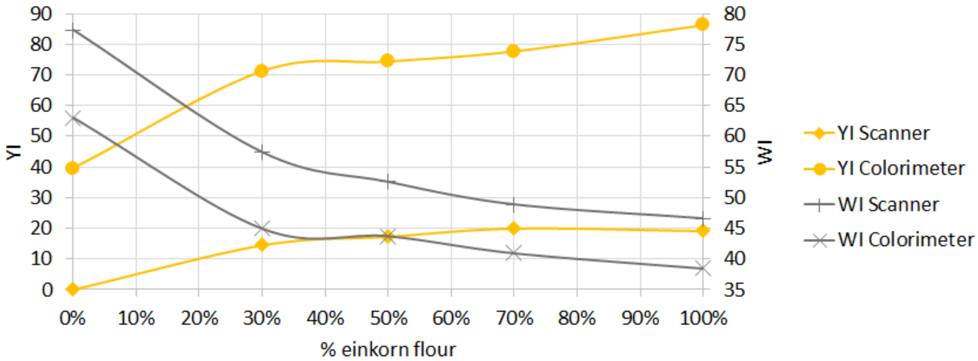

Figure 2. Changes of YI and WI according of einkorn flour content

As with colorimeter data, the same trend in color index changes is observed in those from a scanner. Up to 20% of einkorn flour adds to the increase in the yellow index and, accordingly, to a decrease in the white index. The characteristics are then directed towards the index values.

Table 3 represents results of the similarity analysis of the obtained colors between those from the colorimeter and those from the scanner. High correlation coefficients, over 0,9 for all color components and indices, are observed. Only in b (Lab) and C (LCh) there is a correlation slightly above 0,6. The same trend is observed in the Fischer distance ratio (FDR). Larger distances are obtained at the C (LCh) color component. When assessing the level of significance, most of the color components and indices exhibit a level of significance p <0,05, which means that the values of the color components and the indices obtained with the colorimeter and the scanner are close together. By this criterion, only b (Lab) has a value of significance p> α, which means that the values of this color component obtained with the two measuring devices are not close together.

Table 3. A comparative analysis for similarity of color components and indices determined by measurements with a scanner and a colorimeter

Color component/index Criterion	L	a	b	C	h	YI	WI
Correlation	0,99	0,97	0,61	0,69	0,96	0,98	0,99
FDR	0,02	0,01	0,02	3,12	0,44	0,15	0,04
p-Level	0,02	0,04	0,40	0,00	0,00	0,00	0,00

The results obtained show that the color measurements of bakery products made with a scanner are close to those obtained with a standard colorimeter. The accuracy obtained is sufficient to use this measurement method for training purposes. The color measurements of food products proposed in the present work outweigh those indicated by Baycheva et al. (2016) because the document comeras compared by the authors show a correlation with color sensor measurements slightly above 0,8 and errors up to 52%.

4 Conclusion

The work proposes the use of a scanner as a learning technical presentation and measurement tool. The advantage of using a scanner for color measurement compared to a document camera is supported by an analysis of the similarity of colors obtained from a standard colorimeter.

The proposed color measurement method can be used when conducting classes in bread technology and bread products training.

The use of the proposed laboratory equipment in the learning process can improve its quality. This is possible if students are active participants rather than passive observers.

Using the proposed equipment can be solved pedagogical tasks related to the integration of knowledge from the field of technical sciences and information technologies in bread making technologies as well as the formation of research skills for work with measuring equipment.

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References

AACC International. Methods 10-50D and 10-52. *Approved Methods ofthe American Association of Cereal Chemists, 10th ed*. AACC International,St. Paul, MN, U.S.A., 2000.

ASTM E313 - 15e1. Standard Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates.

Baycheva, S., Zlatev, Z., Dimitrova, A. (2016): Investigating the possibilities of document cameras for quality assessment of foodstuffs by measuring of color. *Proceedings of the 11th International conference on virtual learning* (ICVL), Romania, 204-208.

Bosakova-Ardenska, A., Danev, A., Andreeva, H., Gogova, T. (2018):Bread porosity evaluation by histogram analysis. *Proceedings of the 19th International Conference on Computer Systems and Technologies* (CompSysTech'18), Ruse, Bulgaria, 68-72.

Chonova, V., Chochkov, R. (2012). Effect of liquids and solids fats upon technological property of fortified dough. *Proceedings of University of Ruse*, 51,9.2, 164-168. (in Bulgarian)

Dineva, S., Stoikova, V. (2011): Application of Interactive Devices and Virtual lab in Chemistry Learning. *Proceedings of the 6th International conference on virtual learning* (ICVL), Romania, 261-267.

Jukic, M., Lukinac, J., Culjak, J., Pavlovic, M., Subaric, D., Koceva, D. (2018): Quality evaluation of biscuits produced from composite blends of pumpkin seed oil press cake and wheat flour Komleni. *International Journal of Food Science and Technology*, 54, 3, 602-609.

Kumar, S. (2017). Consumers Buying Behaviour–A Diagnostic Study. *Ushus-Journal of Business Management*, 16, 4, 1-13.

Nakov, G., Brandolini, A., Ivanova, N., Dimov, I., Stamatovska, V. (2018): The effect of einkorn (*Triticum monococcum* L.) whole meal flour addition on physico-chemical characteristics, biological active compounds and in vitro starch digestion of cookies. *Journal of Cereal Science*, 83, 116-122.

Papadakis, S., Abdul-Malek, S., Kamdem, R., Yam, K. (2000). A versatile and inexpensive technique for measuring color of foods. *Food Technology*, 5, 12, 48-51.

Stankova, N., Gogova, Ts., Paramonenko, L. (2018). Determining the modes of technological operations in the production of einkorn wheat bread made of frozen dough and enriched with Jerusalem Artichoke Flour. *Food science and Technology*, 12, 2, 108-112.

Zlatev, Z., Indrie, L., Ilieva, J., Ivanova, T. (2019): Analysis on colors of folk costume and their application in contemporary textile design. *Annals of the university of Oradea Fascicle of textiles, leatherwork*, 20, 1, 125-130.

Learning of Silhouette Shapes in Women's Clothing

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Abstract

The purpose of this report is to track trends in the silhouettes used in women's outerwear for the period 2016-2019 by exploring the collections of a number of world-famous designers and fashion houses. As a result, it can be concluded that after a period of highly expressive female image in romantic style with emphasis on the waist, a geometric style encompasses a straight silhouette with a lack of waistline emphasis, geometric details in a sporty style. The results can be used in training in the field of textile and fashion design.

Keywords: Silhouettes, Design education, Women clothes

1 Introduction

To meet the needs of modern textile production, textile design training must meet a number of conditions. First of all, it is necessary to prepare the curricula that provide the necessary fundamental, general, special design and training that correspond to the degree of development of contemporary theory and practice in this field (Shivacheva et al., 2016; Zlatev, 2016; Indrie et al., 2017;).

Every fashion season, designers create trends in ladies' top clothing, inspired by the latest colors, innovative fabrics, looking for new forms and compositions in their creativity (Statulov et al., 2001; Zlatev et al., 2019).

Depending on the purpose, the models can have sophisticated designs and dynamic compositions for evening and strictly formal attire and simple shapes with minimalist details for everyday wear. A leading role in fashion with a special significance for ladies' clothing is the silhouette shape that characterizes fashion styles for every season.

The aim of the present study is to trace the silhouette shapes used in the design collections during the last fashion seasons for the period 2016-2019.

2 Exposure

The silhouette represents the expression of the costume in the simplest geometric form - triangular, rectangular, square, oval, etc. (Dimitrova, 2012) Depending on the degree of attachment of the garment to the body, three groups of silhouettes are defined: unstable silhouettes, bulky silhouettes with a fit in waist area, bulky silhouettes without waist adjustment.

In fashion, it is accepted to compare the silhouettes with letters: A, O, V, X, Y (T) shaped and Y-shaped inverted (reversed) silhouette as well as the degree of fit in the waist: dense, (Kazlacheva, 2007). In the ladies' garment there are three more silhouettes: trapezoidal, oval and combined, which are a variant of the straight silhouette (Dimitrova-Popska, 2000).

Non-swollen silhouettes – close fit, semi-hulled, hulled, straight are presented onFigure 1.

a) Close fitting b) Sheath silhouette c) Sheath silhouette d) Straight

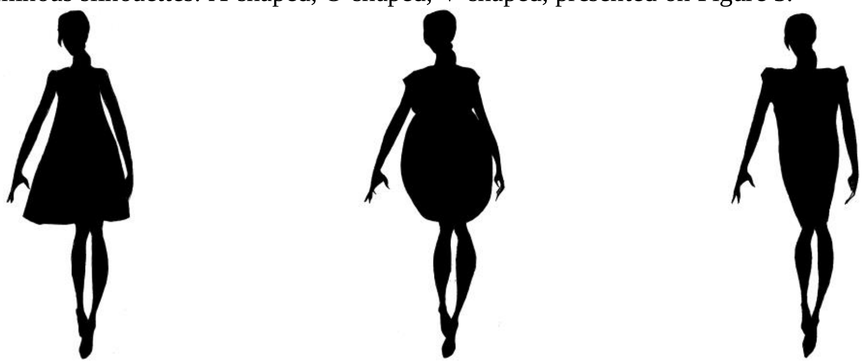
Figure 1. Non-swollen silhouettes

Volumetric shapes by applying to the waist: Y- shaped, Y- shaped turn, X shaped are presented on Figure 2.

Y-shaped Y-shaped-reversed X-shaped

Figure 2. Voluminous silhouettes with fit to the waist

Voluminous silhouettes: A-shaped, O-shaped, V-shaped, presented on Figure 3.



A-shaped O-shaped V-shaped

*Figure 3.*Voluminous silhouettes with no fit to the waist

In fashion models which asymmetry, associated with the dynamics of the compositions is used, a combination of different silhouettes is presented.

A fashion survey for the period 2016-2019 of a number of world-famous designers and fashion houses has been made. Emphasis is placed on the most common silhouettes in fashion collections according to Vogue (2019).Vogue is chosen because it is an internationally recognized and respected fashion publication. The renown of the magazine makes people recognize Vogue as the heart of the fashion industry. Vogue demonstrates the position of leading designers (Alspaugh, 2019).

*Silhouettes in 2016.*In 2016, Y-shaped silhouette women's dresses follow the lines of the body in combination of vertical and diagonal lines. Vertical lines highlight the elongated and exquisite silhouette of the figure. The accent of the composition is the neckline with asymmetrical shape.

A model of a women's dress was created in combination of a tight fitting silhouette and partially attached sleeves that followed the length of the dress to form an A-shaped silhouette. The center of the composition is a vertical decorative pendant in the hip, surrounded by horizontal and diagonal folds, whose softness and plasticity impart movement and femininity.

Another model is characterized by an X-shaped silhouette, a V-shaped neck, an asymmetric pleated length starting from the waist. The softness and softness of matter emphasize the feminine part of the figure.

The proposal for a women's dress is in a X-shaped silhouette, emphasizing the waist, with a richly draped wide belt. The hands are surrounded by folded cloth layers starting from the bust. The accent of the composition is in the neckline, which is decorated with flowers in pink.

In a Y-shaped silhouette, Waist is highlighted with diagonal lines folded, repeating the shape of the neckline, ending in asymmetry accented with a brooch. Composition center is the shoulders, which are underlined with inserted curls.

An ensemble model was designed in a silhouette. Combining different fabrics with inserted curls vertically, diagonally and horizontally and their different widths adds vitality, dynamism and plasticity to the otherwise clean line of silhouette.

The model of the dress is in the right white and black in a straight silhouette, in the form of circles are cut openings, curled with curls, which delicately show shoulder and thalass curve.

Dresses in powder color, deep silhouette, vertical and diagonal lines ending with or with interweave curls inserted in them, sets diagonally positioned forming center of the waist.

Embossed silhouette ensembles with non-standard cuts, asymmetrical lengths and curls complete front and neckline. They descend along the lengths, resembling algae, bringing dynamism and agility.

A dress is created, resembles a metal armor in a silhouette with a strong emphasis on the waist of a strapped wide belt.

*Silhouettes in 2017.*In 2017, a wide variety of models in designer collections and fashion houses characterized by marked femininity, with the emphasis in compositions often on the waist. The silhouette shapes used are straight silhouette, A-shaped, deep, Y-shaped, X-shaped silhouette.

Models of dresses in X-shaped silhouette of ethereal chiffon are designed. In vertical cuts, curls are inserted along the length of the sleeves at the front in a combination of pleated details and sets.

A model of a free silhouette dress is offered, asymmetrical neckline with a wide shoulder steering, ending in a sleeve.

O-shaped silhouette dresses in dramatic black are preferred. The sleeves, the hem, the neckline, and the waist are fixed with sets or interlaced elastics and cords.

The model of the dress is in a silhouette with a bustle attached to smooth vertical curves, handles of horizontal pleats. Valley designed a model of mini dress in a trapezoid silhouette and molded on the shoulders pleated voluminous flowers.

Dresses are offered in A-shaped silhouette with high waist of vertically arranged folds, fixed with the pandelas.

Unusual shapes and exaggerated volume in garments made of polymers lacking connectivity to the human figure.

*Silhouettes in 2018.*In 2018, the design patterns of the designer's collections are dominated by a strong geometric style in a straight free silhouette, A, Y-shaped, Y-shaped inverted and X-shaped silhouette, with the waistline underlined with wide belts. The skirts are straight or trapezoidal with asymmetrical lengths, ending in sharp edges, pleats, sets and wheels. In collections with tunics and dresses, the volume ends in a balloon.

The pants are also wide in combinations of free tunics and shirts. Trousers are 7/8 straight or cut trapeze. Jackets and lightweight raincoats are often straight with overhanging volume and two-fold buckles with large outer pockets. The ensembles have long broad bodices and trousers. The neckline is in V-shaped or asymmetrical folds. Waist dress in straight silhouette dresses is accented with a belt. The patterns have unusual details and cuts and destructive shapes, excessive volumes. Non-typical details are used by folding in asymmetry.

*Analysis of the results.*An analysis of the results of the study of the most commonly used silhouettes for the period 2016-2018 is presented in Table 1 (with all the silhouettes in the waist area, regardless of the degree of subsidence) included in the X-shaped silhouette.Percentage representation of a closely fitting silhouette indicates that it was most used in 2016 by 17%. In collections of designers there is an increase in the use of a straight silhouette, with the highest share reaching 21% in 2018 and a Y-shaped silhouette by 14% in 2017.The A-shape silhouette is used up to 3% in 2016 when the highest rate of application has reached the X-shape silhouette of 75%, and it can be noted that the X-shaped silhouette emphasizing the waist is the silhouette of the highest share in collections during all fashion seasons for the survey period.

Table 1. Silhouettes used for the period 2016-2018

Silhouette / Year	Close fitting, %	Straight, %	T(Y)-shaped, %	X-Shaped, %	A-shaped, %	O-shaped, %	V-shaped, %
2016	2	12	8	66	10	1	0
2017	8	6	14	55	16	2	0
2018	7	26	13	35	18	2	0

For the processing of the data obtained, the method “Principal component analysis (PCA)”is used (Mladenov et al., 2014).Figure 4 shows the results of a method principal component analysis.

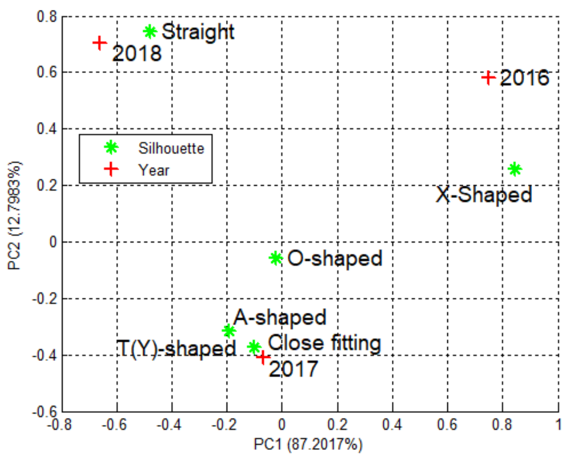


Figure 4. Results from Principal component analysis

This method is chosen because it is defined as an orthogonal transformation that finds linear combinations of the original independent variables describing the maximum part of data variations in a new coordinate system. Spatial directions describing variations are called principal components (PCs). They have zero linear correlations with each other and can be interpreted as independent. The first component carries the most information, ie. explains most of the variance in the source data, the second describes the maximum portion of the residual information.As it can be seen for 2016 X-shaped silhouette is the most used by designers. In 2017 A-, T(Y)- and close fitting silhouettes are preferred. Straight silhouette is commonly used in 2018. For the period under review O-shaped silhouette had the slightest interest in designers.

Figure 5 shows models of ladies' top clothing in different silhouettes. As a basis, the collections of designers for the period 2016-2019 were used in their creation.

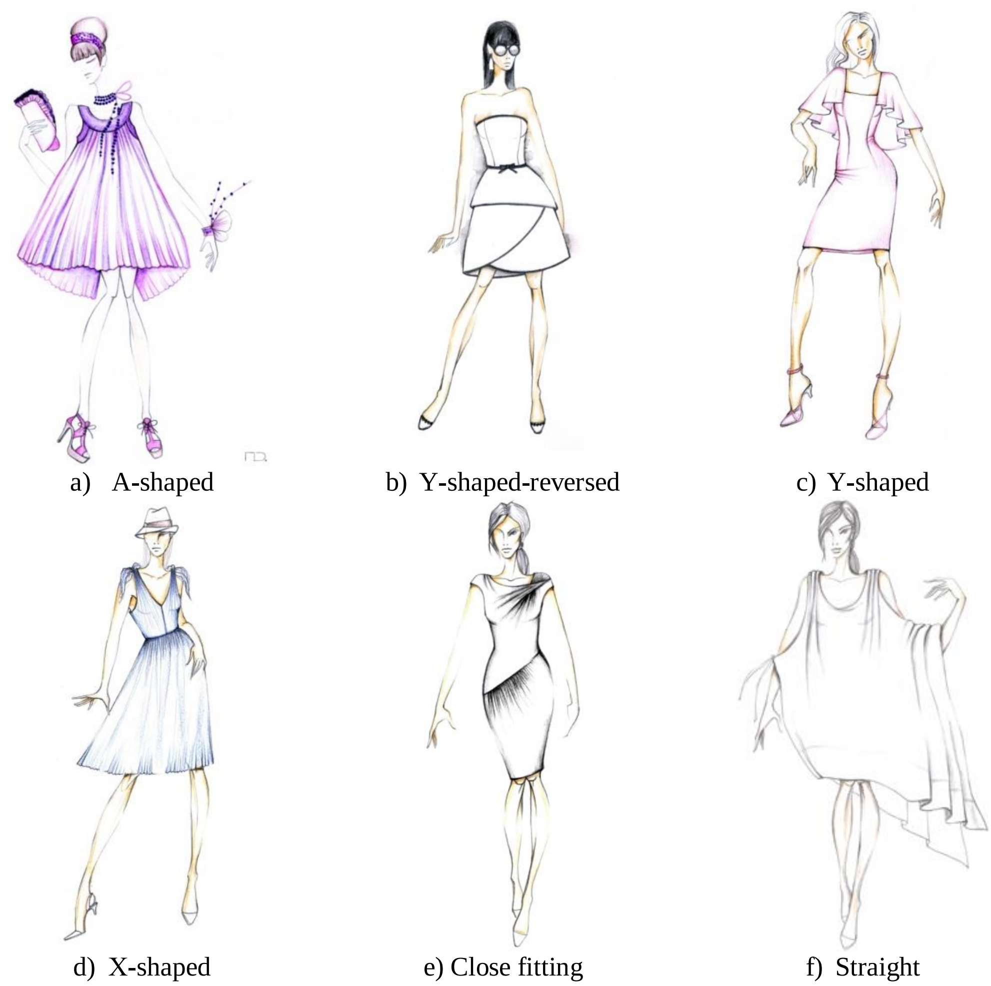


Figure 5. Models of women's clothing in a variety of silhouettes

3 Conclusion

The female figure in a romantic style emphasizing the waist is strongly expressed. The silhouette structure is built into complex compositions of shoulders and pleats in different diagonal directions, sets and twists. Orchid flower sculptures, butterfly-shaped dresses and fly-offs form silhouettes.

In 2016-2017 there was an increased volume of shape, silhouettes accentuating the waist with high dynamics and complexity of construction. Overhangs and curls predominate in horizontal and mixed lines. Unusual shapes and folds, exaggerated volume of polymers in techno style, and lack of connectivity between the volumetric structures of the human figure and clothing.

In 2018 the geometric style of clothing returns, with the emphasis on X-shaped, A and O-shaped silhouettes. The details are in geometric rectangles and squares. Pleats, asymmetries and destructivities are often used in shapes.

The results obtained can be used in training in the field of textile and fashion design.

References

Alspaugh, L. (2019): Is Cultural Appropriation Braided into Fashion Coverage? An Examination of AmericanMagazines. *Elon Journal of Undergraduate Research in Communications*, 10, 1, 6-14.

Dimitrova, P. (2012):*Two-Century Border Fashion*. Krisan-S, Sofia, Bulgaria. (in Bulgarian)

Dimitrova-Popska, P. (2000): *Design of textiles and clothing*. Tehnika, Sofia, Bulgaria. (in Bulgarian)

Indrie, L, Kazlacheva, Z, Ilieva J., Gherghel, S. (2017): Embroidery-from digital designing to fine art. *Revista Industria Textilă*, 68, 5, 366-369.

Kazlacheva, Z. (2007): Silhouettes in the ladies outer garments. *Tekstil i Obleklo*, 9, 8-11.

Mladenov, M., Dejanov, M., Tsenkova, R. (2014): Complex assessment of grain quality using image and spectra analyses. *Journal of food measurement and characterization*, 8, 3, 180-194.

Shivacheva, G., Nedeva, V. (2016): Methods for Teaching Programming Using Virtual Laboratory. *Proceedings of the 11th International conference on virtual learning* (ICVL), Romania, 92-98.

Statulov, I., Balabanova, D., Kazlacheva, Z (2001): Application of colors in fabrics and clothing. *Tekstil i Obleklo*, 7, 8-9.

Vogue, Italia, https://www.vogue.it/sfilate/stagione-corrente, accesed 2019.

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. *Proceedings of 11th International Conference on Virtual Learning* (ICVL), Romania, 209-213.

Zlatev, Z., Indrie, L., Ilieva, J., Ivanova, T. (2019): Analysis on colors of folk costume and their application in contemporary textile design. *Annals of the university of Oradea Fascicle of textiles, leatherwork*, 20, 1, 125-130.

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Learning of Foreign Direct Investment and Their Impact on Main Economic Indicators of the Region

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Abstract

Modern economic analysis training shows that it is necessary to analyze foreign investment that has a direct impact on employment in the regions. The most significant highlight is in small and underdeveloped areas, as supporting a business in a particular sector or opening a foreign company has a significant impact on unemployment and key macroeconomic indicators. The impact of such a local factor can be highlighted through a structural analysis to identify which sector of the economy has the highest weight at the regional level. The examination of the economic situation in an area as a result of investments from abroad gives information on changes in sector employment and gross domestic product.

Keywords: Regional policy, gross domestic product, sectoral employment, economic analysis

1 Introduction

Foreign direct investment (FDI) is the long-term participation of foreign natural or legal persons in the country, with opportunities being: presence in management, setting up a joint venture, use of expertise or assistance in technological improvement of production.

The role of the regional economy as well as analyzing macroeconomic trends and identifying priority economic activities are essential for the national economy (Yarkova et al., 2017). The relevance of this problem is why economic analysis is one of the main areas of study in Economics in the Faculty of Technics and Technology Yambol at Thrakia University, Bulgaria.

Economics education is also related to the realization of modern pedagogical goals related to: integration of knowledge in the field of economic analysis; formation of research skills for analysis in students (Shivacheva et al., 2016; Zlatev et al., 2018); to work with up-to-date data processing methods appropriate to production conditions; developing their professional readiness.

The purpose of the report is to examine the impact of foreign investment on key economic indicators of the region.

The results obtained are applicable to training in economics.Knowledge of the macroeconomics and regional economic analysis disciplines is useful for future student realization. The ability to analyze structural employment and raise funds in areas of potential is particularly important in times of scarce resources.

2 Related studies

With regard to foreign investment, studies and studies have been carried out. Different authors consider that FDI is an integral part of contemporary economic reality, and that they are an important factor in international production and trade (Velushev, 2016). It should be noted that not only attracting quality investments is necessary, but also applying a sectoral and regional approach to managing them. Such a policy should be applied in the formulation of a long-term strategy and would be essential for the economic development of the regions and the country (Mihaylova, 2019).

A European Commission FDI report states that over 35% of all assets in the European Union (EU) belong to foreign-owned companies, which defines a Union economy with a significantly open investment regime. It is also indicated that by the end of 2017, FDIs held by non-EU investors provide jobs to 16 million Europeans. Important trends are outlined, such as an increase in foreign ownership in Union companies, as well as a high share of investment in key sectors of the economy, such as oil refining, pharmaceuticals, electronic and optical products. Investment activity from emerging economies has increased. 11% of companies in the European Union are managed by foreign investors, highlighting their impact (EU Report, 2019).

Considering theoretical concepts, according to Marinov (2008), investments are not usually an outflow of financial resources, they are also "an instrument for the international dissemination of modern technologies and know-how, organizational management skills and marketing experience". According to the theory of company growth, in the presence of a highly competitive market, business expansion is a prerequisite for survival. Since the national market is limited, the development focus must be outside the territory of the country, with the company initially exporting goods and services and only after sufficient expansion and proven economic efficiency does it move to investing in production opportunities and overseas subsidiaries (Horst, 1972).

Given the importance of foreign investment and its impact on key economic indicators, the European Union recommends specific reforms to be undertaken in each country. The main task of Bulgaria is to improve the functionality of the Employment Agency, as well as to improve the business environment for small and medium-sized enterprises. This would increase lending and investment. In Bulgaria, as well as in countries with similar economic status, the share of investment in gross domestic product is similar.

The main conclusions reached by Nikolaev and Stancheva in their surveys (Nikolaev et al., 2013) are first and foremost the strong inverse relationship between the flow of foreign direct investment and the unemployment rate in Bulgaria, as well as the achievement of stability and recovery after the world the use of this interconnection is of particular importance. Without foreign capital, our country cannot achieve high economic growth.

In a similar study on the impact of FDI on the labor market, Tsankov identified two main factors attracting investment in Bulgaria and Romania (Tsankov, 2017). First is the very low wage - the lowest in the European Union and almost the lowest in Europe. The cost of labor is a major cost in production and lower wage payments will reduce production costs. The second major factor attracting investment in our country is the new markets sought by Russia, Turkey and Asian countries. Market-oriented external investment has a positive effect in the short term. It is also important to note that the bulk of the investments in Bulgaria are from the old EU member states, which enhances economic integration.

Investment activity is monitored on a monthly basis for a more accurate analysis of the country's economy and for the implementation of an adequate regional policy. According to data from the Bulgarian National Bank in February 2019, foreign investments in Bulgaria amounted to EUR 21.9 million (Capital, 2019).

3 Analysis of main economic indicators

The main method for analyzing foreign direct investment is to track the growth rate for the period and compare it with the growth rate of gross domestic product. From this study we can deduce the relationship between these two main indicators of the economy of the country or region respectively.

The data considered in this report on FDI and Gross Domestic Product (GDP) are for the South-Eastern Statistical Region of Bulgaria for the period 2009-2017. Data from the National Statistical Institute (NSI) (NSI, 2019) and the author's own studies were used.

Table 1 shows a strong increase in foreign direct investment in Bulgaria districts in the observed period for the Burgas and Stara Zagora districts (over 100%). The largest investments in the South-East region of Bulgaria are in these two large district centers. Considering that these areas are among the top six most developed in the country, the correlation between foreign investment and the increased growth rate at regional level is emerging. Yambol District has an investment growth rate of 40.4% (EUR 14581.1 thousand absolute growth).

Table 1. FDI in Southeastern regions, Bulgaria 2009-2017

Regions	FDI in enterprises at 31.12., Thousand Euro		Growth rate	
	2009	2017	Absolute	%
Total for the country	20441581.2	24475195.8	4033614.6	19.7
Burgas	836737.9	1887318.4	1050580.5	125.6
Sliven	558503.2	139288.5	-419214.7	-75.1
Stara Zagora	425851.7	905945.8	480094.1	112.7
Yambol	36099.2	50680.3	14581.1	40.4

Table 2. GDP of the Southeastern regions, Bulgaria for the period 2009-2017

Regions	GDP, thousand levs		Growth rate	
	2009	2017	Absolute	%
Total for the country	72986	101043	28057	38.44
Burgas	3707	5045	1338	36.10
Sliven	1034	1332	298	28.82
Stara Zagora	3426	5620	2194	64.05
Yambol	787	1078	291	36.93

Comparing the investment data with the Gross Domestic Product (Table 2) for Yambol, an increase rate of 36.93% was observed. For the districts of Burgas and Stara Zagora, an increase in investment above 100% is not linked to a similar increase in GDP. In these areas growth is again observed, but at a lower rate. Regarding the district of Sliven, it is evident that with the decrease of foreign direct investments, the lowest growth of gross domestic product was observed by 28.82% for the studied period.

The structural analysis in Table 3, which presents information on sectoral employment in the Yambol region in 2009 and 2017, shows that the leading sectors in this regional economy are the Manufacturing Industry and the Trade and Repair of Cars.

Table 3. Structural analysis of employees by economic activities in Yambol region for the period 2009-2017

Economic activities	Yambol region 2009		Yambol region 2017	
	Average annual number	Relative share, %	Average annual number	Relative share, %
Agriculture, forestry and fisheries	2365	7.24	2593	8.26
Raw materials industry	192	0.59	236	0.75
Manufacturing	10525	32.23	10831	34.49
Production and distribution of electricity and heat	201	0.62	209	0.67
Water supply, waste management	492	1.51	638	2.03
Construction	2866	8.78	1549	4.93
Trade, car repair	4809	14.73	4702	14.97
Transport, storage and mail	1189	3.64	1320	4.20

Hotels and restaurants	1024	3.14	1054	3.36
Creation and dissemination of telecommunications and information	142	0.43	151	0.48
Financial and insurance services	233	0.71	457	1.46
Real estate operations	297	0.91	231	0.74
Professional activities and research	262	0.80	318	1.01
Administrative activities	838	2.57	570	1.81
Government	2027	6.21	1521	4.84
Education	2474	7.58	2404	7.65
Human health and social work	2043	6.26	1983	6.31
Culture, sport and entertainment	224	0.69	245	0.78
Other activities	455	1.39	393	1.25
Total	32658	100.00	31405	100.00

For the observed period, have increased the share of leading economic activities (Table 3), namely the sectors related to manufacturing and trade. According to NSI data for 2017, the largest share of foreign direct investment in the industrial sector in Yambol region is EUR 40.9 million, as well as in the trade and repair of motor vehicles sector - EUR 9.8 million.

4 Conclusion

As a result of the conducted analyzes and summaries, it should be noted that the investments in Bulgaria are growing and for the period 2009-2017 increase by almost 20%. Gross domestic product also registered growth, with a growth rate of 38.44% by 2017. This tendency to attract foreign investment in Bulgaria must continue. It is necessary to apply high technologies in production, to build important for the country transport networks and connections with the European and world markets, to improve energy efficiency, and last but not least to increase employment.

It was found that at the regional level (Yambol District, Bulgaria) there was an investment growth rate of 40.40% for the observed period. Gross domestic product increased by 36.93% over the same period. Despite the decline in staff, the Manufacturing and Trade sectors have increased shares in the sector's employment in the region due to attracted foreign funds. It is this influence of foreign direct investment that needs to be emphasized in the study of economic disciplines and to provoke the focus of resources in places with high potential.

The results obtained can be used in the realization of modern pedagogical goals and tasks related to the integration of knowledge in the field of economic analysis, as well as the formation of research skills for the analysis of statistics in students.

References

Capital, Foreign Investments in Bulgaria, www.capital.bg, accessed 2019

EU Report (2019): *On Foreign Direct Investment: Foreign ownership in European companies of key sectors continues to increases*. SWD(2019) 1001 final, Brussels, 13.03.2019.

Horst, R. (1972): Firm and Industry. Determinants of the Decision to Invest Abroad. An Empirical Study. *The Review of Economics and Statistics*, 261.

Marinov, V. (2008): Theoretical Concepts for Direct Foreign Investments. Scientific Papers of UNWE, 2, 1, 3-56.

Mihaylova, S. (2019): Analysis and Assessment of Foreign Direct Investment Policy in Bulgaria 1990-2018, *Dialogue*, 20, 1, 71-84.

Nikolaev, R., Stancheva, V. (2013): The effect of foreign direct investment on unemployment in Bulgaria. Izvestiya, 2, 20-32.

NSI, National statistical institute,http://www.nsi.bg/en, accessed 2019

Shivacheva, G., Nedeva, V. (2016): Methods for Teaching Programming Using Virtual Laboratory. *Proceedings of the 11th International conference on virtual learning* (ICVL), Romania, 92-98.

Tsankov, S. (2017): *Direct Foreign Investments and Their Impact on the Labor Market*. PhD thesis, VTU Todor Kableshkov, Sofia, Bulgaria. (in Bulgarian)

Velushev, M. (2016): The Problem of Economic Growth in Bulgaria: Can Foreign Direct Investment Help. *Economy*, 21, 2-16.

Yarkova, Y., Markov, N., Toneva, K. (2017): Analysis and evaluation of the territorial economy in stara zagora district. National Scientific Conference Regional Economy and Sustainable Development at the University of Economics – Varna, 312-324.

Zlatev, Z., Baycheva, S. (2018): Application of optical device in methodology for teaching analysis of essential oils. Proceedings of the 13th International conference on virtual learning (ICVL), Romania, 124-129.

New technologies and teaching ecology

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Abstract

The free web-based resources are tremendously helpful in our new digital decades to teachers and students for developing and reaching good quality education in almost all possible spheres of knowledge. One of the most important missions of any research organization is to spread a knowledge. The research organizations and new technologies offers great possibilities to improve the quality of teaching by open educational channels and implementing supportive interactive materials and activities in classroom.

Keywords: e-learning, ecology education, supportive interactive materials

1 Introduction

Effectiveness of learning depends on quality of content and delivery mechanisms (Jain, 2016). Modern media, internet, spatial data form drones and satellite systems are helpful teacher’s approaches, making the information of processes occurring in the nature to be easier understood (Bryndza *et al*., 2001).

In ecology, many subjects are tidily connected with the scientific information received from the new technologies, which are widely applied in a research of Earth and wildlife. For instance, the origin and assessment of pollution, prediction and consequences from disasters, as well as evaluating and conservation of natural resources.

Remote sensing technology, especially aerial photography and satellite imagery, are used intensively nowadays in all over the world. Geographic information systems (GIS) estimates the natural resources, monitors the pollution and land use, exert biological control and health studies, helps for social and economic planning, disaster avoidance, and management of conservation areas and parks (Fava *et al*, 2010). GIS have been mentioned as a suitable approach in teaching biology, ecology, and geography, and has been adopted in many secondary schools in all over the world (Kerski, 2007; Bryndza *et al*., 2001; Johansson, 2006; Fava *et al*, 2010).

2 Educational resources from new technologies in education

Learning about Earth is part of NASA's mission; NASA offers many education resources for kids, students and researchers in different fields (NASA Science, 2014).

In 2004, NASA launched the Aura satellite as part of its Earth Observing System. Aura carries four science instruments, which study the atmosphere. One of the instruments is TES - Tropospheric Emission Spectrometer. As TES passes over Earth's surface, it gathers data that can give a profile of the atmosphere. The profile shows with different colours how much greenhouse gases are in the atmosphere at different altitudes. Using such of kind new digital scientific data in the lessons can help the teacher better to explain and support his point of view working in classroom. For example, distributions of ozone or other greenhouse emissions (fig.1).

On figure 1, the areas of highest ozone levels are shown in red. All zones, where the red is closest to Earth's surface are situated near to the large cities in the US. Aura's polar orbit takes it over the North and South Poles, Earth rotates beneath, and after16 days of orbits, TES has measured ozone over the whole planet and starts over (NASA Science, 2019). On that web site can be found different kind if supportive learning materials, as classroom activities for kids, infographics, images and movies for kids, students and other learners.

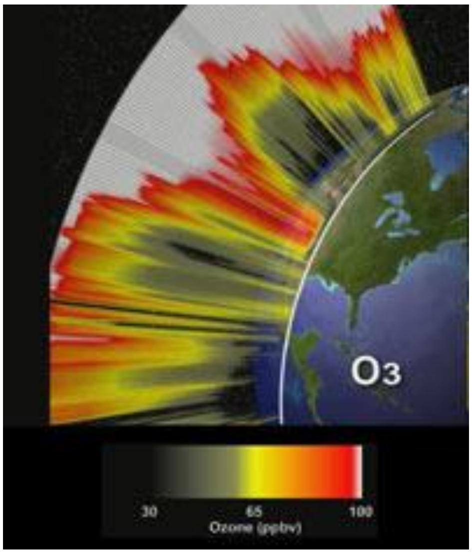

Figure 1. The ozone profile of atmosphere

EU Copernicus is another program that offers information services based on satellite Earth observations, and Copernicus Atmosphere Monitoring Service (CAMS) is one of six services (CAMS, 2019). The (CAMS), provides regular, high quality data about air emissions and atmospheric composition related to pollution and health, solar energy, greenhouse gases and climate forcing (CAMS, 2019). The service also tracked the wildfires and other natural disasters.

Remote sensing data and particularly satellites observations provide precise and broad information for caution and prevention of potentially disasters, rescue and rehabilitation. Satellite images combined with other GIS data helps to analyse a risk and mapping a hazardous zones, early warning, cyclone location, drought monitoring, and assessment of flooding, oil spill, forest fire and progress of desertification, modelling risks in specific regions. GIS takes an essential lot in climate change monitoring (Fava *et al*, 2010). All that questions are difficult topics not only for researchers, but also for ecology learners, and the clearance of those apprehensions is a crucial in all aspects concerning the sustainable development and high quality education (fig.2).

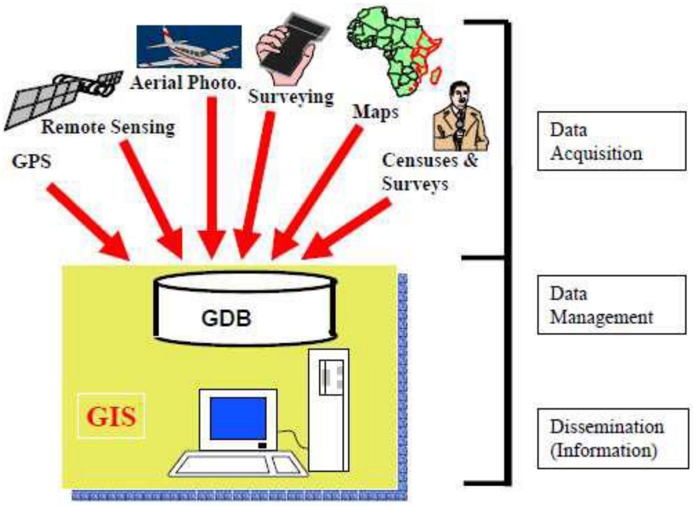

Figure 2. Geographic Information Process (United Nation Statistic Division, 2004)

3 Good practices in applying GIS in secondary schools

The successful EU project GISAS (Geographical Information Systems Applications for Schools), has been run between 2003-2006, with the purpose of water quality assessment of rivers in the neighbourhood of the partner school in different countries. The objectives of the project included: *introduce GIS into European secondary and upper secondary schools; create educational materials, exercises and a webbased-learning environment for teachers; use the GIS as a tool to enhance the study of water quality; support international cooperation among teachers and students in web-based learning environment* (Johansson, 2006). According to Johansson, (2006) applying the innovative learning tools allowed the students in active manner to learn important ecological problems. Moreover, students learn to create databases or how to access to existing digital databases, which providing a new way to study (Johansson, 2006).

There are many reports also from different projects, which are using a digital map created with a GIS, carried out in secondary schools, related to waste management, pollution of a river, and chemical measurements. Sanchez (2009) underline the benefits of applying those tools as enhancing of problem-solving skill and collaboration, so additionally, for the digital culture is important to integrate geotechnologies into the curriculum for the elaboration (Sanchez 2009).

Education is a critical component for the future, and applying GIS information in education is the guaranty of progress (Milson et al., 2012). According to Lenart, (2001), GIS technologies are convenient and attractive approach to satisfy the curiosity of learners, and one of the cheapest ways supporting objective and accurate perception, builds a student’s attitudes, and stimulates solid connection of thoughts, plans and activities. The EC funded network, digital-earth.eu, which encourages the sharing of novel practices and promotion of invention and best practices in the execution of geomedia as a digital learning environment for school learning and teaching (González & Donert, 2001).

4 Free open resources for teaching with GIS

Free and open source software projects provided GIS software (Fava *et al*, 2010). Free available desktop GIS software and applications can be found as:

- GRASS (Geographic Resources Analysis Support System) GIS, - http://grass.osgeo.org/ - offers geospatial data management and analysis, image processing, graphics/maps production, spatial modeling and visualization;
- Map Window GIS - www.mapwindow.com - a desktop application capable of viewing shapefiles, and raster data in many formats. It can reproject data, clip, merge, and perform other geoprocessing through a "GIS Tools" plug-in;
- Quantum GIS – www.qgis-org - runs on Linux, Unix, Mac OSX, and Windows. QGIS supports vector, raster, and database formats. It also can display tracks from GPS. It is also available in a web server version;
- GvSIG - http://gvsig.gva.es/ - is an tool for handling geographic information. It has a friendly interface and it can access to several data format (raster or vector);
- SAGA - http://geosun1.unigeog.gwdg.de/saga/ht ml/index.php – a geographic information system, with a unique 'Application Programming Interface' (API) for geographic data processing. This API makes it easy to implement new algorithms- The SAGA API supports grid data like digital terrain models and satellite images, vector data, and tables;
- uDig - http://udig.refractions.net/ - an open source spatial data viewer/editor, with special emphasis on the Open GIS standards for internet GIS, the Web Map Server and Web Feature Server standards;
- Map Maker - http://www.mapmaker.com/ - ease of use, can learn how to draw, edit and print basic maps, and link them to databases. It has a simple and clean user interface (UI).

In addition to the Desktop GIS software, there are also Web GIS software and additional components, such as Database and Libraries (Fava *et al*, 2010):

- Map Server - http://www.mapserver.com/ - deliver dynamic GIS and image processing via Web, contains stand-alone application for building maps, scale bars and legends offline;
- GeoTool - http://cartoweb.org/ - open source GIS toolkit written in Java, using Open Geospatial Consortium specifications;
- OpenLayers – http://geoserver.org - open source AJAX library for accessing all kinds of geographic data layers, originally developed and sponsored by MetaCarta;
- PostGIS – www.postgis.refractions.net/ - adds support for geographic objects to the PostgreSQL object relational database;
- MapFish – http://mapfish.org/ - it is an easy-to-use and extensible web 2.0 mapping application framework;
- GeoServer – http://geoserver.org - open source software server written in Java that allows users to share and edit geospatial data;
- Cartoweb - http://cartoweb.org/ - ready-to-use Web GIS, as well as a convenient framework for building advanced and customized applications.

Implementing GIS in classroom helps students faster and deeply to understand the content of numerous disciplines: *geography, environmental studies, history, mathematics, language arts, chemistry, biology, civics*, and many other. It helps students think critically, use real data, make community. It does so in informal, primary, secondary, and university settings and appeals to today's digital and visual learners (Kerski, 2018). Geotechnologies, along with biotechnologies and nanotechnologies, are the three key skills on job markets for 21st Century (Gewin 2004).

4 Conclusions

Using a new research information and high technology tools in the training process make the education more valuable and attractive. For nowadays generation, that is classified as a digital native that is a crucial cause, preparing them for integrating in the technology progress that accelerates the speed of executing in all scopes of humankind development.

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References

Books:

Bryndza E., A. Chrząstowska-Wachtel, H. Habera, A. Janowska, J. Poręba-Kwiatkowska, M. Rogala, R. Sidoruk-Sołoducha, M. Krupiński, 2001. GIS at school. Guidebook for biology, geography, and science teachers. Warsaw 2011. ISBN: 978-83-932916-1-8. p.129.

Fava P. R., S. Fritz, A. Castellano, 2010. The Use of Geographic Information Systems for Disaster Risk Reduction Programmes in Africa. p. 93.

Johansson T., 2006. Geographical Information Systems Applications for Schools – GISAS. Helsinki 2006. p.122.

Lenart W., 2001. School with GIS – an opportunity for the student's development. In book: GIS at school. Guidebook for biology, geography, and science teachers. Warsaw 2011. ISBN: 978-83-932916-1-8. p. 127-128.

Milson A.J., A. Demirci, Kerski J.J., 2012. International Perspectives on Teaching and Learning with GIS in Secondary Schools. ISBN 978-94-007-2119-7 e-ISBN 978-94-007-2120-3 DOI 10.1007/978-94-007-2120-3. p.39.

United Nation Statistic Division, 2004. United Nation Statistic Division. Integration of GPS, Digital Imagery and GIS with Census Mapping. New York: DESA, 2004.

González R. de M. and K.Donert, 2001. Innovative Learning Geography in Europe. Innovative Learning Geography in Europe: New Challenges for the 21st Century. ISBN (10): 1-4438-5508-1, ISBN (13): 978-1-4438-5508-2 p.30.

Journal Articles:

Jain A., 2016. Don't Teach Me, Let Me Learn! Millennial Learning. Volume 8, Issue 1, https://www.pwc.com/m1/en/services/consulting/documents/millennials-at-work. pdf last accessed on 27th May 2016.

Gewin, V., 2004. “Mapping Opportunities.” Nature, Vol.427, pp.376-377.

Kerski J. J., 2007. The Implementation and Effectiveness of Geographic Information Systems Technology and Methods in Secondary Education. Journal of Geography. Volume 102, 2003 - Issue 3, p.128-137.

Sanchez E., 2009. Innovative Teaching/Learning with Geotechnologies in Secondary Education, in: A. Tatnall, A. Jones (eds.), World Conference on Computers in Education, WCCE, Brazil: Bento Goncalves. http://eductice.ens-lyon.fr/EducTice/recherche/geomatique/telechargement/WCCE-2009%20Conference%20Book%20-%20ES.pdf

Internet Sources:

CAMS, 2019. https://atmosphere.copernicus.eu/about-us.

NASA Science, 2019. https://spaceplace.nasa.gov/gumdrops/en/.

Kerski J.J, 2018. Why GIS in Education Matters. https://www.geospatialworld.net/blogs/ why-gis-in-education-matters/

Prevention of Cheating when Using Quizzes in Moodle

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Abstract

Development of technologies is permanently changing people's lives. This inevitably affects the education. It gives a great power to the lecturers and opportunities to apply new methods for learning and assessing students, but it also creates a huge responsibility for them. Modern students have a completely different way of thinking and learning. Their access to science, literature, art is easier than any generation before them. Often, they use technologies better than their lecturers. Possessing the power of knowledge about new technologies, some of the students are tempted to apply their knowledge for cheating on the exams.

This article presents classification of the new methods of cheating when evaluating with electronic tests in Moodle and proposes technological, organizational, methodical and psychological measures to prevent them.

Keywords:e-learning, e-tests, Prevention of Cheating

1. Introduction

We live in a world of constantly coming innovations and technologies in all spheres of our live. Computers are becoming more and more powerful and smaller and are now everywhere. Our houses and belongings are becoming "smart". We are talking about virtual reality. We make video calls to all parts of the world. Our society has become more interconnected than ever. Information is disseminated immediately.

Education should also integrate with and adapt to technology. One reason for this is the fact that modern generation have grown up with digital devices, Internet and social networks. Technologies have changed the way of thinking and the style of learning of modern student.

One of the most accessible and quickly entering in the higher education system contemporary educational practices are the electronic forms of distance learning implemented through the Learning Management Systems (LMS). Students are quick and easy to adapt to these systems. Often, in terms of new technologies, they overtake the lecturers, most of who were born and even completed their education before the computers entered our live.

One of the most commonly used LMS capabilities is the assessment with electronic tests. This way of testing has undeniable advantages over others. Unfortunately, it also has a number of disadvantages, one of which is the possibility of cheating. Knowledge of modern digital technologies tempts some students to apply their knowledge for cheating on the exams.

How widespread is fraud in digital exams? There are numerous studies on the topic.

In the (Pehlivanova and Kanchev, 2019) are presented the results of a survey of the opinions of former and current students on issues related to the evaluation with tests in the Moodle e-learning environment in technical and computer disciplines. 65.4% of respondents admit that they have used unallowed help materials based on modern digital technologies at least once during their training. 40% of the respondents admit that they had a complete or partial set of questions from which the test is formed when preparing for e-tests (without this being allowed by the lecturer).

Another study (Watson and Sottile, 2010) conducted among 635 students and graduate students attending a medium size university in Apalachi, found that 32.1% had participated in cheating in live class and 32.7% in online classes.

Study of OnlineCollege.org when conducting an online course "Introduction to Psychology" says that 72.5% of course participants reported fraud usually by consulting the textbook or course materials online (LoSchiavo and Shatz, 2011).

(Matos and Barber, 2013) presents results from surveys according to which 69.3% of Portuguese students have applied some kind of fraud during the assessment. It is concluded that the use of computer equipment and technology is associated with unlawful behavior.

Other studies are also known which show the seriousness of the problem. The examiners must take serious steps to improve security and prevent cheating.

The aim of the article is to classify modern methods for cheating when evaluating with electronic tests in Moodle and to propose measures for their prevention. These measures are aimed at enhancing the security of exams, which are conducted in the computer lab in the presence of an examiner.

2.Methods for Cheating when Evaluating with e-tests

2.1. Classical Methods

Possibilities for obtaining unrealistic results in the evaluation process due to the dishonest behavior of the students have always existed.

The most common classical methods can be summarized as follows:

- Exchange of information between students

The practice of better students 'helping' the weaker ones exists even before electronic tests became popular. Students exchange information, both in writing and orally. Often this happens without the knowledge of one student.

- Use of unallowed materials

The classic use of unallowed materials has several forms: Use of textbooks; Use of paper materials containing notes or parts of textbooks with reduced font size.

- Finding the test questions in advance

This is possible when using the same questions or bank with a limited number of exam questions to test a large number of students at different times within the same exam session or in different years.

Often students go for the exam, knowing that they are not prepared just to get the test questions. They memorize or record the questions they received on the test and share it with their colleagues.

2.2.New Methods of Cheating Based on Computer Technology

The ingenuity of students, especially those with good technological preparation no limits.The most common technological methods can be summarized as follows:

- Exchange of information between students
  - Private messages in Moodle. This is an extremely convenient platform for communication between students during the exam. It is good that they be restricted by system administrators during exam sessions. There are sufficient alternative channels for communication between teacher and student.
  - Sharing the Moodle access code between different fraud participants, allowing them to see what the other student has done.
  - Using of blogs or forums in which some student post information, and others see it.

  - Using the profile of a student who does not participate in the exam as a means of communication with assistants outside the exam room. As this is an unexpected pattern of behavior, it is often overlooked.
  - Using software for teamwork and screen sharing. It is possible for a student to use teamwork software to provide access to the test machine to another person outside or even inside the exam room. The teacher sees a screen, on which tests are solved, but in fact the solutions will be provided by another person, and the student being tested will simply be present and simulate activity. If the one who solving the test is in the hall, it will look like he is solving his own test.
  - With the use of LMS, "Exams Exchanges" between students also appears. A student gives a friend access to his account and he takes the exam instead of him. The test may be performed by another person inside or outside the test room.
- Use of unallowed materials

In e-learning systems, this type of fraud is transformed into the unauthorized use of electronic resources on Moodle or Internet.

Thanks to the modern computer technology it is extremely easy to prepare small paper unalowed materials or photos of lectures and more materials on mobile phones.

Often, unscrupulous students create confusion in the exam room by asking questions to the teachers, asking for help because of fictional technical problems, and distract the examiner. Others take advantage of this to get access to unalowed materials.

- Finding the test questions in advance

Different technological methods are used to obtain the exam tests. The most commonly used are pictures with mobile phones, screenshots, copy to files and more.

To familiarize themselves with the questions and answers, some students voluntarily fail shortly after the start of the test. They then review the questions and disseminate information to their colleagues in the ways described above.

3. Measures for Prevention of Cheating when Using Moodle Quizzes

To achieve a good result in the fight against cheating, comprehensive measures must be taken. The possibility of fraud should be considered when developing the evaluation system and creating the questions. Adequate organization when evaluating is very important. At the same time, the technological capabilities of LMS and in particular Moodle should be used. A summary of the proposed measures is shown in Figure 1.

3.1.Technological Measures

The fight against technological fraud is most effective with the use of new technologies, so the greatest share of the proposed measures are technological. Some of them use the built-in Moodle features, others need to install additional plugins and applications. The measures are as follows:

- Set a time limit for solving the test

This is one of the easiest and most often applied measures. When time is limited, unprepared students are unable to find answers of the questions in textbooks or other pre-prepared unallowed help materials, as well as in internet search engines results. The correct time, according to the difficulty of the test, reduces the sharing of answers among the students.

- Set a different test for each student

This is a very easy and effective measure against cheating. It is possible thanks to the function for introducing random questions from a category into the tests in Moodle.

- Shuffle the order of questions for each generated test

In this way, if the same question falls on two students, it is unlikely that they will understand this and discuss the answer.

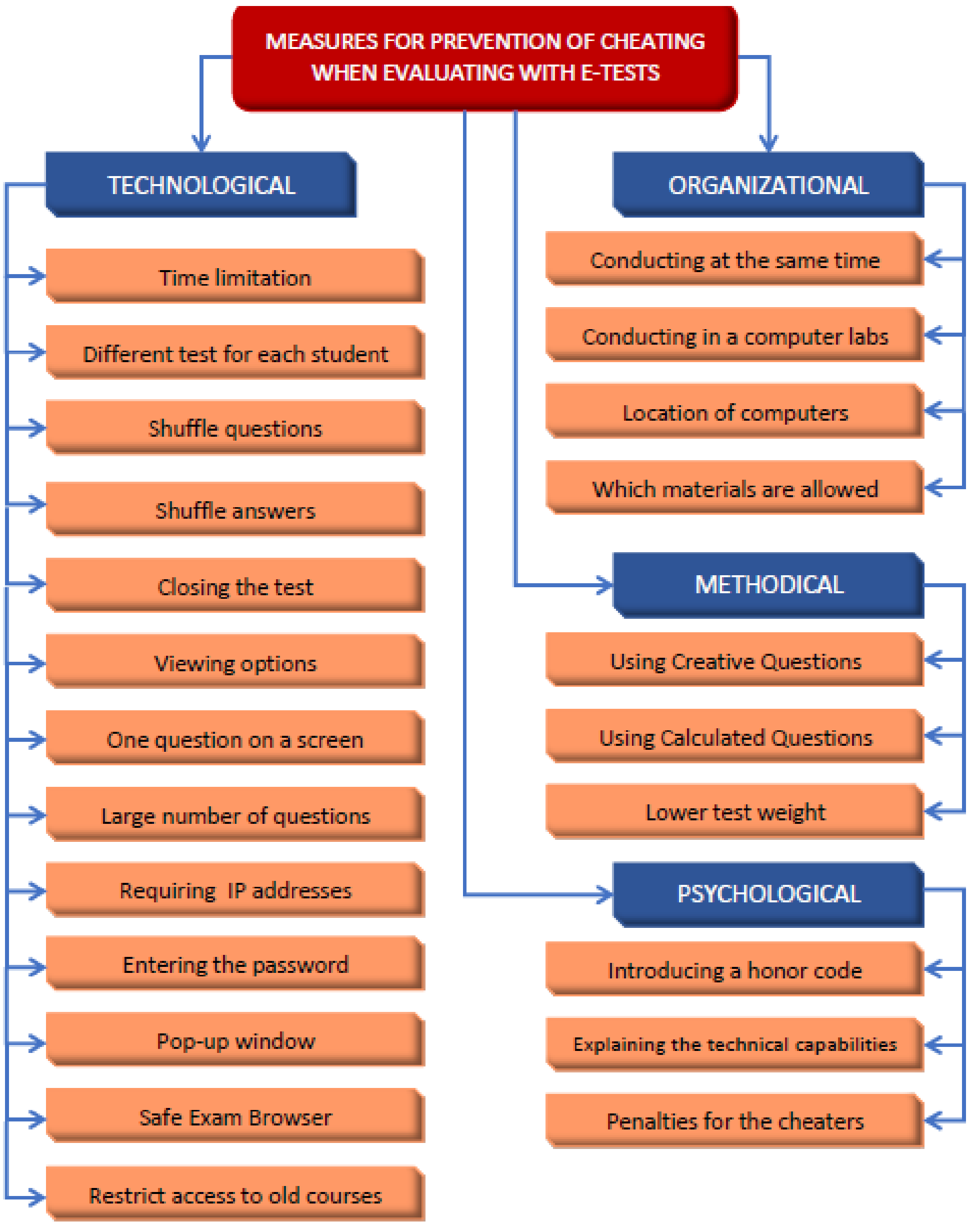

Figure 1. Measures for Prevention of Cheating when Evaluating with e-tests

- Shuffle the answers of the questions

This measure makes senseless the mechanical memorization of the place of the correct answers, because each time the answers are in a different order. When they have photos or prints of already downloaded questions, it is difficult for unprepared students to identify the questions.

When using this measure, care should be taken not to name the answers and not to refer to the previous answers. For example, you do not have to include a response with the "all listed above" text, because this answer will appear anywhere, including first.

- Specify a time interval during which the test is open

Limiting the period of time when the exam is accessible does not allow students who took the test earlier to share the questions and answers with other students who will take it later.

- Be careful when setting options for review

They control what information will be shown to students when they review their test attempts. The information that can be given to the tested refers to The attempt, Points, Right answers, Feedbacks.

For each of the listed items, you can specify the period during which students will see them: During the attempt; Immediately after the attempt (within 2 minutes of the moment when the student hands over everything and finishes); Later, until the test is still open; After completion of the test.

Since all these options are selected by default, settings need to be changed so that students see their results only after the test is over. If the same questions will be used for other exams, allow viewing only the scores and feedback. This will avoid copying the test along with the correct answers and submitting it to the next who will be tested.

- Set the test to show a single question on the screen

If you set the test to show many questions on a page, students can take pictures with their phone or make screenshots and share the questions (though not necessarily with the right answers). Displaying a single question on a page makes it difficult doing photos, especially when the test has a time limit. The photos and files are easily stored and exchanged with colleagues. Displaying a single question per page is the default setting for Moodle tests.

- Maximize the number of questions in the bank

This is very important, especially if you will use the same bank for different exams on different days. Students always find a way to retrieve the questions and the correct answers.

A survey presented in (Pehlivanova and Kanchev, 2019) found that if the total number of questions in the bank from which the tests are formed is greater than 600, 84.62% of the respondents will be encouraged to learn the learning content and not to attempt to use unallowed help materials or to memorize the correct answers. For a total number greater than 1000, this applies to all tested. Such built-in Moodle capabilities provide the use of computing questions (computing, simple computing and closed computing), where it is possible to randomly generate a number of combinations of values within a predefined range. The number of questions in the bank can also be increased automatically by developing plugins for creating new types of questions in the Moodle e-learning system. One such is shown in (Pehlivanova and Kanchev, 2018).

- Restrict the IPs from which the test can be run

When conducting tests in computer labs (as is done in FTT - Yambol), all computers have the same external IP address. Llimiting the the test to be available for only one IP or network ensures that it will only be completed by computers in the building of the university, faculty or even specific computer laboratory. Access to the test may, however, also include people who are not present in the exam room. To prevent this, the next technological measure is built into Moodle.

- Require a password

In order to gain access to the test, students must enter a password. Say the password only in the hall just before the exam begins. When testing a small number of students, enter the password personally without saying it publicly. Change the password before each exam.

- Use pop-up screen

When you setting up the test, in the field “additional restrictions > browser security” select “Full screen pop-up with some JavaScript security”. The test appears in a pop-up window that covers all other windows and has no navigation controls on the course. Students do not have the ability to copy and paste, which is the most commonly used action when cheating. This is not appropriate if there are questions in the test that require Internet use.

However, it is impossible to create a browser window that cannot be minimized or moved aside.

- Use Safe Exam Browser (SEB)

The Safe Exam Browser is a customised web browser that must be downloaded and installed on the device that the student uses to attempt the quiz. The restrictions for students are similar to those in the ‘pop-up window’ case, but because Safe Exam Browser is software running on the student's computer, it can do a much more effective job of restricting their actions. Features include full screen, no web navigation options. The shortcut keys, including copy and paste, switch to other applications and of course the internet search are deactivated during the exam. SEB cannot be closed until submission of the test (Safe exam browser, 2019).

Using Safe Exam Browser is only possible if the system administrator has previously enabled built-in support in the field Settings > Site administration > Development > Experimental > Experimental settings. This adds the choice 'Require Safe Exam Browser' to the 'Browser security' field on the quiz settings form.

Other private solutions are also known that restrict the use of unauthorized communications and materials through Moodle and the access to Moodle by using the network addresses of the computers used by examinees. One such solution is the tool MoodleGate, presented in (Matos and Barber, 2013).

- Restrict access to old courses for the same discipline.

In many universities, new courses are created each year in which current students enroll. Students often join old courses in the same discipline that contain the test, solve it, and learn some of the questions. Therefore, it is a good idea if there are old courses using the same question bank, they to be with limited access. New course should also be with limited access to prevent others to join it, for example, former students or students from other majors with access to Moodle who will "solve" the test and get the answers.

3.2.Organizational Measures

- Simultaneously conducting the exam for all students
- Conducting in computer labs in the presence of a lecturer
- Appropriate location of computer desks and screens
- Clear information for students which materials are allowed to use and which are forbidden

3.3.Methodical Measures

- Using Creative Questions

Encourage students to show a higher level of knowledge of the material. Let them use books, textbooks and notes and ask questions that require creativity, critical thinking or analysis. It is not appropriate to ask questions whose answers are immediately found in Google. Even if you use a locked browser or other measures for the computers, each student has a cell phone that you cannot lock.

- Using Calculated Questions

This type of questions is very suitable for assessment in technical disciplines. When generating the question, a number of combinations of values can be obtained at random in a predetermined range. In this way, students will get different values and have to do the calculations themselves to get the right answer.

- Give less weight to the tests

Make the final assessment by combining the tests with the development of projects and other active forms of training.

3.4.Psychological Measures

- Introducing a honor code in the University

This can make students feel more responsible and reduce cheating. In (LoSchiavo and Shatz, 2011) is presented a study according to which randomly part of the students were asked to sign an honor code before the start of the evaluation. In various tests, the number of students who signed the code and acknowledged cheating is up to 30% smaller than those who have not signed.

- Explaining the technical capabilities of LMS

Make students understand Moodle's tracking and signing capabilities. If they have understood that their actions in Moodle are recorded in log files, they will not try to deceive the technology.

- Strict penalties for the cheaters

If the cheaters do not receive adequate penalties, then it will be an incentive for the next to risk and also try fraud.

Conclusions

Creating of electronic tests and evaluating with them is a responsible task that needs to be done competently by each examiner.

A great deal of students uses perfectly the new technologies and this allows some of them to make electronic tests with cheating.

To prevent cheating in conducting electronic tests, lecturers must take technological, organizational, methodical and psychological measures. These measures are described in detail in this paper.

References

Watson G. R. and Sottile J. (2010) Cheating in the Digital Age: Do Students Cheat More in Online Courses? *Online Journal of Distance Learning Administration13,* 1, 798–803

LoSchiavo, F. M. and Shatz M. A. (2011) The Impact of an Honor Code on Cheating in Online Courses,*MERLOT Journal of Online Learning and Teaching, 7,* 2, 179-184

Safe exam browser, https://docs.moodle.org/37/en/Safe_exam_browser, accessed 2019

Pehlivanova, T. I. and Kanchev, K.T. (2019) Number of questions for creating online quizzes, *Applied Researches in Technics, Technologies and Education7,* 1, 58-63

Pehlivanova, T. I. and Kanchev, K.T. (2018): Plugin for creating a new type of questions in moodle. In *Proceedings of The 5th International Conference on Technics, Technologies and Education,* Trakia University, Stara Zagora, Faculty of Technics and Technologies, Yambol, 179-186

Matos, R. and Barber J. (2013): Moodlegate: Securing computer driven exam environments.*In Proceedings of INTED2013 Conference,* Valencia, 5175-5181

Hierarchical Interdependence of Language Aspects in Virtual Educational Environment

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Abstract

The article discusses the issue of creation of an exercise apparatus, namely the nomenclature of tasks and sequence of their implementation into the framework of virtual educational environment intended for foreign language training. Such aspects of foreign language teaching as linguistic (linguistic material), psychological (professional competences, skills and learning motivation) and communicative (communication behavior) are considered. The basic methodical principles of modern teaching of foreign languages are determined taking into account the potential and facilities of virtual educational environment, namely, communicativeness, which involves the construction of the process of foreign language training as a model of real communication; integrativeness, which requires the inclusion of information from other disciplines into training and communicative exercises; the dominant role of communicative tasks and their interactivity, which contributes to the formation of foreign language communication skills in speech activity, developing creativity and imagination; the focus on achieving social interaction, ensuring the development of intercultural competences, tactical skills and teamwork; interdependence of speech activities, which directs the process of foreign language learning into the boundaries of real communication process, in which speaking, listening, reading and writing are interconnected; adaptability, which allows the teacher to organize self- study of new and previously studied material directly in the classroom or outside the auditorium.

Keywords: Learning tools, Virtual educational environment, Professional competence, Educational technologies

1 Introduction

The concept that the possibilities of virtual educational environments for foreign language training have no limits is accepted by scholars (Chang et.al.2012; Simsek and Tan, 2015; Walker and White, 2013). Various training platforms exist in the Net and are successfully used by educators all over the world (e.g.www.voluxion.com). But the issue of exercise apparatus creation with regard to the nomenclature of tasks and sequence of their implementation into the framework of virtual educational environment intended for foreign language training remains relevant today.

2 Content Components of Foreign Language Learning

Any language is usually characterized by linguistic, psychological, and communicative aspects. Virtual environment can add to these universally recognized aspects the globalization aspect due to the interconnectedness and interdependence of peoples and countries. (Nault, 2006; Block, 2004; Guilherme, 2007) Nowadays these aspects function as a single whole and provide opportunity to any foreign language to be an interactive didactic, information, as well as communication tool to young people. Foreign language as a complex and multi-aspect concept is globally discussed in terms of communicative competences, proficiencies, cross-cultural experiences, etc. (Phillips, 2007). The basic methodical principles of modern teaching of foreign languages taking into account the potential and facilities of virtual educational environment are the following: communicativeness, which involves the construction of the foreign language training process as a real communication model; integrativeness, which requires the inclusion of information from other disciplines into training and communicative exercises; the dominant role of communicative tasks and their interactivity, which contributes to the formation of foreign language communication skills in speech activity, developing creativity and imagination; the focus on achieving social interaction, ensuring the development of intercultural competences, tactical skills and teamwork; interdependence of speech activities, which directs the process of foreign language learning into the boundaries of real communication process, in which speaking, listening, reading and writing are interconnected; adaptability, which allows the teacher to organize self-study of new and previously studied material directly in the classroom or outside the auditorium.

The main aim of any foreign language teaching is practical one that's why lecturer in the process of training in the conditions of virtual educational environment utilization will face all four of the above aspects, which should be considered as learning objects inside the virtual educational environment, i.e. components of the foreign language learning content.

2.1 Linguistic Aspect

The main prerequisite for the controlled formation of foreign language speech activity is lexical material mastering. Under the linguistic aspect any lexical material with two branches - *speech material* (words, collocations, phrases, sentences, texts, dialogues, etc.) and *language material* (grammar means of speech design) is considered. Speech material should be assimilated by students to the level of active/passive language proficiency – for free usage in oral and written speech but this becomes impossible without mastering the grammar material. So, the first step in the hierarchical staircase of virtual educational environment creation is the linguistic aspect with speech and language material as constituents.

In the conditions of a virtual educational environment the training process (in the form of reproductive exercises performance) provide rapid information and appropriate authentic material (Tomlison, 2009). It includes such subject actions in mastering linguistic and lexical material as: scoring, visualization, animation of unfamiliar lexical units, embedding them in the dictionary series of synonyms / antonyms, independent search for their meaning, making phrases and sentences; identification or recognition of familiar language forms based on their representation in virtual / augmented reality, etc. All these actions, presented in the form of appropriate exercises, serve to comprehending and remembering of linguistic material, They not only assist in extracting information, but also remove the entropy of the text. Mastered linguistic material, used on the next level of the hierarchical ladder, will help to overcome psychological barriers and discover a new world with a foreign language.

2.2 Psychological Aspect

The second component of the language – psychological - is the basis for the system of organization of material for productive speech and it should be the second step in the hierarchy. The psychological aspect is considered as the keystone in the formation of the ability to speech activity and communicative behavior. The assimilation of speech culture contributes to the development of skills and the formation of students' skills as well as the psychological conditions will determine the flow of the learning process (Ariyanti, 2016). Overcoming of psychological barriers which include affective (motivation, anxiety, attitudes) and cognitive factors (language aptitude; attention; memory) changes learners' learning attitudes and enhances their self-confidence (Lin and Yang, 2011), which, in turn, allows them to concentrate and to get rid of fear before the unknown and to start foreign language communication easily. The main objective of this training stage is formation and development of speech skills. Fitting up the virtual educational environment with nominally-communication exercises system (given as a set of successive speech/writing actions for multiple repetitions) promotes the achievement of this goal, enhance language learning and motivate learners to learn more (Gençlter, 2015). Repeatability is ensured by the use of speech samples (models) based on lexical material studied at the previous level. Such exercises for skills formation ensure automatism in the possession of previously learned lexical material and at the same time prepare students for exercises with complete freedom of choice at the next stage of training - the communicative one.

2.3 Communication Behavior and Globalization

At the third stage of the hierarchy is the communicative aspect, where the potentiality and facilities of virtual educational environment can be fully disclosed, namely, *communicativeness*, which involves the construction of the process of foreign language training as a model of real communication; *integrativeness*, which requires the inclusion of information from other disciplines into training and communicative exercises; *the dominant role of communicative tasks and their interactivity*, which contributes to the formation of foreign language communication skills in speech activity, developing creativity and imagination; *interdependence of speech activities*, which directs the process of foreign language learning into the boundaries of real communication process, in which speaking, listening, reading and writing are interconnected; *adaptability*, which allows the teacher to organize self-study of new and previously studied material directly in the classroom or outside the auditorium.

The communicative aspect involves entering into the teaching of the utilization of foreign language as a means of communication in professional activities or at the every-day-life level. It is assumed that the language is acquired directly in its function and under the conditions of interaction of all four aspects of the language. Students need to master the skills of communication, critical and logical thinking, creativity, and problem solving. (Hendi and Yuliati, 2016). Virtual educational environment is an ideal tool for creating conditions corresponding to real speech communication. Its use in the educational process allows to create conditions when the student can independently enjoy language in its natural function – for cooperative work (Keser, Uzunboylu, & Ozdamli, 2012), to receive and send information, to participate in the conference, to look for a way out of situation, to help friends, to give advice, etc. At the same time, the material that was presented at the previous levels is remembered peripherally, motivation appears to improve the acquired skills, and students turn to be more "globally-minded" in this changing world (Phillipson, 2001) by means of educational content that includes "world" issues.

So, the fourth level of the hierarchy is globalization aspect which is focused on the achieving of social interaction, ensuring the development of intercultural competences, tactical skills and teamwork. Types of activities at this stage allow reaching real functional oral/written speech communication and include (among others) four most popular online communication tolls. They are e-mail, chat, instant messaging, SMS and Trillian (all-in-one), Video conferencing services (e.g. ezTalks Cloud Meeting), Interactive whiteboards, VoIP (Voice over IP).

3 Results

From the point of view of learning management, it is difficult to overestimate the importance of the virtual educational environment as a holistic learning system, which includes the apparatus of exercises developed in a certain way. Taking into consideration close interconnection of all levels of the exercise hierarchy, tasks in them are created as a sequential course. Moreover, all the auxiliary tools of the virtual educational environment (scoring, visualization, images adding, animation, search engines, interactivity) act as motivational elements stimulating the further speech act.

3.1 Exercises for Linguistic Material Learning

Exercises for the assimilation of lexical and grammatical material serve to comprehend and remember linguistic material, which in the future becomes the basis for further foreign language mastering.

Instructions for Exercises for lexical material familiarization and assimilation prescribe various operations with forms and words. As a rule, these are exercises for written performance. Communicativeness in exercises of this type is assumed only with an avatar, who gives an assessment of the completed task. Therefore, when programming exercises, it is advisable to include emotionally-evaluating phrases into the avatar "phrasebook". Here are some examples of the tasks of this type which were used in the interactive virtual educational environment "Your amazing ecoland" (Author – I.Vereitina).

Task 1 Can you say? Let's do it!

1. Pronunciation drills

2. Tongue twister poem. Read as fast as you can

3. Which word is different? Part of speech. Make up three more word lines

Task 2 Can you translate and explain? Let's do it!

1. Do you remember the meaning of the following words? Fill in the table

2. Find the meaning of the following words

3. Guess the word. The meaning is given to you.

4. Fill in each space with one letter to create words.

5. Rewrite the extract filling in the missing letters if necessary.

Task 3 Can you read and understand? Let's try!

1. Match the words with their correct translation and find the derivative.

2. Fill in the gaps using the necessary words. Answer the questions.

3. Rewrite the extract and guess the word.

4. Attention! Game! The winner is the student who will be the first to make and write questions out of the given set of words.

5. Read the following text, draw in your notebook and complete the table by filling the columns with the underlined words according to the part of speech they are in the text and by forming all possible parts of speech. The example is given.

3.2 Speech Skills Exercises

Such system is usually a set of sequentially located, multiple repeated written and speech actions. Conventionally, such exercises can be divided into two sub-levels – training level and situational one. Taking the speech sample (model) as the basis and using the vocabulary of the previous stage of training (linguistic material), the skills of using this material in speech are automated. The studied material becomes a formative element when performing situational exercises.

1. Make a word combination. Use the verbs given below.

2. Fill in the gaps with prepositions on, into, of, in, with, to, for.

3. Below find information on different operating systems. Fill in the table with appropriate information according to the picture.

4. Choose the ending to the beginning of the sentences and read the text.

5. Think over and fill in the necessary word from the list given below.

6. Dictate the following text to your group mate.

7. Supply the appropriate form of the verb choosing one from given in brackets. Read the sentences and explain the grammar form.

3.3 From Communication in the Class to Communication in the Net

The virtual educational environment is based on a self-learning model, the main elements of which are corrective reproduction, contextualization of situations and real speech communication.

Communicative forms of work are a set of real life situations that should stimulate the performance of a speech action in accordance with the needs of a non-speech action. Exercises of this level are built on the super-phrasal level. The main advantage of these exercises is that when they are performed, the student enjoys the freedom of choice not only of the companion and the means, but also of the content of the statement. opportunity. Here are some examples of such exercises.

1. Write the short monologue in which give the one-sentence definition of energy. Begin your short monologue with phrases As far as I know (remember); To tell the truth; They say; In fact; I suppose; I think; I believe; To my mind; In my opinion. Consult your dictionary.

2. Explain to your group mates the purpose of complex methods for geochemical and sedimentological investigation of the different deposits. Use information taken from the Cordis Focus magazine for your explanation (№62, 2007).

3. Prepare the presentation using information given below

4. Questions are a good opportunity for you to interact with your audience. It may be helpful for you to try to predict what questions will be asked so that you can prepare your response in advance. You may wish to accept questions at any time during your presentation, or to keep a time for questions after your presentation. Normally, it's your decision, and you should make it clear during the introduction. Be polite with all questioners, even if they ask difficult questions. They are showing interest in what you have to say and they deserve attention. Sometimes you can reformulate a question. Or answer the question with another question. Or even ask for comment from the rest of the audience. Google for the answers and check yourself.

5. Answer the questions and expand upon the problem of population growth on Earth and its influence on the ecosystem of the planet.

6. Humanity uses many kinds of energy: renewable and non-renewable. To make sure we have plenty of energy in the future, it depends upon all of us to use energy wisely. We must all conserve energy and use it efficiently. It also depends on those of you who want to create the new energy technologies of the future. One of you might be another Albert Einstein and find a new source of energy. It depends upon all of us. The future belongs to us, but we need energy to get there. Get familiarize yourselves with the composition of the Earth atmosphere, given in the D. M. Gates book «Energy and Ecology» (p.43); Propose the source of energy to save air clean for future generation.

7. Watch the episode, discuss what you have seen and present your position from the point of view of the total world energy consumption.

8. Imagine working on a project to build an experimental reactor, demonstrating the scientific and technological possibility of producing energy by recycling of materials of biosphere. But you have no colleagues. Prepare the bulletin online, aimed to keep researchers up to date with developments on the European stage. Clarify the harm of wastes for humans and invite colleagues for the joint research. Use the additional information.

9. Research and report on how plant and animal populations have increased, decreased, or disappeared on the Earth during the last 100 years. Prepare and send your foreign partner an e-mail in which give arguments for Ukraine.

10. Find in the Internet some episodes concerning biosphere stability or the noosphere or the place of the human in the biosphere. Watch the episodes; make up ten questions on the topic. Send e-mail message to your pen-friend with these questions and ask him/her to answer.

11. The Second International Conference on Closed Life Systems defined biospherics as the science and technology of analogs and models of Earth's biosphere; i.e., artificial Earth-like *biospheres. Others may include the creation of artificial non-Earth biospheres–for example, human-centered biospheres or a native Martian biosphere–in the field of biospherics. The purpose of your project is to build a working ecosystem that is capable of sustaining human life without any input except energy and which could be transported into space and continue to function as viable ecosystem (barring the effects of the lack of gravity) .Unlimited energy resources will be assumed. The problem being addressed is the cycling of matter within the biosphere and keeping it balanced. Design therefore disregards energy conserving measures, though where practical they will be employed. Get acquainted with the extracts from the project Biosphere II which was designed by Ray R. Collins (Fairbanks, Alaska) in 1988.*

The system of exercises in a virtual educational environment consists of a complex interweaving and interaction of approaches to the formation of tasks, which allows us to ensure effective foreign language learning.

4 Conclusion

All of the above gives reason to conclude that the virtual educational environment for teaching a foreign language should contain an apparatus of exercises consisting of four systems, each of which ensures the assimilation of one of the language aspects. So, exercises for familiarization and memorization of material are fragmented and involve actions at the level of words and sentences, speech skills are formed as a result of multiple repetitions of speech patterns, and communication skills are developed on the basis of speech units above the sentence, using the structure of natural speech. Differing functionally in the frames of virtual educational environment these aspects coexist, complement each other and provide the opportunity to learn several aspects of the language at the same time.

References

Ariyanti (2016). Psychological factors affecting EFL students' speaking performance. ASIAN TEFL Vol. 1 No.1, 2016 www.asian-tefl.com e-ISSN: 2503-2569, p-ISSN: 2527-5038 doi: ttp://dx.doi.org/10.21462/asiantefl.v1i1.14

Barker, J. & Gossman, P. (2013). The learning impact of a virtual learning environment: students' views. *Teacher Education Advancement Network Journal*, 5(2), 19-38.

Block, D. (2004): Globalization and language teaching. ELT Journal: English Language Teachers Journal; 58 (1) 75-77

Chang, B., Si, M., Sheldon, L., Hand, A., (2012). Foreign language learning in immersive virtual environments. *Proceedings of SPIE - The International Society for Optical Engineering 8289*:1- · February 2012. DOI: 10.1117/12.909835

Conacher and H. Kelly-Holmes, eds. *New learning environments for language learning: moving beyond the classroom?* Frankfurt am Main: Peter Lang, pp. 189-204.

Gençlter, B. (2015): How does technology affect language learning process at an early age? Procedia -Social and Behavioral Sciences, 199(2015), 311 –316. doi: 10.1016/j.sbspro.2015.07.552

Guilherme, M. (2007): English as a Global Language and Education for Cosmopolitan Citizenship. Language & Intercultural Communication; 7 (1) 72-90

Hendi, P. and Yuliat (2016): Global Education in English Classroom:Integrating Global Issues into English Language Teaching. *International Journal of Social Science and Humanity*, Vol. 6, No. 9, September 2016719 doi: 10.18178/ijssh.2016.6.9.739

Keser, H., Uzunboylu, H., & Ozdamli, F. (2012): The trends in technology supported collaborative learning studies in 21st century. World Journal on Educational Technology, 3(2), 103-119.

Lin, W., & Yang, S. (2011): Exploring students' perceptions of integrating Wiki technology and peer feedback into English writing courses. English Teaching: Practice and Critique, 10(2), 88-103.https://eric.ed.gov/?id=EJ944900

Nault, D. (2006): Going global: rethinking culture teaching in ELF contexts. Language,Culture and Curriculum, 19:3, pp. 314-328

Phillips, June K. (2007). Foreign Language Education: Whose Definition? *The Modern Language Journal*. Vol. 91, No. 2 (Summer, 2007), pp. 266-268 https://www.jstor.org/stable/4626010

Phillipson, R. (2001): English for Globalisation or for the World's People? International Review of Education 47 (3-4). 185-200.

Rose, H., (2017): Global approach to English language teaching: Integrating an international perspective into a teaching methods course Preparing Teachers to Teach English as an International Language, Publisher: Multilingual Matters, Editors: Aya Matsuda, pp.171-18 doi:10.21832/9781783097036-014

Simsek, I., Can, T., (2015): The Use of 3d Virtual Learning Environments in Training Foreign Language Pre-Service Teachers**.** *Turkish Online Journal of Distance Education* 16(4):16-4, October 2015 DOI: 10.17718/tojde.53012

Tomlinson, B. (2009): Materials development in language teaching. Cambridge: Cambridge University Press

Walker, A., & White, G. (2013): *Technology Enhanced Language Learning. Connecting Theory and Practice*. Oxford, UK: Oxford University Press.

Using Distance Educational Methods For Training People, Experienced High Psycho-Emotional Stress

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Abstract

The article presents the results of the joint research project between the Laboratory of Social Projects of Belgorod State University and Belgorod Law Institute, conducted in 2019. In order to collect primary sociological data the following methods are used: (1) the expert survey, where the experts are the staff and teachers from the above-mentionedinstitutions of higher education (n = 9); (2)the survey ofstudents, attending the retraining program, who experienced high psycho-emotional stress in the past (n = 220). The results of the research show that there are a number of difficulties in education of people, experienced high psycho-emotional stress:(1) vivid emotional reactions in response to a teacher or students' verbal and non-verbal actions; (2) behavioral disorders due to the consequences of former stressful profession; 3) respondents' individual and psychosocial characteristics. To increase the efficiency of education, we propose a number of distance learning methods: (1) the method of cognitive visualization of cases taken from respondents' professional activity,which perform illustrative as well as cognitive function in the learning process; (2) the research method, which allows the student to show more independence, creativity in his/her educational trajectory; (3) the information-receptive method is aimed at the assimilation of information through the use of various electronic didactic tools; (4) the reproductive method is based on the implementation of different exercises and tasks, contributing to the formation of the practical skills.

Keywords: distance educational methods, psycho-emotional stress.

1 Introduction

Distance learning is one of the most rapidly growing fields of education which is in demand of different categories of learners, especially those who have some difficulties inmasteringthe materials in traditional way, for example, disabled, elderly, people experienced high psycho-emotional stress, etc.

A number of studies emphasize the importance of using distance learning technologies to educate people who have experienced high psycho-emotional stress [1; 2]. For example, G. Virgil (n = 570), studying the degree of concern of people about the disclosure of their medical diagnosis, found that most respondents were negative about disclosing information about their physical or mental health, referring to confidentiality [3]. At the same time, the success of the educational process depends, on the one hand, on the conditions of the social and educational environment, and on the other hand, on the psychological and emotional state of the student himself, who has experienced a high level of stress.

Y. Lee states that education of people experienced high psycho-emotional stress is due to several factors, including public skepticism about the need to educate certain categories of the population and doubt about its effectiveness and usefulness to the society; the need to increase funding sources to ensure sustainable development of distance learning and to create various software products to meet the people' needs [4].

The use of modern distance technologies and various gadgets in everyday life (computers, laptops, smart phones, readers, etc.) provides new opportunities for professional retraining and advanced training of people experienced high psycho-emotional stress. Distance learning technologies allow them to choose their own pace of studying at a particular time and focusing on their ownhealth and emotional well-being.

2. Main Part

2.1 Data and Methodology

The article presents the results of the joint research project between the Laboratory of Social Projects of Belgorod State University and Belgorod Law Institute, conducted in February - August 2019 in the western region of Russia - Belgorod region. In order to collect primary sociological data the following methods are used: (1) the expert survey, where the experts are the staff and teachers from the above-mentioned institutions of higher education (n = 9); (2) the survey of students, attending the retraining program, who experienced high psycho-emotional stress in the past (n = 220). Processing and analysis of the collected primary data was carried out using the following methods: (1) compilation of comparative tables; (2) commented primary texts.

2.2 Results and Discussion

The results of the research show that there are a number of difficulties in education of people, experienced high psycho-emotional stress. The comparative data,collecting from experts as well as students are presented in Table 1.

Table 1 – The assessment of traditional open education methods

№	Criteria of assessment	Experts, %	Students,%
1	Vivid emotional reactions in response to a teacher or students' verbal and non-verbal actions	54,2 %	41,9 %
2	Behavioral disorders due to the consequences of former stressful profession	52,3 %	40,1 %
3	Respondents' individual and psychosocial characteristics	51,6 %	38,6 %

Thus,experts assessed the existing difficulties more seriously, pointing out that more than half of students have experienced some kinds of challenges and almost every student has multiple types of them.

According to the research, distance learning can eliminate many of the difficulties experienced people with high psycho-emotional stress during undergoing professional retraining and increase the effectiveness of education. In order to look at the education process from teacher's and student'spoints of view, we also asked students, attending the retraining program about the most effective methods of distance learning. The comparative data analyses are presented in Table 2.

Table 2 –The assessment of effectiveness of distance learningmethods

№	Criteria of assessment	Experts,%	Students,%
1	The method of cognitive visualization of cases taken from respondents' professional activity, which perform illustrative as well as cognitive function in the learning process	74,5 %	79,4 %
2	The research method, which allows the student to show more independence, creativity in his/her educational trajectory	71,2 %	74,2 %
3	The information-receptive method is aimed at the assimilation of information through the use of various electronic didactic tools	70,3 %	72,1 %
4	The reproductive method is based on the implementation of different exercises and tasks, contributing to the formation of the practical skills	53,8 %	41,8 %

The interpretation of the results, providing experts as well as students, show that the first priority is given to method of cognitive visualization, research and information-receptive methods, the reproductive method is viewed as less important.

Table 3 – The assessment of types of electronic materials

№	Criteria of assessment	Experts,%	Students,%
1	Complex audio-video files	89,3%	90,3 %
2	Professionally oriented workbooks	71,6%	82,6 %
3	Electronic textbooks	70,1%	73,5 %
4	Video files only	49,2%	47,3 %
5	Audio files only	33,1%	32,1 %

As we can see from Table 3, most experts as well as students give similar answers regarding types of electronic materials that are used in education. The majority of representatives of both groups focus on complex audio-video files and oriented workbooks, less often on electronic textbooks.

3 Conclusions

At present, training people, experienced high psycho-emotional stress in the past is an acute social and educational issue, because this is one of the vulnerable groups of people receiving education. The research helped to detect a number of challenges **facing distance learning students who** experienced high psycho-emotional stress: (1) vivid emotional reactions in response to a teacher or students' verbal and non-verbal actions; (2) behavioral disorders due to the consequences of former stressful profession; 3) respondents' individual and psychosocial characteristics.

To increase the efficiency of education, we propose a number of distance learning methods: (1) the method of cognitive visualization of cases taken from respondents' professional activity, which perform illustrative as well as cognitive function in the learning process; (2) the research method, which allows the student to show more independence, creativity in his/her educational trajectory; (3) the information-receptive method is aimed at the assimilation of information through the use of various electronic didactic tools; (4) the reproductive method is based on the implementation of different exercises and tasks, contributing to the formation of the practical skills. The most effective methods are complex audio-video files and oriented workbooks.

References

[1] Colleen, D., 2017. Public attitudes toward disclosing mental health conditions, Social Work in Mental Health, Vol. 15, Iss. 5, Pag 588-599.

[2] Virgil, G., 2010. Cognitive-Behavioral Therapy for Schizophrenia: Applications to Social Work Practice, Social Work in Mental Health, Vol. 8, Iss. 2, Pag 140.

[3] Virgil, G., 2010. Cognitive-Behavioral Therapy for Schizophrenia: Applications to Social Work Practice, Social Work in Mental Health, Vol. 8, Iss. 2, Pag 140-159.

[4] Lee, Y., 2015. Older adult education: new public pedagogy in 21st Century Taiwan. Australian Journal of Adult Learning, 55 (3). URL: https://www.ajal.net.au/older-adult-education-new-public-pedagogy-in-21st-century-taiwan. DateViews 03.07.2019.

An approach to using Instagram in secondary education

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Abstract

In this paper, the authors study the possibility of applying Instagram in education and increasing the level of knowledge of high school students. The use of the Instagram app aims to motivate students to gain and improve knowledge of economics, develop environmental awareness and increase awareness of the importance of caring for their health using modern services. The possibility of improving the teaching process in secondary education by introducing mobile and pervasive technologies that would make the teaching process more effective and attractive to students was tested by posting "Challenges" on Instagram. This paper presents the research that was done with students of the third grade of secondary vocational school in the period March - May 2019

Keywords: Instagram, secondary education, e-education,social media

1 Introduction

Social networks and mobile technologies have become an integral part of the lives of a large part of the world's population. Historically, mobile technologies and social networks were originally used for entertainment, personal needs and direct communication. Over time, these technologies have become widely used in business communication and collaboration. Today, there is an increasing trend in the use of these tools in teaching, as well as a growing interest of the academic community and a growing number of diverse studies on these topics(Arceneaux & Dinu, 2018a). The basic idea is to reach a level where mobile devices and applications are not considered a problem in the educational process, but as a tool available to lecturers to advance educational practice.

There is an obvious ubiquity of using mobile and smart technologies in education, both formal and informal, as well as increasing interest of theacademic community for research in this field.The main idea is to achieve a level where mobile devices and applications are not considered as a distraction but as a tool for improving the practice of teaching and learning(Stojanović, Bogdanović, & Nedeljković, 2016).

Social media uses mobile and web technologies to create interactive platforms through which individuals and communities share, create and modify content generated by users (Kietzmann, Hermkens, McCarthy, & Silvestre, 2011).

The most important social media are (Dewing, 2010):

• Blog - one of the first and most basic social media, easy-to-create online blog form. It is organized chronologically and accessible to a large number of users, enabling them to express their opinions, views, as well as the ability to link to other blogs and online articles;

• Wiki - a collective website where participants can create new content or modify existing content. The most famous example of using wiki technology is Wikipedia;

• Bookmarking - allows users to organize and share links to other websites;

• Social Networks - Web services that allow users to create public or semi-public profiles, create lists of users with whom they share certain content, and view a list of user activities to which they are associated(Boyd & Ellison, 2007);

• Microblogging - allow users to share short messages in a form of a post and view other users' posts;

• Content sharing sites - Users can post and share content such as videos or photos (e.g. YouTube and Instagram).

When educational institutions recognized the potential of using social media as a marketing and educational tool, the idea of using social media gained importance(Gilroy, 2010). Social media allows learning to take place regardless of physical location and to make the learning process creative, thanks to social interaction and online collaboration.

Through sharing information, knowledge and experience using various tools, social media users learn from each other and receive social support by participating in online activities and interacting with other users(Hajli, Bugshan, Lin, & Featherman, 2013;Labus, Simić, Barać, Despotović-Zrakić, & Radenković, 2012).

The paper presents an idea based on Instagram challenges that were realized in e-commerce classes at a high school of economics, where students were given a new form of learning through the Instagram social network. After completing the challenge, students completed a survey on the general use of the Instagram social network, its use for educational purposes, and specific questions about the challenge. Based on the results of the challenge analysis and the survey, conclusions were drawn and will be presented below. The methodology, as well as a full description of the challenges posed to students were also presented.

Social networks have great potential and it is necessary to react in a timely manner to harness this potential. The paper presents some of the benefits of integrating social networks for educational purposes and provides suggestions for possible ways to use them.

2 Literature review

Academic research on the use of mobile devices and social networks in the field of education has intensified since 2005, with the most commonly analyzed student population followed by primary and secondary school students. The most commonly analyzed social networks used in the education process are Facebook, blogs, Twitter and Instagram (Tess, 2013).

Statistics show that 88% of college students in America use social networks(Newberry, 2019). In Serbia, it is estimated that 75% of people between the ages of 18 and 24 have a profile on one of their social networks(Jevtić & Zelenović, 2015). As this number grows year by year, it is necessary to consider how and whether it is possible to use social networks to assist students in education.

The first surveys were conducted in the developed Western countries, where mobile technologies first came to life, while more recent research is increasingly covering the fields of developing societies. In addition to analyzing the practice and efficiency of conducting the education process through mobile technologies and social networks, a great deal of research has included the development of specific applications for the specific educational needs of the analyzed sample(Mavroudi, Divitini, Gianni, Mora, & Kvittem, 2018). The ultimate goal of applying individual research is most often identified in the advancement of the entire state education system, after synchronized education of trainers, improvement of access to mobile technologies and the Internet and motivation of students and students to use modern technologies for the purposes of acquiring and sharing knowledge and familiarity with the curriculum and activities.

The largest number of studies conducted so far on the use of mobile technologies in the field of education has shown that these devices have a positive impact on the effectiveness of learning in secondary schools and colleges(Wu et al., 2012;Al-Bahrani & Patel, 2015;Kassens, 2014).

Previous research has shown that students use modern technology the least in the field of education and learning, although they state that they are very open to the future application of these technologies in learning(Roblyer, McDaniel, Webb, Herman, & Witty, 2010). With regard to the way students use mobile technologies in the field of education, academic research has shown that internet content is interchangeable, combined, and created by new users(Halder, Halder, & Guha, 2015). Internet enables simpler way of work collaborationfor solving problems posed by a senior lecturer. In addition to the process of learning and sharing knowledge, mobile technology can also be used to facilitate the organization of teaching activities and the communication of professors and students(Arceneaux & Dinu, 2018b). The intensity of the use of modern technologies in the field of education is increasing with the greater engagement of teachers and their inclusion on social networks, which are already used by students(Timothy, Jeffrey, Kaitlyn, & Margarita, 2016). Social media has proven particularly effective in specific vocational schools, such as information technology, language, or medical schools.

Although great benefits are expected from the use of mobile technologies and social networks in the field of education, some studies have shown that there is sometimes aversion towards the use of these technologies for learning by students(Al-Bahrani, Patel, & Sheridan, 2015). The reason behind this aversion is a desire to isolate private and "student" lives and the fear of being overwhelmed by the always accessible and practically unprecedented content. In addition, a large number of teachers take a cautious approach to the use of modern technologies for educational purposes.The fear of various types of abuse, cheating in the learning process and other psychological, pedagogical and social consequences of using these technologies are some of the reasons for teachers to be distrustful towards the usage of modern technologies for educational purposes (Veletsianos & Navarrete, 2012; Stojanović et al., 2016).

2.1Instagram in Education

Instagram is a free app that was released in October 2010. The application is primarily intended for use through mobile devices, but there is also the possibility of access through other platforms. The main functionality is that it allows users to process and share photos and videos, both within the app itself and on other social networks if they link their account from the app to accounts on other social networks. In addition to these features, Instagram is getting a new one in 2013, an Instagram story that allows users to share videos for up to 15 seconds that are visible to other users for the next 24 hours. Recently, Instagram television functionality has also been introduced, allowing users to post videos longer than 60 seconds. (Instagram, 2019).

Instagram is considered the fastest growing app in the world. In 2017, it was reported that Instagram has 700 million active users per month(Rouse, 2019). In addition to users using the app for personal use, it is estimated that around 2 million advertisers worldwide use Instagram to promote their business or products(Clarke, 2019). Statistics today show that Instagram has a billion active users a month, and more than 500 million use the app every day(Clarke, 2019). Of the total application users, 71% are under 35(Clarke, 2019) and 53% of users are in the 18- to 29-year range (Bischoff, 2016)which is the student age range. As many as 500 million users use Instagram stories every day(Clarke, 2019).

There are a myriad of possibilities for how social networks can be used for educational purposes, especially Instagram. As a platform that provides the ability to communicate through photos and videos, it is well suited to convey any message.

3 Methodology

The research was conducted as part of the e-commerce course at the Secondary School of Economics, in the second semester of the academic year 2018/2019, and lasted between March and May 2019. It involved participating students in various activities on the Instagram social network and then completing a survey related to the activities mentioned.

3.1 Procedure

For the purpose of this research, an Instagram “campaign” was conducted that lasted for three months, from March to May 2019. The Instagram "campaign" was divided into sections that presented interactive challenges, followed by an Instagram announcement marking the beginning of the challenge. Students in the subject of e-business were informed about the implementation of the "campaign" and presented the benefits of successful participation in it. Following the "campaign", a survey was made that covered both Instagram usage in general and for educational purposes, as well as questions regarding the specific Instagram "campaign" we conducted.. The campaign covered two challenges:

- Learn a new word and explain their meaning
- Clean environment, healthy environment

Students in the e-business course had the right to participate in the challenges.All students took an active part in all the challenges during the "campaign" and were rewarded with additional points on the subject in accordance with their engagement.

3.1.1 The first challenge - Learn a new word and explain their meaning

The first in a series of challenges was a challenge “Learn a new word and explain their meaning”. The challenge was announced the day before via an Instagram story, and on the very day the challenge began with a post that illustrated an example of a successfully fulfilled challenge. The task could be completed within the next 5 working days.

The idea behind this challenge was for students to write as many words in economics as they thought were relevant and needed to be known. Students posted the words to their Instagram profiles with the hashtag #naucinovurec.

Since the challenge appealed to the students, it was extended for another 5 days. The new assignment was to write words that they felt they needed to learn and relate solely to the modules the students were learning in the subject of e-business. They posted the words on their Instagram profile with the hashtags #e-business, #e-commerce, #e-banking.

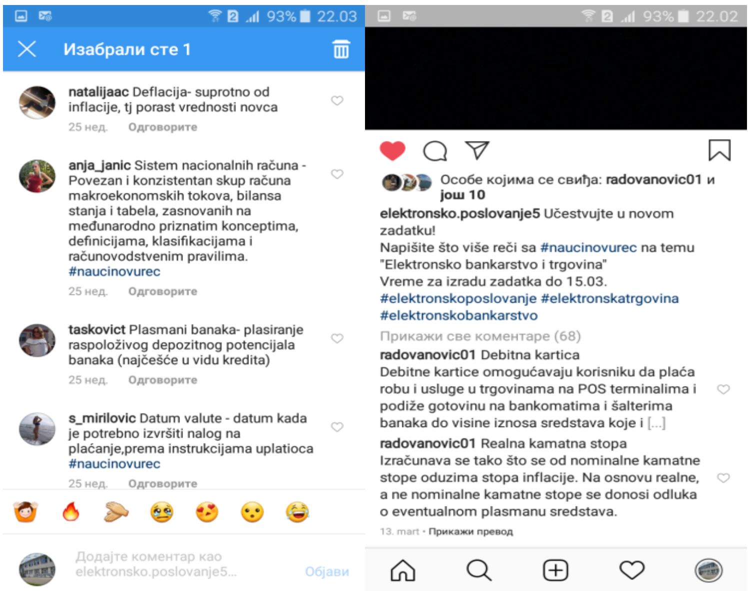

Figure 1. An example of a challenge

3.1.2 The second Challenge -Clean environment-healthy environment

The second in a series of challenges was a "clean environment-healthy environment" The challenge was announced the day before via Instagram story, and on the very day the challenge started with a post that illustrated an example of a successfully fulfilled challenge, and which described all the requirements related to the challenge. The task could be completed within the next 5 working days.

The idea behind this challenge was to show examples of healthy and clean environments through the image or video as well as the development of environmental awareness among students. The students were tasked with giving an example of the contaminated environment they noticed in their surroundings and suggesting that they should "solve the problem". Participants posted related content to their Instagram stories with the hashtag #healthyenvironment.

4 Results analysis

The Instagram "campaign" consisted of two challenges and lasted a total of three months. After each challenge, the participants' published solutions were saved in prominent stories on the school's Instagram profile, so that the results could be tracked even after each challenge had been completed.

The Instagram story as functionality offers a lot of information about whether the content was liked by the users, how many of them saw the particular content, whether they shared, saved or similar. All of this is of great importance for our research, and below we will process the data for each challenge individually. More than 30 people followed the profile during the campaign. Following the "campaign", a survey was conducted for each of the challenges. Survey included several questions that could be answered by circling one out of five options: 1 – totally disagree, 2 – disagree, 3 – neither disagree nor agree, 4 – agree, 5 – totally agree. The results of the surveywill be presented as well, for each challenge individually.

Table 1 *Learn a new word and explain their meaning*

Question	Mean score	Standard deviation
It helps me learn something new.	4.46	0.92
It helps me be more productive.	4.11	0.86
It helps me to learn the given material..	3.84	0.89
It gives me more control over the learning activities.	4.05	0.73
Teachers should encourage the use of the app for educational purposes.	4.24	0.91
It's fun to use it for educational purposes.	3.92	0.82
It gives me more motivation to complete the task at hand.	4.19	0.83

The results from Table 1 show that the students find the application useful to learn something new (4,46), but do not find it to be fully appropriate to learn the given material within the individual modules (3,84).

Table 2 *Clean environment, healthy environment*

Question	Mean score	Standard deviation
The development of environmental awareness among students is essential	4.51	0.60
I think the challenge is interesting	4.46	0.79
I don't think the challenge makes sense	3.78	0.99
The challenge motivated me to think about ecology	4.00	0.96
The challenge motivated me to stay more in nature	4.24	1.08
Teachers should encourage students to use Instagram for educational purposes.	4.30	0.98

The results in Table 2 show that students consider the development of environmental awareness in students important (4,51), but do not find the challenge fully meaningful (3,78).

4 Conclusion

This paper is an example of the possibility of applying Instagram in the high school education process. The students of the third grade of secondary economic school participated in the research. The goal was to motivate students to expand their knowledge of economics, develop an awareness of the importance of environmental conservation, and increase care for their health by using a step-measuring application. The main advantages of using Instagram in education are the ubiquity of student use of the app, its ease of use, and the great daily use of mobile phones by students.

Future work will focus on the development of multiple tasks and a complete technical and educational evaluation of the system.

Acknowledgement

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References

Al-Bahrani, A., & Patel, D. (2015). Incorporating Twitter, Instagram, and Facebook in economics classrooms. The Journal of Economic Education, 46(1), 56–67.

Al-Bahrani, A., Patel, D., & Sheridan, B. (2015). Engaging students using social media: The students' perspective. International Review of Economics Education, 19, 36–50.

Arceneaux, P. C., & Dinu, L. F. (2018a). The social mediated age of information: Twitter and Instagram as tools for information dissemination in higher education. New Media & Society, 20(11), 4155–4176.

Arceneaux, P. C., & Dinu, L. F. (2018b). The social mediated age of information: Twitter and Instagram as tools for information dissemination in higher education. New Media & Society, 20(11), 4155–4176.

Bischoff, M. (2016). 15 Universities That Are Nailing It on Instagram (And What You Can Learn from Them) - eCity Interactive. Retrieved from https://www.ecityinteractive.com/blog/14-universities-that-are-nailing-it-on-instagram-and-what-you-can-learn-from-them/

Boyd, D. M., & Ellison, N. B. (2007). Social Network Sites: Definition, History, and Scholarship. Journal of Computer-Mediated Communication, 13(1), 210–230.

Clarke, T. (2019). 22+ Instagram Statistics That Matter to Marketers in 2019. Retrieved from https://blog.hootsuite.com/instagram-statistics/

Dewing, M. (2010). Social media: An introduction. Retrieved from https://quotebanq.com/wp-content/uploads/2018/05/Social-Media-An-INtroduction.pdf

Gilroy, M. (2010). Higher Education Migrates to YouTube and Social Networks. The Education Digest, 75(7), 18–22. Retrieved from www.eddigest.com

Hajli, M., Bugshan, H., Lin, X., & Featherman, M. (2013). From e-learning to social learning – a health care study. European Journal of Training and Development, 37(9), 851–863.

Halder, I., Halder, S., & Guha, A. (2015). Undergraduate students use of mobile phones: Exploring use of advanced technological aids for educational purpose. Journal of Media and Communication Studies, 7(4), 81–87.

Jevtić, J., & Zelenović, J. (2015). Internet and social networks in the promotion of higher education institutions. Ekonomija: Teorija i Praksa, 8(2), 17–30.

Kassens, A. L. (2014). Tweeting Your Way to Improved #Writing, #Reflection, and #Community. The Journal of Economic Education, 45(2), 101–109.

Kietzmann, J. H., Hermkens, K., McCarthy, I. P., & Silvestre, B. S. (2011). Social media? Get serious! Understanding the functional building blocks of social media. Business Horizons, 54(3), 241–251.

Labus, A., Simić, K., Barać, D., Despotović-Zrakić, M., & Radenković, M. (2012). Integration of social network services in e-education process. Metalurgia International, 17(7).

Mavroudi, A., Divitini, M., Gianni, F., Mora, S., & Kvittem, D. R. (2018). Designing IoT applications in lower secondary schools. IEEE Global Engineering Education Conference (EDUCON), 1120–1126.

Newberry, C. (2019). 130+ Social Media Statistics that Matter to Marketers in 2019. Retrieved from https://blog.hootsuite.com/social-media-statistics-for-social-media-managers/

Roblyer, M. D., McDaniel, M., Webb, M., Herman, J., & Witty, J. V. (2010). Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. The Internet and Higher Education, 13(3), 134–140.

Rouse, M. (2019). What is Instagram? - Definition from WhatIs.com. Retrieved from https://searchcio.techtarget.com/definition/Instagram

Stojanović, D., Bogdanović, Z., & Nedeljković, N. (2016). Upotreba mobilnih tehnologija u srednjoškolskom obrazovanju. Zbornik Radova XLIII Simpozijum o Operacionim Istraživanjima - SYM-OP-IS 2016, 71–74.

Tess, P. A. (2013). The role of social media in higher education classes (real and virtual) – A literature review. Computers in Human Behavior, 29(5), A60–A68.

Timothy, P. G., Jeffrey, B., Kaitlyn, L., & Margarita, V. D. (2016). Delivery of educational content via Instagram. Medical Education, 50(5), 575–576.

Veletsianos, G., & Navarrete, C. (2012). Online social networks as formal learning environments: Learner experiences and activities. The International Review of Research in Open and Distributed Learning, 13(1), 144.

Wu, W. H., Wu, Y. C. J., Chen, C. Y., Kao, H. Y., Lin, C. H., & Huang, S. H. (2012). Review of trends from mobile learning studies: A meta-analysis. Computers & Education, 59(2), 817–827.

Specific Opportunities for Visualization a Reason for Modern Interior Design Education

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Abstract

The design of furniture today is as important as the spatial planning of an object, its structure, materials and walls. This condition is due to the fact that contemporary architecture truly reflects the life habits and social organization of today. The activity of modern design is enriched with new features and tasks that lead to its differentiation, and from there, we notice changes in the theory and practice of design education. The type of seating position is a challenge for analysis and processing, as well as studying seating positions for different purposes depending on the specific seating position and the need for how long it is used. The review is based on the design of chairs in the symphony orchestra as a specific way of sitting for performing a certain work activity.

Key words: Design education, Chair position, Ergonomics, Interior

1 Introduction

The authors Kok et al. (2016) recommends focusing only on factors that are risky when problems arise during playing, due to the fact that there is little room for variation in the movement of the body while playing. The factors that would take into account are the repertoire of the musician or the conditions in which the action takes place.

The conditions in which the musician performs the repertoire is the piece of furniture-chair on which he sits while playing the instrument. In this context, the ergonomic factor of the chair should be taken in relation to the musician-construction of the chair and the quality of the surface of the seat (Despot et al., 2017; Zlatev et al., 2019).

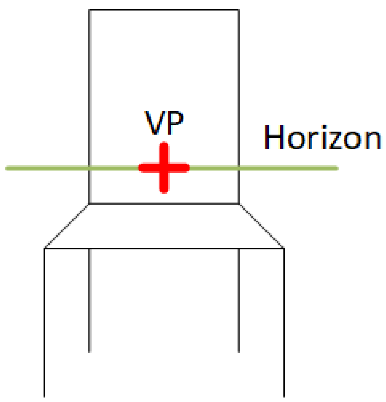

Figure 1. Chair with one point perspective, horizon and vanishing point (VP)

We can only assume how many types of chairs exist, approximately as much as the number of different people. The chair as an object is available to everyone, exists in various forms that are transformed depending on the material, it can be simple in its concept or with a different meaning. The base form consists of a horizontal surface at a standard distance from the floor intended to support the body while sitting, the vertical surface is set to support the back (Figure 1).

Besides the basic elements, the chair consists of many more elements. The psychological connection with the user (Steinmetz et al., 2015; Indrie et al., 2017), which is stronger than with any other furniture, can be a symbol of status and belief.

The authors Fiell et al. (1993) write that the success of a chair is measured by the designer's synthesis of aesthetics and function while meeting certain needs. Designer George Nelson argues that the shape of the chair consists of three factors: function, aesthetics and material.

2 Materials and Methods

This paper covers extensive analysis and research on the sedentary position, the characteristics and problems that man faces every day at different seating positions.

The problems that arises from long hours of sitting in a specific working position (Litchfield, 1893; Nelson, 1994; Gibbs, 2005). Through ergonomic analyses and various tests, data are obtained for the ideal seating positions of pre-defined positions, backed up by the construction and selection of materials that facilitate the seating and workload of a person during a job position.

The design activity is enriched with new features and tasks that lead to its differentiation, and from there, we notice changes in the theory and practice of design. Expanding the range of contemporary design is realized not only through the line of enriching the content, but also thanks to the growing uninterrupted information links between different needs - social, economic, cultural or contemporary design extends the territorial scope and scope of its application.

3 Results and Discussion

In recent decades, the interest in the magnitude of the human body and dimension as a critical factor in the design has grown. This interest is greatest in the field of engineering (Zlatev, 2016)and education, including contemporary learning tools (Dineva et al., 2011; Nedeva et al., 2013; Shivacheva et al., 2016) that deals with the human factor or as it is called in Europe ergonomics.

Age is another important factor in the size of the body. The human body reaches its highest growth in teenage years and the early twenties, while reduction in growth in both sexes occurs with aging.

Although attempts have been made to standardize anthropometric measures in terms of definitions and terminology, the interpretation and significance of the recorded data is often complicated. Architects and industrial designers must bear in mind that the same factors that make up anthropometry complex and monotonous require serious access to the application of its data.

The seating dynamics can be more clearly illustrated by studying the mechanics of the carrier system and the structure of the bones in the human body. According to *Tichauer*: "The torso support axis is a line that passes through the lowest point of the pelvis on the surface of the seat."

Marcuse (1975) disorders associated with musical performance are a problem for professional musicians.

Given the numerous consequences that musicians have in using musical instruments, these consequences can be considered a threat to their professional activity. In this issue, musicians of wire instruments are considered as a target group. Defects in the upper body position when playing the instrument, causing ergonomic static back pressure and non-ergonomic movements, are the main cause of musculoskeletal disorders and pain syndromes commonly occurring in the spinal column.

Literature related to seating comfort (Nikol et al. 1993; Sembach et al., 2002; Sousa et al., 2016) states that seat pressure is a basic measure that is associated with the user's comfort when sitting. One of the studies to be noted is carried out by three authors from the University of Naples based on the data carried out on the basis of the measurement. This study analyses the seating comfort test during experiments involving 22 volunteers and 4 different chairs. Research in the field of medicine has shown that in recent decades back pain in the population has increased due to sedentary lifestyle as a result of the long period of sitting.More than 60% of people have at least one type of back pain during the working period. Ergonomic solutions of stools are taken as a preventive solution. The purpose of their study was to explore the biomechanical aspects of ergonomic office chairs as a benchmark for further designers to improve human health.

Specialized literature does not recognize the definition of comfort, but in recent years there are assumptions that comfort and discomfort are two different things.

The comfort is based on subjective analysis and analysis of the position of the body while the discounter is an objective analysis of the acquired problems.

Ergonomics of music chairs: This study consists of 40 examinees-musicians all at different levels (professionals, amateurs and students) and 6 different music chairs with different ergonomic features.

The differences that occur between the chairs are mainly related to the distribution of the pressure along the seating surface. Playing an instrument adds extra force to the surface of the chair, greater than the weight of the instrument. When playing one instrument, the body adapts to fast, repetitive, asymmetrical, complicated movements of hands and fingers. In order to support these movements, the torso simultaneously performs static work. These combined movements of dynamic and static muscular work in the respective parts of the body are accumulated by increasing the level of performance in terms of intensity, density, duration, degree, occurrence and frequency of movement. Additional loads on the motion systems are associated with instrument-specific performance, and in the worst case, it can cause overload. This can lead to symptoms such as pain in the chin, back, neck, shoulder and arms.

These symptoms that occur when playing certain instruments are most commonly associated with musculoskeletal disorders, and are therefore referred to most frequently and are analyzed in this paper in order to confirm the given hypotheses. These disorders emerge among professional musicians, students, as well as amateur musicians, concluded by various research carried out by several authors. By analyzing the previously conducted research it can be concluded that taking a position typical of playing a particular instrument causes an unfavorable position of the body. The effects of playing different regions of the musculoskeletal system have so far been observed in many cases using different measurement techniques highlighted by various authors.

In order to compare the different ergonomic concepts of the chairs with respect to the musical position, the distribution of the seating pressure is just as important as the upper part of the body, which must be assumed to be adjusted to the pelvic position during sitting. Whether the different concepts of music chairs depending on the position of playing compared to the usual seating position have different effects on these aspects is the subject of this study. Various researches on a wide range of musicians have been made to determine whether the level of professionalism, experience or the way of playing play a role in sitting. Through this analysis, two hypotheses are identified: Hypothesis 1: The geometry of the chair affects the sitting position.Hypothesis 2: The sitting position depends on the professional level of the musician.

Ergonomic movements and positions are a necessary condition for continuous instrumental performance. The economic in this context means that the musician applies minimal physical effort to maintain the position of the body and the movements. Musculoskeletal discomfort usually generates a desire to avoid certain pain. The musician is forced to try out alternative positions of the body using additional muscles, leading to deviation from the necessary direction of movement that can impair performance. The occurrence of musculoskeletal dysfunction is generally reflected early in the unhealthy holding of the body.

After considering all aspects of problems in the specific seating positions of the musicians of wire instruments that are still included in the category of specific positions of the long-term sitting, design concepts should be made which will be used by the musicians, which would facilitate their working pose.

The design of chairs for the specific seating positions is primarily limited by pure functionality, where particular attention is placed on the horizontal and vertical structural connection of the chair and its choice of material, also the main emphasis should be placed in the part of the backrest where it should be supported by the third vertebrae on the spinal column, which would ensure the safety of the sitting position in a long-term performance with the upper part of the body, as presented on Figure 2. The choice of the upholstery material to be made of intelligent textile that would avoid sweating and contribute to sedentary incompetence, it enters the category of modern design that we cannot skip and the changes that prompt in this field the rapid development of technology and technology, and possibilities of production.

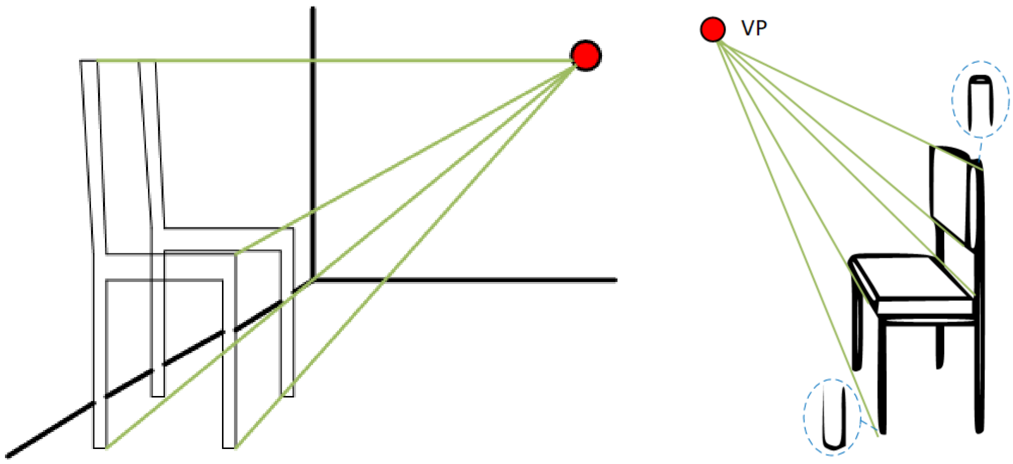

Figure 2. Chairs with their perspective and orthogonal

4 Conclusion

While musicians who play the instrument in a standing position can use the whole body, musicians in a sitting position cannot use their legs and knees to compensate for the asymmetric moves the body takes in playing. A good chair should be reimbursed to maintain the most favorable position of the body where the bulk of the weight is prevalent in the ischemic tuberculosis or bone for sitting.

A table designed for anthropometric dimensions does not necessarily mean that it is convenient. If the design does not correspond to the measures of the human body and the size of the body, then sitting will be uncomfortable.

Musicians should be aware of the prevention and equipment of orchestral musicians to be the best from an ergonomic point of view.

Knowledge of different types of stools that satisfy certain instrumental groups can contribute to the prevention of musculoskeletal disorders.

References

Despot, K., Sandeva, V., Namicheva, E. (2017): TimeLESS concepts of the sitting form-chairs. *International conference "Utopia and Future"*, Bulgaria. 2017.

Dineva, S., Stoikova, V. (2011): Application of Interactive Devices and Virtual lab in Chemistry Learning. *Proceedings of the 6th International conference on virtual learning* (ICVL), Romania, 261-267.

Fiell, C., Fiell, P. (1993): *Modern chairs*. Kèoln: Benedikt, Taschen, 1993.

Gibbs, J. (2005): *Dizajn enterijera*. Jenny Gibbs, Translator Daniela Ninković, Aleksandar Pavić. Srpsko izd. – Beograd, Don Vas.

Indrie, L, Kazlacheva, Z, Ilieva J., Gherghel, S. (2017): Embroidery-from digital designing to fine art. *Revista Industria Textilă*, 68, 5, 366-369.

Kok, L., Huisstede, B., Voorn, V., Schoones, J, Nelissen, R. (2016): The occurrence of musculoskeletal complaints among professional musicians: a systematic review. International archives of occupational and environmental health, 89, 3, 73-96.

Litchfield, F. (1893): Illustrated History of Furniture from the Earliest to the Present Time. Project Gutenberg's Illustrated History of Furniture.

Marcuse. S. (1975): *A survey of musical instruments*. David & Charles, Newton Abbot. 1975.

Nedeva, V., Dineva, S., (2013): Design and development of efficient e-learning courses. *Proceedings of the 11th International conference on virtual learning* (ICVL), Romania, 108-115.

Nelson, G. (1994): *Chairs*. New York: Acanthus Press.

Nicol, K, Rusteberg, D. (1993): Pressure distribution on mattresses. *J Biomech*, 26, 14, 79-86.

Sembach, K., Leuthauser, G., Gossel, P. (2002): *Twenthieth-Century furniture design*. Taschen.Koln. 2002.

Shivacheva, G., Nedeva, V. (2016): Methods for Teaching Programming Using Virtual Laboratory. *Proceedings of the 11th International conference on virtual learning* (ICVL), Romania, 92-98.

Sousa, C., Machado, J., Greten, H., Coimbra, D. (2016): Occupational diseases of professional orchestra musicians from northern Portugal: a descriptive study. *Medical Problems of Performing Artists*, 31, 1, 8-12.

Steinmetz, A., Scheffer, I., Esmer, E., Delank, K., Peroz, I. (2015): Frequency, severity and predictors of playing-related musculoskeletal pain in professional orchestral musicians in Germany. *Clinical Rheumatology*, 34, 9, 65-73.

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. *Proceedings of 11th International Conference on Virtual Learning* (ICVL), Romania, 209-213.

Zlatev, Z., Indrie, L., Ilieva, J., Ivanova, T. (2019): Analysis on colors of folk costume and their application in contemporary textile design. *Annals of the university of Oradea Fascicle of textiles, leatherwork*, 20, 1, 125-130.

Tutorial for Improving Student Skills in the Area of Power Quality

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Abstract

The paper presents a tutorial for learning about power quality problems, especially neutral conductor dimensioning. This method is explained in a case study in order to familiarize future engineers with the concept of power quality. The teaching method is based on the concept of design of electrical installations where electrical energy is analysed both by variation of supply voltage and the presence of harmonics. In order for the electric receptors to function properly it is necessary to ensure that the voltage at their terminal matches as closely as possible their nominal voltage, which involves avoiding voltage drops over the established limits in the power conductors. For this purpose there are fixed limits for the percentage of losses of voltage in networks at the terminals of the branches and in the installations used, limits that must not be exceeded. The presence of harmonics in electrical networks is also analyzed because they are those that increase additional losses on the lines of transport, in asynchronous electric motors, and in transformers, as well as the danger of the apparition of over-voltages that cause high insulation demands. This learning by doing technology is finalised by analysis of experimental results.

Keywords:tutorial, power quality, voltage, harmonics

1. Introduction

According to thestandards in the area of electricity, power distribution systemsmust provide their customers electrical energy with certain characteristics that define power quality.In practice, power systems have many nonlinear loads, which affect the quality of power supplies and the sinus waveform of the power supply is lost.Besides nonlinear loads, there are some system events, such as capacitor switching, motor starting and sometimes faultsthat could also provokepower quality problems. (Mehebub A., Mandela G., 2014)

The objective of thispaper is to highlight the importance of the correct dimensioning of the neutral conductor in power installations in order to ensure the quality of electricity delivered to consumers.

The overall structure of the paper includes three sections, first of them being the introduction. Section II describes the lecture with basic knowledge of dimension of power conductors and harmonics presence in current signal, from a theoretical point of view. Section III presents thepractical activities related to thethe study of voltages and currents from power transformer, representing the designing aneutral conductor for an electrical network and handling of experimental equipment. Finally, the conclusion gives a brief summary of the learning and training in the area ofpower quality.

2. Theoretical considerations

In case of electric transport networks, distribution networks and generally when electricity is transported over large distances, it is compulsory to consider the dimensioning of conductors and the limits of percentage losses of voltage.

Therequested powers values provided by the currentare determined firstand then the following are established:

- conductor section is chosen;
- heating check of the section is obtained by establishing the density of current in the conductors in permanent mode as well as in transitional mode;
- voltage dropin conductors is be checkedboth in rated and transient mode.

Incase of short-circuit fault, the stability of the network during the time of fault,the consequences for consumers after arc extinction and the elimination of the defect all depend on the way the neutral points of the power transformers are treated.

The neutral point treatment method is a complex problem, linked to several factors, the most important of these being the stability of the network in the event of a grounding. (Daniel O. J. et.all, 2014)

The purpose of treating the neutralpoint,is that when a phase is grounded, power supply to the consumers is not interrupted and conditions are created so that the electric arc can be extinguished in the shortest possible time. The value and nature of the current circulating in the ground in the place and time of the electric arc depend on the nominal voltage of the network, the type of the lines (aerial or cable), their lengt, and not least of the mode of treatment of that network.(C. Venkatesh, et. All, 2010)

The mode of treatment of the neutral point must contribute to the rapid liquidation of the grounding arc, if it is possible without interrupting the supply of consumers.

Frompoint of view of the position of the neutral to the ground, the following types of networks may exist:

-electrical networks with isolated neutral, in which the neutral has no connection with the ground;

-compensated networks with the neutral bound to the ground through coils, with the reactance of enough small value that, in the case of a defect between a network phase and ground, the inductive current circulating between the place of defect and coil compensates substantially the component of the defect current. In case of a network correctly compensated by the extinguishing coil, the resulting current at the point of defect is thus limited so the electric arc of the earthgoes out spontaneously in the air;

-electrical networks with ground-bound neuters, either directly or through a durable or reactance of sufficiently low value.

Aspart of electric networks design it is necessary to take into consideration the harmonics effect. In AC voltage and current signalsharmonics are presents. These are integral multiples of the supply fundamental frequency, 50Hz. Generally, in a three-phase system odd harmonics are analyzed: 3^{rd}, 5^{th}, 7^{th}, and so on. When these harmonics haveimportant values, they result in distorted waveform of supply voltage.Harmonics are caused bywelding machines, powerful electronic equipment, variable drives, etc.A few consequences of harmonics presence are increased neutral overload in 3-phase systems, overheating of all cablesand decreased efficiency of electric machines.(Keerthana Suganthi.V,et.all,2014).

2.1 Dimensioning of the neutral conductor

This subchapter analyses the problems regarding the dimensioning of the neutral conductor in the presence of electrical energy quality problems, for example, of multiple-ranking harmoniccurrents. This situation is important in low voltage networks, in which the harmonic pollution determined by the single-phase tasks is increased. The harmonic currents multiples of 3 are gathered arithmetically in the neutral conductor towards the fundamental harmonic and the other harmonics which in a unbalanced system are geometrically added and cancel one another.

Therefore an electric current is obtained in the neutral conductor which can reach very high values compared to the other active phases, respectively up to 170% of the current on the phase.

In case of a three-phase system with linear single-phase loads-different on each phase, the current in the neutral conductor is different from zero.When a non-linear load is supplied and the load is unbalanced on the three phases, it is most probable that an important electrical current appears in the neutral conductor.

Thus, the three or multiple of rank three harmonics of the phase currents are zero' sequence components that gather arithmetically and not geometrically and therefore do not cancel one another. Due to these three harmonics, the current in the neutral conductor can exceed the current amplitude of the industrial frequency phase.

For poly-phased circuits the neutral conductor will be able to have a smaller transverse section if the following conditions are met cumulatively:

- the maximum current foreseen (including harmonics) in the neutral conductor in normal operation is not greater than the load capacity of the reduced section in the neutral conductor;
- the neutral conductor is protected from overload;
- the cross-sectional area of the neutral conductor shall be at least 16 mm^2 copper or 25 mm^2aluminum.

3. Case study

To analyse power quality of distributed energy, an experimental study was conducted on the substation by measuring the parameters of energy to output of power transformer. The analysed parameters are: currents, voltage and harmonics. The measurements are registered for five days.

3.1 Experimental layout

These results are obtained using the quality analyser connected to outputs of a power transformer. The transformer supplies single phase and three phase consumers with maximum 6.7 % drop voltage.The power quality is monitored for five days.

The measurement results are shown in the following charts.

3.2 Measuring results for voltages

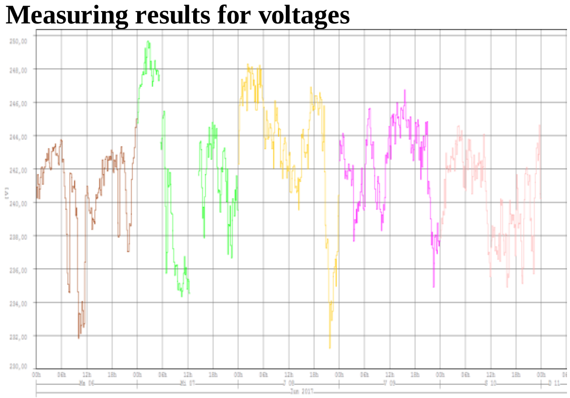

*Figure 1*Voltage on phase "R" of power transformer

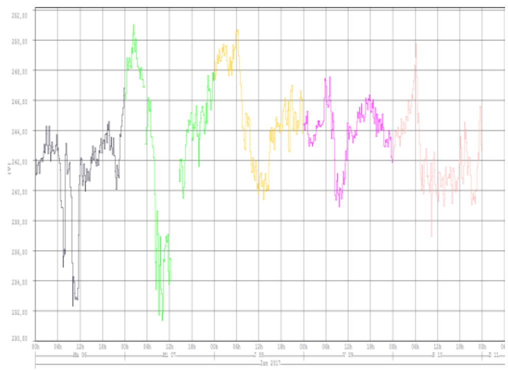

*Figure 2*Voltage on phase "S" of power transformer

Figure 1 presents the measurements made on phase "R" of circuit of the power transformer. The results of these measurements over the five days indicate a maximum voltage of 249 V and a minimum voltage of 231 V. The conclusion it is that we have observed increased voltage over short periods of time with values 8% higher than the normal standard.

Figure 2 shows the measurements done on the “S”-phase of output of the power transformer with a maximum voltage of 251 V and a minimum voltage of 231 V. Over short periods of time we have noticed an increase in voltage with a value higher by 9% than the standard.

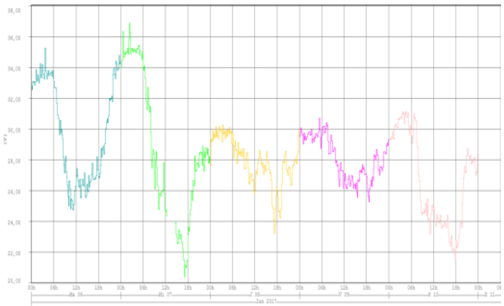

*Figure 3*Voltage on the neutral conductor of power transformer output

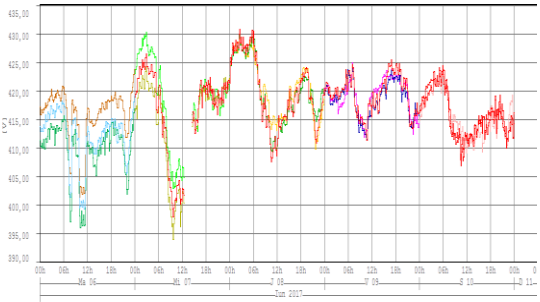

*Figure 4*Circuit line voltage of power transformer

Figure 3 presents measurements made on the neutral conductor of the power transformer circuit. Maximum voltageis 37 V and minimum voltage is 20 V. Notice how, due to different types of loads, the neutral conductor has a potential 37 V higher than the theoretical 0.

Figure 4presents the measurements of the line voltage with values ranging from 431 V to 394 V, values that fall within the allowable limits of a partially balanced network. The allowable values are limited bya percentage ± 10% to the nominal standard of rated voltage, in this case 400V.

3.3 Measuring results for currents

In the second phase currents are measured for the active and neutral conductors of the power transformer.

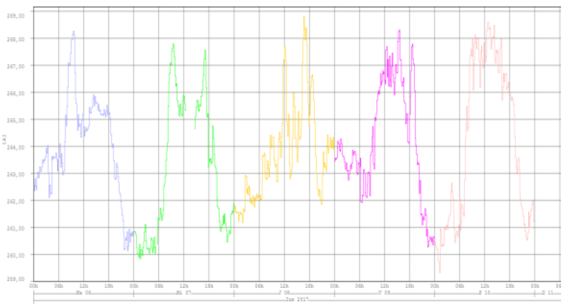

Figure 5 Current on phase R of power transformer output

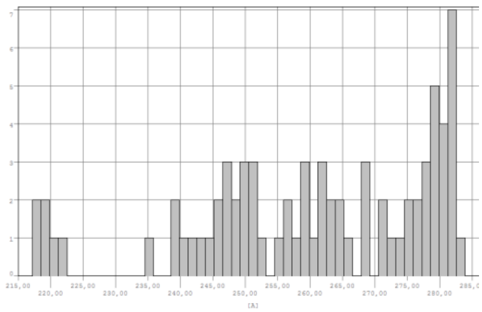

Figure 6 Current on the neutral conductor of the power transformer circuit

Figure 5 presents measurements done on phase R of the power transformer outputs. The results of these measurements over the five days indicate a maximum current of 268 A and a minimum current of 260 A. Note that the circuit must be protected by a fuse or automatic of minimum 280 A.

Figure 6 presents measurements done on the neutral conductor of the powertransformer output. Over the five days,the maximum current through the neutral conductoris 7 A and the minimum one is 0 A.Note that the circuit does not require protection in the distribution box of the power station.

3.4 Measurement results for harmonics

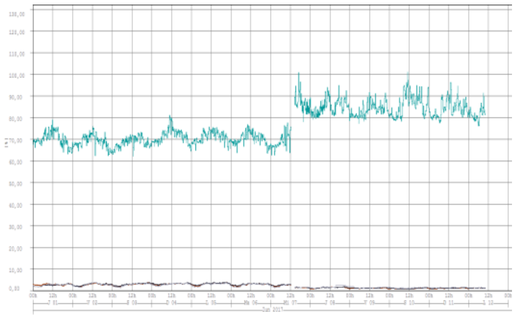

Figure 7 Harmonic distortion on active conductors of circuit power transformer

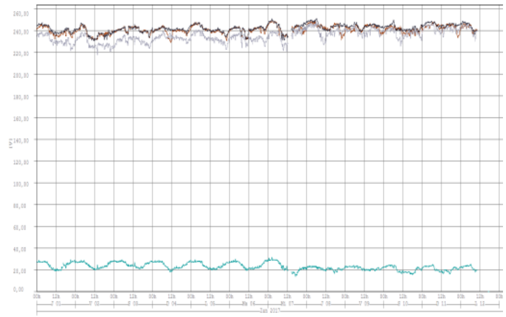

Figure 8 First harmonic on circuit power transformer

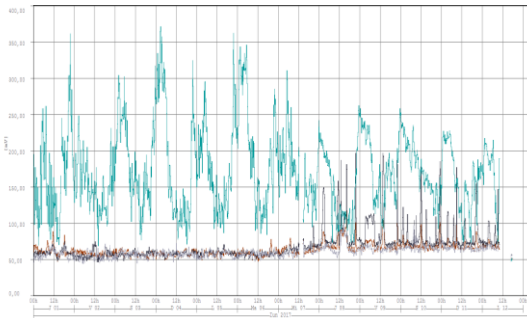

Figure 9 Harmonic rank 24 on circuit of power transformer

Figure 7 presents the results of measurements takenat power transformer outputswith the distortion of 1 to 24 harmonics, with values between 6% and 8% of the phase voltage value and 0% and 1% of the value of the neutral voltage. These values can be reduced by using filters for different types of consumers or by distributing consumers on the three phases depending on theloads.

Measurements presented in figure 8 are done on power transformerand indicate a distortion of the first harmonics with values between 2 and 10 volts of the phase voltage value and 1 and 3 volts of the value of the neutral voltage.

Measurements presented in figure 9done on power transformershowa distortion of the 24-rank harmonics, with values between 100 and 350 mV of the phase voltage value and 50 and 60 mV of the value of the neutral voltage.

Discussions

In low voltage installations the increase ofelectrical potential on the neutral conductoris provoked by the different loads in the power grid. This electrical potential can reach up to 51% of the nominal phase voltage, becoming dangerous for all receptors supplied by the distribution network. A potential solution for reducing the electrical potential of the neutral conductor balancing of single-phase consumers on different phases.

Circulation of current harmonics in an electrical network can be controlled and limited by harmonic filters. Harmonic filters connected to the derivation in electrical grids of distribution can be used for this purpose.

For low voltage distribution installations, the most efficient and safest method of treatment of neutrals remains the grounding of the installations, as it presents a lower risk to the operating personnel and for the possible damage.

Conclusions

This paper presents the development of a method using theoretical and experimental partsmethod that aids in better understanding of power quality problems and that can be used for teaching and tutorials. This may serve as a powerful tool to teach basic power quality concepts to the students in a simplified and easy-to-understand way. Theexperimental measurementspresentingconsequences of power quality events on voltage and currents waveform were discussed. Other power quality events may be monitored by further development of the software.

Based on this experience the electrical engineering students will learn to present a few measures to monitor the quality of electric power. The learning method is useful for students, based on experimental results provingthat this method is efficient.

References

Journals:

Mehebub Alam, Mandela Gain, Power Quality Problems and Solutions: An Overview,International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Volume 3 Issue 10, October 2014

Daniel O. Johnson, Kabiru A. Hassan, Issues of Power Quality in Electrical Systems, International Journal of Energy and Power Engineering. Vol. 5, No. 4, 2016, pp. 148-154. doi: 10.11648/j.ijepe.20160504.12

C. Venkatesh, D.V.S.S. Siva Sarma, Techniques used for Detection of Power Quality Events – a Comparative Study, 16th National Power Systems Conference, 15th-17th DECEMBER, 2010

Keerthana Suganthi.V, Madhuridevi.L, Sindhuja.K,Development of Software Tool for L Classroom Teachingof Power QualityLABVIEW,2014 International Conference on Advances in Electrical Engineering (ICAEE) , DOI: 10.1109/ICAEE.2014.6838506, Publisher: IEEE

The Road from Blackboard Learning Management System to Moodle Learning Management System in Modern Universities

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Abstract

In this modern and smart technologies era, unlimited access to online resources is a must, and the millennial learners are smart learners. In academic environment, the learners' needs mandates teachers to create great sharable content and to provide an innovative learning experience.E-learning systems has increasingly become an important key element of the institution's strategy for delivering online learning. In this regard, choosing the right Learning Management System (LMS) is crucial. After nine years of proprietary system LMS (Blackboard) usage, the University Alexandru Ioan Cuza of Iasi (UAIC) has decided to move on to an Open-Source Software(OSS) LMS (Moodle), mainlyto avoid the high licensing fee, but also because it is configurable, highly-flexible, feature-rich and more open to be used on all types of mobile devices.The migration of courses process from one LMSto another it requires close planning, impliestechnical and decision making issues, and could be influenced by various factors: user perception, staff development, institutionalorganization. This paper try to cover the experience of UAIC in switching from Blackboard LMS to Moodle LMS, and also to provide other universities with a migration process model as an example for their resembling endeavors.

Keywords: E-learning, Open-Source Software, Moodle, Learning Management System migration.

1. Introduction

The role of the university in today's society is evolving in a direction difficult to define, finding itself between the tradition it represents and a new social framework, where knowledge and learning is online and the required qualifications are more present in virtual spaces than in a traditional classrooms, as it shows in Figure 1.

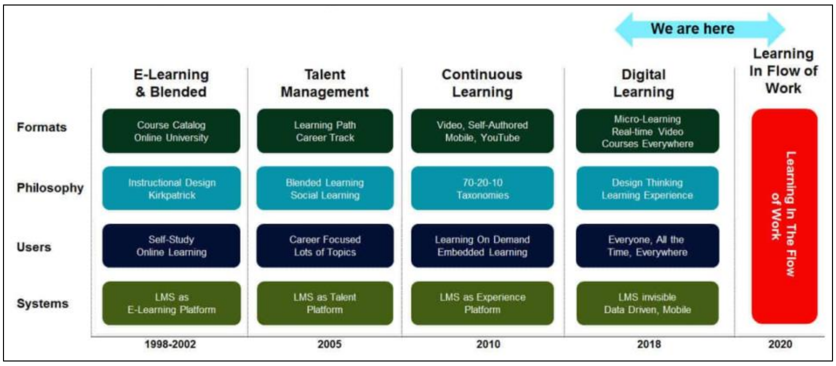

Figure 1. The evolution of learning, from classrooms to digital

Source: Josh Bersin(2018), available at https://joshbersin.com/2018/06/a-new-paradigm-for-corporate-training-learning-in-the-flow-of-work/

In order to maintain their identities and also to be up to date with the latest trends, a lot of the universities from around the world are becoming smarter than ever. In the past and now many of them have used Information and Communications Technology (ICT), Cloud Computing and Internet of Things (IoT) to improve performances related to education process, utilities, student's community and other services. Also the today's learners become more and more smarter, are well-informed and interested aboutso-called “communicative learning”, using to this aim the e/m-learning technologies (Boltonet al.,2013;PînzaruandMitan,2013), mobile gadgets and online tools as well as social network sites (Bergh and Behrer, 2011; Horváth et al., 2014). Their needs mandates teachers to create great sharable content and to provide an innovative learning experience.

E-learning systems seems to be the perfect chosen solutions (Homocianu et al., 2014; Yanson and Johnson, 2016; Ruth and Mayer, 2016) and increasingly becomean important part of the institution's strategy for delivering online knowledge. In this regard, choosing the right Learning Management System (LMS) is crucial.

According to Lonn and Teasley (2009) a LMS is “a web-based system that enable teachers and students to share materials, to submit assignments and to communicate each other”. Almrashdeh et al. (2011) stated that a LMS is a software “used to plan, implement and evaluatea specific learning process”.

University Alexandru Ioan Cuza of Iasi (UAIC) deployed the Blackboard LMS in 2009, and after nine years it decided to move on to an Open-Source Software (OSS) LMS, mainly to avoid the high licensing fee, and also because the second one it is more configurable, highly-flexible, feature-rich and more open to be used on all types of mobile devices. In this regard, UAIC made the decision to seekout a more flexible LMS. Moodle, strongly supported by a global community of developers, was deployed in 2018 and couple of courses were implementedprior to theproper released.

Performing the migration in phases, so as to avoid the reluctance and lack of confidence from university and users regarding the new software, was one of the toughest challenge.

2. Theoretical and practical approaches regarding the migration process

Since the ‘90s LMSshavebecomecommonintheuniversitiesasakeyelement of e-learning (Pina, 2010), and by now, there are more than 100 different types of them available. For a university, the LMS's selection process is an important step in his development strategy and the decision could it be critical, principally due to the major impact that could have on the education activities and policies over a serious number of years.

The context of LMS deployment is that they are available in two generic types: proprietary and open source, and that's why they requires specific planning and attention.

As Saeedikiya (2010) suggests, there could be six stages in the e-learning's implementation process: diagnosis, decision-making, design, development, delivery, post-delivery. Earlier that time, Khan (2004) also suggests six stages: planning, design, development, evaluation, delivery, maintenance. Thesetheories provided guidance to anyuniversityin terms of how the course migration processes could be approached, as both of thememphasize the need for planning and designing. It was, more or less, nearly in the same way for UAIC, where all the activities were carried out in four phases, as it shows in Figure 2.

Moving to an open source LMS makes sense for universities in developing countries, first, because acquiring license-free software could be an advantage on seeking to alleviate costs (Cavus et al., 2007), and second, because it can be more customizable and it is community-driven (Gozdiskowski et al., 2007). This kind of approach can “lead to the development of better software” compared to the ‘classic’ one, where just a “limited number of programmers have access to the source code”.

Migrating to an OSS solution it's not an easy and unobstructed step. The university have to deal with the change required in the mind-set of users, with the resistance from staff and with the probability to engage expenses generated by hardware needs.

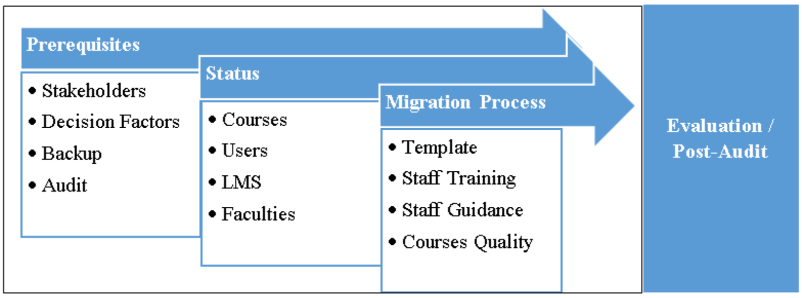

Figure 2. Migration process phases between source LMS and target LMS, used in UAIC
Source: own construction

The **Prerequisites** phase imply a list of activities that are mandatory for migrating process: 1. technical preparations for assuring that the LMS servers are up to date and stable on the long run, 2. taking online and offline back-ups of courses and source LMS as to reduce the risk of failure, 3. identification of the stakeholders, as it shows in Table 1.

Table 1.Stakeholders and theinfluence in the migration process

Stakeholder	**Key activity**	**Influence** •low /•• medium /••• high
Vice-rector for Institutional Development	Decision-making / Institutional and Strategy level	•••
Managing Director	Decision-making / Institutional level / Financial Assistance	••
Deans of Faculties / Heads of Academic Depts.	Decision-making / Department level / Academic programmes level / Implementation	•••
Heads of Administrative Depts.	Decision-making / Logistic Support	•
Heads of IT Depts.: Server unit, E-learning unit	Implementation / Technical Support / Training and Guidance	•••
Academic Staff	Course creators / Users of LMS / Need Training and Guidance	•••
Students	Users of LMS / Need Training	••

Source: own construction

For audit purpose a procedure as instrument was created, in order to have good structure, fit form and desired consistency of materials, and a sample is shown in Table 2.

Table 2.Audit sample used for collecting information in course migration process

Course ID	**Course Name**	**Course Information**	**Course Content Materials**	**Teacher Name**	**Contact Information**	**Observations**
		• Syllabus • Goals • Objectives • Competencies • Calendar • Duration • No of Users	• Study units • Presentations • Forms • Annexes • Assignments • Forums	• Instructor • Assistant	• Email • Picture • Webpage	• Additional information • Hyperlinks

Source: own construction

The **Status** phase includes identification of potential courses and users within Blackboard LMS – the primary source of data, in order to find out who could take part in the migration process. A potential course is one which has reasonable amount of content in it: documents and study materials, sizeable disk quota on data server, large number of enrolled students, or high number of postings into the forums.A non-potential course, or an incomplete course, is one which has few study materials, just the name or fictitious name, and the teacher's name.

All courses and users in the system was tracked down by course ID and username, using the course audit sample (see Table 2). All courses were grouped into three categories: ready to migrate, ready to migrate **-** but need changes and improvements, andready to stand by – not to be involved in the migration process.For instance, in the biggest faculty (by number of students) within UAIC, it was found that a total of 368 courses spread across study domainswere registered in Blackboard LMS by December 2018 (the starting date), of which 329 were ready to migrateto Moodle LMS, and 39 were inactive.

This phase involved determining the status of teachers that take part as instructors or teaching assistants within the courses. In this regard, we have tried to find out the current status of some courses that included issues like whether the subject of the content or the syllabus is still relevant and up to date with the faculty's academic programmes, and in the same way for the actual state of the current teacher versus registered teacher in the system.

The inaccuracy of data on the source LMS (Blackboard) has led to difficulty to identify the exact number of courses and users. Blackboard has7.301 users regardless of their status or role in the system. Some of the users had more than one account with a different username and couple ofteacherswere givingacommon usernameandpasswordtoall their students.

Another challenge was the way the courses has to be exactly categorized, because some of them were not organized properly in Blackboard, or have information outdated since their first registration.

In the **Migration Process** phase we tried to identify the migration options and to highlight the advantages, disadvantages and activities to be carried out. These key options were examined and analyzed as it shows in Table 3.

Table 3. Key options for migration process

Key Option	**Implication** • low /•• medium /••• high	**Carried out Activities**	**Observations**
Fresh Start /Designing the courses inside target LMS	•••	- Extract course materials from source LMS - Upload course materials to target LMS - Reviewing the existing course content/layout - Provide assistance on course design layout /Target LMS template - Courses implementation - Users enrollment	- Time and effort consuming
Copy-Paste /Conversion	•	- Extract course materials from source LMS - Convert courses from sourceLMS to target LMS - Reviewing the target course content - Create an automation template for further use	- Assistance needed
Combo /Mixture of the above	••	- Combine all the activities from above - Add improvements	- Assistance needed

Source: own construction

The **Evaluation and Post-Audit** phase is a significant one because enables the university to assessif themigration process is successful or not.The resultswereregistered and monitored using a course audit sample,seen in Table 2.

3. Conclusion

The involvement of stakeholders has had significantly importance for the success of the migration process, which has to becarefully planned by identifying their influence withinevery phases.

The absence of institutional enforcement policies on the use of LMS makes the engagement of the staff slightly voluntary andsome of the teachers were reluctant to use it. This deficiency could be covered through directives issued by the Vice-rector for Institutional Development.

Also, some information regarding the course content or the contact details was difficult to obtain in order to keep them up to date (e.g. email could be mandatory field). Moreover, it is recommended to avoid the presence of dummy information within LMS (by disablingself-registration and/or auto-enrollment).

Assuring the quality of courses is also other important aspect of the migration process.To achieve the desired quality parameters, there could be established some mechanisms, such as involving of academic staff on the designing of courses phase. This could be a serious challenge due to the fact that many academic staff were pretty caught up with teaching and research activities.

Support mechanisms for teachers and students are essential in order to build a positive user perception. The support should be either technical or pedagogical as it was noticed that some teachers did not want to use the new LMS due to lack of end user support or training. Technical support needs to make sure the system is on the run and back-ups/snapshots is taken often, at specific times. Also, the maintenance and update operations needs to occur as quickly as possible.

Like in the most other modern universities, UAIC has successfully carried out the migration process. There is no differenceregarding teaching through an OSSLMS or proprietary LMS. It's all about the software itself and ease of use offered by the technical and community support.

The key options analyzed in this paper may be used as a migration process model by universities willing to take their chances in this endeavor, but the choice belongs to the key decision makers and it depends on the available resources.

References

Almrashdeh, I.A., Sahari, N., Zin, N.A.M., Alsmadi, M. (2011): Distance learning management system requirements from student's perspective. *Journal of Theoretical and Applied Information Technology*, 24(1), 17-27.

Bolton, R., Parasuraman, A., Hoefnagels, A., Migchels, A., Kabadayi, S., Gruber, T., Loureiro, Y.K., Solnet, D. (2013): Understanding Generation Y and Their Use of Social Media: A Review and Research Agenda, *Journal of Service Management*, 24(3), 245-267.

Cavus, N., Uzunboylu, H., Ibrahim, D. (2007): Assessing the success of students using a learning management system and together with a collaborative tool in web based teaching of programming languages. *J EducComput Res. 2007*, 36(3), 301–321.

Gozdiskowski, M., Chen, W. (2007): Open Source Software in Virtual University Development: An Overview, in C. Montgomerie & J. Seale (Eds.) *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2007*, Chesapeake, VA, 603-605.

Homocianu, D., Necula, S.C., Airinei, D., Radu, L.D., Georgescu, M., Baciu, L., Damian, A. (2014): Multimedia for Learning in Economy and Cybernetics, *Economic Computation and Economic Cybernetics Studies and Research*, 48(3), 121-140.

Horváth, G., Bakó, R.K., Biró-Kaszás, E. (2014): Ten Years of Facebook, *Proceedings of the Third International Conference on Argumentation and Rhetoric*, Debrecen University Press.

Khan, B.H. (2004): People, process and product continuum in e-learning: The e-learning P3 model. *Educational Technology*, 44(5), 33-40.

Lonn, S., Teasley, S. (2009): Saving time or innovating practice: investigating perceptions and uses of learning management systems. *Computers & Education*, 53(3), 686-694.

Pina, A. (2010):*An Overview of Learning Management Systems*. Learning Management System Technologies and Software Solutions for On-line Teaching: Tools and Applications. Y. Kats. Pennsylvania, IGI Global.

Pînzaru, F., Mitan, A. (2013): Generation Y students: using Facebook for communicating with university staff and professors, *Management Dynamics in the Knowledge Economy*, 1(2), 221.

Ruth, C.C., Mayer, R.E. (2016):*E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*, New Jersey, John Wiley & Sons.

Saeedikiya, M., Mooghali, A., Setoodeh, B. (2010): Stages of the Implementation of E-Learning in Traditional Universities, *Edulearn10 Proceedings*, 6620-6624. http://library.iated.org/view/saeedikiya2010sta, accessed 08/09/2019.

Van der Bergh, J., Behrer, M. (2011):*How Cool Brands Stay Hot, Branding to Generation Y*, London, Kogan Page Limited.

Yanson, R., Johnson, R.D. (2016): An empirical examination of e-learning design: The role of trainee socialization and complexity in short term training, *Computers and Education*, Vol. 101, 43-54.

A Learning Journey from ICT teaching to Reflective Practice

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Abstract

Reflection is part of continuous development and can become an important source of renewal and enhancement of good educational practices. This can help teachers create real challenging learning environments to maximize the impact of learning on students. Reflective practice includes reflection and the development of metacognition and leads to decisions for action, learning, the achievement of goals and changes to immediate and future practice.The research provides specific details regarding the important data obtained applied two research instruments: reflection journal and interviews with the future teacher. The results are organized into four dimensions of learning: Learning through Performing. Critical Reflection on their own Teaching Experiences, Learning from Colleagues' Feedback, Seeing the Class through Students' Eyes, Learning from Suggestions of the Mentor Teacher. Analyzing the data obtained from the research, it is noted that most students encountered difficulties regarding the ways of managing the teaching time, regarding the management of the class, the difficulties about the work tasks for the learners, as well as interactive teaching methods adaptable to the content of ICT. The aspects noted by the students correspond to those recommended by the mentors.

Keywords: ICT and computer science teachers, initial teacher training programme, reflective practice.

1 Introduction

Over the past several decades schools reform reflects the tension between the complexity of political pressures and the social pressures, that included the inability to sustain the continuous change. Most of the professional development provided to teachers with several training models regarding the skills set of and did not measure the change in instructional practices. In this context, the concept of reflective practice is more likely to improve their effectiveness in the classroom and professionally growbecause the teachers are directly involved, so the practices that can add value to the teaching are contextualized.

This paper provides an overview of different options available for teachers to described transformative learning to the next generation of ICT teachers. This perspective was explored using models of reflecting in combination with five reflective practice models.

What is reflective practice?

Reflective practice is a process associated with professional learning, which includes reflection and the development of metacognition, and leads to decisions for action, learning, the achievement of goals and changes to immediate and future practice (Hegarty, 2011a, p. 2011). The same author thinks that reflection is deliberate and mindful thinking about one’s experiences and the self-evaluation of feelings, decisions, understandings, and actions, which may lead to the development of professional learning for professional practice. The reflection which demonstrates these attributes is regarded, as ‘effective reflection’ and is associated with reflective practice (Hegarty, 2011a, p. 20). According to Moon (2007) reflection is a form of mental processing- like a form of thinking - to achieve an anticipated outcome.

Zwozdiak-Myers (2012) refers to reflective practice as “a disposition to inquiry incorporating the process through which student, early career and experienced teachers structure or restructure actions, beliefs, knowledge, and theories that inform teaching for professional development” (p. 5).

Schon’s (1995) model of how to think reflectively comprises three phases: “1. Providing students with technical training; 2. Helping students think like professionals; 3. Enabling students to develop a new form of understanding and action” (Meierdirk, 2016, p. 371). According to Schon, reflective practice is a cyclical process, as a reflection in action allows students/ professionals to generate new knowledge that influences students/ professionals’ behaviors and can be used for solving problems.

Over time, the practice of reflection was extended from Schon’s technical approach to “critical reflection”, which implies reflection on the context of teaching, and individual’s beliefs of teaching practitioners (Zeichner, 1996; Arthur, 2007).

While some authors use the term “critical reflection” concerning both types of reflective practice, other authors (Finlay, 2003) makes a distinction between reflection on social structures (critical reflection) and reflection on oneself (reflexivity).

Reflective Practice in the Initial Teacher Training

The evolution of the term of reflective practice originates in the scientific works of Dewey (1933), who used as a method of describing how people think and learn. In his acceptance, reflectionmeans a"turning a subject over in the mind and giving it serious and consecutive consideration, thereby enabling us to act deliberately and intentionally”.

Reflection is part of continuous development and can become an important source of renewal and enhancement of good educational practices. This can help teachers create real challenging learning environments to maximize the impact of learning on students.

Schon’s perspective on “reflection-in-action” was included since 2007 in the core professional standards for teachers, published by the Training and Development Agency for Schools (TDA), but “critical reflective practice” is not even now part of the standards for teachers in England (Meierdirk, 2016).

The 2011 Teaching Staff Statute sets up some methodologies regarding the teacher profession. However, Romania does not have professional teaching standards describing what teachers should know and be able to do to provide a common basis for teacher appraisal (OECD, 2017). The only document that provides some skills that teachers should have is the national standard of the teaching profession, but this is not newand the competences described should be reanalyzed. This standard comprises some competences domains as communication, curriculum, professional development, assessment/ evaluation, student training, family-school-community relationship. Analyzing each domain separately, it turns out that reflective practice is not explicitly found, not even at the general description level.

Models used for reflection

The most famous reflective model was developed by Gibbs (1988), around six components: description, feelings, evaluation, conclusion, action plan and evaluation of the model.

In the context of reflection, Brookfield (1995) thinks that is a process based on four perspectives: the personal standpoint, the learners’ views, the colleagues’ views, and the theoretical “lens”.

Rolfe, Freshwater and Jasper (2010) have developed a model of reflective practice, based on three types of questions. This model was adapted to be cyclic and the questions can be used to explain the key elements of every kind of experience that will be part of reflective thinking.

Another point of view was developed by Johns and Burnie (2013) around five key questions types: aesthetic questions, personal questions, ethical questions, contextual questions, and reflective questions.

Other authors developed different kinds of reflective models. For example,Kolb (2014) consider that reflectionas a part of learning cycleand the reflective practice on teaching processas part of the professional stage of experience.

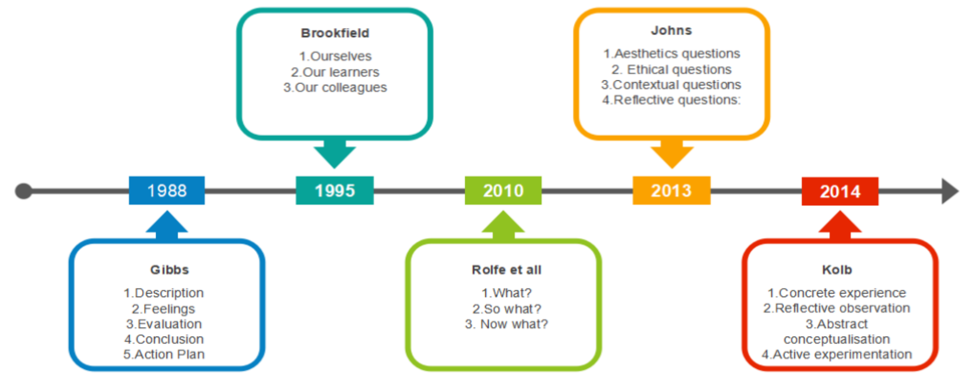

Fig.no1 Models used for reflection (different authors)

4 Research methodology

The purpose of this research was to describe the perceptions of future ICT teachers concerning reflective practice, with a focus on ways to improve the impact on student learning.

The research questions derive from the purpose described above: what are the future ICT teachers perceptions regarding the reflective practice process?; which are the ways to change/modify/ adapt the teaching practices developed by future ICT teachers, following the use of reflective practice?

Since the process of practical reflections is one with a large amplitude, analyzed and explained from different perspectives, as it appears from the data described above, the research instrument used was the reflective journal, consisting of four categories of questions(describe the experience, reflection, theorizing and experimentation). In some cases, in which the information obtained was insufficient or students did not provide very concrete data through explanations, interviews were conducted, to correlate the data obtained and examine their veracity.

The research group has consisted of 63 students and 6 mentor teachers. Students were selected from the Teacher Training Programme, from a technical university, 3rd grade, bachelor's degree, and the teachers are working either in high schools with a technical profile or in secondary schools. A pilot test of the survey instrument was administered to eliminate bugs and the ambiguity questions.

4 Results and discussions

In the following, we will describe the results obtained, especially those developed in the reflection category (the second categories of questions).

4.1 Learning through Performing. Critical Reflection on their own Teaching Experiences

Students from the research group felt **the need to develop effective methods of classroom management**, differentiated according to the learners' age. E.g. "At a certain time [of the lesson], students became agitated and talkative, so I could improve the way to impose myself in front of the students." (C.G, a lesson taught at 9th grade); "I appreciate that I could improve the way I manage the group of students so that to create a psycho-pedagogical climate in which students are more calm and attentive." (R.T.,10th grade); "I have to learn to pay attention to all the students in the class, even when some students need additional guidance from me." (A.E.,10th grade)

Although they were generally satisfied with their teaching activity, the practicing students also pointed out several aspects that could have been done better. The highest frequency was recorded by the answers regarding:

- **The time management and the dosage of exercises and practical examples**

"As far as I am concerned, it is necessary to correctly anticipate the time allocated to the teaching-learning activities depending on their level of difficulty." (O.R., a lesson taught at 10th grade); "I would better organize the time and allocate more time for the theoretical part of the lesson." (G.B., 10th grade); "I would better organize the time and try to find more practical examples." (T.D., 10th grade); "I think I could better structure the lesson to fit in 50 minutes, and design an additional set of exercises in case that students solve faster the first ones." (C.S., 9th grade); "If I could afford more time, I would increase the degree of complexity of the taught content." (C.A, 9th grade)

- **The adaptation of the contents to students' learning needs**

"I could improve the example section of the lesson. I would add more examples from everyday life." (A.E.lesson taught at 9th grade); "[...] more emphasis should be placed on the practical utility of the domain." (C.G.B, 9th grade); "The worksheet could be improved by slightly increasing the difficulty level of the problems because the class has a higher level than I expected". (U.P., 9th grade); "I could have made the lesson more interesting for those with more developed abilities. I can also work on the rhythm of the speech and the intensity of the voice. If I could teach the lesson again, I would choose more difficult exercises to arouse students' curiosity. I would also introduce some practical examples and present them through interactive videos. I would also introduce two applications to be solved in class. I would bring more information about the extended applications of the algorithm. [...]" (U.A., 10th grade)

A large number of students reported that most of their students achieved the learning objectives of the lesson, due to the pace of work imposed in the lesson, the gradual increase of the content/ learning task difficulty, the practical examples presented in the lesson. They consider this a positive aspect and also a limitation of their activity since the very well trained students could have achieved much better results if certain aspects of the lesson had been organized differently. E.g. "[…] Thus, the pace of the lesson was slow and the content was excessively exemplified for students with a high level of knowledge in the field of computer science. Finally, exactly as I expected, the majority of students have demonstrated the understanding of the lesson." (A. P., a lesson taught at IX grade)

The data recorded in the reflective journals show that the majority of practicing students have made efforts for helping all students to understand the learning contents. It remains to analyze to what extent the future teachers are aware of the need to establish learning objectives regarding the higher-order cognitive skills, and to what extent they can conduct teaching activities for achieving these types of learning objectives.

4.2 Learning from Colleagues' Views

The appreciations of the lessons reinforce the statements made by students about the classes they have conducted. Aspects regarding the students' behaviors during the class, their attitudes towards learners, and also the effort they made to prepare the lesson, were mentioned by colleagues.

In the opinion of those who assisted at the lessons, practicing students showed confidence in their strengths and established a close relationship with the learners. Their enthusiasm and self-confidence are closely related to the thorough preparation of the lesson. E. g. “She made a good impression. She had the exercises prepared beforehand and was confident in her strengths.” ”(B.D.G,lesson taught at 9th grade); “Before the lesson, the colleague was confident in her and knew exactly what to do.” (F.C, a lesson taught at 9th grade); “She was calm and showed self-control.” (O.S, a lesson taught at 9th grade); “He trained intensely as a true professional.” (C.A, a lesson taught at 9th grade);

Organizing inquiry-based learning situations, highlighting connections with the real world and providing students with relevant practical examples were highly appreciated by the practicing students who attended the lessons.

4.3 Seeing the Class through Learners’ Eyes

Practicing students have mentioned their concern for preparing and sustaining interesting lessons, not only effective, in terms of achieving the learning objectives. Students who have taught “Computer science and ICT” in secondary school have been mainly concerned about whether they will be able or not to provide learners with appropriate explanations and to make lessons fun and engaging: “I've been thinking a lot about the learning goals and how to make myself well understood by students. I felt a little excited, being my first lesson taught”. (O.V, a lesson taught at 7th grade); “I was just looking forward to interacting with learners and teach computer science in a fun way”. (R.P, a lesson taught at 8th grade).

In the same time, students, who have taught in the first two high school grades (9th grade and 10 grade), have been mainly concerned with aspects related to the contents to be taught and classroom management: "Being the first time I conducted a lesson, I had some emotions, I didn't know how it would go, if I could handle it, if students would understand my explanations and if I would have a positive feedback from learners." (U.A, a lesson taught at 9th grade); “I felt well prepared and I was thinking of methods of catching students' attention in case of noise in the classroom. (V.B, a lesson taught at 9th grade); “I was relaxed and confident in myself. I expected students to be cooperative”. (C.S, a lesson taught at 9th grade); “Before the lesson, I was filled with emotions. I was afraid of situations when I did not know how to answer the students' questions, or I did not know how to react in the class.” (C.A.M, a lesson taught at 9th grade).

In general, the practicing students mentioned that, in accordance with their expectations, the students felt good in the ICT classes they thought. The positive feedback received from learners was mainly explained by the fact that students have had sufficient opportunities to practice their ICT skills. Some practicing students highlighted the importance of practical examples offered in the class for achieving the learning objectives and for obtaining a high level of students’ satisfaction of learning. E.g. “The students were already familiar, to some extent, with the Scratch program, but they seemed fascinated by the new exercises and the way of thinking needed to solve them. They also felt confident in their abilities, due to the feedback they received from us.” (A. P., a lesson taught at IX grade)

4.4 Learning from Suggestions of the Mentor Teacher

The recommendations of teachers (mentors for pedagogical practice) refer to various aspects associated with the variables of the instructional situation: the difficulty level of the contents taught; the relevance of the practical examples; the ICT integration in teaching, alternating various organization forms of the student activity (frontal activity, activity on groups and individual activity); communicating the objectives of the class; activating students; making inter and intra-disciplinary connections; using differentiated strategies for students with special educational needs (SEN).

A higher frequency was recorded by the suggestions regarding the activation of the students and offering more practical examples for illustrating the contents.

Couple of times the need to correlate the difficulty level of the requirements in the worksheet with the students' understanding level was pointed out, which suggests, on the one hand, the need to get to know the learners better, on the other hand, the need to more effectively communicate with the mentor teacher.

5 Conclusions and recommendations

Reflective practice is a good way to increase teachers self-confident skills, by reflecting on the barriers in teaching, on the skills that are needed to create attractive content for students. As the reflective process is a daily practice, the teachers will develop the confidence to find new models that work in their classroom, according to the subject taught. Using questioning and selecting adaptive knowledge to deliver, teachers will transform learning and will develop their skills to solve the problems that can occur in the class.

Reflecting, the future teachers can better understand the teaching process, with its strengths and weaknesses, the factors that improve learning and the process involved in the school progress. For a teacher is very important to understand how she/he have helped learners to achieve the goals and to practice learning, and, in this respect, the reflective practice can be the first rule in a transformative process of an impacted teacher.

Reflective practice is an active part of the learning cycle, can encourage innovation in teaching, by adapting lessons to the needs of the labor market in order to experiment the new ways that have to succeed to better learning and be ready to think critically, to adapt to new richer thinking.

Ultimately, the reflective practice encourages teachers' engagement in challenging learning, in justifying decisions and choosing the right one, in understanding students' different points of view, in order to become aware of the learners' interests and needs and create an appropriate learning environment. In this context, new technologies are often a catalyst for the development of reflective strategies for teachers and can be useful tools to create a visual design of the online learning environment and collect the data. Istrate (2011) described a model for designing and evaluating e-learning that can be adapted for a reflective model: understanding the learning process, development, delivery and integration, support, evaluation, and quality assurance.

Following similar lines, Stîngu (2011) warned about the social context and about the importance of the organizational culture of the school regarding the culture of a reflective teacher.

However, reflective practice in teaching needs to be taken into consideration, especially in teacher training programs. A new wave of changes is expected in the area of initial teacher training, Șerbănescu (2013) mention that is important to establish a deep analysis, under the context of social and economic changes. In this respect, there is a necessity to promote reflective skills in all educational policy documents but also to analyze the training needs in this direction.

References

Brookfield, S. D. (2017). *Becoming a Critically Reflective Teacher,* Second edition. Jossey-Bass, San Francisco.

Department for Education (2011). Teachers' Standards. Guidance for school leaders, school staff and governing bodies.

Dewey, J. (1933). *How We Think,* New York: D. C. Heath. Classic and highly influential discussion of thinking.

Finlay, L. (2003) Mapping multiple routes. In L.Finlay and B. Gough (eds.) *Reflexivity: a practical guide for researchers in health and social sciences*. Oxford: Blackwell Publishing.

Gibbs, G (1988). *Learning by Doing: A guide to teaching and learning methods*. Further Education Unit. Oxford Polytechnic: Oxford.

Hegarty, B. (2011a). A Framework to guide professional learning and reflective practice. Doctor of Education thesis, Faculty of Education, University of Wollongong. Retrieved from http://ro.uow.edu.au/theses/3720

Hegarty, B. (2011b). Is reflective writing an enigma? Can preparing evidence for an electronic portfolio develop skills for reflective practice? In G.Williams, P. Statham, N. Brown, B. Cleland (Eds.), Changing Demands, Changing Directions Proceedings ascilite Hobart 2011.(pp. 580 - 593).

Istrate, O. (2011). E*ducation Staff Working in Elearning Environments: Skills and Competences*. In: Roceanu, I. (Ed.) The 7thInternational Scientific Conference eLearning and Software for Education. Bucharest: Editura Universitara.

Johns, C.; Burnie, S. (2013).*Becoming a reflective practitione*r (4th ed.). Chichester, UK; Ames, Iowa: Wiley-Blackwell

Kolb, D. A. (2014). *Experiential Learning: Experience as the Source of Learning and Development*. New Jersey: FT Press.

Meierdirk, C. (2016). Is reflective practice an essential component of becoming a professional teacher? *Reflective Practice 17*, 3, 369-378.

Moon, J. (2007). Getting the measure of reflection: considering matters of definition and depth. *Journal of Radiotherapy in Practice* 6(4), 191-200.

OECD (2017). OECD Reviews of Evaluation and Assessment in Education. Romania. 2017.

Rolfe, G., Freshwater, D., Jasper, M. (2010). *Critical reflection in nursing and the helping professions: a user's guide*. Basingstoke: Palgrave Macmillan

Schon, D. (1995).The New Scholarship Requires a New Epistemology, *Change* 27(6), November/December, 27–34.

Stîngu, M. (2012). Reflexive Practice in Teacher Education: Facts and Trends, P*rocedia – Social and Behavioral Sciences*, Vol. 33, No. 0, pp. 617-621.

Șerbănescu,L. (2013). Educational policies on initial training for the teaching career in Romania, *Procedia - Social and Behavioral Sciences*, 76 (2013), pp. 749-753.

Zeichner, K. M. and Liston, D. P. (1996). *Reflective Teaching: An Introduction*. Lawrence Erlbaum Associates Publishers.

Zwozdiak-Myers, P. (2012). *The teacher's reflective practice handbook*. Abingdon, Oxon: Routledge

About learning and innovation skills-a self-perception of critical thinking competency profile of future ICT teachers

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Abstract

The ability to think critically has always been important, but nowadays is a must for the citizens of the 21st century.A considerable body of evidence shows that thinking skills courses have positive effects that are transferable to a wide variety of situations.

The paper presents the results of an investigation conducted in the University Politehnica of Bucharest, with the aim of identifying the level of critical thinking (CT) skills to students, future ICT professionals, attending the teacher training program. Starting from the premise that the self-perception of thinking skills is a good predictor of academic performance, we aimed to create a CT skills profile and to analyse it in relation with the CT skills required in the field of education.

The measure (self-assessment) of students' CT skills is a part of the process of empowering pre-service teachers for socio-scientific issues-based instruction.

Keywords: critical thinking skills, pre-service teachers, transfer of training.

1 Introduction

Numerous studies attest the effectiveness of critical thinking skills among citizens, especially in the 21st century and the positive effects that are transferable to a variety of situations.Learning the skills of clear thinking can help everyone to participate in the democratic process with responsibility, to create knowledge every time we learn a new concept, to thought about the relationship between the newly acquired information.

Critical thinking has become a central focus of education, in the official documents, such as the official programs of the school disciplines. Among other competencies, critical thinking is still found at an early age, such as primary classes, and this is also found in the official documents, such as the official programs of the school disciplines. This discussion also includes the organization and development of training programs in the direction of developing the critical thinking skills of teachers so that they, in turn, offer lessons that will help students develop their skills.

According to "Standards for Teaching Functions (Teachers for Secondary School)" (approved by O.M. 5660/2004), teacher training programs should empower pre-service teachers to design learning environments and experiences that creatively combine digital tools and resources for maximizing the learning outcomes of their students.

Digital literacy is seen as a key goal not only for the initial teacher training, in the university, but also for the training of professionals in other fields of activity. Students must be trained as future digital content creators in their fields of study/ work, able to judge the reliability of content, to discern credible from inaccurate resources.

According toChinien and Boutin(2011) "there is an emerging consensus in the literature that digital skills include complex critical thinking and problem-solving skills.

The importance of digital skills in higher education is closely linked to workforce demands. Due to technological advancements, future jobs will involve knowledge creation and innovation.

The World Economic Forum report, The Future of Jobs (2016), identifies the top ten essential skills for 2020: 1. Complex problem solving; 2. Critical thinking; 3. Creativity; 4. People management; 5. Coordinating with Others; 6. Emotional intelligence; 7. Judgment and decision making; 8. Service Orientation; 9. Negotiation; 10. Cognitive Flexibility. Among all these skills, critical thinking occupies a privileged position, being advanced form the fourth place in 2015 to second for 2020. Anticipating the development of artificial intelligence, the importance of creativity increases. Since more and more low-skilled jobs will be covert by artificial intelligence, the jobs that will remain and the new ones will require creativity.

1.1 Digital literacy and critical thinking concept

The current understanding of “digital literacy” has the origin in the work of Glister (1997). He popularized the term as “the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers. It is the fundamental act of cognition. Digital literacy likewise extends the boundaries of definition. It is cognition of what you see on the computer screen when you use the networked medium. At the same time, it conjures up a new set of challenges that require you to approach networked computers without preconceptions. Not only must you acquire the skill of finding things, but you must also acquire the ability to use these things in your life”. (Gilster, 1997, pp. 1-2).

In the opinion of this author, digital literacy is about “mastering ideas, not keystrokes” (Huvila, 2012).Analyzing Glister's scientific conception of “digital literacy”, Martin and Grudziecki (2006) highlights the importance of critical thinking: “Gilster identifies critical thinking rather than technical competence as the core skill of digital literacy, and emphasizes the critical evaluation of what is found on the Web, rather than the technical skills required to access it” (Martin & Grudziecki 2006, p. 254). Digital literacy includes the ability to be critical to sources of information and assess the content of information resources. Critical thinking allows to transfer specific knowledge and skills and to exploit the opportunities offered by ICT.

The conceptual sphere of “digital literacy” comprises the ability to find, contextualize, understand, critically evaluate and responsibly and effectively use information, for communication, collaboration and problem-solving. It goes beyond finding and using the information and encompass “communication, collaboration and teamwork, social awareness in the digital environment, understanding of e-safety, and creation of new information. Eshet-Alkalai(2004) referred to digital literacy like a term that includes a large variety of complex cognitive, motor, sociological and emotional skills, which users need to function effectively in digital environments.” (Eshet-Alkalai, 2004, apud Chinien & Boutin, 2011).

ICT literacy integrates both cognitive and technical skills: “ICT literacy includes critical cognitive skills such as reading, numeracy, critical thinking and problem solving and the integration of those skills with technical skills and knowledge”. (OECD, 2009, apud Chinien & Boutin, 2011, p. 16, 17); “Information Literacy is closely allied to learning to learn, and to critical thinking” (UNESCO, 2008, apud Chinien & Boutin, 2011, p. 17).

In scientific literature, critical thinking (CT) is defined as a process or a learning outcome. CT encompasses a broad range of skills, whose use is mediated by different attitudes and values. Scriven and Paul(1987) referred at critical thinking as“the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. Khun (1991) describes CT as “a reasoned argument” and emphasizes the importance of the argumentation practice for developing the capacity to differentiate the opinions from scientific evidence (Mosquera Bargiela, Puig, Crujeiras Pérez & Blanco Anaya, 2017, p. 2799). For Ennis (1987) CT is as "a reasoned reflective thought that focuses on deciding what to believe and do" (Mosquera Bargiela et al., 2017, p. 2799).

According to Dumitru et al. (2018) for employers CT skills of the employees are less important than their CT dispositions. Among the CT skills and dispositions, the most valued by the professional representatives are self-regulation and analyticity (Dumitru et al., 2018). Table no 1 shows the CT skills needed in STEM((Sciences, Technology, Engineering, and Mathematics) fields and Social Sciences, research appeared in 2018, in the report of the project CRITHINKEDU (Dumitru et al., 2018a, p.29)

Table no.1 CT skills needed in STEM fields and Social Sciences

Nr. Crt	CT skills	In STEM fields	In Social Sciences
1	Self-regulation	21,35%	25%
2	Explanation	25,84%	7,14%
3	Evaluation	17,98%	13,78%
4	Inference	10,11%	15,31%
5	Analysis	7,87%	19,39%
6	Interpretation	16,85%	19,39%

1.2 Critical Thinking in higher education

The development of critical thinking in higher education is the subject of many studies recently published. Critical thinking is also one of the subjects covered by the European projects in the education domain.

Created through social and educational needs of critical thinking development, the project Critical Thinking Across European Higher Education Curricula (CRITHINKEDU), aims to identify instructional strategies for the integration of CT in curricula of European higher education institutions.

The project Preparing Science Educators for Everyday Science (PreSEES) aims to engage elementary and secondary pre-service teachers in critical discussions of everyday science through socio-scientific issues (SSI), and prepare them to teach SSI. The main interest is to explore how pre-service teachers (elementary and secondary) engage with everyday science and socio-scientific issues (SSI), and how they transfer their knowledge of SSI.

Considered one of the most vital 21st-century skills, CT is a difficult task for teachers, due to the complexity of his nature. Not only the CT concept generates debate among experts, but also whether CT is a specific domain or not. Some experts suggest “the need for explicit teaching of CT, arguing that there is little evidence suggesting that ICT merely develops because of instruction in a discipline” (Halpern, 2014/ Pnevmatikos, Christodoulou & Fachantidis, 2019). Willingham (2008) considers that the development of critical thinking is achieved by processing a domain-specific knowledge (Dumitru et al., 2018b).

The measure (self-assessment) of students‘ CT skills is the first step in the process of training pre-service teachers for socio-scientific issues-based instruction. Critical thinking is essential for teachers, considering their responsibility to facilitate the development of CT skills to their students.

2 Research methodology

The target group of the research is represented by students enrolled in the first year of study in the bachelor's education cycle, Initial Teacher Training Programme They specialize in the field of IT, at the Faculty of Automation and Computers, in a state university in Romania. The age of the subjects is between 18-20 years. The research group is made up of 109 students, 55 female, and 54 male. However, the data to be described are analyzed from a global perspective.

The main research tool is a self-perception questionnaire of the stage of development of critical thinking competence, adapted to the age of the subjects. It consists of 19 items, grouped into categories, according to the components that are part of the above mention competences: Self-regulation, Explanation, Evaluation, Inference, Analysis, Interpretation (Facione, 1998, apud Knox, 2017). Before using the instrument, the internal validity test was considered, so the data obtained for the verification of the Alpha Cronbach internal consistency are verifiable, so the index is .881, which indicates a high validity of the obtained data (Table no2. Reliability Statistics).

Table no 2. Reliability Statistics

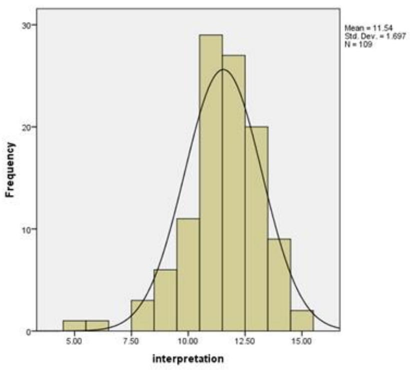
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.880	.881	19

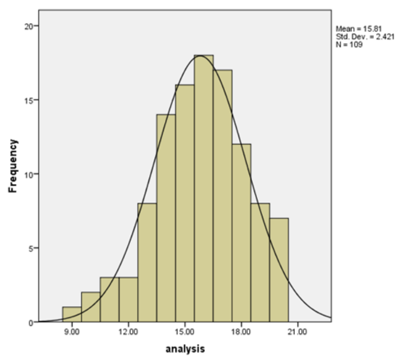
The hypothesis from which the research starts is that the students who are part of the target group (because they study disciplines that are part of social sciences skills) have partially developed the competence of critical thinking. More precisely we suppose that they excel in the field of Self-regulation, of Analysis and Interpretation moreover than in the field of Inference, of Evaluation or in the field of Explanation.

3 Results and Discussions

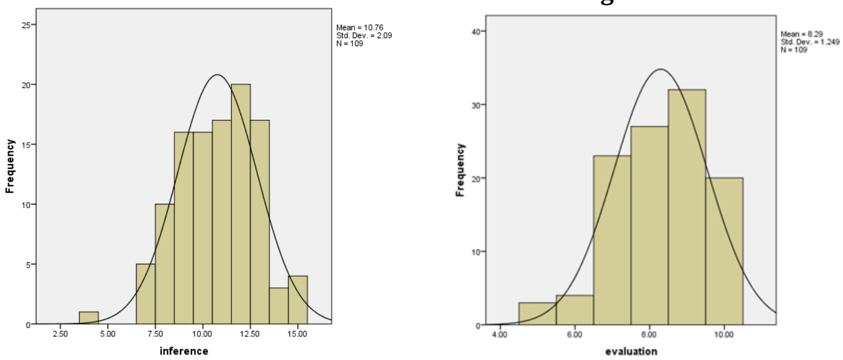
Before analyzing the data obtained in the research, it will be analyzed whether they have a normal distribution. From the following histograms, it can be observed that each of the 6 categories that are part of the critical thinking competency has a normal distribution of the collected data(Histogram no1-Histogram no6). A normal distribution of data means that most of the examples in a set of data are close to the average, while relatively few examples tend to one extreme or the other. Normally distributed data shown on a chart (diagram) will typically show a bell curve.

Histogram no1 and Histogram no2- Normal distribution of data-interpretation and analysis dimensions of critical thinking





Histogram no3 and Histogram no4- Normal distribution of data- inference and evaluation dimensions of critical thinking



Histogram no1 and Histogram no2- Normal distribution of data-explanation and self-regulation dimensions of critical thinking

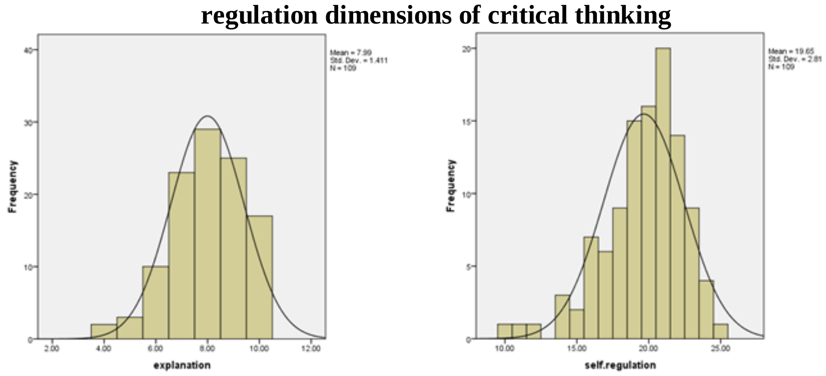


Table no. 3 shows the descriptive statistics which confirm the hypothesis, according to which students from the target group are partially developed the competence of critical thinking. As it can be noticed in the table below, all the 6 dimensions of critical thinking show high scores, although the highest score we encounter is about the self-regulation dimension (mean 19.6514) , followed by analysis (mean 15.8073), by interpretation (mean 11.5413), by inference (mean 10.7615), by evaluation (mean 8.2936) and the last one,with the lowest score, the explanation dimension (mean 7.9908).

Table no.3 Descriptive Statistics of critical thinking dimensions

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
interpretation	109	5.00	15.00	1258.00	11.5413	1.69712
analysis	109	9.00	20.00	1723.00	15.8073	2.42089
inference	109	4.00	15.00	1173.00	10.7615	2.09010
evaluation	109	5.00	10.00	904.00	8.2936	1.24946
explanation	109	4.00	10.00	871.00	7.9908	1.41091
self.regulation	109	10.00	25.00	2142.00	19.6514	2.80996
Valid N (listwise)	109					

As we have seen, the results confirm our hypothesis, that the students who are part of the target group (because they study disciplines that are part of social sciences skills) have partially developed the competence of critical thinking. The assumption according to which they excel in the field of Self-regulation, of Analysis and Interpretation moreover than in the field of Inference, of Evaluation or in the field of Explanation has been confirmed.

The results obtained based on the analysis of the research data reveals that the students have a strong level of critical thinking development. Of course, it is necessary to delimit the research problem from its context. Regarding the general context of the development of the labor market and its requirements, students are familiar with the need to develop other skills, besides the technical ones, for which they are preparing, which is also one of the reasons why they choose to enroll in the initial teacher training programs. Therefore, we can talk about their need to develop cross-sectionally, doubled by a subjective perception of their capacities (given that the applied instrument aimed especially at self-evaluation of critical thinking). It is worth mentioning that the students who are part of the target group are motivated students to learn, who came from their initiative to these training programs and have studied during the high school disciplines that explicitly develop critical thinking skills.

4 Conclusions and recommendations

Numerous studies attest the effectiveness of critical thinking instruction and a body of evidence suggests that thinking skills courses have positive effects that are transferable to a variety of situations.

Learning the skills of clear thinking can help students recognize propaganda, analyze instead assumptions in arguments, realize when there is deliberate deception, consider the credibility of an information source, and think a problem through in the best way possible.

It is important to mention that the development of critical thinking for students cannot be achieved outside the educational context. Some researches talk about the importance of the teachers' representations regarding the general perception of the students, framing them in different categories (good student, mediocre student, poorer student). In a research at the university level, Lițoiu(2015) certifies that the effect of these representations (by teachers) should be considered even when learners start to build a self-image and form perceptions and appreciation of those with whom related.

Exercising the critical thinking skills within the psycho-pedagogical training courses and critically reflecting on their attitudes and behaviors during the teaching-learning activities allows students to raise awareness of the cognitive behaviors that contravene the principles of critical thinking, and contributes to the development of higher-order thinking skills. In this respect, we consider that it would be useful to carry out an experimental study to demonstrate the pedagogical potential of some instructional strategies.

References

Chinien, C., Boutin, F. (2011). *Defining Essential Digital Skills in the Canadian Workplace:* Final Report. Gatineau, CA: Policy and Research Office of Literacy and Essential Skills Human Resources and Skills Development Canada.

Dumitru, D. et al. (2018a). *A European collection of Critical Thinking skills and dispositions needed in different professional fields for 21st century*. Vila Real: UTAD.

Dumitru, D. et al. (2018b). *A European review on Critical Thinking educational practices in Higher Education Institutions. Vila Real*: UTAD.

Facione, Peter A. (1998). *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction*. The Delphi Report. Millbrae, CA: California Academic Press.

Gilster, P. (1997). *Digital Literacy*. New York: John Wiley.

Huvila, I. (2012). *Information services and digital literacy*. In Information services and digital literacy. In Search of the Boundaries of Knowing, Chandos Publishing.

Knox, D. K. (2017). *Assessing Critical Thinking Skills*, 2017 SACSCOC Annual Conference.

Kuhn, D. (1991). *The skills of argument*. Cambridge, England: Cambridge University Press.

Lițoiu, N.(2015).The teachers and their representations about the students: what is beyond the labels?, *Journal of Educational Sciences and Psychology*, Vol. V (LXVII),No. 2/2015, 03 – 14.

Martin, A., Grudziecki, J. (2006) DigEuLit: Concepts and Tools for Digital Literacy Development. *Innovation in Teaching and Learning in Information and Computer Sciences, 5*:4, 249-267.

Mosquera Bargiela, I., Puig, B., Crujeiras Pérez, B., Blanco Anaya, P (2017). *Pensamiento crítico en educación superior: análisis de un grupo de discusión*, Universidad de Santiago de Compostela, Sevilla.

Paul, R., & Scriven, M. (1987). *Critical thinking as defined by the national council for excellence in critical thinking*. The 8th Annual International Conference on Critical Thinking and Education Reform.

Pnevmatikos, D., Christodoulou, P., & Georgiadou, T. (2019). Promoting critical thinking in higher education through the values and knowledge education (VaKE) method. *Studies in Higher Education*, 44(5), 892-901.

*** *Standards for Teaching Functions (Teachers for Secondary School)*, approved by O.M. 5660/2004. Available at http://site.anc.edu.ro/lista_so/. Accesed in august 2019.

****The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution*, World Economic Forum. January 2016.

Social media in the educational environment. What? How? Why?

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Abstract

In the last years especially, the development of new technologies has strongly influenced the lifestyle of the population, drawing new directions in social, economic and cultural life, both in developed and least developed countries. In a relatively short period of time, the use of social media applications in teaching - learning - evaluation activities has become one of the major trends in contemporary education. Social media has become a growing phenomenon with many and varied boundaries in public and academic use. In this context, one of the natural questions is: "How do we select and implement a social media application in the educational process?". The purpose of this article is trying to draw some possible answers to this question, answers formulated basied on our own experiences but also on other studies in specialized literature.

synthesizing the information we can say that the innovations in this field come from the developers and not from the users, thus the selection process is strongly influenced by the popularity of an application, popularity which can fluctuate quickly thus making the selection process more difficult. At the same time, the criteria under which these applications are analyzed do not concern the pedagogical side in depth, but rather the informal environment for which they are developed. And yet teachers use social media applications in the educational process. What application is best? How? Why? These are just a few of the questions we will try to answer in this article.

Keywords: educational process, social media, comparative analysis

1. Introduction

Whenever we are put in the situation of selecting and implementing either a new method or a new application in the educational process we wonder if we have made the best choice. In this article we will focus on the main categories of social media applications that are used mainly in the teaching-learning process.

We will talk about blogs (Google Blogger versus Wordpress), social networks (Google Plus versus Facebook) and video content communities (Youtube versus Vimeo). For each of these categories, two applications will be chosen and compared according to previously established criteria.

We would like to mention from the beginning that all these applications were created for the informal environment. Moreover, they will be analyzed and compared on criteria that do not concern the pedagogical side. This aspect, we want to be clarified by a finding related to the degree of development of technological applications in the educational sector. We are aware the the development in the educational area encounters a number of obstacles and this is precisely why applications destined for this purpose do not materialize. There is a marketing of education.

This is why, because we are talking about a large public, there must be a series of product analysis criteria that take into account the educational context but also the specific requirements of the educational system. We can see that these applications not only cover aspects of creating and modifying the content and distributing it to a very large number of users but also modify the teacher-student relationship.

Through the comparative analysis, a range of minimum requirements can be established that target the main categories of social media applications that have an important role in the selection process of an application.

In this comparative analysis we selected three main types of social media applications and the most used platforms for this type of applications:

- Blogs - Google Blogger platform versus Wordpress platform
- Social networks - Facebook platform versus Google Plus platform
- Communities with video content - Youtube platform versus Vimeo platform

These three types of platforms have been used mainly in the teaching-learning process for students from the frequented educational forms from the Bachelor's degree programs of Pedagogy, Special Psycho-pedagogy and Primary and pre-school education pedagogy.

The motivation behind the selection of these three types of applications and respectively of these platforms is represented by their different typology and their popularity within the users.

The social media applications and the selected platforms respectively were used in the personal experience with a large number of students; from 2012 the applications in the Google suite, from 2013 the video tutorials through the Youtube platform and from 2015 the social networks.

2 The comparative analysis. Criteria

The criteria that formed the basis for this comparative analysis were derived from the observations made in the activities carried out and from the analysis of the specialized literature:

- financial implications,
- popularity among users,
- personalization of accounts,
- information security,
- communication, collaboration, cooperation.

The combination of these three types of applications ensures the elements necessary for a complex and complete educational process that can be folded on the different learning styles of the students (visual-audio-video) and which at the same time support collaboration and cooperation.

2.1 Financial implications

Financial criteria are one of the most important aspects when it comes to selecting and implementing new technology services, an essential aspect as more and more institutions of higher education are facing a decrease in the number of candidates. Moreover, the universities in Romania must now respond to the challenges launched by similar institutions abroad that offer online courses.

In this context, the costs involved in using these applications in general and the social media in this case are an important pawn on this chessboard.

In each of the three categories of proposed applications there is a platform provided by Google. Thus a general feature of them (Google Plus, Google Blogger, Youtube) is that it does not require installation and the license fee does not exist. Even more so if the user accounts are created by the educational institution then the data storage space is unlimited.

Moreover, they can be managed directly by the person who creates their respective accounts but the disadvantage from this point of view is that the ones at Google own all your materials (regardless of which of the three platforms we are talking about).

Facebook, the social network that ranks first in the list of preferences does not require any account creation or administration costs.

Wordpress instead is promoted as a free application, but there are costs for domain registration, hosting, and if the user wants to add premium themes or plugins, certain security options but also for storing and backing up information then additional fees are charged.

2.2 Popularity among users

When you choose to implement one or more social media applications within the teaching-learning process, one of the motivations is the desire to be present in the environments in which your students are present and spend most of their free time. Given the wide and varied range of platforms that offer the same types of services, it is quite difficult to decide which is the best option for that person, personally, we consider that the popularity of one network over another may be a criterion. to consider.

Students are sometimes quite reluctant to what is "unknown" or presented by the teacher. It is an advantage to "move" in the online environment to the "places" they know very well and believe they can "control".

However, the popularity of an application is a variable factor. The application that occupies the first place in the next year may no longer work, which is why this selection process represents a continuous challenge for the teacher.

2.3 Customizing accounts

The user profile on the Facebook network offers complex information about one's own person (places of birth, family, studies followed, jobs, movies watched, books read, etc.). The profile is also a place to post your personal status (a status can express what you do, think, feel, etc.). The profile can be customized at the profile image level, background image for the user profile, personal images or videos made live but also at the level of complexity of personal information can be added. There are different options for each of them (public / private / only certain people).

The Google Plus profile works just like Facebook. There is a cover photo, a profile photo and then a multitude of tabs where personal information can be filled in, photos can be uploaded, YouTube videos, things you like, etc. One of the nice features of Google Plus is that the photos are automatically linked to a Picasa account. Also, if you have a YouTube account, they will also appear.

Both Facebook and Google Plus have a feedback button. For Facebook initially there was only the "Like" option, afterwards a number of other buttons were developed and for other reactions (sad, cheerful, excited, etc.), and for Google Plus there was a "+1" button. These buttons represent the user's way of recommending an article / photo / video or updating a status.

Personally, looking at the two platforms we belive Facebook is a way to interact with friends and family while Google Plus is a way to find fascinating content, new ideas or interesting experiences. While Facebook accepts personal connections and even makes connections (through the "friends suggestion" option), Google Plus promotes intellectual matchmaking, with communities being very "closed".

At the time of this research, the Google Plus application was still functional.

It should be mentioned that Google announced its decision to shut down Google+ for consumers in April 2019 due to low usage and challenges involved in maintaining a successful product that meets consumers' expectations.

As for video communities - Vimeo is a platform used by film producers as well as professionals in the field focusing on film and video. Thus, creative professionals have an advantage in terms of Vimeo, thanks to peer-to-peer feedback and engagement with professionals in their own field.

YouTube is a video community open to anyone and in terms of content it is also free and varied. Unlike Vimeo, YouTube users can be both amateur and professional in a certain field.

From an educational point of view, Vimeo can be a very good option for students from the arts, especially from the film area, the area of interest being a specific one.

Vimeo accounts are designed as a professional portfolio. YouTube has a more crowded and distracting look and is less focused on displaying professional productions. The YouTube channel page offers some customization options, such as banners of different sizes for different types of screens (desktop / mobile). Since there is no time limit for the length of a video, the site is particularly attractive for filming.

Blogger and Wordpress also allow customization of profiles. Google Blogger is linked to the profile on Google Plus or the user can create a new profile directly within the application (Blogger's profile) and this is relevant for article sharing or commenting. The same can be done on the Wordpress platform where the articles made can be shared on other social networks.

2.4 Security

For teenagers, the Internet is not only a source of information but also a way of life. However, safety in the online environment is one of the topics that I think should be emphasized. Viruses, the confidentiality of the information displayed, the attacks and images we choose to upload and upload to social networks, cyberbulling are just some of the issues young people should be informed about.

Regarding security, there are two directions that we can focus on:

- technical aspects and
- the personal security of the user.

These platforms allow the sharing of documents, photos, videos and their content is most often known by administrators who can filter or even block this content if problems are noticed.

All the mentioned applications require login to the account, this involves a user and by default a password. The passwords are personal and therefore it is good for them to have a high level of security and not be shared.

Another important aspect is the image you create in the virtual environment. The profile is created and personalized by each user. Most of these applications allow you to define lists of friends so that you can share information according to your wishes. Most of the time, the users do not focus on the real identity of those with whom they communicate in the virtual environment, nor do they analyze the importance or character of the information they choose to share, which is why they are increasingly frequent harassment phenomena in the online environment.

One of the things that should always be emphasized is that the profiles created only have the option to deactivate, most of the times even if they are no longer visible, the information and uploaded images remain saved.

Each platform has a security policy so it is recommended that you read the "Terms and Conditions" section carefully.

Students should be informed about:

- offensive or vulgar language or content;
- discrimination based on race, gender or sexual orientation, religion, color, age, financial status, provenance, physical or mental disability,
- conducting or encouraging illegal activities,
- public safety,
- ownership in the virtual environment,
- confidential information.

We must not lose sight of the fact that no matter what platform we use the most used ways to attack security are theft of authentication data, theft of identity - spoofing.

2.5 Communication, collaboration, cooperation.

Taking into account the public character of these platforms which are based on an active participation of the users, it is necessary that when we talk about their use in the educational environment, a series of rules for the correct management of information and comments, as well as the tracing of certain roles, must be elaborated. and responsibilities for members of educational groups. Also, the feedback generated by them must be filtered and managed so that it can be used in a constructive manner.

Thus, the entire activity on these platforms must be monitored by the teacher who answers and moderates the content placed by the users.

Also, when such roles and responsibilities are also established, it is advisable for the moderator (in this context the teacher) to set deadlines for offering answers to any uncertainties.

Through the profile, for each of these applications we can track their activity according to the number of posts, chat activity, etc. The reports generated by the available statistical services provide from simple to very complex information, specifying the number of hours spent on each resource. We can also identify inactive students. This information can only be seen by the group administrators (or those who have been granted these rights), but the group members can see the basic information of all the members such as username, date of registration.

Communication and collaboration are two extremely important aspects. Analyzing these platforms we could say that all allow both synchronous and asynchronous communication.

As far as synchronous communication is concerned, it is available to all group members and in the case of Facebook and Google Plus video conferencing or voice services are integrated. However, these options are not available for Blogger, Wordpress, Youtube or Vimeo too - for these the communication is ensured through chat (text) services. (Visan, A., M., (2019), pp.65-76).

3. Conclusion

Each element of novelty has advantages and disadvantages, and its implementation in the educational process is without difficulties, but both students and teachers are aware that social media applications will gradually become an indispensable part of the educational process.

We cannot ignore the fact that the typology of the students has changed and we affirmed this, referring both to financial considerations (most students being forced to work during the studies), to the different ages of students (many adults returning to the faculty banks) but and to social and professional aspects (job mobility) and to the need to train transferable skills.

Using social media applications, the focus is on learning through construction and discovery, the role of the teacher changing, he being the one who accompanies and directs the student throughout the educational process.

In order to be able to make a selection of these applications, however, a larger and more in-depth analysis is required, which will focus on the importance of optimum selection and correct implementation of these types of applications in the educational process. All these issues will be discussed in other articles.

References

Visan, A., M., (2019): Utilizare aplicațiilor social media în mediul universitar. Sitech, Craiova.

E-tutor educational support for digital organization: theory or practice in university life

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Abstract

This article represents a global vision of all e-tutors that work in the Department of Distance Learning and Low Frequency(ID-FR) – CREDIS (established in 1999, as a consequence of EDUCO project supported by a program financed by Romanian Government and World Bank) is a specialised institutional structure which manages distance learning and as well as postgraduate programmes for long life learning and professional development.As part of Bucharest University structure and as a consequence of its specific tasks inside as manager of distance learning, CREDIS which due to TEMPUS –PHARE REDEC (regional distance education centre) project identify itself as digital organization offering teachers of different grades a large scale of opportunities to achieve necessary competences for 21st century professional life.Along its activity the necessity of establishing a dialogue, as well as a creative cooperation between students and teachers, all designed in order to develop new educational supports and students' creativity which lead to an open way of learning were the main goals of-tutors activity. This shaped their profile as a linking support between teachers/coordinators and students as beneficiaries of educational services.The research case study is based on the educational networks and platforms on which the activity of the e-tutors is based represent an e-learning component that we present through a qualitative research. It is detailed due to professional achievements of the students, the feedback of the employers are indicators of the implementation of the digital organization in universities. All those aspects contribute to a highly complex image.

Keywords: *Distance Learning, e-tutors, digital organization, educational platforms*

1 Introduction

Modern education in the 21st century is based on innovation, and the ability to implement modern technologies throughout society. The education and the educational process must have as its main target the innovation, research and use of digital technologies.

Department of Distance Education and Reduced Frequency (ID-IFR) - CREDIS (established in 1999 as a result of the EDUCO project, with the support of a program funded by the World Bank and the Government of Romania, is the specialized institutional structure that ensures the management of distance learning programs, low-frequency education programs and postgraduate training and continuing professional development programs.

Credis, as a part of the University of Bucharest with responsibilities on distance education and empowered and through the project TEMPUS - PHARE REDEC (regional distance education centers) has been identified as a digital organization, which offers training to teachers in order to obtain new specific competences within the University of Bucharest. The process of preparing the students in the form of educational ID is the sum of the tutorial activities and temporally differentiated applications, customized to each student. This means that each student can establish his/her own study program, pace, as well as conducting self-tests or assessments that give the image of his/her actual state of preparation, and all depending on the specific program and conditions of each participant. All of these are achievable because there has been a constant concern for digitization, innovation and quality educational services, centered on the student and on the organization's ability to permanently modeled it. The educational services offered within the Credis Department, over the years have been based on: respect and on the development of student’s autonomy as a precondition in the formation of professional competences, on cooperation, collegial learning / collegiality through the creation and formation of a professional academic community with a relevant component of critical analysis and sharing of experiences but it alsoworkes on identifying the values of the organization in order to internalize them and become a reference frame both at the organizational and individual level.

2 The research agenda

In the analysis that we will be perform two suggestively images are presented in order to understand the size of the opening of education to technology and the resource already considered common on the Internet:

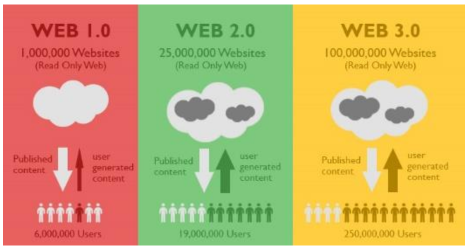

Figure 1 web evolution– Source google images

The exponential number of users shows that openness is complete and education can only benefit from these solutions. That is why by the following figure (figure 2) I have highlighted what it means to maximize learning.

Characteristics	**Education 1.0**	**Education 2.0**	**Education 3.0**
Primary role of professor	Source of knowledge	Guide and source of knowledge	Orchestrator of collaborative knowledge creation
Content arrangements	Traditional copyright materials	Copyright and free/open educational resources *for* students within discipline, sometimes across institutions	Free/open educational resources created and reused *by* students across multiple institutions, disciplines, nations, supplemented by original materials created *for* them
Learning activities	Traditional, essays, assignments, tests, some groupwork within classroom	Traditional assignment approaches transferred to more open technologies; increasing collaboration in learning activities; still largely confined to institutional and classroom boundaries	Open, flexible learning activities that focus on creating room for student creativity; social networking outside traditional boundaries of discipline, institution, nation
Institutional arrangements	Campus-based with fixed boundaries between institutions; teaching, assessment, and accreditation provided by one institution	Increasing (also international) collaboration between universities; still one-to-one affiliation between students and universities	Loose institutional affiliations and relations; entry of new institutions that provide higher education services; regional and institutional boundaries breakdown

Figure 2 Education Evolution 1-2-3 (Source Google images)

Inorder to answer to the necessity to establish the segment of target public, active teachers, meaning adult people implicated in a social and professional life, it should be underlined that the above mentioned analyze answers to the necessity of developing distance learning. This learning system consists in a balance between individual learning, tutorial activates for laboratory activates, synthesis lessons and collaborative learning activities. Tutorial activities are essential for students’ guidance and support for educational correct platforms use.

The advantages of implementing education 3.0 within the university are multiple, both organizationally and individually and at the student level.

The need for dialogue and cooperation between students and teachers in order to create an educational system aimed at creativity, innovation, and the creation of new educational supports as well as the use of technology for open learning has been a professional aim of e-tutors activities representing the binder between teachers / discipline coordinators. and student / beneficiary of educational services.

The research I have done and highlighted in this article is part of a constant research concern within Credis. It is based on the presentation of a case study conducted during the last academic year in order to see, identify and monitor the rate of qualitative growth of the services offered by e-tutors within our distance learning department.

In order to respond to the training requests of the targeted applicant segment, active teachers, so adult persons integrated in an active social and professional life, the program is designed to respond to the need for distance education training. By alternating periods of individual study with face-to-face meetings with tutors / instructors for carrying out laboratory work as well as for synthesis lessons and consultations, students are assured both the possibility of studying at their own pace in a personal environment, as well as the possibility of learning through collaboration. The assisted study, in which the learner benefits from counseling and guidance, support during the use of the educational platforms represents the e-tutors main tasks.

Taking into consideration those aspects we define the e-tutor as:*the e-tutor is the liaison person between the student and the discipline coordinator; he uses his technological competences to transfer educational, academic and administrative-managerial information, having communication responsibilities one to one and one to all.*

The courses offered to students respect fundamental pedagogical principles: integrating theory with practice, accessibility and individualization of learning, but they also cover a general problematic area regarding the integration of modern technologies in education, in general and in education, in particular; ensuring the formation of fundamental skills of efficient operation / use of the computer; training of practical skills and competences to work on a regular basis, using the computer (teaching, simulation of experiments, testing / evaluation); flexibility, the contents can be modified according to the evolution and dynamics registered on the market of new IT products and technologies with educational impact; personal development of the learner, aiming at the capacity of self-learning, the desire for continuous improvement and the competence to learn from materials elaborated in eLearning technology.

Within CREDIS, implemented by Professor Bogdan LOGOFĂTU, there was a Virtual Campus of Communication enabling a constant and easy communication with students. These technical facilities have the final aim to meet the desires and training needs of the students. For this a good correlation of the technical aspects with the pedagogical ones is necessary. At the University of Bucharest, the first platform for students from distance education was created in 2003 - Virtual Campus UNIBUC - portal.credis.ro, being the first academic platform in the country at that time.

We currently use Google Classroom which is a free service for teachers and students and is included in the Google Education suite.

Within CREDIS it is used for all study programs.

The Google Classroom platform has a friendly and intuitive interface, is available in Romanian, has a high level of security, can be configured quickly and can be used successfully from any device connected to the Internet.

This app integrates all other Google education services: Google Docs, Google Slides, Google Sheets, Google Forms, Google Sites, Google Drive, and Calendar.

Making the educational process more efficient by efficiently managing time and costs, prompt feedback for students, systematic assessment, real-time communication and teacher-student collaboration are just some of the benefits of using this platform.

The application allows the creation, collection and scoring of projects in the online environment. Teachers can see just before they reach the classroom who has completed their projects and can provide direct feedback to each student, post announcements and questions. Thus, communication becomes more efficient and, at the same time, extends beyond hours.

The benefits of using this application in distance education programs, CREDIS are:

a. educational aims consisting of:
   1.Quality of the teaching process
   2.Easy accessing of the support materials
   3. Synchronous and asynchronous teaching activities
   4. Access to updated information (including schedule of activities)
   5. Evaluation and self-evaluation
b. supporting benefits
   1. Support in individual study
   2. Feedback
   3. Communication
c. Administrative
   1. Managing user data
   2. Accounting accounts
   3. The activity of the students on the platform (number of hits, accessed services, etc.)
   4. Communication with the administrative department

By using this e-learning solution, a permanent, interactive and easy learning process is fluid and adapted to the needs of each individual student.

A user account is required to access the platform services.

Figure 3. Google Classroom main page

The role of e-tutors is to support this entire training process and to succeed in engaging students in learning and assessment processes by encouraging critical thinking, developing creativity, teamwork. That is why we can say that e-tutors are the initiators of the development of communication networks and then only have the role of monitoring the needs of students.

3 Analysis and the development of the research

3.1 Working Hypotesis

The research was carried out using the communication platform, Google Classroom, with students, during the academic year 2018 - 2019 along the second semester, for the students in 1st. academic year I within the specialization of the pedagogy of primary and pre-school education. It studies of degree of implementation and identify the quality of the services offered. by e-tutors within the organization providing training in the field of distance learning, CREDIS. The whole approach was outlined according to the following working hypothesis:

1. An institution designed to provide educational services in distance learning system is capable to be structured in a digital organization?
2. Is there the possibility of training a body of experts, teachers and auxiliary teaching staff to motivate, manage, implement, monitor the structure of the digital organization.

3.2. Some Aspects of the Research Analysis

"The challenges of our clients during digital transformation programs do not necessarily relate to the financing or implementation of the technologies themselves. Most are derived from the adoption of the technology by the employees, from the limited availability of the internal resources necessary for the transformation and, last but not least, from the approach of the technology as an implicit element of the organizational behavior and culture. The success of a digital transformation program lies in how companies manage to manage these challenges,"says Bogdan Ion, Country Managing Partner EY Romania and Moldova and Chief Operating Officer for EY Central and South-East Europe and Central Asia. (Calatorie catre organizatia digitala, 5.09.2019)

We subscribe to this point of view and support these assertions, and through previous observations and research, "One of the challenges of distance learning is the training of students for group activities, from the point of view of acquired skills, the formation of teamwork skills. This is quite difficult, because students cannot get to know each other well enough during tutorial meetings, so that these groups cannot be form spontaneously. The one who has to take the initiative and coordinate the formation of the groups is the tutor teacher. This is even more difficult to achieve when students either come from different groups with different cultural profiles and different educational background. At the beginning they tend to work individually, sometimes even refusing group activity due to the initial formation. In both cases, it is the tutor who has to intervene and offer the motivation to change the initial attitude. The choice for qualitative research was based on the need to highlight the aspects of individualization and student-centeredness, as an essential component of distance learning.

3.3 Case study setting and results

Settings

a. Identification of tutorial activities as processes of informing, advising and guiding the students throughout the schooling, in order to facilitate the integration in the university education,

b. The choice of the most suitable didactic options, as well as to encourage the preparation in a group in virtual environment.

c. Establishing the methods and tools used for beneficiaries (students), Observation and Reflective Journal

Results of the case study:

a. We have interpreted and analyzed the data obtained,

b. We extracted some statements of the student beneficiaries from the reflective journal to faithfully render "the state, the emotion and the involvement" *case study level:*

Observation means taking part, as far as the situation allows, consciously and systematically in the active life, as well as the interests and feelings of the studied group. It is used in all stages of research and accompanies all other methods, providing important data for the researcher. Practicing this type of observation, the researcher not only is present in the studied community, but also manages to capture manifestations of the natural, natural behaviors of the individual.

The participatory observation provided us with information on how to relate and report students with tutors and teachers, allowing us to observe the behavior and involvement of the students in the semester and final assessments.

The discussions with the course coordinator and the student aimed to capture the argument regarding:

- ✓ Opportunity and importance of the course;
- ✓ General characteristics of the course:
- ✓ to whom it is addressed
- ✓ how it is designed
- ✓ types of materials and didactic activities
- ✓ evaluation methods
- ✓ types of certifications obtained
- ✓ Difficulties encountered in organizing and conducting the course;
- ✓ The successes they have registered and the positive elements

The reflective journal is an alternative method of evaluation. By this method three aspects are pursued, the self-regulation of learning, the control of actions, the control of knowledge. In the reflective journal are registered opinions, thoughts, feelings, emotions shared with a critical point of view. This method allows the student to reflect on what he has learned to mobilize and develop metacognitive skills by reflecting what he has learned and through the representations he has acquired while performing these actions.

4 Results. Samples of Students' Journals

"The accommodation was relatively easy, although I can not forget not even now the emotions of the first exam and the disfigurement with which I expected the first grade. From the first year I liked the idea of poster that I had to make at the urging of the lady teacher and the teacher. I liked it because it stimulated our creatively, it helped us to get to know each other better, to interact and to pass the first oral exam. I felt a closer proximity to the teachers, the opportunity to connect friends, but also a challenge in front of something new.

Without the constant use of the platform and especially without the support of my e-tutor I could not have accessed the platform, transmits the topics received on the communication platform. "

NC Student. 40 years

Conclusion

It is necessary that digitization should become a fundamental part of the educational institutions, of the daily organizational life and of each student separately. CREDIS proves as an organization that has formed an important resource in this economy of educational services, that of the e-tutors who have the skills to use the technologies but also the human qualities that are needed in a transformation society.

The professional achievements of the students are validated by the feedback of the employers and are indicators of the implementation of the digital organization in universities.

References

Almasan, B., (2015), *Multiculturalitatea și implicațiile ei în definirea rolului tutorilor In invațamantul la distanța*Available onhttp://www.sinuc.utilajutcb.ro/SINUC-2015/SECTIA--V/V.1...6.pdf

Calatoria catre organizatia digitala. (2019) Available on http://www.clubitc.ro/2019/06/05/calatoria-catre-organizatia-digitala/Accesed 5.09.2019

Logofatu B., Visan A.M., (2015) *Google classroom - the new educational challenge. Pilot test within the Department for Distance Learning*, The 11th eLearning and Software for Education Conference - eLSE. Rethinking education by leveraging the eLearning pillar of the Digital Agenda for Europe, Carol I NDU Publishing House, Bucharest, Romania

Web Based Tools for Education

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Abstract

This year the world wide web celebrates 30 years of existence, and the Internet 50 years. Despite the 20 years gap between the two innovations, today these two terms are overlapping and are used with the same meaning. The fast development process together with other technologies resulted in increased accessibility and wide use in different domains. Education took advantage of the Internet, WWW and other technologies since their emergence, and since then many studies on the field were conducted, most of them showing the multiple advantages that education could benefit from.

Still, the process was not simple, neither the transition smooth, being influenced by many external factors: financial, openness to innovation, teaching habits, learning support, community's feedback. Most of these factors are still valid today, only the proportion of their influence changing.

The main issues in implementing new technologies were financial ones, but over time these became more accessible for education providers, despite still having teachers with high resistance to change or very weak support for teachers who wanted to use technology in their classes.

The aim of this paper is to present some technological innovations used in education with minimal costs for institutions, with facile implementation and user friendly interfaces. These are cloud based technologies and their development has increased to the highest levels in the last decade.

Keywords: Education, Learning tools, Cloud tools

1. Introduction

There are many studies underlying the power of ICT in education and deep changes that the Internet brought on education and learning (Rovai, 2009; Breivik and Gordon, 2006). The generic term "technology" is not new anymore, the first example of a significant discovery in this field being made many years ago, it being used in education and training. If one adds to this the emergence of the Internet and World Wide Web, their rapid spread and wide integration into daily life, we can expect to have them more deeply intertwined with the educational system. There are many examples of good practice in using technology in education and training, but also examples of difficulties in integrating and using these tools.

Starting with the simple use of a computer during a lesson, or a software to practice specific skills, continuing with accessing the Internet for researching information, resources and adhering to learning communities, every process is accompanied by learning.

Over time, due to technological development and as a direct impact of these innovations, the educational system has faced many changes, and a diversification of training options. The time, space and modes of learning have undergone notable changes, making it more accessible, open and diverse.

The aim of this paper is to present a selection of user friendly tools to be used in education and training.

2.Technology in Education: Challenges and Opportunities

The speed of technology development determined a difficult adaptation for educational institutions. Learning how to use technology was often preceded by learning via technology, this meaning having the tools but lacking on know-how. Paradoxically, even if the technology and internet connection were used in schools to increase accessibility and equity in education, in most cases, it became a discriminatory factor. There are still schools with no computers or internet connection, this giving some children less chances to learn using the same tools as others. Fortunately, the number of people having less or no access to technology is diminishing, while the costs of technology are also decreasing.

Besides computer use, the use of internet (and www) was an important engine for education, and a delivery vehicle that allowed major changes in education paradigms.

Internet based learning (or web based learning, online learning, e-learning) is a term defining a learning paradigm based on the internet as a tool for instructional delivery. In this way the education became boundless, not only with the barriers of space and time being eliminated, but also with continuous access to educational resources.

The main vulnerabilities of learning by using the internet (internet based learning - IBL) are the current bandwidth and speed limitations. These could be overcome by the newest 5G technology that is already partially implemented. These highly developed technologies were influenced by their connectivity and included more features to enhance interconnectivity.

Cloud computing was the next step in increasing access to education in general and especially educational resources, because most of the available resources can be posted/uploaded on the internet and can be shared between users. Regardless of the device used, all the resources will be within clicking distance, 24/7. This leads to an increased number of educational opportunities. The best-known example of using cloud computing in education is Google with its services and platforms. These are tools to be used in the teaching process to create valuable resources to support and enhance students' involvement in class.

The advantage of using digital educational resources is validated by many researches in the field, and more examples of the best practices of using them in classrooms are provided (D'Antoni, 2007). Some schools already have a wide experience in introducing technologies in face-to-face classrooms, while others are still facing some resistance or delays from various reasons, still adapting to this trend. If, at the beginning, the challenge was about having hardware technology and well-equipped labs, nowadays the use of technology in a classroom is more relaxed and less dependent on a physical space or equipment. Small devices and wireless internet connections are simplifying the process, removing the need of being in a specially designed space (lab) in a specific timetable. Also, the BYOD (Bring Your Own Device) or BYOT (Bring Your Own Technology) encourage users (students, teachers) to take along with them in the classroom personal devices that they usually use. This gives more freedom to involved actors and offers more unplanned digital activities, increasing class involvement.

One of the most important barriers encountered by teachers that want to use technology in classes nowadays is the lack of resources, being more of a software-related problem rather than hardware. It can be challenging to find adequate educational resources to be used in the classroom. An adequate resource must be easy to use, easy to integrate into current curricula, with educational objectives and outcomes, compliant with devices' technical characteristics and free of charge.

Teacher training in using specific applications or in accessing various learning databases is once again important. Most of the devices are now familiar to most of the teachers and now the challenge is to find learning resources that respond to educational purposes.

The learning communities are very useful in this case, as are individual initiatives to share one's own findings with colleagues, creating meaningful communication and collaboration. Usually, teachers are helping each other to identify specific learning resources or applications that may be useful. Online learning communities are important information sources and the common projects can open new perspectives to teachers.

Teacher training is also important in enhancing teachers' experience, in using technology and in encouraging them to plan their didactical activity with the help of technology. The study programs for teacher training have in their curricula at least one discipline related to technology in education, which is a good start for future teachers and is meant to prepare them for the information society and challenges that occur by new ways of teaching and learning.

3.Web Based Tools in Educational Practices

Cloud technology has a great development and there is no doubt that the future of education is in the Cloud, with clear advantages in terms of costs, accessibility, collaboration and effective use. There are more providers of cloud technologies, with wide experience in this industry, expanding their know-how in the education sector.

Google is one of the most important providers for education technologies. It offers multiple solutions for education: applications, storage, platforms. Most of these are offered for free in educational purposes. Started with some basic services – Google Apps for Education (GAFE) such as: Gmail, Calendar, Contacts, Groups. Google has invested resources in developing other complex services: Drive, Docs, Forms, Sheets, Slides, Talk/Hangouts and Vault and Google Classroom, in the current Google Suite for Education. These are several applications created by Google, that can be used in education. All the services provided allow and encourage users to collaborate and work together. It is estimated that now, more than 90 million students and teachers are using Google Suite for Education and more than 40 million students and teachers are using Google classroom.

At the University of Bucharest, Faculty of Psychology and Educational Sciences these tools are extensively used by students regardless of their program study or educational system: full time, low frequency or distance education.

3.1 Google Drive

It is a storage space, launched by Google in 2005, which can be organized similarly to an offline folder, and can be accessed both online and offline on a computer. Once the computer goes online the information between the online and offline drive will synchronize and the folders will be updated with the latest changes. For educational accounts the storage space is up to 5 TB, and for personal accounts the free space is 15 GB and can be increased by paying a fee.

The users will be able to create files and folders in place and to upload files and folders from different sources.

One of the best features of this service is the sharing option: all items (files, folders) can be shared with any other user(s) and with different rights (depending on the item this can be to edit, to view, to comment). This offers multiple opportunities for collaboration and communication within groups.

3.2 Google Applications

Are developed by Google and offered for free to all users. The applications are working both offline and online and have similar features with licenced software. There are specific applications for document editing (Google Docs), for spreadsheet (Google Sheets), for presentation (Google Slides), to create questionnaires or quizzes (Google Forms) to edit images (Google Drawings). Over time, new versions, add-ons and updates were added by Google in order to increase work efficiency and to make a smooth transition from other licensed software. The created documents are automatically saved in Google Drive. In 2014 Google launched a dedicated mobile app for Docs on the Android and iOS mobile operating systems which increased accessibility and collaboration between users.

3.3 Google Hangouts

Developed by Google for synchronous communication, it integrates both Google Meet and Google Chat, and started to work in 2013. Google Meet is a tool for video conference, between two or more users. Offering video, sound and chat it is a suitable environment to discuss with students, hold lectures and is especially useful for distance education or low frequency education, removing space barriers and offering access to the same content for all participants. Moreover, this application has a feature that allows the users to present partially or fully their screens, in order to offer a full learning experience.

At any time, users can attend a conference using a link or a code, and can also discuss between them using a chat.

3.4 Google Classroom

It is an easy-to-use tool to create and manage virtual classrooms, using and combining different google applications. The interface is user friendly and can be easily used by non-experienced teachers. Educational institutions get free access to Google Classroom as part of Google Suite. It is a document management system which fits perfectly in a classroom, in face-to-face interaction or remote.

The roles that a user can have using this tool are teacher or student, with different features.

Within the classroom, there are two main roles: teacher and student. With one account you can create and manage multiple classrooms and, as a student you can be enrolled in multiple classes. This educational platform has been launched in 2014 and since many updates have been performed in order to increase the usability and to add new features. One of the most important updates has been in 2018 when the "Classwork" section has been added, which allowed for better organization of the work. The "Topic" label was added, which makes it much easier to organize and search for specific posts by categories.

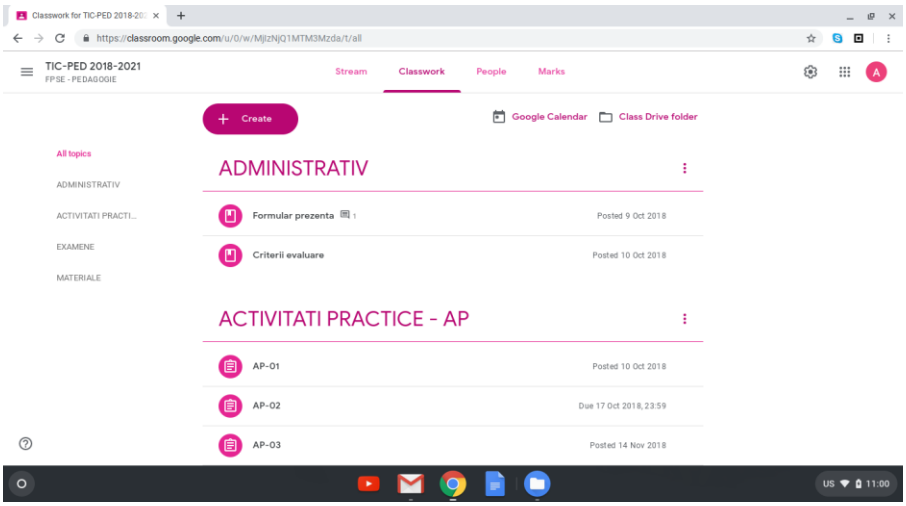

Figure 1. Classroom Screenshot

The teachers can post on Classroom: announcements, assignment, quiz assignment, question, material. All posts can be reused (with or without editing) between classes.

The assignment section has features that enable teachers to manage different types of exams, to offer personalised feedback to each student, to administer multiple exams, to store and see all marks and to have precise information on the state of individual exams (done, done late, not done). All the grades can be downloaded in different formats.

Each class has a designated GDrive folder in which all the uploads/or created documents (for assignments, materials) will be stored and can be accessed.

This tool can be used with basic IT skills, on different levels, from primary school to universities.

3.5 Screencastify

It is an extension from Google Chrome, allowing to record screen activity, along with sound using the device's microphone. It can be used by teachers as a common way to record different videos for instructional purposes and then deliver to the students. It offers a high quality of recorded video and can be used to create video tutorials with examples and explanations given by the author, in a simple manner without downloading sophisticated applications. When the recording is stopped, the final result is automatically saved on drive, can be uploaded on YouTube and can be distributed to users using a link.

4. Conclusions and Final Remarks

The applications presented are currently used by the authors in their educational practice, in higher education, with great impact on students. Each application can be adapted in different approaches for teaching and enhancing learning: creating, editing, accessing documents regardless the used device, which gives a great flexibility both to students and teachers, access to updated information at any time, synchronous communication and learning. These tools are helping teachers to create learning materials and online distribution, online classroom management and personalized feedback. For educational providers, the Google tools are valid options for student management with a minimum of costs and the opportunity to increase teachers' positive attitude towards ICT use in educational process.

Despite students' digital literacy, these are tools easy to use both for students and teachers, with friendly and intuitive interface. The great connectivity offered by mobile is a plus in using these technologies in teaching and learning, helping in building learning communities. This is vital to keep students connected and motivated, removing barriers and decreasing dropout rate, which is still very high due to various challenges that occur especially for distance learning system. Also, it can be used for project based learning, for collaborative tasks and for creating online learning resources.

References

Breivik, P. S., E. Gordon, G. (2006). Higher education in the Internet age.Libraries creating a strategic edge.American Council on Education, Praeger, Connecticut.

D'Antoni, S. (2007). Open Educational Resources: The way forward. Deliberations of an international community of interest. Retrieved fromhttp://www.pontydysgu.org/wp-content/uploads/2008/03/oer-way-forward-final-version-for-printing.pdf, accessed July 2019

Kawachi, P. (2014). Quality assurance guidelines for Open Educational Resources: TIPS Framework. Retrieved fromhttp://oasis.col.org/bitstream/handle/11599/562/TIPSFramework_Version%202%5b1%5d%20Copy.pdf?sequence=1&isAllowed=y, accessed July 2019

Rovai, A. P. (2009). The Internet and Higher Education.Achieving global reach. Chandos Publishing, Oxford

United States. Web-based Education Commission, United States.Department of Education (2000). The Power of the Internet for Learning: Moving from Promise to Practice, Report of the Web-based Education Commission. Publisher: U.S. Department of Education

https://www.screencastify.com/blog/7-classroom-screencasting-activities, accessed September 2019

http://services.google.com/fh/files/misc/g_suite_for_education-collaborative_tools_for_learning.pdf, accessed September 2019

http://services.google.com/fh/files/misc/g_suite_for_education-collaborative_tools_for_learning.pdf, accessed September 2019

https://googleblog.blogspot.com/2014/04/new-mobile-apps-for-docs-sheets-and.html, accessed September 2019

Designing Virtual Learning Systems: Current Trends and Evaluation

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Abstract

A growing number of virtual learning systems implement adaptive and/or intelligent behaviors. In this context, at least two issues can be identified. First, there is a need to establish which adaptive and intelligent features are more effective, and under what conditions. Second, the extent to which such features can be used without detriment to the pedagogical aspects. The paper surveys design patterns for adaptive and intelligent learning systems, as well as quantitative and qualitative criteria used for evaluating these systems, with a special focus on the latter. We also provide a discussion of the advantages and limits of automated adaptivity/intelligence in the learning process.

Keywords: adaptive educational system, intelligent tutoring system, learning system evaluation, impact of technology on education

1. Introduction

Despite the enthusiasm generated by technological advancements, especially in the field of artificial intelligence (AI), stakeholders in education remain somewhat reserved with respect to the wide adoption of these techniques. The consensus is that educational technology should complement, rather than replace, traditional approaches to instruction (UNESCO, 2019).

Based on an extensive survey of e-learning solutions, Avgeriou et al. extracted the following catalog of common design patterns in virtual learning system (VLS) architectures (Avgeriou et al., 2003):

- Personalization (personalized organization of and access to learning content);
- Course announcements (notifications of relevant courses);
- Pervasive references (resources visible in any context, such as instruments in a toolbar);
- Study toolkit (possibility to make annotations, bookmarks, etc.);
- Searching (based on learning object metadata);
- Course creation and customization (template-based support for building courses);
- Student tracking (contents read, tools used, conversations);
- Course initialization (possibility for administrators to setup new courses and provide customizable templates for instructors);
- Course backup-restore;
- E-book delivery (dynamic structuring and delivery of learning content);
- Glossary;
- Web-page editing (for instructors);
- Registration-authentication-access control;
- Management of online questionnaires (possibility for instructors to create quizzes and question banks)
- Student group management (support for collaborative work and group-level tracking);
- Student assignments management;

- Asynchronous collaboration (e.g., fora);
- Sychronous collaboration (e.g., whiteboarding);
- Online support (system documentation);
- Information distribution (support for publishing events and notifications).

Many of these patterns require VLS adaptivity, and many developers choose adaptive designs even for components for which they are not strictly necessary, such that adaptivity has become a sine qua non feature of modern VLSs.

2. Adaptivity and Intelligence

It may be important to note that adaptivity does not imply intelligence or vice-versa (Brusilovsky and Peylo, 2003). Adaptive systems modify their behavior according to user (or larger context) characteristics, and intelligent systems employ artificial intelligence (AI) techniques. Common AI techniques used in VLSs include fuzzy logic, decision trees, Bayesian networks, artificial neural networks, genetic algorithms, and hidden Markov models (Almohammadi et al., 2018). Behaviors that qualify as both adaptive and intelligent include adaptive group formation support or support for collaboration, virtual learning assistants or intelligent tutor agents.

Assessment activities were among the first to be automated, and probably the most heavily researched (Hsiao et al., 2010; Butucea and Cervinschi, 2011; Kose and Deperlioglu, 2012; Ionescu and Sburlan, 2019). In its most basic form, adaptive assessment consists of choosing the current assessment item (or batch) based on responses to previously administered assessment items (batches). AI-fueled adaptivity is based on inferring diverse learner characteristics pertaining to knowledge, style, or preferences.

More generally, learning path personalization has become a widespread concern in VLS development. It has been demonstrated that curriculum planning can be integrated in popular e-learning platforms. For example, Caputi and Garrido (2015) introduce the fictitious lesson concept in Moodle to represent a learning state, which can in turn restrict learner access to contents.

Another aspect that can be automated is learning content. Interestingly, though the first intelligent tutoring system (ITS) architectures are decades old, the current trend seems to favor (quasi)traditional interaction with human teachers. A disadvantage of ITSs is that, to be effective and reliable, they still need to be highly specialized (Harrer and Martens, 2006). Consequently, since the classical Blackboard architecture, where relevant expert agents called knowledge sources collaboratively expose their contributions to solving a problem formulated by the learner (Velthuijsen, 1992), few prominent VLS architectures that delegated content generation to AI have been proposed. Notable exceptions are information narratology-based approaches to learning law (Capuano and Toti, 2019). Conversely, online tutoring platforms supporting real-time collaboration between students and instructors through virtual classrooms, whiteboarding, etc., have proliferated.

3. Evaluation of Virtual Learning Systems

The first recommendations for VLS evaluation were driven by *research in humanistic fields* such as pedagogy, cognitive science, management, and ethics. Examples are Badrul Khan's e-learning framework (consisting of eight dimensions: pedagogical, technological, interface design, assessment – including assessment of the VLS by learners, management, resources, ethical, and institutional) and the How People Learn (HPL) framework, which stipulates that VLS design should simultaneously be learner centered (personalized), knowledge centered (with a focus on transfer of learning), assessment centered, and community centered (i.e., adapted to the socio-cultural context) (Kuchi et al., 2003). Many other scholars stressed the importance of qualitative criteria, such as a simple and intuitive interface design (Ragan et al., 2002) or adequate assessment feedback and responsiveness (Pain and Le Heron, 2003).

Other approaches were based on empirically-assessed *learner perceptions of quality of service*, or quality of experience in educational technology. For instance, in their empirical study based on regression analysis on questionnaire data, Uppal and colleagues (Uppal et al., 2018) found assurance (inspiring trust and certainty), responsiveness (timeliness), tangibility (physical presence of materials and people), course website (interface design, navigation, attractiveness, ease of use) and learning content (presentation style, content structure, level and type of interactivity, language and communication, delivery mode) to be positively correlated with student perceptions of e-learning quality. However, the study was conducted on a sample of business undergraduates in Pakistan, and generalizability of results may therefore not be guaranteed.

A similar study on U.S. population (Pham et al., 2018) found e-learning administrative and support service quality, course materials, and most of all instructor quality to be positively related to perceived e-learning service quality.

4. Three Opportunities for AI Expansion

We can identify at least three particularizations of general technological advancements that hold much promise for VLS developers, listed below.

4.1. Ubiquitous Training

Ubiquitous computing (Quigley, 2018) brought about the promise of a spatially and temporally (quasi)unlimited two-way connection between users and software systems. For education, this could mean that:

- *haptic-based simulators* such as HapticMed or Virdent (Popovici et al., 2013) could be used for any physical activity (even workout sessions can benefit from feedback regarding the correct execution of movements and the physiological parameters), or for learning to use a new technology, if its manipulation/handling would imply risks (such as in surgery, dentistry procedures, driving vehicles, conducting dangerous chemical or physical experiments, heavy industry, military training, etc.), through simulations.
- virtual learning systems should be designed to feed *multi-modal inputs* (including – but not limited to – diverse sensor inputs, location data, speech, gestures, or touch) into machine learning algorithms to better „understand” how people learn in general and in particular, and better „read” learner states (such as engagement, interest, frustration, etc.), traits (psychological characteristics relevant to the learning goals), and mastery of learning contents.

4.2. Learner Emotional State Recognition

Emotion recognition currently uses speech (Kapala et al., 2017), text (e.g., Wu et al., 2006), or visual cues in facial expressions (Velusamy et al., 2011) or in multimodal inputs such as facial expressions combined with body motion (Barros et al., 2015) or keystroke dynamics, text and heart rate (Kumar et al., 2015). Emotion recognition techniques have been used in virtual learning (see, e.g., Yang et al., 2018), but few attempts have been made to actually make (automated) decisions based on the detected emotions. Integrating emotions in the input-output chain to tailor the user’s learning experience is a promising avenue for future research.

4.3. Explainable Teaching Intelligence

The emerging field of explainable AI (XAI) aims to overcome the problematic opacity of AI methods and algorithms. A XAI approach offers human-understandable/interpretable justifications (usually visual or textual) for automated decisions, enhances control of the system and supports its further development/improvement by acting as a debugger, and may lead to new significant discoveries (Adadi and Berrada, 2018). The XAI promise of increased accountability, responsibility and transparency of AI-based decision-making could empower learners and boost their trust in educational technology. Moreover, glimpses in the VLS's personalization work logic could increase the learner self-awareness.

5. Discussion: The Impact of Technology in Education

AI solutions may still be costly, their success cannot be guaranteed, and may incur risks. Therefore, UNESCO recommendations include pilot tests of AI solutions before their adoption by institutions. Moreover, as the replacement of teachers with AI is strongly discouraged by UNESCO policies, teachers' roles should be redefined and teachers should be inherently trained to adapt to the AI integration (UNESCO, 2019).

Integration of AI-based solutions in educations raises at least two categories of concerns:

- *General concerns regarding AI*, mainly ethical (such as participation and non-discrimination, transparency and accountability, etc.) or related to data privacy and security (Hasse et al., 2019)
- *Pedagogical concerns* typically revolve around learner *engagement* and *motivation*. For example, due to present day AI limitations, AI-based assessment cannot properly evaluate, e.g., the problem-solving process for a given problem. The focus is thus restricted to results to the detriment of processes, which can be a serious threat to intrinsic motivation. AI-driven personalization may severely limit learner self-regulation by removing choice and agency (Bulger, 2016). This threatens to frustrate all three basic psychological needs conceptualized by self-determination theory (Ryan and Deci, 2017): the need for autonomy is undermined by constraining learner decisions, the need for competence through the lack of control over the progress, and the need for relatedness by limiting face-to-face interactions with other people (teachers and other learners). Furthermore, besides the intrinsic disadvantage of reducing the social dimension of learning, personalization may drive a wedge between learners, as their learning experiences fundamentally differ and they find themselves unable to share knowledge, abilities, emotional states, etc. another notable concern are related to the impact of present-day educational technology on *human memory*, given their support for storage rather than links and abstract representations (Puddifoot and O'Donnell, 2018).

In Table 1, we summarize the advantages and disadvantages of several important features of modern VLSs, and offer suggestions to attenuate the disadvantages.

Table 1. Advantages and Disadvantages of Modern Educational Technology

	Advantages	**Disadvantages**	**Potential solutions**
Automation	Speed and precision	Excessive reliance on system	Designing the system to aid, not to replace, human decision-making
Personalization	Possible enhancement of learning outcomes by accounting for learner characteristics	Desynchronization with respect to other learners, amotivation	Collaborative activities; connections with learners based on shared path/stage/etc.
Computer-mediated communication	Disinhibition; overcoming physical space barriers	Reduction of teacher authority, disengagement	Videoconferencing
Attractive interfaces	Increased motivation to use the system	Possible decreased interest for the learning contents	Prevalence of pedagogical principles in interfaces design
Ease of access to information	More comfortable learning experiences	Underuse of human memory and limited transfer of learning (Puddifoot and O'Donnell, 2018)	Conditional access to resources; restricted search, copying and sharing

6. Conclusions

Our review shows that development of current-generation virtual learning systems is driven by technological advancements rather than pedagogical knowledge. Pedagogical concerns are sometimes raised, but often fail to crystalize in quantitative analyses of the didactic impact of e-learning systems.

We believe it is essential that virtual learning system developers conduct rigorous pedagogical experiments to test prototypes. The strongest experimental designs involve a longitudinal design (with measurements at minimum two, pre-test and post-test, or more points in time), one or more treatment groups (subject to one or more educational interventions, i.e., variants of the prototype modified with respect to a focal characteristic under study) and a control group (see, e.g., Longva and Foss, 2018). Another essential aspect for developers to deliver pedagogically-informed systems is to include educators in all phases of software development. Otherwise, there is a risk of developing features that implement pedagogically irrelevant aspects, or can be even deleterious from a didactic point of view.

In particular, we suggest that besides customizing learning experiences according to learner pace, demonstrated competences and preferences, virtual learning should also seek to synchronize personalized learning experiences. Such a goal could be achieved through more collaborative assignments, as well as with the possibility to share experiences with other learners who have identical or similar learning paths or are administered the same learning setting at the same time.

References

Adadi, A. and Berrada, M. (2018): Peeking inside the black-box: A survey on Explainable Artificial Intelligence (XAI). *IEEE Access, 6*, 52138-52160.

Almohammadi, K., Hagras, H., Alghazzawi, D., & Aldabbagh, G. (2017): A survey of artificial intelligence techniques employed for adaptive educational systems within e-learning platforms. *Journal of Artificial Intelligence and Soft Computing Research, 7*, 1, 47-64.

Avgeriou, P., Papasalouros, A., Retalis, S., & Skordalakis, M. (2003): Towards a pattern language for learning management systems. *Journal of Educational Technology & Society, 6*, 2, 11-24.

Barros, P., Jirak, D., Weber, C., & Wermter, S. (2015): Multimodal emotional state recognition using sequence-dependent deep hierarchical features. *Neural Networks, 72*, 140-151.

Bulger, M. (2016). Personalized learning: The conversations we're not having. *Data and Society, 22*.

Brusilovsky, P. and Peylo, C. (2003): Adaptive and Intelligent Web-based Educational Systems. *International Journal of Artificial Intelligence in Education, 13*, 156–169.

Butucea, D. and Cervinschi, C. L. (2011): Building Robust E-learning Software Systems Using Web Technologies. *Informatica Economica, 15*, 2.

Caputi, V. and Garrido, A. (2015): Student-oriented planning of e-learning contents for Moodle. *Journal of Network and Computer Applications, 53*, 115-127.

Capuano, N. and Toti, D. (2019): Experimentation of a smart learning system for law based on knowledge discovery and cognitive computing. *Computers in Human Behavior, 92*, 459-467.

Harrer, A. and Martens, A. (2006): Towards a pattern language for intelligent teaching and training systems. In *Proceedings of the International Conference on Intelligent Tutoring Systems*. Springer, Berlin, Heidelberg, 298-307.

Hasse, A., Cortesi, S., Lombana-Bermudez, A., & Gasser, U. (2019): Youth and artificial intelligence: Where we stand. Y*outh and Media, Berkman Klein Center for Internet & Society*. Retrieved from https://cyber.harvard.edu/publication/2019/youth-andartificial-intelligence/where-we-stand, accessed 2019.

Hsiao, I. H., Sosnovsky, S., and Brusilovsky, P. (2010): Guiding students to the right questions: adaptive navigation support in an E-Learning system for Java programming. *Journal of Computer Assisted Learning, 26*, 4, 270-283.

https://idroo.com accessed 2019

https://www.chegg.com/tutors, accessed 2019

https://www.f6s.com/tutoruniverseinc, accessed 2019 https://www.wiziq.com/ accessed 2019

Ionescu, A. F. and Sburlan, D. (2019): AdABI: An adaptive assessment system based on Bayesian inference. In *Proceedings of the 15th International Scientific Conference on eLearning and Software for Education (eLSE) - New Technologies and Redesigning Learning Spaces*, Bucharest, 288-295.

Kapala, K., Krawczyk, D., and Brachmanski, S. (2017). Emotional state recognition in speech signal. *Advances in Science, Technology and Engineering Systems Journal, 2,* 3, 1654-1659.

Kose, U. and Deperlioglu, O. (2012): Intelligent learning environments within blended learning for ensuring effective c programming course. arXiv preprint arXiv:1205.2670.

Kuchi, T., Gardner, R., and Tipton, R. (2003): A learning framework for information literacy and library instruction programs at Rutgers University Libraries: recommendations of the Learning Framework Study Group.

Kumar, A. K. M., Kiran, B. R., Shreyas, B. R., and Victor, S. J. (2015): A multimodal approach to detect user's emotion. In *Proceedings of the 4th International Conference on Eco-Friendly Computing and Communication Systems*, Natl Inst Technol, Kurushetra, India, 296-303.

Longva, K. K. and Foss, L. (2018): Measuring impact through experimental design in entrepreneurship education: A literature review and research agenda. *Industry and Higher Education, 32*, 6, 358-374.

Pain, D. and Le Heron, J. (2003): WebCT and Online Assessment: The Best Thing Since SOAP? În Journal of Education Technology and Society, *International Forum of Education Technology and Society 6*, 2, 11-24.

Pham, L., Williamson, S., & Berry, R. (2018): Student perceptions of e-learning service quality, e-satisfaction, and e-loyalty. *International Journal of Enterprise Information Systems, 14*, 3, 19-40.

Popovici, D. M., Hamza-Lup, F. G., Bogdan, C. M. (2013): Haptic feedback systems in education. *Proceedings of The 9th International Scientific Conference eLearning and software for Education,* Bucharest.

Puddifoot, K. and O'Donnell, C. (2018): Human Memory and the Limits of Technology in Education. *Educational Theory, 68*, 6, 643-655.

Quigley, A. (2018): From GUI to UUI: Interfaces for Ubiquitous Computing. In *Ubiquitous Computing Fundamentals*. Chapman and Hall/CRC, 251-298.

Ragan, P., Lacey, A., and Nagy, R. (2002): Web-based learning and teacher preparation: Stumbling blocks and stepping stones. *Teaching with Technology Today, 8*, 5.

Ryan, R. M. and Deci, E. L. (2017): Self-determination theory: Basic psychological needs in motivation, development, and wellness. *Guilford Publications*.

UNESCO (2019): Beijing Consensus on Artificial Intelligence and Education: Outcome Document of the *International Conference on Artificial Intelligence and Education "Plan Education in the AI Era: Lead the Leap,"* United Nations Educational, Scientific and Cultural Organization (UNESCO)

Uppal, M. A., Ali, S., and Gulliver, S. R. (2018): Factors determining e-learning service quality. *British Journal of Educational Technology, 49*, 3, 412-426.

Velthuijsen, H. (1992): *The nature and applicability of the Blackboard architecture*. Maastricht University.

Velusamy, S., Kannan, H., Anand, B., Sharma, A., and Navathe, B. (2011): A method to infer emotions from facial action units. In *Proceedings of the 2011 IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP*, 2028–2031.

Wu, C. H., Chuang, Z. J., and Lin, Y. C. (2006): Emotion recognition from text using semantic labels and separable mixture models. *ACM transactions on Asian language information processing (TALIP)*, 5, 2, 165-183.

Yang, D., Alsadoon, A., Prasad, P. W. C., Singh, A. K., and Elchouemi, A. (2018): An emotion recognition model based on facial recognition in virtual learning environment. *Procedia Computer Science, 125*, 2-10.

Computer-Based Learning of Cotton Drawing

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Abstract

This paper presents a web-based learning module designed for computer-based learning of cotton drawing, a topic that is taught to the 3rd year students of the Faculty of Industrial Design and Business Management from Iasi, the "Technology and Design of Textile Products" specialization. The multimedia learning module merges in an integrated way different media elements such as text, schematic drawings, photographs, animations, videos, and assessment tests. The schematic drawing of Ingolstadt draw frame existing in the spinning laboratory of the faculty has been created using AutoCAD software. A Nikon D 5100 digital camera has been used to take pictures and to record videos. The animation of the cotton drawing process has been created using a free online animated GIF Maker. In order to create the evaluation tests Hot Potatoes software has been used.

Keywords: Computer-based learning, Cotton drawing, Interactive animation.

1. Introduction

The rapid growth of computer science and information and communication technology has created a great impact in every aspect of our lives, including in the field of education. The computers provide teachers with a diverse and innovative range of tools, methods, techniques that enhance the teaching and learning process. In Computer-Based Learning the computer is a key component of the educational environment suitable for promoting individualized learning in accordance with learner's inner characteristics. The use of computers in education facilitates student learning according to social constructivist theory that places the responsibility for the learning path in the hands of the learner, encouraging learner autonomy and self-direction. According to this theory, learners actively construct their own knowledge through experiences aquired by observing, exploring and doing. Computers offer a variety of tools that can help learners to construct their own knowledge, therefore they are suitable for this type of learning since they stimulate independent, individualized, and discovery learning. The new ways of teaching and learning enabled by computers facilitate the shift from teacher-centered learning to student-centered learning, therefore the shift in the role of the teacher from knowledge provider to learning facilitator helping students to construct their own understanding and capabilities (Cingi, 2013; Ichim et al, 2017).

Computer-based instruction gives students the freedom to access the learning resources at any time from anywhere, to learn at their convenience, at their own pace, according to their ability and learning style (Ichim and Sava, 2018).

Over the past years, teachers of the Faculty of Industrial Design and Business Management have partially integrated computer technology in the educational activities (Cascaval and Cascaval, 2005; Blaga and Dan, 2016; Curteza et al, 2017; Ichim et al, 2018). In this paper, a multimedia learning module for computer-based learning of cotton drawing has been designed. The learning module has been created with the aim to supplement the traditional face-to-face activities and to allow students to study out-of-class, either online or off-line.

2. Methods

In the development of the multimedia learning module for computer-based learning of cotton drawing a XML file has been used in order to create the table of content of the learning module. The conversion of the learning module without content to html format has been done using ModulEst application and for the addition of content Macromedia Dreamweaver software has been used.

The content of the module is presented in a diverse range of formats (text, graphics, animations, videos, assessment tests) aiming at increasing student/content interaction. The AutoCAD software has been used to create the schematic drawing of the Ingolstadt S 4104 draw frame that endows the spinning laboratory of the faculty. The animation of the cotton drawing process has been created using a free online animated GIF Maker. In order to create the evaluation tests Hot Potatoes software has been used.

3. Results

The result of this work is a web-based multimedia learning module whose content allows students to successfully complete course requirements so that after the completion of the module students would be able to:

- Explain the principles of roller drafting and the devices used to achieve this operation.
- Describe the purposes and method of doubling.
- Define the terms associated with the drafting process and distinguish between mechanical and actual drafts.
- Describe the various methods of controlling fibers in drafting.
- Explain the purpose of autolevelling of slivers and the devices used for this process.
- Calculate the main technological parameters and choose the settings in accordance with fibers characteristics.
- Control the quality of sliver.

The window of the learning module has two panes (Figure 1). The left pane displays the chapters and subchapters in a hierarchical tree. Chapters that contain subchapters have a + sign in a box next to them. A click on the chapter title in the left pane highlights and expands the section. The + changes to a -, a list of subchapters appears and the content of the chapter is displayed on the right pane of the window. The navigation pane allows the students' access to the module pages in any order they prefer. The module also contains navigation keys through the pages (next page, previous page), navigation keys within a page (up and down) and keys for access to the bibliography, webography, glossary of words and to a help page.

Figure 1. The Window of the Learning Module - Screen Shot

In order to change learning into an active process, the module includes an interactive application designed and developed for learning the components of the cotton draw frame. The application gives the schematic drawing of the Ingolstadt draw frame whose components are associated to a number that acts as an interactive button (Figure 2). When student selects a number a text box appears, giving the name of the machine component and a short explanation about its function. Also, by placing the mouse over a machine component, a picture of the component can be seen or a short video can be run.

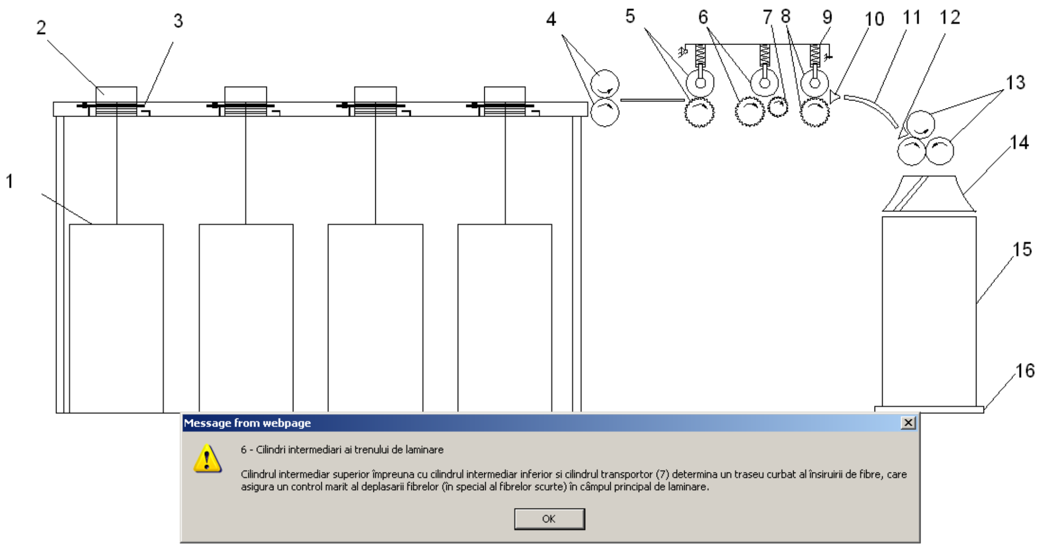

Figure 2. Screen Capture with Interactive Description of the Components of Cotton Draw Frame

With the purpose to support students' learning of the operating principle of draw frame, an animation showing the working principle of Ingolstadt S 4104 draw frame has been created. Because the draw frame running mechanisms cannot be seen by students from safety reasons, this topic requires focused teaching efforts to provide clarity to students. Therefore, animation helps students to visualize the draw frame mechanisms in better manner and can significantly enhance student learning in ways that were not possible in traditional teaching. Animations as an instruction medium are interactive tools that meet the needs of today's students due to their benefits:

- Provide explanation of challenging topics in easy to comprehend manner;
- Make learning more enjoyable;
- Present topics in a new perspective.

The animation of the cotton draw frame allows students to understand the path of the fibrous material and the objectives of the drawing process:

- Reduction of sliver irregularity by doubling.
- Blending of raw material by doubling.
- Straightening and parallelizing of hooked fibers in the sliver by drafting.
- Reduction the sliver thickness or weight/unit length by drafting.

In traditional instruction the assessment is mainly summative, the student learning being evaluated at the end of the semester. Therefore, the assessment is set apart from instruction. In computer-based instruction the assessment is formative, being integrated into the teaching and learning process. Thus, the formative assessment can help both teachers and students. On the one hand, the formative assessment can help teachers to monitor student learning, to identify learning needs and to improve their teaching, and on the other hand, the formative assessment can help students to identify their academic strengths and weaknesses and to take greater responsibility over their own learning.

The web-based assessment tests have been developed using Hot Potatoes program that creates different question-based quizzes. For this lesson multiple-choice, multi-select and short-answer questions have been created (Figure 3).

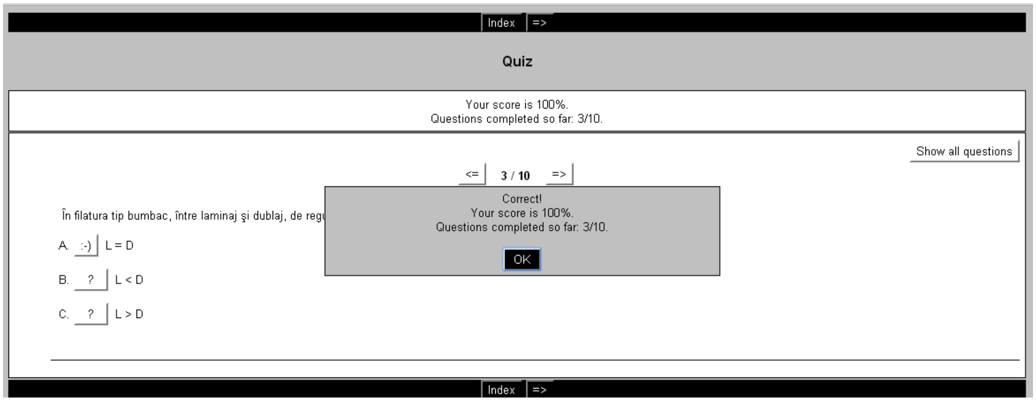

Figure 3. Screenshot of an Assessment Test

The content of the learning module is improved continuously according to students' feedback and needs.

4. Conclusions

Computers have revolutionized education providing a wide range of interactive tools that can increase student engagement and achievement. In addition to text that remains one of the most important tool to transmit information, integration of simulations, graphics, animations, and videos make students' learning more efficient. Learning gets easier if the information is given by a combination of different sources.

This paper presents a web-based learning module that integrates multimedia tools (schematic drawings, pictures, animations, videos, and assessment tests) into teaching and learning of cotton drawing process. The module can be accessed either online or off-line and is designed to complement face-to-face instruction.

References

Journal Articles:

Cascaval, D., Cascaval, P., (2005) Analytical and Simulation Approach for Efficiency Evaluation of the Weaving Machines with Filling Break Tolerance. *WSEAS Transactions on Information Science and Applications*, Vol. 2, No. 12. 2243 – 2251.

Cingi, C.C., (2013) Computer aided education, *Procedia - Social and Behavioral Sciences*, 103, 220 – 229.

Conference Proceedings:

Blaga, M., Dan, D., (2016): Blended teaching for advanced knitting technologies. In *Proceedings of the 12th International Scientific Conference "eLearning and Software for Education"*, April 21-22, Bucharest, Volume 3, 437-444.

Curteza, A., Farima, D., Buliga, V., Ichim, M., (2017): Applying Shannon and Boltzman Laws when Simulating Thermal Comfort. In *Proceedings of the 13th International Scientific Conference "eLearning and Software for Education"*, Bucharest, April 27-28, 416-422.

Ichim, M., Dan, D., Sava, C., (2017): Interactive tools used in blended instruction to teach the blow room line processes. In *Proceedings of the 13th International Scientific Conference "eLearning and Software for Education",* Bucharest, April 27-28, Volume 3, 445-448.

Ichim, M., Sava, C., (2018): Computer-Assisted Teaching and Learning of Cotton Carding. In *Proceedings of the 14th International Scientific Conference "eLearning and Software for Education"*, Bucharest, April 19-20, Volume 3, 172-177.

Ichim, M., Sava, C., Farima, D., (2018): Online Learning of Textile Engineering Using Moodle Platform, In *Proceedings of the 14th International Scientific Conference "eLearning and Software for Education"*, Bucharest, April 19-20, Volume 3, 178-181.

S e c t i o n

TECHNOLOGIES & VIRTUAL LABORATORY

Technologies (TECH):

- **Innovative Web-based Teaching and Learning Technologies, Virtual Laboratory**
- **Advanced Distributed Learning (ADL) technologies**
- **Web, Virtual Reality/AR and mixed technologies**
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- **New technologies for e-Learning, e-Training and e-Skills**
- **Educational Technology, Web-Lecturing Technology**
- **Mobile E-Learning, Communication Technology Applications**
- **Computer Graphics and Computational Geometry**
- **Intelligent Virtual Environment**

Monitoring and Alarming System for an Gas Central Heating Boiler

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Abstract

Gas detectors have the role of warning in the case of natural gas escapes, to prevent intoxication, explosions or fires. The aim of this paper is to make a functional system in terms of hardware and software, to monitor any gases emitted by an gas central heating boiler, as well as to shut down the gas supply to the boiler and to ventilate the room where the boiler is located. The system is also equipped with a vibration sensor to detect a possible earthquake, in which case the gas supply is also turned off. Programming of the microcontroller is done using the LabVIEW graphical programming language. The electrical layout of the project was done in EasyEDA, which is a software used to design, simulate and PCBs realization.

Keywords: MQ gas sensors, vibration sensor, Arduino, LabVIEW, LINX.

1 Introduction

The uncontrolled leak of different gasses can be very dangerous for human life and health, e.g., carbon oxides lead to suffocation and natural or liquefied petroleum gas lead to fires or explosions (Mahalingam, A., (2012))

The alarm is made optically and/or acoustically, and if it does not intervene, a complete system activates the second component, the solenoid valve, mounted as close as possible to the gas meter, which automatically shuts off the supply of gas natural.

The components required for the technical project are:

- Arduino Uno Platform;
- MQ-7 Gas Sensor: this is a carbon monoxide (CO) sensor, suitable for detecting CO concentrations in the air. The MQ-7 sensor can detect CO-gas concentrations from 10 to 10,000 ppm. This sensor has a high sensitivity and a fast response time;
- MQ-5 Gas Sensor: this sensor is ideal for detecting gas leaks (home or industrial). It is perfect for detecting LPG (Liquified Petroleum Gas) leaks, methane, carbon monoxide, alcohol;
- SW-420 Vibration Sensor;
- 3 LEDs with 3 suitable resistors for to limit the current through LEDs;
- 2x5VDC Relays Module;
- DC motor as a fan;
- 5V bulb, as a solenoid valve

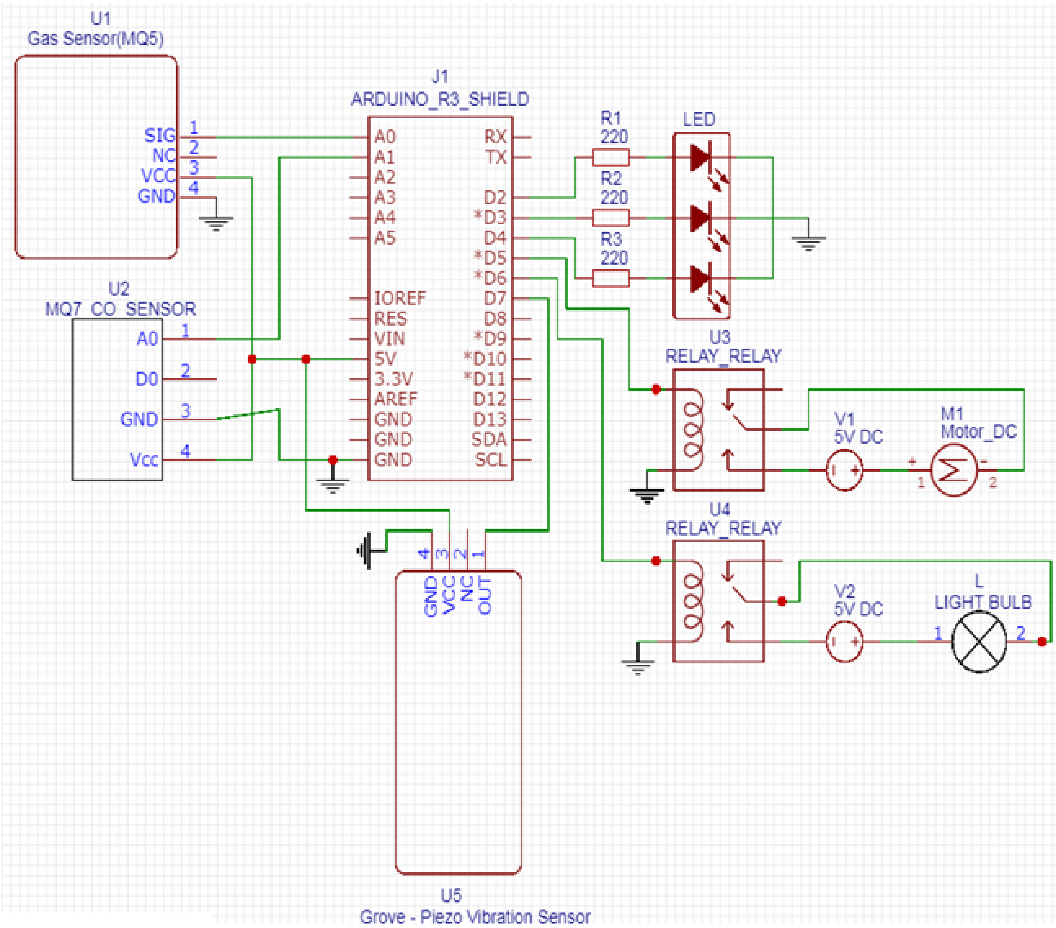


*Figure 1.*The wiring diagram of the project

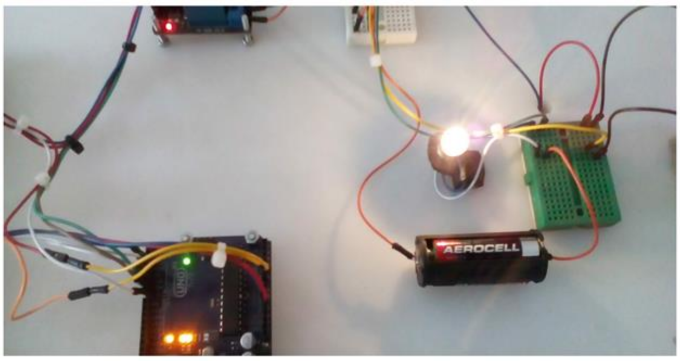


*Figure 2.*The images of the project

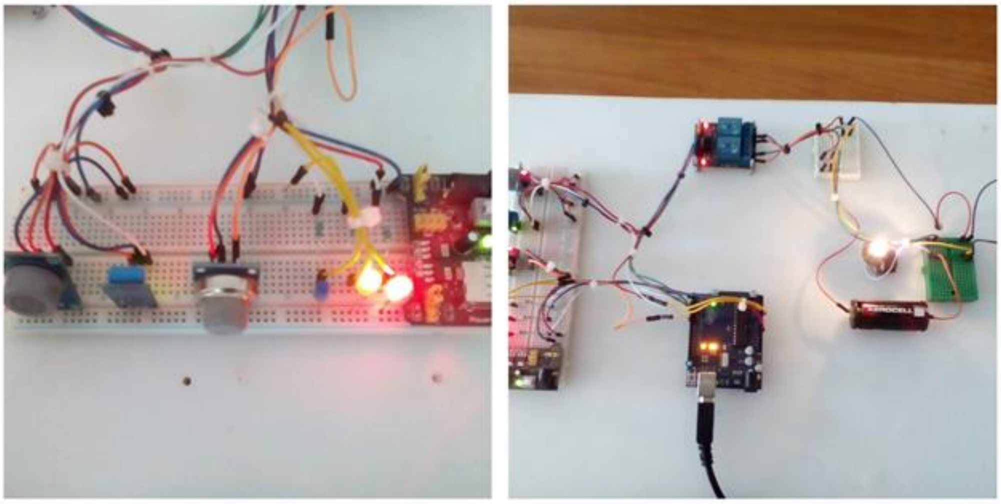


*Figure 3.*The images of the project (forwards)

2 The virtual instrument of the project

LabView is a more sophisticated program that can also be used to program the Arduino board if a toolkit called LINX is installed to recognize the Arduino microcontroller.

LabVIEW for X (LINX) is designed to replace LabVIEW interfaces for Arduino and to provide a LabVIEW generic protocol for the interface with any programmable device, but specifically targeting Microcontrollers and SoCs (System on a Chip). LINX will provide a high level of programming that allows users to communicate with a number of devices, including Arduino (https://www.labviewmakerhub.com/). A firmware specification will be provided to developers to create the LINX firmware for the device you choose.

An example of Arduino board firmware is shown in the Figure below.

*Figure 4.*Arduino board recognition Firmware

As a result, LINX is a level of hardware abstraction that allows us to have a single LabVIEW interface for a variety of hardware devices. The VI with the LINX function, sends commands to the LINX firmware running on a device connected to the development computer via a USB, WiFi or Ethernet connection.

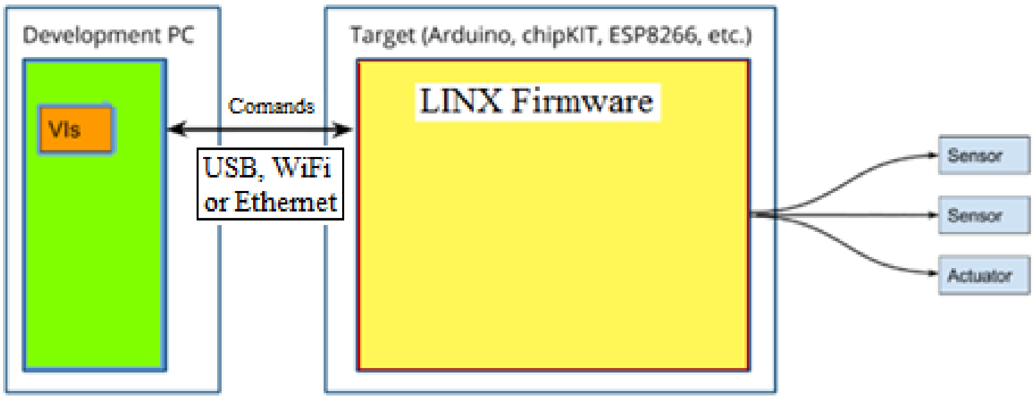


Figure 5. Communication between VIs made with LINX functions and different hardware devices

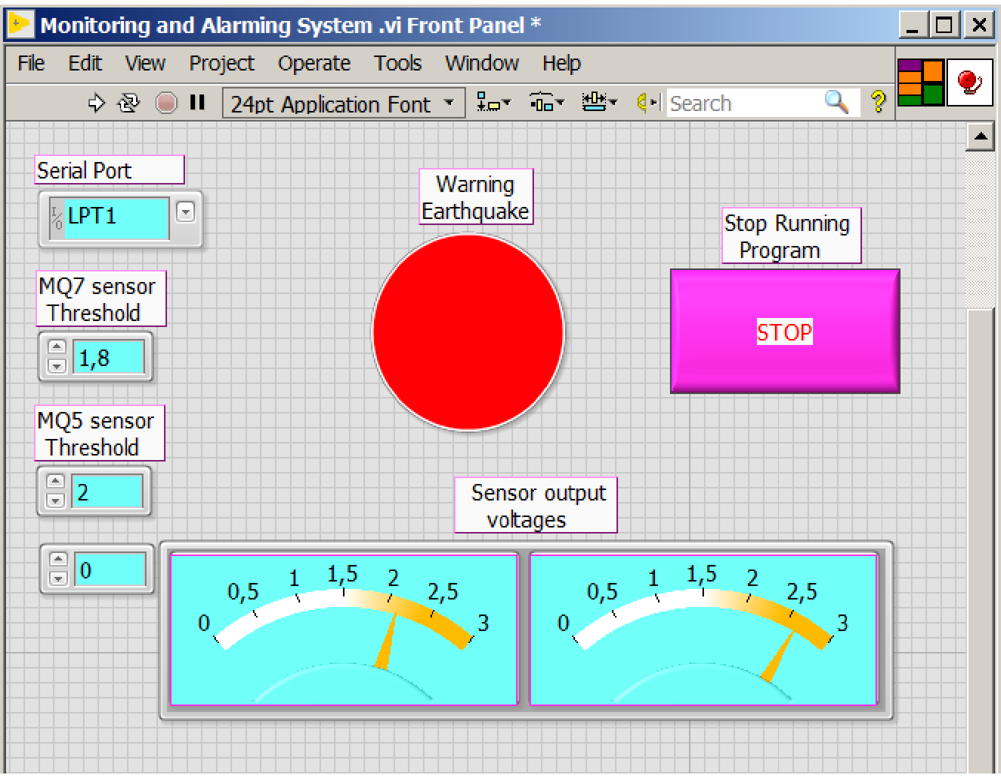


Figure 6. The Front Panel of the VI

The figure above shows the VI front panel. It contains the following controls and indicators:

- a control (Serial Port) for setting the serial port to which Arduino is connected;
- a boolean control (Stop Running Program) to stop running the virtual instrument;
- an array (Sensor Output Voltages) that contains two numeric Meter indicators for displaying the output voltages of the two gas sensors (MQ7 and MQ5 respectively);
- two numerical controls (MQ7 Sensor Threshold and MQ5 Sensor Threshold) for setting the two voltage thresholds from which the alarm starts;
- an LED (Warning Earthquake) for indicating a possible earthquake.

The Block Diagram of VI contains the controls and indicators terminals of the Front Panel, the various nodes, constants and the wires. The nodes in LabVIEW are different functions, subVIs and programming structures (Bogdan, 2018).

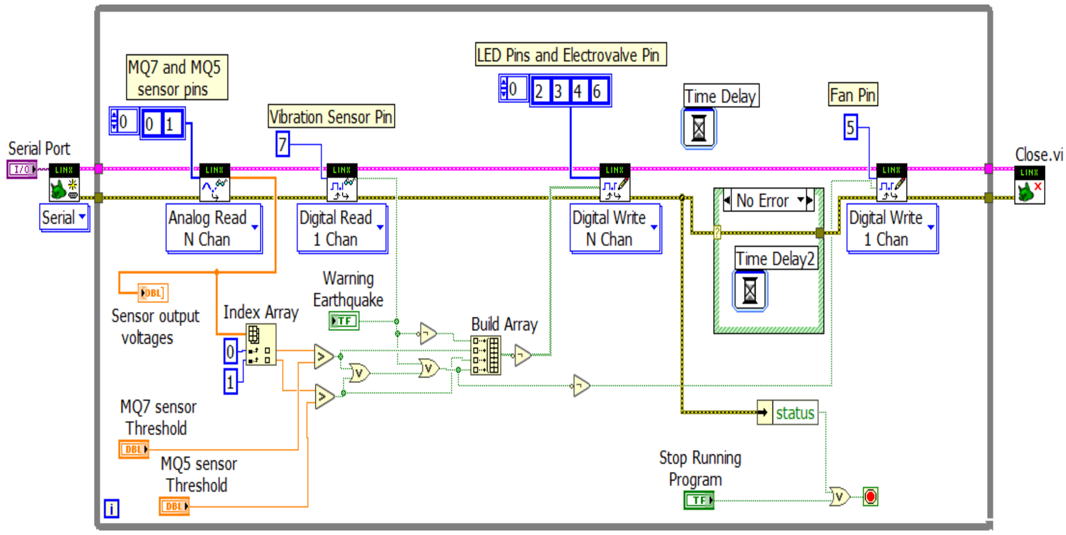
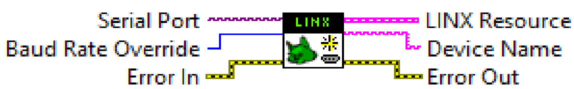


Figure 7. The Block Diagram of the VI

In the block diagram, the following functions and programming structures were used:

- The **Open Serial** Function: this function opens a serial connection with the Arduino platform. Each different program starts with the Open function.



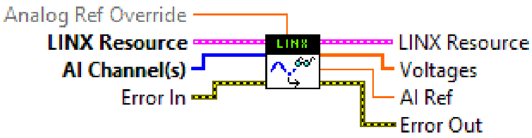
Inputs:

- Serial Port: Specifies the COM port of the Arduino platform.
- Baud Rate Override: (Optional) When specified, allows the user to change the default baud rate used for serial communication. By default, LINX establishes communication using a baud rate of 9600.
- Error In: Describes the error conditions that may occur before running this node. This entry provides a standard error in functionality.

Outputs:

- LINX Resource: Contains the LINX connection resources.
- Device Name: The name of the device connected to the Serial Port.
- Error Out: Contains information about possible errors. This output provides a standard error.

- The **Analog Read n Chans** Function: reads the values of the specified input channels. In this project, this function reads the voltages of the two MQ7 and MQ5 gas sensors. The two sensors are connected to the AI0 and AI1 analog inputs.



Inputs:

- Analog Ref Override: (Optional) Allows you to change the analog reference voltage (in volts) used by the digital to analog converter (ADC).

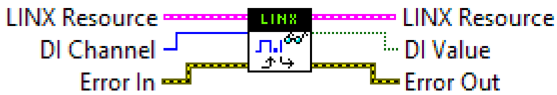
- AI Channel (s): Specifies which analog channels are to be read.

Outputs:

- Voltages: Returns analog values in volts.

- AI Ref: Returns the device's current analog input reference voltage.

- The **Digital Read 1 Chan** Function: Read the value (high or low) from the specified digital pin. In this VI, this function reads the high or low digital value of the vibration sensor SW-420 connected to the digital input pin 7.



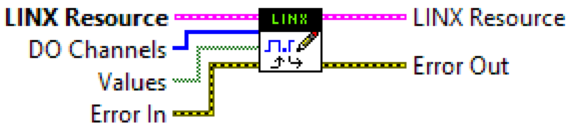
Inputs:

- DI Channel: Specifies which digital input channel will be read.

Outputs:

- DI Value: Returns the value of the digital input (high or low).

- The **Digital Write N Chans** Function: write the digital values (high or low) at the specified digital output channels. In this project, this function writes the digital values (high or low) to the digital output pins 2, 3, 4, and 6, to which are connected the three LEDs (pins 2,3 and 4) and the relay coil for control the gas valve solenoid (pin 6).

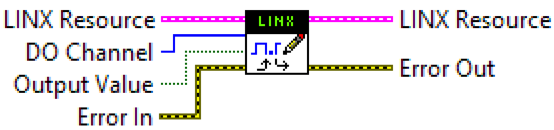


Inputs:

- DO Channels: Specifies the digital output channels to write to.

- Values: Specifies the digital values to write.

- The **Digital Write 1 Chan** Function: Write the digital values (high or low) to the specified digital output channel. In this VI, this function writes the digital values (high or low) to the digital output pin 5, to which the relay coil for the fan control is connected.

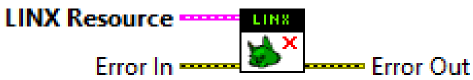


Inputs:

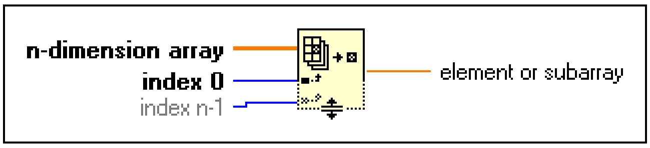
- DO Channel: Specifies the digital output channel to write to.

- Output Value: Specifies the digtal value to write..

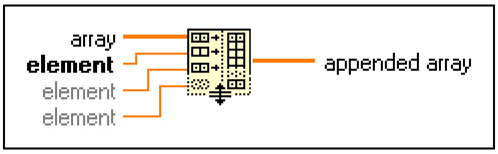
- The **Close** Function controls the end of the program. This function close the connection to the remote LINX device and free any local I/O resources. We must finish each different program with Close function;

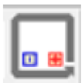


- The **Index Array** Function: Returns the voltage values from the analog outputs of the two gas sensors (MQ7 and MQ5).



- The **Build Array** Function: adds the four boolean input values to a four-element array that will be applied to the input of the Digital Write N Chans function that will write these values to pins 2, 3, 4 and 6.



-  The **While Loop** structure: that will continuously execute the functions inside it until the conditions for termination are reached.

3 Conclusion

The LabVIEW's environment from National Instruments is a graphical development environment for the rapid creation of flexible, affordable design, control and testing applications at a minimal cost. Applications cover all phases of product development: research and testing, production and maintenance.

The advantages of virtual instrumentation over traditional instruments:

- occupy a small space (basically a computer and a monitor);
- it can be with distributed elements (can measure in several places at a time);
- the data can be transmitted over the internet (the measuring laboratory can be located in a certain place, and the analysis of the results can be done in another part);
- the instruments no longer occupy a physical space (a repository) being stored in the computer memory;
- maximum flexibility in the setting up instruments (whenever a instrument can be deleted from the memory and another can be added, or various other command elements can be added);
- practically disappear problems related to dirty switches or imperfection of connections;
- many offset or calibration errors disappear or decrease;

References

Bogdan M., (2018): „Gas Detector Using Arduino and LabVIEW", Proceedings of the 13th International Conference on Virtual Learning ICVL 2018, ISSN: 1844-8933, p. 315-318, October 26-27, 2018

Bogdan M., (2018): „Monitoring and Alarming the Level of Liquid in a Tank", Proceedings of the 13th International Conference on Virtual Learning ICVL 2018, ISSN: 1844-8933, p. 319-323, October 26-27, 2018

Mahalingam, A., (2012): "Design and implementation of an economic gas leakage detector", Recent Researches in Applications of Electrical and Computer Engineering

https://www.arduino.cc

http://zone.ni.com/reference/en-XX/help/371361H-01/lvconcepts/intro_to_vis/

https://www.labviewmakerhub.com/

http://www.ni.com/getting-started/labview-basics/shift-registers

https://playground.arduino.cc/Main/MQGasSensors

http://www.ni.com/getting-started/labview-basics/execution-structures

https://cdn.sparkfun.com/datasheets/Sensors/Biometric/MQ-7%20Ver1.3%20-%20Manual.pdf

Greenhouse Monitoring and Control of Temperature and Soil Moisture

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Abstract

Monitoring and controlling the temperature and humidity in a greenhouse is essential for increasing productivity, reducing energy consumption, increasing efficiency and reducing production and storage losses. In cold stores, vegetable and fruit storage, greenhouses, and so on, it is necessary to maintain a certain temperature and humidity.The purpose of this paper is to design and implement a low cost system intended in terms of hardware and software, to make the monitoring and controlling the temperature and humidity in a greenhouse. This system will be built using the Arduino Uno development platform, and programming will be done using the LabVIEW graphical programming. Hardware resources that will be used in the paper are: Arduino Uno, an LM35 Precision Centigrade Temperature Sensors, an Soil moisture sensors that measure the volumetric water content in soil, an DC 12V Brushless Cooling Fan, a breadboard, 3 LEDS with 3 x suitable resistors for to limit the current through LEDs (220 Ohms is fine) and connecting wires.The results will be displayed through the serial interface on the computer, in the LabVIEW program.The electrical layout of the project was done in EasyEDA, which is a software used to design, simulate and PCBs realization.

Keywords: LM35 Temperature Sensors, Soil Moisture Sensor, Arduino, LabVIEW, LINX.

1 Introduction

The monitoring and control of environmental temperature and soil moisture in a Greenhouse, is a new alternative to control some variables inside the greenhouse. The objective of the control is to maintain a certain value within a preset interval or value (set point) regardless of whether an external influence disrupts the process.

The components required for this technical project are:

- Arduino Uno development board, that is a processing platform that contains thirteen digital inputs/outputs, six analog inputs and a serial port that allows communication with peripherals, in addition to a serial port a USB connection, for interaction with the user. In the figure 1 we can see the location of the analog inputs and digital as the power pins. It also has a button to reset any malfunction that exists in the processes that will be performed with the Arduino development board;

- LM35DZ temperature sensor, which are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. LM35 is three terminal linear temperature sensor from National semiconductors. It can measure temperature from -55 degree Celsius to +150 degree Celsius. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. Thus, at 0°C it will have an output voltage of 0V and increases by 10mV when raising the temperature by 1°C.

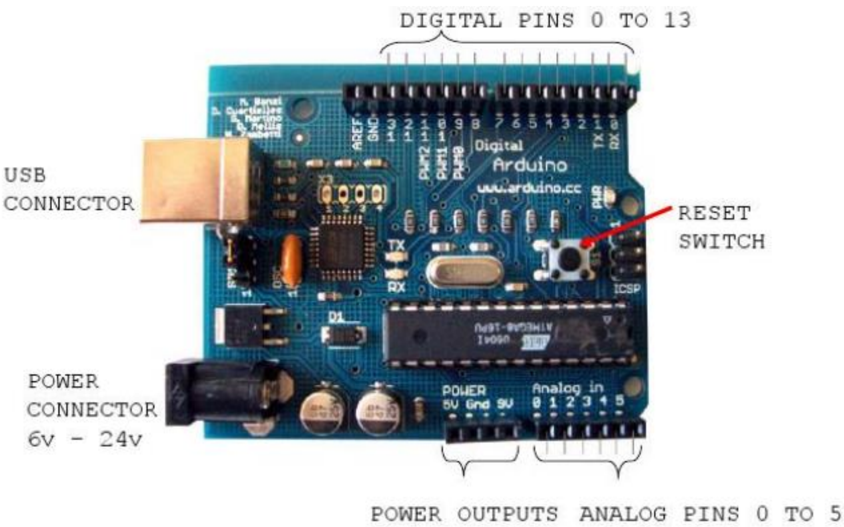


Figure 1. TheArduino Uno development board

LM35 can be operated from a 5V supply and the stand by current is less than 60uA (http://www.ti.com/product/LM35);

- FC-28 Soil Moisture Sensor, which consists of two probes that are used to measure the volumetric content of water. The two probes allow the current to pass through the soil, which gives the resistance value to measure the moisture value.

When there is water, the soil will conduct more electricity, which means that there will be less resistance. Dry soil conducts electricity poorly, so when there is less water, then the soil will conduct less electricity, which means that there will be more resistance.

This sensor can be connected in analog and digital modes. We will connect it in analog mode (https://maker.pro/arduino/projects/arduino-soil-moisture-sensor).

Specifications:

Power supply:	3.3V or 5V
Current:	35 mA
Output	analog (0 – 1023)/digital (0 or 1)
Comparator Chip	LM393

In analog interfacing mode, the sensor will give the percentage value of the moisture. The sensor gives value from 0 to 1023 and with the help of LabView will map the value to the percentage from 0 to 100.

- 3 LEDs with 3 suitable resistors for to limit the current through LEDs;
- 5VDC Relay Module. A relay is an electromechanical device that allows a microcontroller, like Arduino, to control a load at a voltage or intensity level much higher than the microcontroller can support. In this project, the relay will connect the fan to the battery;
- AV-752512S DC 12V Brushless Cooling Fan. Brushless DC fans tend to be the solution of choice for most electronic enclosures. These fans couple high reliability with ease of use. The basic DC brushless fan is a 2-wire device over which a DC voltage is applied;
- 9 VDC battery, for powering the Brushless Cooling Fan.

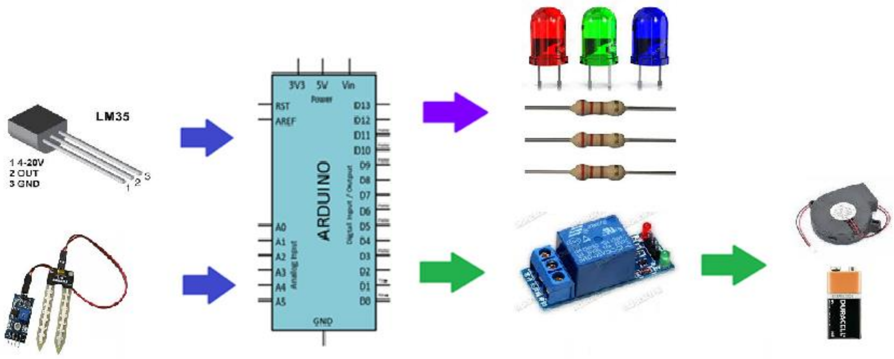


Figure 2. The components necessary for the elaboration of the technical project

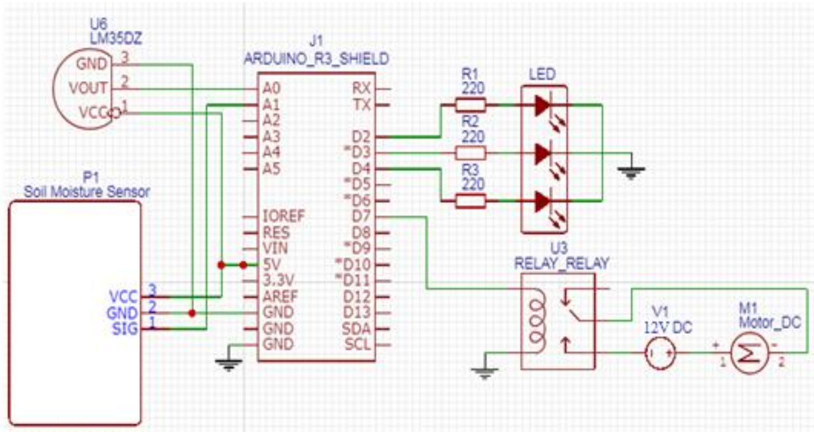


Figure 3. The wiring diagram of the project

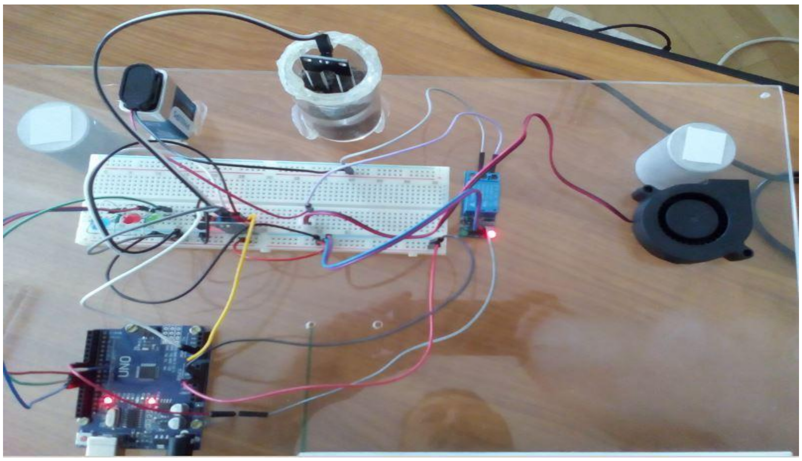


Figure 4. The image of the project

2 The virtual instrument of the project

The virtual instrument accomplished, will monitor the temperature and humidity in a greenhouse.

If the greenhouse temperature is between two levels (Min and Max set by the user), a green LED will light up. If the greenhouse temperature is lower than the Min level, a blue LED lights up and at the same time should start a heating system. If the temperature exceeds the Max level, the red LED will come on, and a relay will start the ventilation system.

Represented in Figure 3 is the Front Panel of the VI. It contains the following controls and indicators:

- a control (Serial Port) for setting the serial port to which Arduino is connected;
- a boolean control (Stop Running Program) to stop running the virtual instrument;
-2 controls (Max and Min) for setting the two temperature levels;
-2 thermometer indicators to display temperature and humidity;
-3 LEDs to display greenhouse temperature (Moderate, Warm, Cool);
-a graphical display for graphical display of temperature and humidity.

The Block Diagram of VI contains the controls and indicators terminals of the Front Panel, the various nodes, constants and the wires. The nodes in LabVIEW are different functions, subVIs and programming structures (Bogdan, 2018).

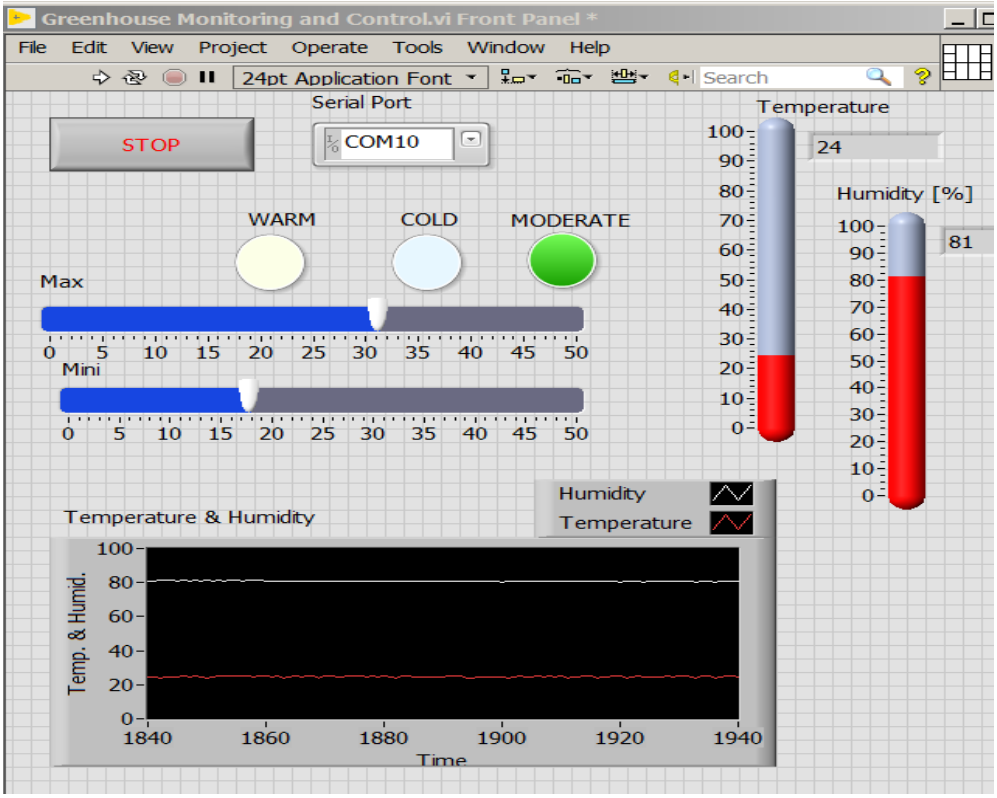


Figure 5. The Front Panel of the VI

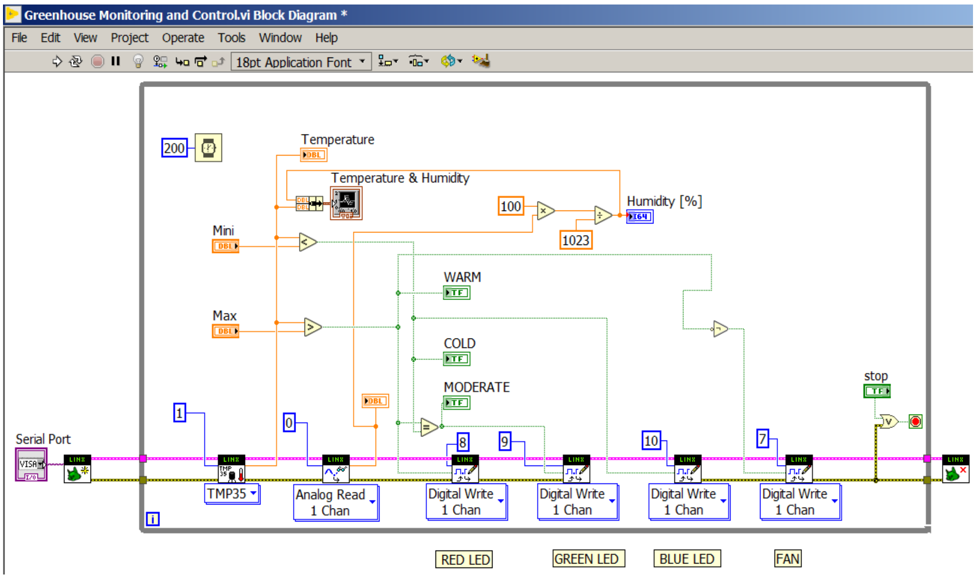
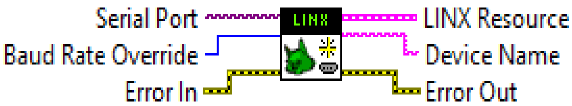


Figure 6. The Block Diagram of the VI

In the block diagram, the following functions and programming structures were used:

➢ The **Open Serial** Function: this function opens a serial connection with the Arduino platform. Each different program starts with the Open function.



Inputs:

- Serial Port: Specifies the COM port of the Arduino platform.

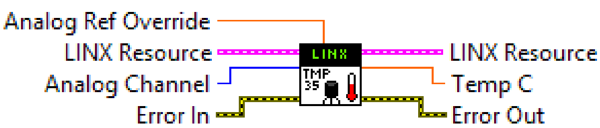
- Baud Rate Override: (Optional) When specified, allows the user to change the default baud rate used for serial communication. By default, LINX establishes communication using a baud rate of 9600.

- Error In: Describes the error conditions that may occur before running this node. This entry provides a standard error in functionality.

Outputs:

- LINX Resource: Contains the LINX connection resources.
- Device Name: The name of the device connected to the Serial Port.
- Error Out: Contains information about possible errors. This output provides a standard error.

➢ The **TMP35** Function: Read temperature from LM35 sensor.



Inputs:

- Analog Ref Override: (Optional) Specifies the analog voltage reference used to convert ADC ticks to voltage.

- LINX Resource: Contains LINX connection resources.

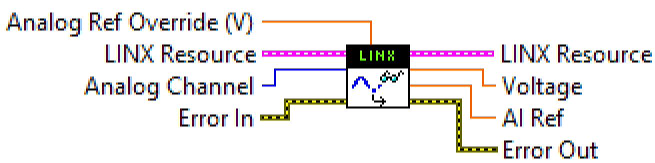
- Analog Channel: Specifies the LINX device analog input channel that the LM35 is connected to.
- Error In: Describes error conditions that occur before this node runs. This input provides standard error in functionality

Outputs:
- Temp C: Returns the temperature from the LM35 in C.
- LINX Resource: Contains LINX connection resources.
- Error Out: Contains error information. This output provides standard error out functionality.

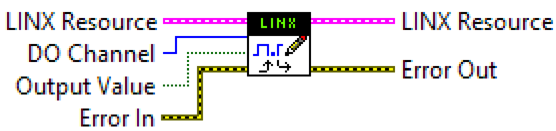
➢ The **Analog Read 1 Chan** Function: reads the values of the specified input channel. In this project, this function reads the voltages of the Soil Moisture Sensor. The sensor are connected to the AI0.

Inputs:
- Analog Ref Override (V): (Optional) Allows the analog reference voltage used to convert ADC ticks to volts to be overridden.
- AI Channel: Specifies which analog channel are to be read.

Outputs:
- Voltages: Returns analog value in volts.
- AI Ref: Returns the device's current analog input reference voltage.

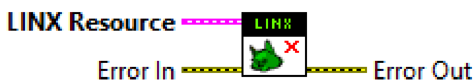


➢ The **Digital Write 1 Chan** Function: Write the digital values (high or low) to the specified digital output channel.

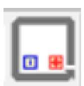


Inputs:
- DO Channel: Specifies the digital output channel to write to.
- Output Value: Specifies the digtal value to write..

➢ The **Close** Function controls the end of the program. This function close the connection to the remote LINX device and free any local I/O resources. We must finish each different program with Close function;



➢ We also used three comparison functions (Less?, Greater? and Equal?) for comparing the current temperature with the two levels (Min Level and Max Level).

➢  The **While Loop** structure: that will continuously execute the functions inside it until the conditions for termination are reached.

3 Conclusion

This project consists in developing an application that allows monitoring, recording and control of a greenhouse crop by implementing various devices (microcontrollers, sensors and actuators) to give the user a history of the most relevant variables to be measured (temperature, relative humidity, and soil humidity) throughout the crop development process.

After having performed the respective tests, it is verified that the objectives set are met, that is, the control and monitoring of the ambient temperature is carried out so that it does not exceed its established value, and for the humidity the control and monitoring of the soil moisture through the drip system so that it does not fall below a set minimum value. With the control of the temperature depending on the requirements of the crop excessive temperatures are prevented inside the greenhouse.

References

Barsoum N., Peter A., (2015): „GSM Greenhouse Monitoring and Control of Temperature and Soil Moisture", European International Journal of Science and Technology, Vol. 4 No. 6 August, 2015

Bogdan M., (2018): „Monitoring and Alarming the Level of Liquid in a Tank", Proceedings of the 13th International Conference on Virtual Learning ICVL 2018, ISSN: 1844-8933, p. 319-323, October 26-27, 2018

Park, J., Yoe, H., (2015): "Greenhouse Environment Monitoring and Control System using CoAP", Advanced Science and Technology Letters, Vol.95 (CIA 2015), pp.168-172

https://www.arduino.cc

http://zone.ni.com/reference/en-XX/help/371361H-01/lvconcepts/intro_to_vis/

https://www.labviewmakerhub.com/

http://www.ni.com/getting-started/labview-basics/execution-structures

http://www.ti.com/product/LM35

https://maker.pro/arduino/projects/arduino-soil-moisture-sensor

Gaming simulator and industrial software tandem for industrial applications

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Abstract

In the context of Industry 4.0 environment, simulation of industrial applications is the topic of today's headlines of major companies and universities. All the actors involved in production industries are interested in verifying their proposed solutions both hardware as well as software before installation in the field.
The gaming companies develops industrial environmental simulation software with the purpose that the users will learn how to develop control program for different installations. This article's purpose is to present some software solutions for industrial simulation installations. They work in tandem with commercial programs, thus the user being able to develop a complete solution.

Keywords: Factory I/O, Tia Portal, Cartesian robot, Warehouse cell, GRAFCET, SFC

1 Introduction

In the context of Industry 4.0 environment, simulation of industrial applications is the topic of today's headlines of major companies and universities. All the actors involved in production industries are interested in verifying their proposed solutions both hardware as well as software before installation in the field.

The gaming companies develops industrial environmental simulation software with the purpose that the users will learn how to develop control program for different installations.

Beloiu (Beloiu, 2018) presents a software program – Factory I/O ("NEXT-GEN PLC TRAINING 3D FACTORY SIMULATION," 2019) – that allows users to create a virtual solution of certain industrial installations. This program can communicate with various industrial controllers programming software produced by very known companies: Siemens and Allen Bradley. Thus this simulation solution helps users to get accustomed with PLC programming (Beloiu, 2017) that are most popular in Europe and USA.

Reis and Gins (Reis and Gins, 2017) present a description of the evolution of the Industrial Process Monitoring. They present the evolution of this field from optimization centered, to root cause analysis and diagnosis and in the future to prognosis of process monitoring. They conclude that the final and most important purpose of monitoring is to provide a secure working environment for people and equipment. Also a critical aspect is the reduction of non-function time of machines due to failure and maintenance.

If the users learn to use simulation software, then these aspects can be obtained.

Industry 4.0 is a very popular topic among the industrial researchers (Varela et al., 2019), (Stock and Seliger, 2016), (Schuh et al., 2014), (Roblek et al., 2016) and many others due to the impact that will have on the future production companies. In modern day production lines and future ones, the typical resources are converted in intelligent elements (Zhong et al., 2017) that are able to communicate between themselves and with a controller. Traditional design of industrial facilities should be upgraded to Virtual Reality and Augmented Reality. Therefore, users should be exposed and have access to such tools and making the use of them to look much more similar to gaming than to industrial applications.

1.1 Paper Contributions

This article's purpose is to present some software solutions for industrial simulation installations. They work in tandem with commercial programs, thus the user being able to develop a complete solution.

There will be presented two applications that simulates industrial applications. It is not enough for users to make a connection between the controller simulator (in this case a PLC) with the simulated installations. Usually, industrial installations contain actuators, controlling elements, command elements, power cables, signal cables, illumination installation, etc. Therefore, someone should be exposed to different CAD systems dedicated to these requirements.

2 Simulation of industrial applications

2.1 Cartesian Robot cell

In Figure 10 is presented a Cartesian robot cell with two conveyors that have to manipulate objects according to the technological process (Morlovea, 2019). The system contains several sensors that will provide information to the PLC about several parameters of the processed objects.

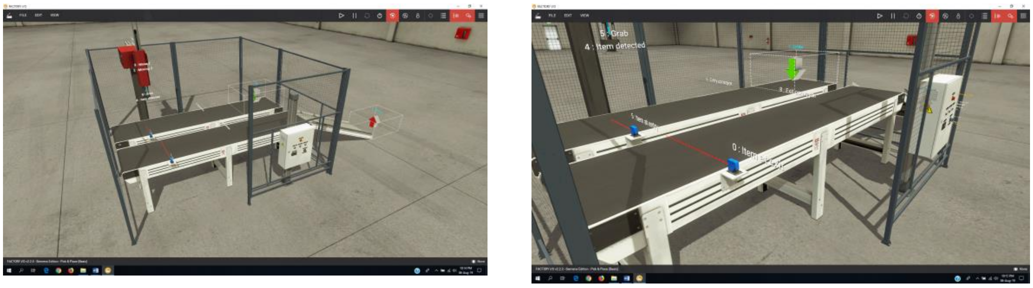

Figure 10. Cartesian robot cell

The Cartesian robot has electrical installation for suppling the actuators with energy, as indicated in Figure 11. This installation has a command component as well as high power component. In this case, the actuators are squirrel cage induction motors. The control is provided by a Siemens Step7 PLC.

Once the electric schematic is designed using a CAD software and is checked to have a correct function using a simulator, there is the need to select the electrical elements involved.

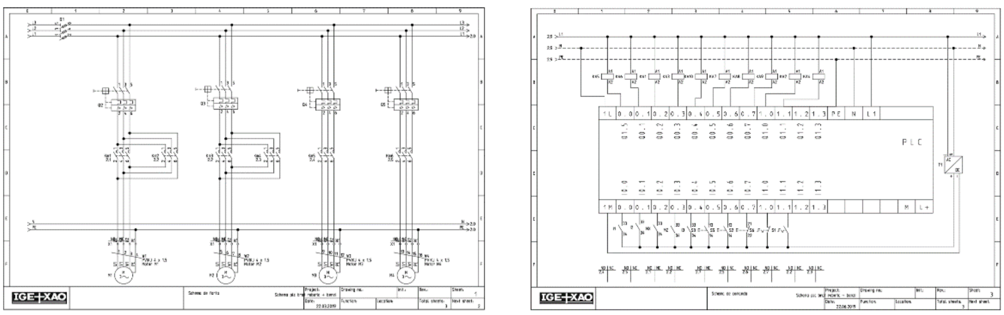

Figure 11. Electric schematic of the Cartesian robot

Figure 12 provides the result of the element calculation that results from a CAD system ("EcoStruxure Power Design - Ecodial," 2019). This software indicates all the elements in the power system schematic including their electrical parametes.

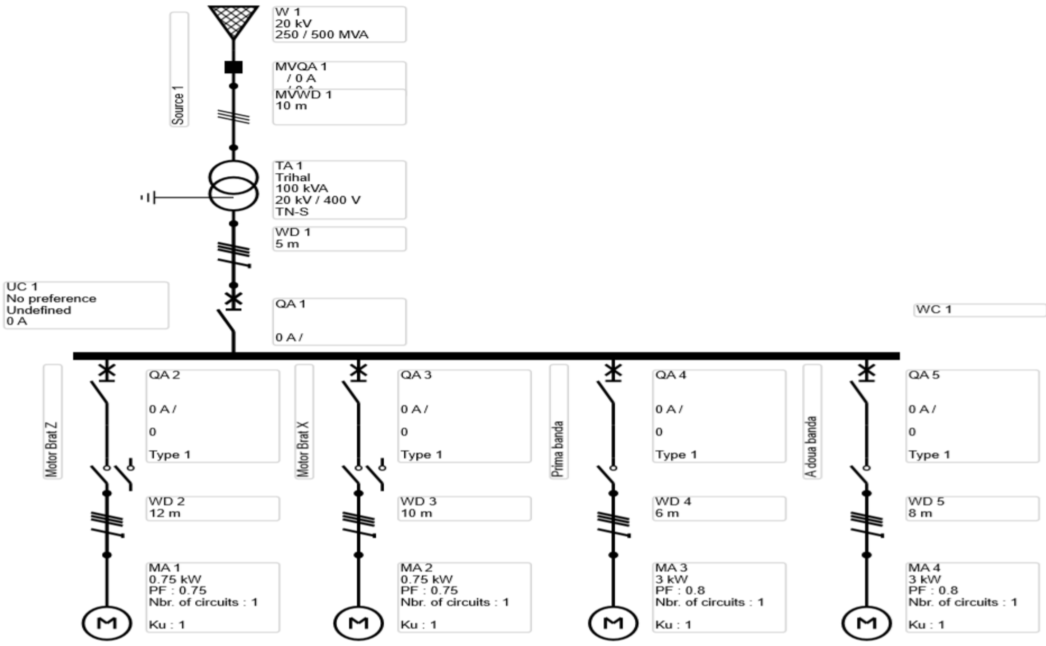

Figure 12. Calculated schematic of the Cartesian robot

Figure 13 presents the logic diagram used to command the Cartesian robot cell. This is a visual logic description of all the steps that the software should do for a good process control. Once the logic diagram is done, it can be implemented in the programming software of the PLC (Beloiu, 2017). The logic diagram is also very useful in case of maintenance of both the software as well as the hardware in case of malfunction.

2.2 Warehouse cell

In Figure 14 is indicated the warehouse which contains several elevators that separates the analyzed products according various parameters indicated in the technological process description (Marin, 2019). The system is provided with several sensors that detect the selection parameters of the process objects. According to the technological description, these objects are processed by the elevator.

Figure 15 and Figure 16 indicate the electrical schematic as well as the calculated elements that this contains. The correct function of the electrical schematic was tested using a free simulation software (Villanueva Montoto, 2019). This is a very simple program, but it proves to be quite useful especially if someone wants to do a rapid check of the functionality of a simple electrical schematic.

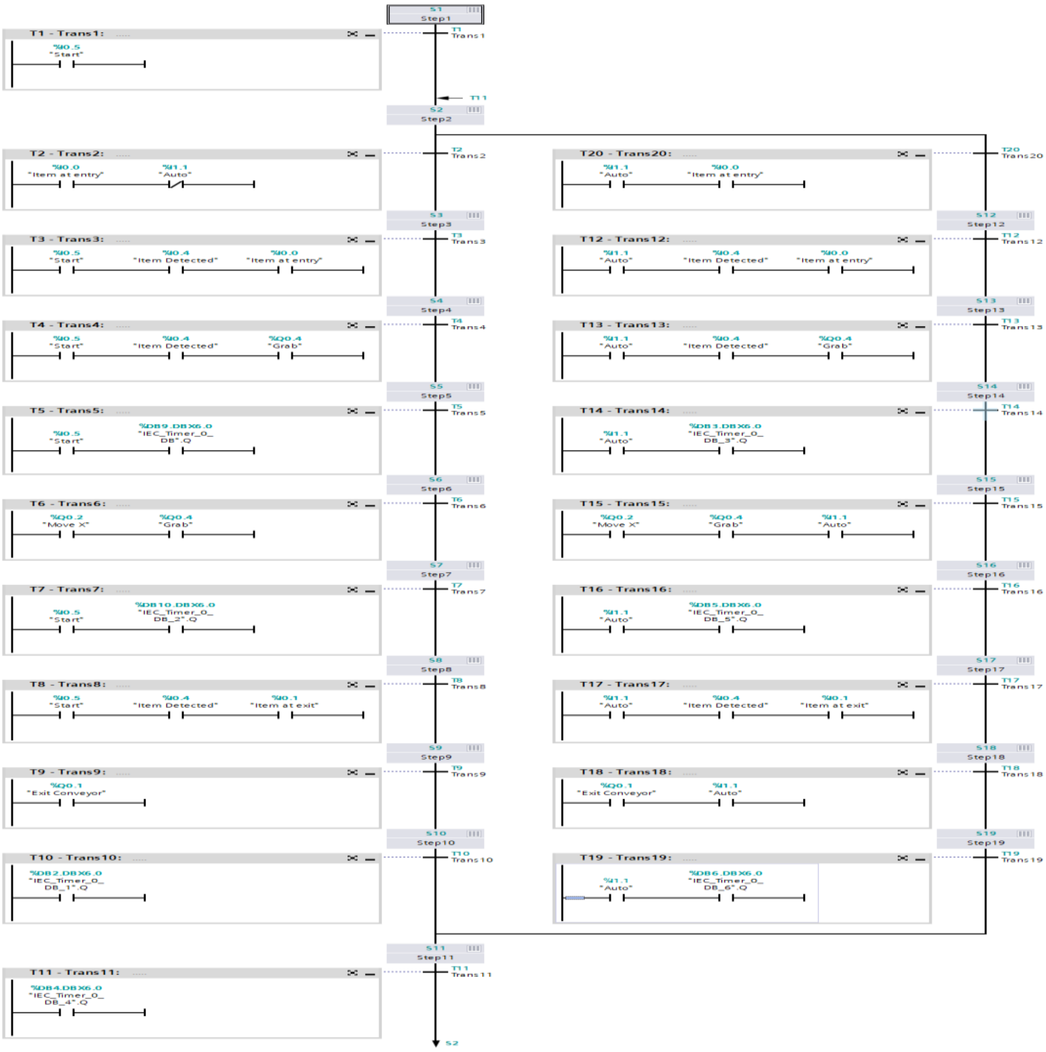

Figure 13. Logic diagram of the Cartesian robot

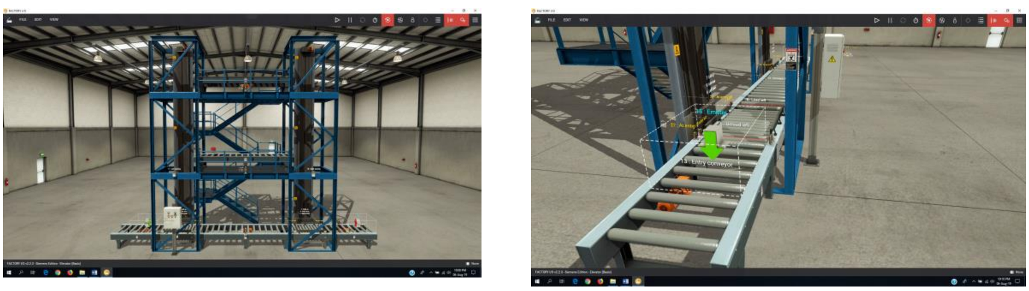

Figure 14. Warehouse cell

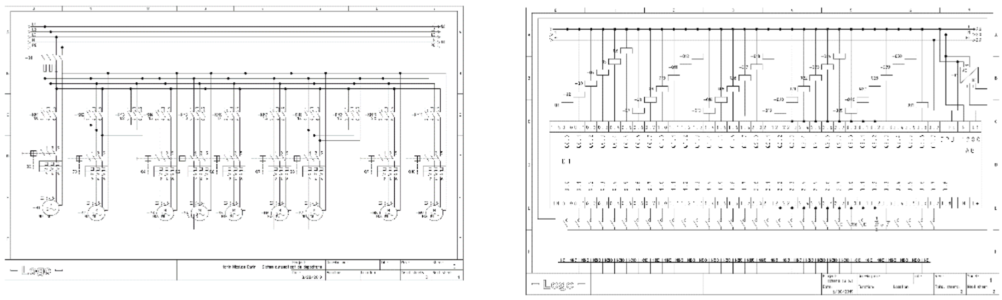

Figure 15. Electrical schematic of the warehouse cell

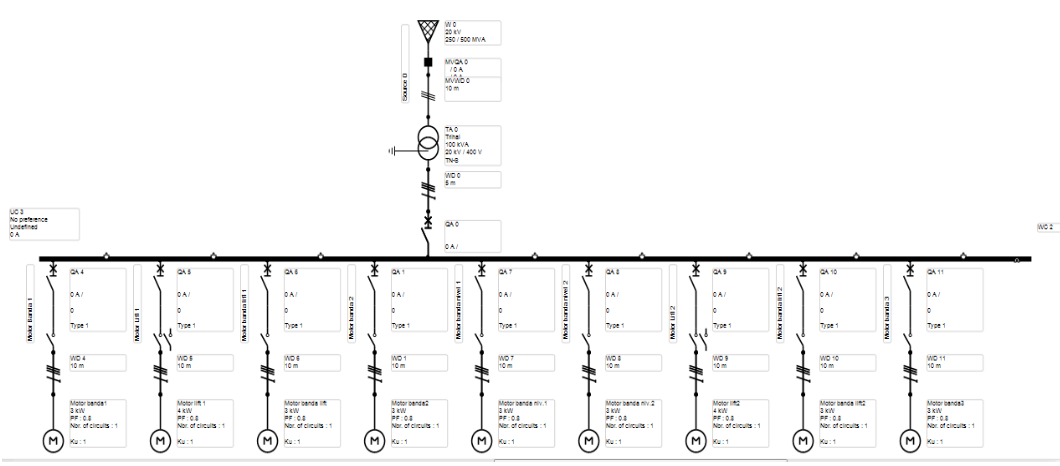

Figure 16. Calculated schematic of the warehouse cell

Figure 17 indicates the logic diagram of the program that has to be implemented in the PLC that controls the warehouse. Using this type of representation makes easy the understanding of the operation that are implemented in the software. Also, this representation makes it possible that the program could be implemented in different types of PLC and different PLC programming environments (Beloiu, 2017).

The logic diagram (Figure 13, Figure 17) contains all the actions and conditions that are required to be included in the program. It is developed in the GRAFCET (“Grafcet,” 2019)representation that complies with the SFC(“Sequential function chart,” 2019) and IEC 61131-3 (“IEC 61131,” 2019)standard.

3 Conclusions

This article presented few software tools that can be used to simulate and design industrial applications in the context of Industry 4.0 concept.

There were introduced:

- Factory I/O developed by a gaming company. The gaming approaching is quite popular especially in younger generations. These generations are used to use software tools much more than other generations. The use of simulators/games that simulate industrial applications has important benefits for all actors involved in designing and maintaining industrial facilities.

- Ecodial developed by Schneider Electric. This program makes the process of calculation and verification of electrical schematics to be quite fast and easy. The fact that the company provides it free of charge makes it to be quite popular among electricians.
- CAEe-SIMU freely available for anyone who wants to use it. This a simple program that can simulate electric schematics. Though the program does not match commercial equivalent software programs, the fact that is free makes it very useful in maintenance operations for electrical schematics.

Using software tools in industrial environment helps to develop faster and easier solutions. As much the students are exposed to use of commercially or free software, they will know how to verify their solution to the problems they will face as future specialists

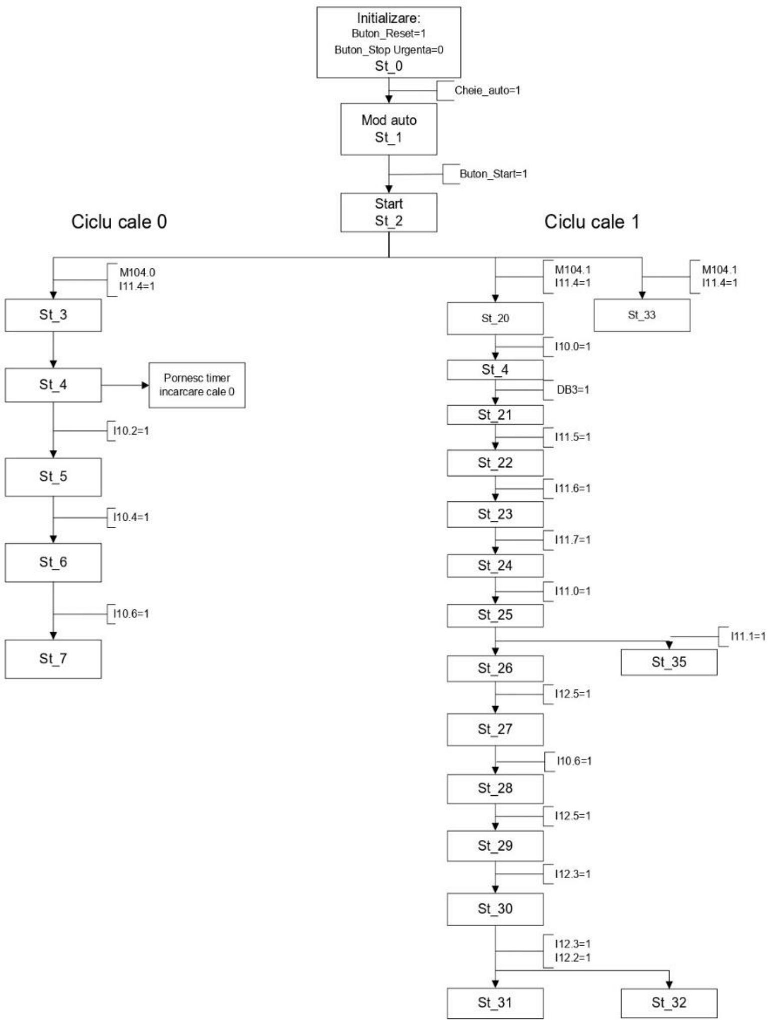

Figure 17. Logic diagram for the warehouse cell

References

Beloiu, R., 2018. Virtual solutions for industrial automation education, in: MODELS & METHODOLOGIES, TECHNOLOGIES, SOFTWARE SOLUTIONS Phase II - Period 2010-2020: E-Skills for the 21st Century. Presented at the The 13th International Conference on Virtual Learning VIRTUAL LEARNING – VIRTUAL REALITY, University of Bucharest, Alba Iulia, Romania, pp. 290–296.

Beloiu, R., 2017. PLC - modern programming environment, in: MODELS & METHODOLOGIES, TECHNOLOGIES, SOFTWARE SOLUTIONS Phase II - Period 2010-2020: E-Skills for the 21st Century. Presented at the The 12th International Conference on Virtual Learning VIRTUAL LEARNING – VIRTUAL REALITY, University of Bucharest, Sibiu, Romania, pp. 295–302.

EcoStruxure Power Design - Ecodial, 2019. URL https://hto.power.schneider-electric.com/ecodialadvancecalculation/#/homepage

Grafcet, 2019. URL https://fr.wikipedia.org/wiki/Grafcet

IEC 61131, 2019. URL https://en.wikipedia.org/wiki/IEC_61131

Marin, N.D., 2019. Proiectarea unui sistem automatizat de depozitare (BA). of Pitesti, Romania.

Morlovea, A.M., 2019. Proiectarea unui brat robotic automatizat Pick and Place (BA). of Pitesti, Romania.

NEXT-GEN PLC TRAINING 3D FACTORY SIMULATION, 2019. URL https://factoryio.com/

Reis, M., Gins, G., 2017. Industrial Process Monitoring in the Big Data/Industry 4.0 Era: from Detection, to Diagnosis, to Prognosis. Processes 5, 35. https://doi.org/10.3390/pr5030035

Roblek, V., Meško, M., Krapež, A., 2016. A Complex View of Industry 4.0. SAGE Open 6, 215824401665398. https://doi.org/10.1177/2158244016653987

Schuh, G., Potente, T., Wesch-Potente, C., Weber, A.R., Prote, J.-P., 2014. Collaboration Mechanisms to Increase Productivity in the Context of Industrie 4.0. Procedia CIRP 19, 51–56. https://doi.org/10.1016/j.procir.2014.05.016

Sequential function chart, 2019. URL https://en.wikipedia.org/wiki/Sequential_function_chart

Stock, T., Seliger, G., 2016. Opportunities of Sustainable Manufacturing in Industry 4.0. Procedia CIRP 40, 536–541. https://doi.org/10.1016/j.procir.2016.01.129

Varela, L., Araújo, A., Ávila, P., Castro, H., Putnik, G., 2019. Evaluation of the Relation between Lean Manufacturing, Industry 4.0, and Sustainability. Sustainability 11, 1439. https://doi.org/10.3390/su11051439

Villanueva Montoto, J.L., 2019. canalplc. URL http://canalplc.blogspot.com/

Zhong, R.Y., Xu, X., Klotz, E., Newman, S.T., 2017. Intelligent Manufacturing in the Context of Industry 4.0: A Review. Engineering 3, 616–630. https://doi.org/10.1016/J.ENG.2017.05.015

Software tools for logical equations in robotics programming

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Abstract

Robot programming involves treatment of signals of different kind. A vast majority of signals are BOOL types. For developing programs, it is necessary to develop logical relations between various input and output signals. This requires logic equation manipulation: developing, minimizing, logic-gate implementation, contact implementation, etc. If the number of signals is small (usually less than 4) then minimization can be implemented by hand quite accurate and reasonably fast. If the number of signals rises, then the minimization and logic implementation gets quite laborious. This article presents some tools that ease the effort of a regular user of logic signals. Also it presents the state of the art of software package used in robot simulation for logic equation verification.

Keywords: BOOL, Process Simulate, minimization, Industry 4.0, software tools

1. Introduction

Industry 4.0 concept requires the use of software tools that could implement the simulation and virtual commissioning of industrial processes. Companies have to be able to offer customized products that are superior in quality and have a competitive price. This can be obtained only by automation(Brettel et al., 2014).

Nowadays robotics is a field that grows all around the world. Logic block use in the robotic command reduce the cost of the project and increases the speed of the robot. (Ahlawat et al., 2014)

Mahulea and Kloetzer present (Mahulea and Kloetzer, 2014) a method to automatically plan a group of cooperating mobile robots based on logic algorithms. They developed a Petri net with fixed topology with the variation of number of tokens with the number of robots.

1.1 Process Simulate signal treatment

Process Simulate(Siemens, 2019) is a software program that allows the simulation of a complete production line that involves several intelligent objects as well as robots and operators. The program is able to communicate with either a physical PLC or a simulated one. The purpose is to develop the command and control program before the installation is really built. Thus it is saved a lot of time and production costs (Guerrero et al., 2014). This solution is also good for the academic environment as it lowers the costs and possible incidents in the equipment.

Process Simulate also allows "human operator definition" that can be introduced in the fabrication line. (Trebuňa et al., 2014)

Process Simulate has dedicated tools for the signal definition, treatment and supervision Figure 18 and Figure 19.

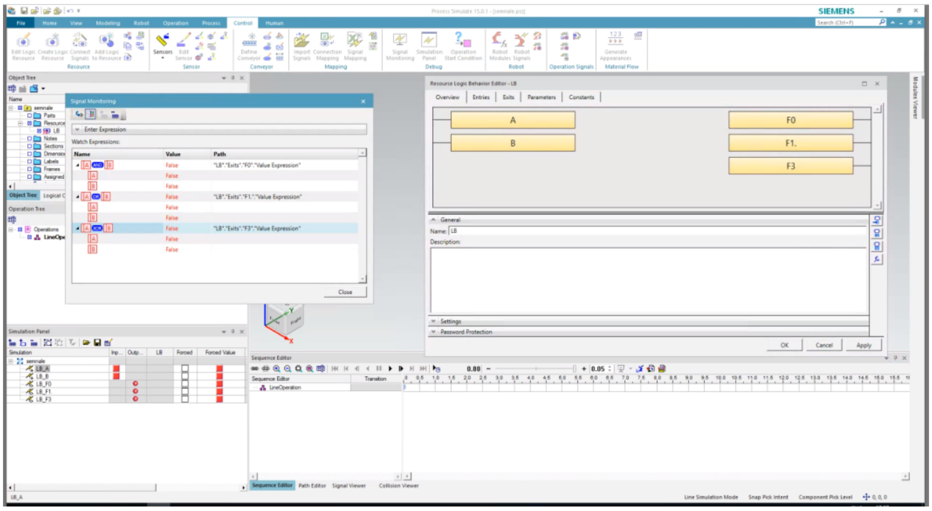
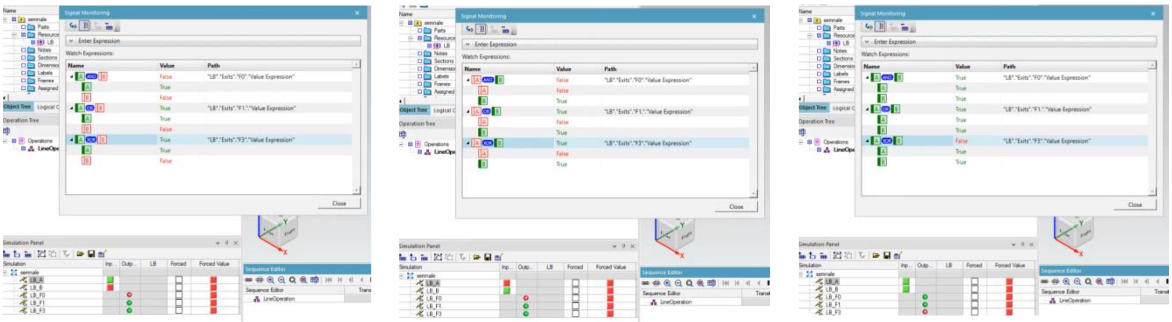


Figure 18. Process Simulate signal definition and monitoring



a. A – true, B – false b. A – false, B – true c. A – true, B – true

Figure 19. Process Simulate logic equation simulation

The treatment of signals in Process Simulate is based on basic Boolean laws. Nevertheless, the program does not provide for a way to minimize the logic expression and equations.

2. Logic equations

2.1 Two variable logic equations

The simplest logic expressions are the one based on two variables as indicated in Table 1. The operations can be implemented as logic blocks as indicated in Figure 20. Basic logic functions.

The two variable Boolean expressions does not require any processing once they are defined.

Table 1. Two variable logic equation

A	B		AND	OR	XOR	NOT-AND	NOT-OR
0	0		FALSE	FALSE	FALSE	TRUE	TRUE
0	1		FALSE	TRUE	TRUE	TRUE	FALSE
1	0		FALSE	TRUE	TRUE	TRUE	FALSE
1	1		TRUE	TRUE	FALSE	FALSE	FALSE

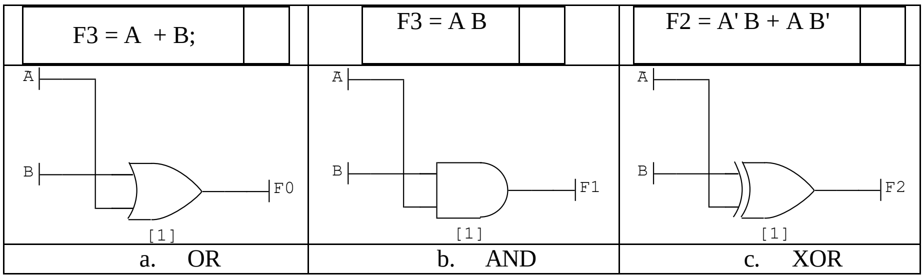


Figure 20. Basic logic functions

2.2 Three variable logic equation

There variable logic equations are more complicated Boolean expressions. Usually these expressions need to be minimized once they are defined. Minimization is a Boolean operation applied to the original equation with the purpose of obtaining a simpler equivalent expression with the original one resulted from the truth table as indicated in Table 2.

Table 2. Three variable logic equation

A	B	C		F0
0	0	0		0
0	0	1		1
0	1	0		0
0	1	1		1
1	0	0		1
1	0	1		0
1	1	0		1
1	1	1		1

F0 = A' B' C + A' B C + A B' C' + A B C' + A B C	F0 = A' C + A C' + B C
a. Logic equation	b. Minimized equation

Figure 21. Three variable logic equation

As indicted in Figure 21 the minimized equation has simpler form that the original one. This makes it easier and more appropriate for circuit implementation, as indicated in Figure 22

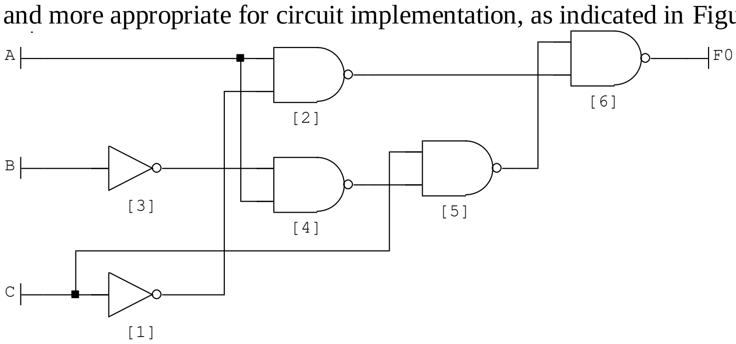


Figure 22. Three variable logic gate implementation

2.3 Multiple variable logic equation

If the truth table implies a small number of Boolean variables, there is no need for powerful software tools to minimize the original expression. This might be the case of regular and simpler applications. Nevertheless, if the application requires the analysis of multiple input variables combined with several output variables, the use of software tools becomes indispensable (Beloiu, 1996).

The minimization process is done with a free software (“Logic Friday,” 2012) that is based on an algorithm developed in Berkeley University (Brayton, 1986).

Table 3. Multiple variable logic equation

A	B	C	D	E	F	G	H	I		F1	F2	F3	F4
1	1	X	1	1	X	0	1	0		1	0	0	0
1	1	X	0	0	X	0	1	0		1	0	0	0
1	1	1	1	1	X	0	0	1		1	0	0	0
1	1	0	0	0	X	0	0	1		1	0	0	0
1	1	X	1	1	1	0	0	1		1	0	0	0
1	1	X	0	0	0	0	0	1		1	0	0	0
1	1	1	1	1	X	1	0	0		1	0	0	0
1	1	0	0	0	X	1	0	0		1	0	0	0
1	1	1	1	X	X	0	1	0		0	1	0	0
1	1	0	0	X	X	0	1	0		0	1	0	0
1	1	0	0	1	X	0	0	1		0	1	0	0
1	1	1	1	0	X	0	0	1		0	1	0	0
1	1	0	0	X	1	0	0	1		0	1	0	0
1	1	1	1	X	0	0	0	1		0	1	0	0
1	1	0	0	1	X	1	0	0		0	1	0	0
1	1	1	1	0	X	1	0	0		0	1	0	0
1	1	X	0	1	X	0	1	0		0	0	1	0
1	1	X	1	0	X	0	1	0		0	0	1	0
1	1	1	0	1	X	0	0	1		0	0	1	0
1	1	0	1	0	X	0	0	1		0	0	1	0
1	1	X	0	1	1	0	0	1		0	0	1	0
1	1	X	1	0	0	0	0	1		0	0	1	0
1	1	1	0	1	X	1	0	0		0	0	1	0
1	1	0	1	0	X	1	0	0		0	0	1	0
1	1	0	1	X	X	0	1	0		0	0	0	1
1	1	1	0	X	X	0	1	0		0	0	0	1
1	1	0	1	1	X	0	0	1		0	0	0	1
1	1	1	0	0	X	0	0	1		0	0	0	1

1	1	0	1	X	1	0	0	1		0	0	0	1
1	1	1	0	X	0	0	0	1		0	0	0	1
1	1	0	1	1	X	1	0	0		0	0	0	1
1	1	1	0	0	X	1	0	0		0	0	0	1

In this application there are nine input variables and four output variables. The Boolean original equation is indicated in Figure 23. The mere construction of this expression [6] is quite complicate without the use of software.

F1 = A B C' D' E' F' G' H' I + A B C' D' E' F' G' H I' + A B C' D' E' F' G H' I' + A B C' D' E' F G' H' I + A B C' D' E' F G' H I' + A B C' D' E' F G H' I' + A B C' D E F' G' H I' + A B C' D E F G' H' I + A B C' D E F G' H I' + A B C D' E' F' G' H' I + A B C D' E' F' G' H I' + A B C D' E' F G' H I' + A B C D E F' G' H' I + A B C D E F' G' H I' + A B C D E F' G H' I' + A B C D E F G' H' I + A B C D E F G' H I' + A B C D E F G H' I';

F2 = A B C' D' E' F' G' H I' + A B C' D' E' F G' H' I + A B C' D' E' F G' H I' + A B C' D' E F' G' H' I + A B C' D' E F' G' H I' + A B C' D' E F' G H' I' + A B C' D' E F G' H' I + A B C' D' E F G' H I' + A B C' D' E F G H' I' + A B C D E' F' G' H' I + A B C D E' F' G' H I' + A B C D E' F' G H' I' + A B C D E' F G' H' I + A B C D E' F G' H I' + A B C D E' F G H' I' + A B C D E F' G' H' I + A B C D E F' G' H I' + A B C D E F G' H I';

F3 = A B C' D' E F' G' H I' + A B C' D' E F G' H' I + A B C' D' E F G' H I' + A B C' D E' F' G' H' I + A B C' D E' F' G' H I' + A B C' D E' F' G H' I' + A B C' D E' F G' H' I + A B C' D E' F G' H I' + A B C' D E' F G H' I' + A B C D' E F' G' H' I + A B C D' E F' G' H I' + A B C D' E F' G H' I' + A B C D' E F G' H' I + A B C D' E F G' H I' + A B C D' E F G H' I' + A B C D E' F' G' H' I + A B C D E' F' G' H I' + A B C D E' F G' H I';

F4 = A B C' D E' F' G' H I' + A B C' D E' F G' H' I + A B C' D E' F G' H I' + A B C' D E F' G' H' I + A B C' D E F' G' H I' + A B C' D E F' G H' I' + A B C' D E F G' H' I + A B C' D E F G' H I' + A B C' D E F G H' I' + A B C D' E' F' G' H' I + A B C D' E' F' G' H I' + A B C D' E' F' G H' I' + A B C D' E' F G' H' I + A B C D' E' F G' H I' + A B C D' E' F G H' I' + A B C D' E F' G' H' I + A B C D' E F' G' H I' + A B C D' E F G' H I';

Figure 23. Multiple variable logic equation

The minimization of the Boolean equation would be a very complicate process if required to be done by hand. Even after the minimization operation, the resulting equations' expressions are still very complicate [7].

F1 = A B D E G' H I' + A B D' E' G' H I' + A B C D E G' H' I + A B C' D' E' G' H' I + A B D E F G' H' I + A B D' E' F' G' H' I + A B C D E G H' I' + A B C' D' E' G H' I';

F2 = A B C D G' H I' + A B C' D' G' H I' + A B C' D' E G' H' I + A B C D E' G' H' I + A B C' D' F G' H' I + A B C D F' G' H' I + A B C' D' E G H' I' + A B C D E' G H' I';

F3 = A B D' E G' H I' + A B D E' G' H I' + A B C D' E G' H' I + A B C' D E' G' H' I + A B D' E F G' H' I + A B D E' F' G' H' I + A B C D' E G H' I' + A B C' D E' G H' I';

F4 = A B C' D G' H I' + A B C D' G' H I' + A B C' D E G' H' I + A B C D' E' G' H' I + A B C' D F G' H' I + A B C D' F' G' H' I + A B C' D E G H' I' + A B C D' E' G H' I';

Figure 24. Multiple variable logic minimized equation

The minimized equation [7] needs to be processed in an electronic circuit, logic gates based or processed in a different way. The results of the electronic implementation is indicated in Figure 25.

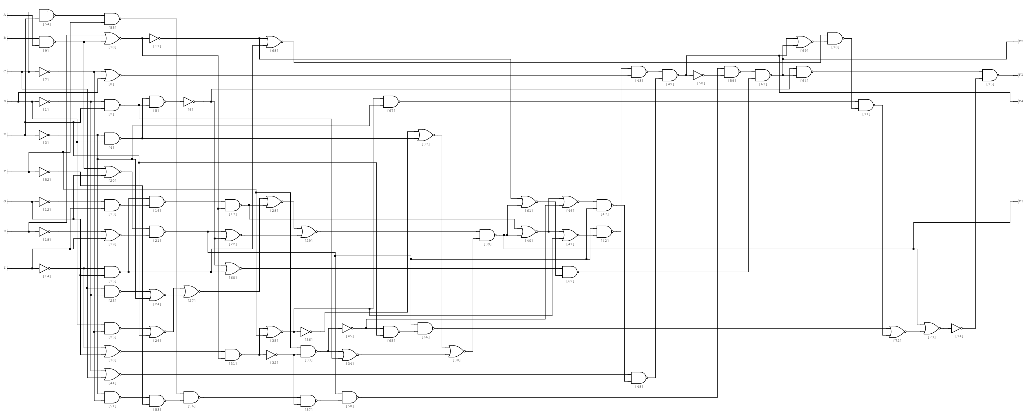


Figure 25. Multiple variable gate implementation

In (Beloiu, 1996) it is presented the algorithm of developing a VLSI circuit based on the above algorithm. The next step is to implement the logic gate circuit indicated in Figure 25 in an integrated circuit using specific tools.

3. Conclusions

This article presented some tools that could be used for minimization of Boolean equations. Boolean expressions are used in Process Simulate in virtualization of the robotic applications. It allows the analysis of the simulated environment based on signals.

One useful tool that can be used for minimization is Logic Friday. This is a free software, Windows based that helps to develop circuits and logic expressions based on truth tables. This program is useful especially when the Boolean expression is complicate and contains several input and output variables.

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References

Ahlawat, N., Gautam, A., Sharma, N., 2014. Use of Logic Gates to Make Edge Avoider Robot. Int. J. Inf. Comput. Technol. 4, 629–632.

Beloiu, R., 1996. Proiectarea unui circuit VLSI pentru motoare pas cu pas. Universitatea Politehnica Bucuresti, Romania.

Brayton, R., 1986. Espresso heuristic logic minimizer. URL https://en.wikipedia.org/wiki/Espresso_heuristic_logic_minimizer

Brettel, M., Friederichsen, N., Keller, M., Rosenberg, M., 2014. How Virtualization, Decentralization and Network Building Change the Manufacturing Landscape: An Industry 4.0 Perspective 8, 8.

Guerrero, L.V., López, V.V., Mejía, J.E., 2014. Virtual Commissioning with Process Simulation (Tecnomatix). Comput.-Aided Des. Appl. 11, S11–S19. https://doi.org/10.1080/16864360.2014.914400

Logic Friday, 2012. URL http://sontrak.com/index.html

Mahulea, C., Kloetzer, M., 2014. Planning mobile robots with Boolean-based specifications, in: 53rd IEEE Conference on Decision and Control. Presented at the 2014 IEEE 53rd Annual Conference on Decision and Control (CDC), IEEE, Los Angeles, CA, USA, pp. 5137–5142. https://doi.org/10.1109/CDC.2014.7040192

Siemens, 2019. Engineer automated production systems using robotics and automation simulation. URL https://www.plm.automation.siemens.com/global/en/products/manufacturing-planning/robotics-automation-simulation.html

Trebuňa, P., Popovič, R., Kłos, S., 2014. Methodology of the Creation of Human and Robot Operation in the Tecnomatix Process Simulate. Procedia Eng. 96, 483–488. https://doi.org/10.1016/j.proeng.2014.12.119

Using Tracker as Augmented Reality Tool in Teaching Real Oscillator Model in Physics.

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Abstract

Tracker is one of the applications recommended by its capabilities as typical AR – augmented reality tool, which otherwise has been extensively used in the last years at all levels of teaching physics. The software has an optical tracking system based on Java and a flexible data tool analysis, specially designed for physics experimental activities. The paper presents a simple approach of teaching the aspects concerning the oscillatory movement of a gravitational pendulum for big initial angular amplitudes using Tracker. The analysis of the movement of the gravitational pendulum with initial big initial angular amplitudes requires advanced data fitting software, in order to integrate the movement equation and find the expression of the time–and–angle dependence of the period T. Using the capabilities of Tracker, it is possible that using real data to prove the non isochrone characteristic of the phenomenon. They also allow to make an in-depth analysis of the real oscillator in an intuitively and adequate approach of teaching the topic to high school students.

Keywords: physics education, augmented reality, Tracker software, experimental methods, elastic constant, spring

1 Introduction

The augmented reality (AR) applications and tools are increasingly used in teaching sciences (Cieutat et al. 2011). The assets of using AR tools in general teaching and learning are related to the efficiency and augmentation of the learning process. Among these assets presented elsewhere (Yip et al. 2019) we also mention the better delivery by the teachers of the basic knowledge for topics with high complexity. The teachers' approach has to be correlated with less time and effort for the students to understand the delivered information by at-home learning or by reviewing the AR tools research results.

The study of the real gravitational pendulum motion is one important physics teaching experimental topics. In high school physics teaching this experimental activity is usually addressed as an application of the linear harmonic oscillator model: first in ideal conditions (by ignoring the dumping force) and then in by considering it. Even if both experimental approaches use the isochronous initial condition, they are theoretical approximations of the real motion that, in fact, is non-isochronous.

The theoretical models describing oscillators with large initial amplitudes have higher mathematical complexity than the understanding level of the high school students. The suitable use of Tracker's AR capabilities allows a comprehensive analysis of the high initial amplitude motion of a gravitational pendulum, appropriate for teaching the topic of oscillatory motion for high school physics.

Tracker it is one of the applications used extensively in performing experimental tasks while teaching physics, a free application designated for use in experimental physics classes. Tracker is built on Open Source Physics (OSP) Java framework, developed in the Open Source Project (OSP – ComPadre, 2016) as a video analysis and modeling tool. According to its creator (Brown, 2008) the main feature of Tracker is the "overlay of simple dynamic particle models on a video clip" by using an optical recognition module based on Xuggle video engine. The tracking process allows for calibrating the loaded video clip and recording for each frame the (x, y) position versus time of the tracked object, or to overlay a kinematic/dynamic model of an object built according to a theoretical model. Due to its Data Tool module, Tracker allows data processing, data plotting while finding / building suitable fitting function. All these Tracker features indicate it as an important AR tool.

The subject of this paper is the use of Tracker in making a simple analysis of a real gravitational pendulum. The pendulum consists of an iron ball attached to a wire and set in oscillation with initial amplitude of about 58^0, far above the small angle approximation.

The main effect that can be eye-observed is the amplitude attenuation in time, which is a quite easy topic to approach in high school physics teaching. The analysis of the recorded body motion in Tracker allows studying the behavior of the attenuation function. The slow positive variation for the motion period T of the pendulum with large initial amplitudes can be better investigated by using suitable processing and analyzing software such as Tracker's Data tool. By employing Tracker we gain access to examine the two mentioned aspects, in a suitable and accessible manner to the student, despite the complicated specific mathematical models.

2 Theoretical Model

The equation of motion for a gravitational pendulum of length l and mass m in the gravitational field g and in a dumping medium may be obtained from the second law of dynamics or from the law of variation of the total energy in the presence of a dumping force in the following form adapted from (Keith, 1960):

$$[1] \quad \ddot{\theta} + f(\theta, \dot{\theta}) + \frac{g}{l}\sin\theta = 0$$

where θ is the elongation of the oscillation measured in radians with respect to the downward vertical direction and $f(\theta, \dot{\theta})$ is the resistant force which generally depends on the position and speed. In our case, the dumping medium is the air and the speed of the body has low values, so the resistance force depends only on the velocity, which is proportional with the angular velocity (Serway and Jewett 2010). The relation [1] may be rewritten:

$$[2] \quad \ddot{\theta} + \frac{b}{ml}\dot{\theta} + \frac{g}{l}\sin\theta = 0$$

with $-\alpha \le \theta \le \alpha$, α being the angular amplitude.

The solution of equation [2] is easy to obtain for small values of the angular amplitude $|\alpha| \le 5^0$, where

$$[3] \quad \sin\theta \approx \theta$$

Equation [2] becomes

$$[4] \quad \ddot{\theta} + \frac{b}{ml}\dot{\theta} + \frac{g}{l}\theta = 0$$

According to (Serway and Jewett, 2010) equation [4] has the solution

$$[5] \quad \theta(t) = \theta_0(t)\sin(\omega' t + \varphi)$$

where the amplitude has an exponential decrease with time

$$[6] \quad \theta_0(t) = \alpha e^{-\left(\frac{b}{2lm}\right)t}$$

ω' is the frequency of oscillations in the low friction regime:

[7] $\omega' = \sqrt{\left(\frac{g}{l}\right) - \left(\frac{b}{2lm}\right)^2}$

Equations [6] and [7] describe the model of the damped harmonic oscillator. In the absence of the friction, the solution of the motion equation [4] becomes:

[8] $\ddot{\theta} + \frac{g}{l}\theta = 0$

Relation [8] illustrates the ideal isochronous model of the linear oscillator applied to the gravitational pendulum whose period of motion is:

[9] $T_0 = 2\pi\sqrt{\frac{l}{g}}$

We notice that there is no dependence between T_0 and the amplitude α, both quantities being constant.

The study of the motion of a simple gravitational pendulum in conservative conditions has many approaches in order to find an exact mathematical expression of the dependence $T = T(\alpha)$ of the motion period T versus the initial amplitude α, by integrating the equation of motion (Thornton and Marion 2009):

[10] $\ddot{\theta} + \frac{g}{l}\sin\theta = 0$

The canonical approach is to rewrite equation [1], starting from the condition of conservation $-mgl < E < mgl$, where E is the total energy (Keith 1960):

[11] $\frac{1}{2}ml^2\dot{\theta}^2 - mgl\cos\theta = \mathrm{E}$

According to (Hite, 2005; Beléndez et al. 2009), the second approximation solution for $\theta = \theta(t)$ with $-\alpha \le \theta \le \alpha$ $-\pi \le \alpha \le \pi$ and $\phi \in (0, 2\pi)$, includes, as parameter, the pulsation of the oscillation ω_1 as function of the angular amplitude

[12] $\omega_1 = \frac{2\pi}{T} = \left(\frac{g}{l}\right)^{\frac{1}{2}}\left(1 - \frac{1}{16}\alpha^2 + \frac{11}{3072}\alpha^4 + \cdots\right)$

In (Lima 2008) it may be found an interesting discussion about the best-fit relation [12] given in (Cromer, 1995; Ganley 1985; Molina 1997). All the cited solutions are approximations that prove the increase of the oscillations period with the initial angular amplitude.

3 Experimental Model Adapted For Tracker

In the experimental verification of the theoretical model designed for the high school level, we used the experimental device illustrated in Fig. 1.

The motion of the pendulum released at $t = 0$, $\theta = \theta(t)$ at an angle $\theta(0) = \alpha = 59^0$ was recorded with a Sony Cyber-shot DSC-H2 camera. The 640 x 480-movie resolution in the MPEG VX file format (30 FPS) was imported in Tracker. The optical tracking extracted a number of 8772 data values over 292 seconds (the tracked length of the movie, multiplied by the frame rate).

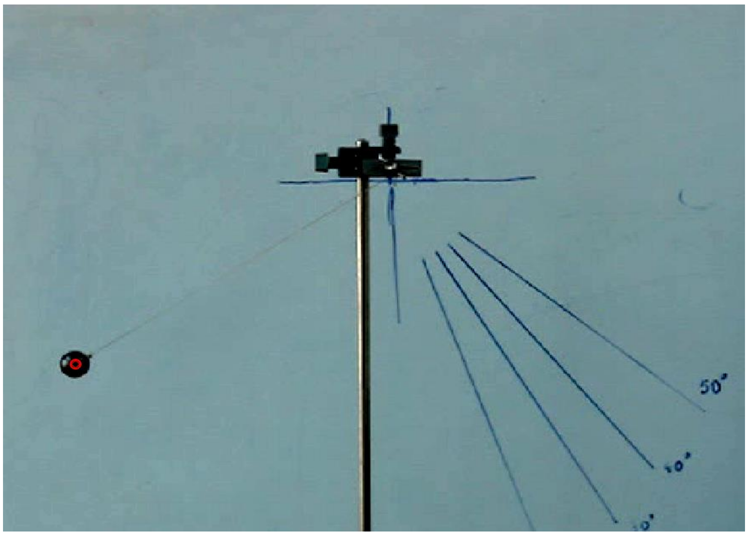

Figure 1. One - frame image of the movie with the motion of the system loaded in Tracker for our experiment.

We chose as working data the angular elongation as a function of time and the table $\theta = \theta(t)$ was exported in .xml file format for further data processing.

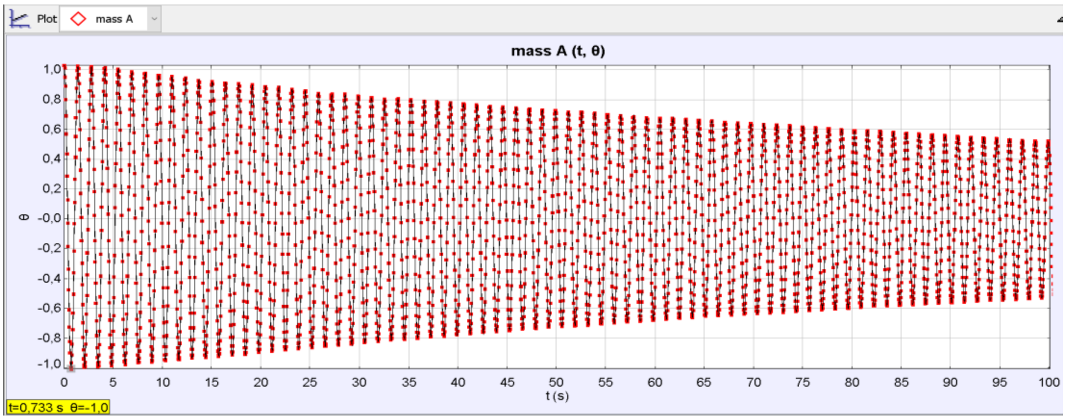

Figure 2. Plot of the extracted data using Tracker $\theta = \theta(t)$ for $t \in (0,100)$ seconds and θ in radians

Finding the guess function $\theta_{fitt} = \theta_{fitt}(t)$ to be employed in Tracker's Data tool for fitting the experimental data plot from Fig. 2 can be a difficult task, due to the conditions suggested by the quasi-symmetrical periodicity in the time distribution of the points, along with the exponential time decrease of the amplitude. An expected variation of the motion period T versus amplitude is suggested by the theoretical model.

The main idea employed to simplify data analysis was to extract from the experimental data only the extreme values, positive and negative pics of $\theta = \theta(t)$, as in Fig. 3.

For doing that, we used the capability of Tracker to export and import data in and from text files and some MS Excel functions. The plot of the processed data is presented below, in Fig. 3.

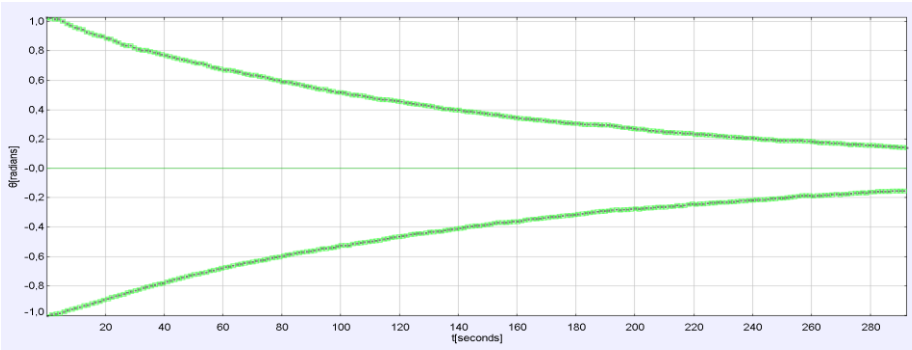

Figure 3. Plot of data sets with positive and respectively negative pics of $\theta = \theta(t)$

The data set (α_0, t) built from the reunion of the positive and respectively absolute values of the negative pics of $\theta = \theta(t)$ was loaded in Tracker. Its data tool fitting facility gave the following fitting function:

[13] $alfa = 1.0140 \cdot e^{-t \cdot 0.0066} (radians),\ RMS_{deviation} = 5.492 \cdot 10^{-3}$

The fitting function [13] together with the (α_0, t) dataset plot illustrated in Fig. 4 confirm the theoretical model of the damped oscillation relationship [6].

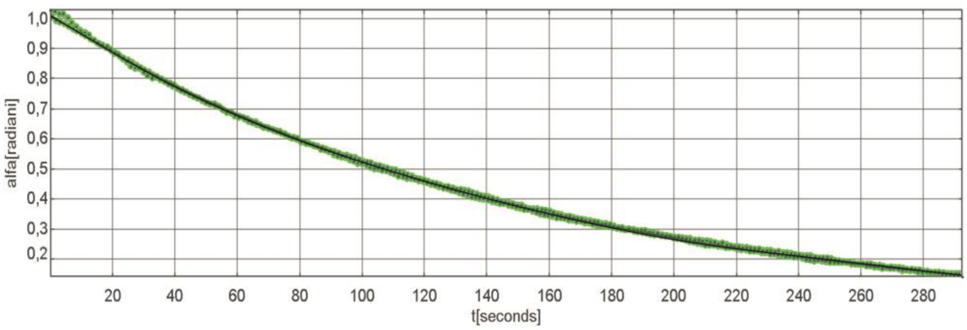

Figure 4 Plots of (α_0, t) data series (green dots) and its auto fitting function

Considering the data subset (α_0^+, t) of the positive pics from (θ, t) data set, we have that if N is the number of pairs of data $\alpha_0^+(n), t(n)$, $n = 1...N$, we can assume that the value $\alpha_0^+(n)$ is the initial amplitude of the pendulum which starts moving frictionless at the moment $t(n)$ and $t(n+1) - t(n)$ is the period T of the motion. With this hypothesis, we use the calculated values of T to build from (α_0^+, t) data set a new one (T, α_0^+) that reveals that period T slightly increases with the initial amplitude, as the theoretical model predicts.

The experimental results obtained by using the Tracker's features confirm the theoretical model and the experimental procedure that is suitable for employment in teaching the topic of oscillatory motion in high-school physics.

4 Conclusions

By its optical tracking capability and using real experiment movies in order to extract quite accurate experimental data, Tracker can be considered a very suitable AR tool for performing experimental tasks in teaching and learning physics.

The analysis for the motion of the real pendulum presented in this paper is an appropriate approach for teaching physics at the high school level. The use of AR tools such as Tracker compensates the lack of the students' mathematical knowledge, by emphasizing the important aspects of the real phenomenon rather than exact mathematical relationships, such as the dependence of the period T on the amplitude of the oscillation.

The analysis of the dumping effect gives us a good result, in concordance with the theoretical model of the damped harmonic oscillator.

We also consider the approach presented in this manuscript, exclusively studied using Tracker, as being a great challenge for any physics teacher creativity, by uncovering new ways of using AR tools in teaching physics (*i.e.* to adapt the experimental methodology to be used with an AR tool such as Tracker).

Concerning the experimental method, the main feature of using Tracker is the number of experimental data sets, which allows more accurate data processing.

Tracker is a free Open Source application and its potential can be further enhanced with some Java programming knowledge and it can be attuned for specific experimental needs in different physical study domains such as mechanics (Eadkhong et al, 2012; Vozdecký et al, 2014; Leme and Oliveira, 2017; De Jesus et al, 2018; De Jesus and Sasaki, 2018), electricity and magnetism (Carlos et al., 2012; Onorato et al., 2012; Bonanno et al., 2015; Aguilar-Marín et al, 2018) or even astronomy (Belloni et al., 2013).

References

Books:

Keith, S.. (1960). *Mechanics*. Second edition. London: Addison-Wesley Publishing Company.

Serway, R. and Jewett., J.Jr. (2010). *Physics for Scientists and Engineers , with Modern Physics*. 8th ed. edited by B. Cole.

Thornton, S. and Marion. J. (2009). *Classical Dynamics of Particles and Systems*. Second edition. Pp. 155–56 Thomson Broocks/Cole.

Journal Articles:

Aguilar-Marín, P., Chavez-Bacilio, M., Jáuregui-Rosas, S. (2018). Using analog instruments in Tracker video-based experiments to understand the phenomena of electricity and magnetism in physics education. *European Journal of Physics 39*, 3, 035204.

Beléndez, A., J. J. Rodes, T. Beléndez, and Hernández A.. (2009). Approximation for the Large-Angle Simple Pendulum Period. *European Journal of Physics 30*, 5, L83-L86.

Belloni, M., Christian, W., ; Brown, D. (2013). Teaching Astronomy Using Tracker. *The Physics Teacher 51*, 3, 149–151.

Bonanno, A., Bozzo, G., Camarca, M., Sapia, P. (2015). An innovative experiment on superconductivity, based on video analysis and non-expensive data acquisition. *European Journal of Physics 36*, 4, 045010.

Carlos, J., Mendoza, R., Mora, C., Aguilar, N. Á. (2012). Implications for teaching college physics in the development of creativity. *Latino American Journal of Physics Education 6*, 1,175-178.

Cieutat, J.-M., Hugues O., and Ghouaiel N. (2011). *Une Pédagogie Active Basée Sur l'utilisation de La Réalité Augmentée. Observations et Expérimentations Scientifiques et Technologiques, Apprentissages Technologiques*. 21–24 in *Journées de l'AFRV*.

Cromer, A. (1995). Many Oscillations of a Rigid Rod. *American Journal of Physics 63*, 2, 112–21.

De Jesus, V. L. B., Haubrichs, C., De Oliveira, A. L., Sasaki, D. G. G. (2018). A low-cost experiment to visualise the Fourier series: Video analysis of a real plucked coiled spring. European Journal of Physics, 39, 2, 025704.

De Jesus, V. L. B., Sasaki, D. G. G. (2018). A Simple Experiment to Determine the Moments of Inertia of the Fidget Spinner by Video Analysis. *The Physics Teacher, 56,* 9, 639–642.

Eadkhong, T., Rajsadorn, R., Jannual, P., Danworaphong, S. (2012). Rotational dynamics with Tracker. *European Journal of Physics, 33,* 3, 615–622.

Ganley, W. P. (1985). Simple Pendulum Approximation. *American Journal of Physics 53,* 1, 73–76.

Hite, Gerald E. 2005. Approximations for the Period of a Simple Pendulum. *The Physics Teacher 43,* 5, 290–92.

Leme, J. C., ; Oliveira, A. (2017). Pendulum Underwater – An Approach for Quantifying Viscosity. *The Physics Teacher 55,* 9, 555–557.

Lima, F. M. S. (2008). Simple 'log Formulae' for Pendulum Motion Valid for Any Amplitude. *European Journal of Physics 29,* 5, 1091–98.

Molina, M. I. (1997). Simple Linearizations of the Simple Pendulum for Any Amplitude. *The Physics Teacher* 35, 8, 489–90.

Onorato, P., Mascheretti, P., Deambrosis, A. (2012). Investigating the magnetic interaction with Geomag and Tracker Video Analysis: Static equilibrium and anharmonic dynamics. *European Journal of Physics 33,* 2, 385–395.

Vozdecký, L., Bartoš, J., ; Musilová, J. (2014). Rolling friction - Models and experiment. An undergraduate student project. *European Journal of Physics 35,* 5, 055004.

Yip, Joanne, Sze Ham Wong, Kit Lun Yick, Kannass Chan, and Ka Hing Wong. (2019). Improving Quality of Teaching and Learning in Classes by Using Augmented Reality Video. *Computers and Education 128*, 88-101.

Conference Proceedings:

Brown, D. (2008). *Video Modeling : Combining Dynamic Model Simulations with Traditional Video Analysis*. 1–9 in *AAPT 2008 Summer Meeting*.

Internet Sources

OSP - ComPadre. (2016). Tracker Video Analysis and Modeling Tool for Physics Education. *Open Source Physics*. https://physlets.org/tracker/).

The Potential of the Robotic Process Automation in the Field of Education

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Abstract

Robotic process automation (RPA) refers to the use of technology that aims to automate a wide variety of otherwise manual processes. Although the Robotic Process Automation field is relatively new, the market is growing fast. Recent worldwide studies have reported that the RPA application in different industries brings multiple benefits, such as better service, control and quality, improved speed and employee satisfaction, reduced costs and rate of errors. However, there is little prior research on RPA adoption in education field, and on the conducted research we found few studies and papers that reveal benefits of the RPA deployment in this domain. Taking into account the above-mentioned facts, this paper aims to give insight into the RPA application in the field of education. As a case study, we proposed an application for a student information management system, with great advantages for teachers in terms of reducing time and error when recording the students' grades.

Keywords: Robotic Process Automation, Student Information Management System, grades recording, People Soft

1 Introduction

Robotic Process Automation (RPA) refers to the use of technology that aims to automate a wide variety of otherwise manual processes. Although the Robotic process automation field is relatively new, the market is growing fast. Thus, even if the total RPA market revenue was slightly less than $850 million in 2018, according to (Miers et al., 2019), RPA registered a rapid growth, estimated at more than 63% in 2018.

Recent worldwide studies have reported that the RPA application in different industries (Lacity & Willcocks, 2017), including manufacturing, construction, telecommunication, transportation, utilities, healthcare, etc., brings multiple benefits, such as better service, control and quality, improved speed and employee satisfaction, reduced costs and rate of errors. However, there is little prior research on RPA adoption in the education field, and on the conducted research, we found few studies and papers that reveal benefits of the RPA deployment in this domain. Considering the above, this paper aims to give insight into the RPA application in the field of education. As a case study, we proposed an application for a student information management system, with great advantages for teachers in terms of reducing time and error when recording the students' grades. By comparing the results obtained in the conducted experiments, we can conclude that the presented system allows the speeding up the process and the elimination of the keying errors. But, in order to strengthen its capabilities, there is a need to continue to improve the system in time.

1.1 Paper Contributions

Considering the above, the research questions proposed on this paper are:

- What is Robotic Process Automation (RPA)?
- How can RPA help education stakeholders to increase efficiency?

- What is the current status of RPA implementation in education?
- What are the results on applying RPA to an education activity, like grade recording?

This paper aims to answer the above questions, with a primary focus on the second and the last questions.

For answering the above questions, the paper continues with a literature review of the RPA concept and evolution, followed by the revision of different RPA applications in the education field. Section 4 presents a use case for a student information management system. We draw the results on Section 5 and finally conclusions and future work.

2 Literature Review and Related Work

To review the scientific literature for successful adoption of RPA in the education field, we focus on the above considered research questions.

2.1 Robotic Process Automation

The combination of the component word leads to the "notion of a technological replacement for a human worker" (Fersht & Slaby, 2012). According to (van der Aalst, Bichler, & Heinzl, 2018), "RPA is an umbrella term for tools that operate on the user interface of other computer systems in the way a human would do. RPA aims to replace people by automation...", reducing "the burden of repetitive, simple tasks on employees" (Aguirre & Rodriguez, 2017). Robotic Process Automation is defined by Gartner as follows: "RPA tools perform [if, then, else] statements on structured data, typically using a combination of user interface interactions, or by connecting to APIs to drive client servers, mainframes or HTML code. An RPA tool operates by mapping a process in the RPA tool language for the software robot to follow, with runtime allocated to execute the script by a control dashboard." (Tornbohm & Dunie, 2017).

Currently, there are already numerous RPA software tools on the market (i.e., Another Monday, Automai, Automation Anywhere, Blue Prism, Contextor, Foxtrot, G1ANT, Jacada, Kryon, OpenConnect, Pega, Redwood, UiPath, WinAutomation, WorkFusion, etc.), each of them with various features and benefits. Moreover, a continuously growing number of new tools enter the market every year. Choosing one of these could be a challenge.

Organizations preparing to embark on service automation have multiple options to meet their needs, such as insourcing, outsourcing, cloud sourcing, etc., each of them with pros and cons. In order to maximize RPA value and minimize risk, the adoption of the solution must be made after a careful evaluation. Worldwide there are various studies, such as (Miers et al, 2019), that review a continuously growing number of solutions, recommend specific approach and propose the criteria for selecting the one that best fits the needs of the organizations.

2.2 Related Work

Google Trend allows to visualize the relative popularity of the "robotic process automation" and RPA keywords over time (between 2014 and 2019), as we can see in Figure 1.

Figure 1. Search Volume Index for the Data Provided by Google Trends Corresponding to the "Robotic Process Automation" and RPA search terms

To capture relevant knowledge and work on the topic, we conducted a systematic literature review in which we searched different electronic databases (IEEE Xplore, Science Direct, Springer, Web of Science, Google Scholar), using "robotic process automation" and RPA as keywords. The number of publications that addressed RPA is quickly growing.

Table 1. The Number of Scientific Publications on RPA

Database	Number of papers
IEEE	14
ScienceDirect	15
Springer Link	161
Web of Science	15
Google Scholar	1420

Various publications have focused on this new concept, analyzing, among others issues, both the multiple possible benefits and the challenges generated by the application of RPA in various industries.

Researchers estimate that the RPA development is expected to have a significant impact on different sectors, influencing both the industry and the labor market. Thus, various research papers highlight that organizations building automation capabilities will need to prepare their business for RPA integration considering, among other things, the skill sets needed for the various service automation roles, such as "the ability to extract logical structures from chaotic business data to build algorithms" (Lacity & Willcocks, 2017), good communication skills, IT skills, etc.

The findings of this review could be used to guide research and development of robotic process automation in various industries, including education.

3 RPA Application to Education Field

Although there is an increasing trend to use robotic process automation in different industries due to its benefits, there are few examples of RPA applications for the education sector. But, we appreciate that this is due to the inertia of the education sector response to technological innovations.

Next, we try to highlight some actions performed in the education sector that could benefit from the adoption of the RPA.

- **Secure logging.** Staff Personnel from different departments of an educational institution need to log securely in one or multiple applications.
- **Data migration and entry.** For example, different systems must use data from other systems. If there is no capability to ensure interaction between these systems, data must be entered manually or migrated using formats like xls or csv, etc. RPA solutions can reduce manual labor and potential errors.
- **Data validation.** Although most data validation is assured within the applications, the need for further validation may occur, for example, after the installation of the respective applications. In these cases, RPA solutions can be used successfully.
- **Data update.** Most departments in the education sector, including human resources, secretariats, etc. are faced with the need to update student or personnel data. For this purpose, RPA can be used to update the data based on reliable sources.
- **Event monitoring.** RPA could be used to monitor the occurrences of various activities, such as receiving certain student emails related, for instance, to exam planning, etc.
- **Generating and sending emails.** Sending frequent emails relying on data from one or multiple systems could be a time consuming task. For example, there is a need to send students warning emails regarding the belated payment of their tuition fees.

- **Preparing and sending reports.** In order to analyze the results and progress of the students, tutors need reports from the secretary's office, regarding the number of absences, the grades obtained by the students, etc. Preparing such reports and email the corresponding report to each tutor is not labor-intensive, but time-consuming. RPA could prove a viable solution to these issues.
- **Reading and extracting data from files in different formats.** In order to reduce data entry, RPA solutions could be used in interaction with various applications based on technologies such as Optical Character Recognition (OCR), pattern recognition, screen scraping, etc., to allow reading and extracting data from different sources (email, scanned documents, files in different formats, such as PDF, DOC, etc.).

According to the results of various researches conducted worldwide, highlighting that the adoption of RPA technologies could bring multiple benefits in various fields, stakeholders in education should analyze the need to adopt these technologies in the education industry.

Because of space limitations, this paper does not address the issues related to the skills needed to adopt RPA solutions in education.

4 Case Study: RPA Application to a Student Information Management System

To illustrate some benefits of the RPA adoption in the education field, we consider a case study conducted on the student information management system used in Ştefan cel Mare University of Suceava. This system is a module within PeopleSoft solution that includes Human Resources Management System (HRMS) and Student Administration (admissions, graduate financial support, student financials, student records, etc.).

All teachers must complete the grade book with the grades awarded to students after the exams. An example of a user interface for the grade book is presented in Figure 2.

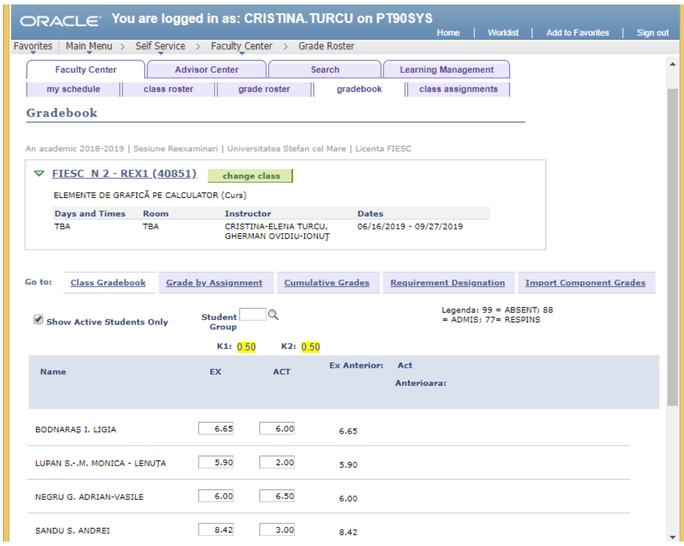

Figure 2. An Example of User Interface from the Current System

As we can see in this figure, the final grade of the student for a discipline is the weighted average of two grades: one that assesses the entire activity of the student during the semester and the other is obtained during the exam.

But, to record grades awarded for the activity of the students during the semester (tests, homework, etc.), teachers use various solutions. For instance, while some use simple Excel spreadsheets, others use different software applications. Unfortunately, these solutions and the student information management system are completely disconnected. Thus, in PeopleSoft the final grades for the students' activity during the semester must be completed manually by teachers.

Also, some of the exams consist of two or more tests, for example, a theoretical and a practical one. Each of these tests is evaluated individually for each student. The weighted average of the grades awarded for each test represents the exam grade and must be registered by the teacher in the electronic grade book. Unfortunately, even if teachers use various learning management systems, for example, Moodle, these systems and PeopleSoft are completely disconnected. And, once again, teachers need to manually fill in students' grades.

There was a need to find a solution in order to read the data processed in one application and enter it into the existing student information management system, without developing expensive interfaces or changing existing software.

In order to address these requests, we designed and developed a system that allows teachers to streamline the recording of grades by automating tasks and workflows, without the need to write code.

The system functionalities are presented in the UML use case diagram (Figure 3).

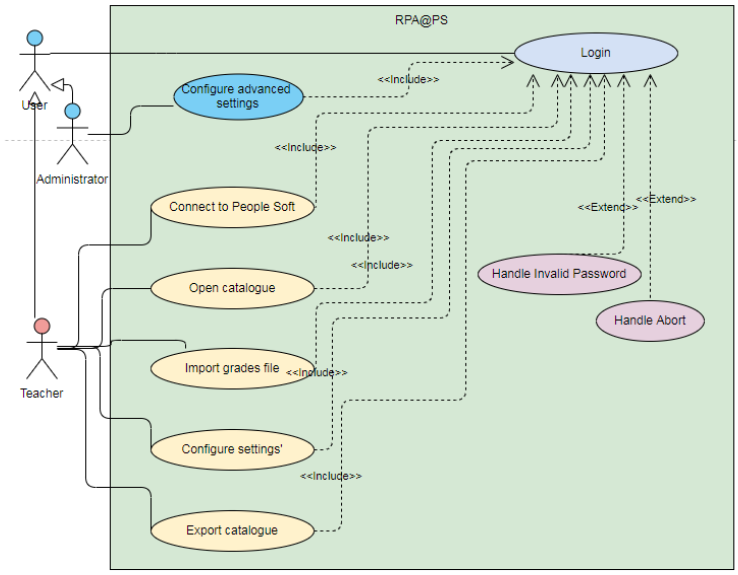

Figure 3. The UML Use Case Diagram

The proposed system sits on the top of the existing system and accesses it through the presentation layer. There is no need to change existing infrastructure. This solution does not require programming skills to configure the system in order to record the grades based on the data from imported files. Our system deals with structured data and deterministic outcomes.

4.1 Results

The evaluation of the potential of our system was made with the help of some teachers who had to register the grades of the students from the same bachelor program. These teachers involved in the operation were divided in two groups, one group using the proposed system and the other group using the traditional method offered by the existing student information management system.

Due to the fact that there is no change in the user interface for accessing the functionalities of the student information management system, the teachers using the proposed system had no problem connecting to the respective system. In order to benefit from the additional capabilities offered by our system, teachers have easily accessed the new options. Thus, they managed to quickly configure the system to record grades based on data from the imported file.

The main benefit of our solution is the reduction of time for correct recording of the grades, as the experiments reveal. All teachers that used our system experienced an improved speed of grade recording process. Error reduction is also a measure, and even if it was not measured on the case study, it could be improved by the developed system. The involved teachers appreciated having fewer repetitive tasks, thus having the opportunity to dedicate more time to focus on education or research related activities.

The results show the value of our system in the grade recording process. But, an increased number of automated processes determines the increase in RPA complexity. There is a need to understand RPA in order to build a successful and adequate structure and to continue the development in time in order to strengthen its capabilities.

5 Future Work

Comparing the results obtained in conducted experiments, we can conclude that for the time being the presented system allows speeding up the process and eliminating the keying errors.

In what concerns the short-term directions for research and development related to our system, the following are identified.

Table 2. Future Research and Development Directions

System feature	**Future research directions**
System platform	Using distributed platforms
System architecture	Developing mobile applications
Security and privacy	Exploring the required amount of user data Analyzing the possible vulnerabilities of the system
System performance	Analyzing the usability of the system Investigating user perception by considering users' experience

According to (Joseph et al, 2019), the robotic process automation (RPA) market will reach $12 billion by 2023.

Future RPA systems could benefit from the development in machine learning and artificial intelligence. In the future it is expected that adding machine learning capabilities will allow the performing complex tasks, such as automatic adjusting configurations, adaptation, self-learning and self-correction, or other various tasks requiring intelligence, etc., making RPA more powerful.

6 Conclusion

A lot of manual labour can be entirely eliminated in the educational institutions using Robotic Process Automation, by automating structured tasks in a fast and cost efficient manner.

This paper presents a short overview on RPA concept and some applications in education industry.

Also, we propose a system as an immediate, short-term solution for simplifying the recording of students' grades within the student information management system, now used in our university, without the need to change this current system. Comparing the results obtained in conducted experiments, we can conclude that the proposed system can help teachers by:

- Eliminating the need for manual data entry;
- Allowing grade recording processes to be completed much more rapidly;
- Saving the time otherwise wasted on manual and repetitive tasks.

References

Aguirre, S., & Rodriguez, A. (2017). Automation of a business process using robotic process automation (RPA): A case study. Workshop on Engineering Applications, 65–71. Springer.

Fersht, P., & Slaby, J. (2012). Robotic automation emerges as a threat to traditional low-cost outsourcing: Cheap, easy-to-develop software robots will eventually supplant many offshore FTEs. Horses for Sources Research.

Joseph, L., Le Clair, C., O'Donnell, G., Sharma, A., Dangi, S., Nagel, B., (2019), The RPA Services Market Will Grow To Reach $12 Billion By 2023. Despite Growth, Scale Remains Elusive For Enterprises, Forrester

Lacity, M. C., & Willcocks, L. P. (2017). A new approach to automating services. MIT Sloan Management Review, Available at: http://eprints.lse.ac.uk/68135/1/Willcocks_New%20approach_2016.pdf.

Miers, D., Kerremans, M., Ray, S. and Tornbohm, C. (2019). Magic Quadrant for Robotic Process Automation Software, Gartner, Available at: https://www.gartner.com

Tornbohm, C., & Dunie, R. (2017). Gartner market guide for robotic process automation software. Report G00319864. Gartner.

van der Aalst, W. M. P., Bichler, M., & Heinzl, A. (2018). Robotic Process Automation. Business & Information Systems Engineering, 60(4), 269–272. https://doi.org/10.1007/s12599-018-0542-4

Online environment, the places where employers meet the new generation

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Abstract

Technology facilitates an unprecedented degree of connectivity among people, especially for the young generation and between it and the rest of the population. Most members of the new generation have access to a PC or laptop at home, but also to a portable device. However, the percentage is highly influenced in this segment by the families' wealth, but also by the parents' education status. That makes generational shifts more important and speeds up technological trends as well. For companies, this shift brings about both challenges and equally attractive opportunities. The employers are those who come to meet the younger generation, which assumes their presence in the online environment. How young generation (Gen Z) choose an employer, which sites they use, what field they find attractive for a professionally successful career, are just a few questions this study tries to answer. The study has been carried out in spring 2019 through an online questionnaire applied to 545 students at the Politehnica University of Bucharest, with the average age of 21.2 years. The carelessness of the young people for the educational domain is highlighted by the results, which show that 66.2% of them do not want to work in this field. When they choose an employer, they also check what field the employer works in and its reputation. Recommendations and online sites are still highly used by Gen Z for finding a workplace for, but they also for inform themselves about the future employers' reputation.

Keywords: young generation, employers, online environment, Generation Z (Gen Z)

1. Introduction

Generation Z (Gen Z) is already an important share of the human capital, active on the labour market. This generation is born and raised in new environments, by comparison to the former generations. Scientific literature calls the youngsters born after 1997 „the Z generation" with a reference to the fact that it is the last generation to grow in a technology-dense environment, with an overwhelming Internet presence, but still dominated by humans (McCrindle 2019).The future generations allegedly will share the public space with Artificial Intelligence, since robots not only become part of the work environment, but already enjoy citizenship and take over activities previously considered typically human, from taxi driving up to medical and educational services. Gen Z (also labelled iGen) are fully integrated with mobile devices and social platforms, accustomed to use social media not only for personal communication and social interactions (which they prefer over face-to-face encounters), but also for shopping, travel planning, exchanges of emotional experiences. The smart phone is the main gate to the virtual community, due to an unprecedented number of apps that shorten the time, necessary to carry out routine operations, but also simplifying the world and annulling the time and space constraints. As Ruzsa states, these apps influence the behaviour of the young generation and can lead to changes in their attitude towards the educational system and, further, towards the work they are willing to carry out. The labour market will have to face the challenges this generation brings to the table and to consider the specificity of the virtual environment at the workplace (Ruzsa, 2018). Organisations have recognised that Facebook has vast potential as a communication channel, which allows them to reach and engage with literally hundreds of millions of consumers by establishing Facebook pages and/or using a number of communication opportunities, which are available via Facebook (Duffett, R.G 2017).

The Generation Z (1996-2010), ready to enter the labour market already forces employers to adopt strategies fit for the new features of the human capital. CEOs need to learn how to manage multigenerational teams, which contain both digital natives and digital immigrants, people whose features do not depend solely on the age or gender differences, but also on motivations, skill sets and values (Prensky 2001). Smart and forward-thinking employers already work on studying the needs and expectations of the Gen Z, in order to attract and retain the young people and to make visible success according to the new type of metrics (Schroth, H. 2019). Although Generation Z youngsters are described as narcissistic and idealist, they are also the generation most willing to learn and upgrade the level of skills and knowledge (Petersen, 2017). ”Entrepreneurship is a culture amongst this generation; they want to make products or help in making products. They witnessed the recession and the effect it had on their parents, which caused many job losses. Therefore, entrepreneurship is often seen as the only option for them.” (Rammopo, K., 2016). The results of a questionnaire-based survey carried out in Poland by Anna Dolot (2018) on a pool of 1162 Gen Z youngsters highlights some of the features relevant for the relationship between this generation and the labour market: the output of their work is a crucial element, and they strongly relate to it (72%); although there is an expectation that Gen Z is ready to multiple changes of the workplace, the survey shows that they are ready to commit to long-time, even lifetime employment with the same employer, if offered challenging, attractive work (39%). A swift career ascension is the least selected feature when choosing an employer (only 17% responded yes to this choice). Although the polled sample was consistent, the author cautions that the results may not be extrapolated for the entire Polish youth. However, it indicates tendencies on the labour market and on the way in which Gen Z searches and choses to apply for vacant positions. The digital natives and the challenges they bring to recruiters and employers became a critical issue worldwide, and scientific research as well as economic literature brings ample evidence that much is still to be discovered (Cernicova-Buca et al., 2019).

2. Methodology

The present study is part of a larger research carried out by a team from Politehnica University Timisoara concerning the behaviour, expectations and perceptions of students from Romanian technical universities linked to the way in which they socialize, learn and project their future careers. According to the largest Romanian study concerning the behaviour of recent alumni on the labour market, students in engineering are the most likely to pursue careers in their field of specialization (Voicu et al., 2010). Yet, their perceptions and expectations are more nuanced than this bulk appreciation. The results presented here refer to the pilot stage of the research, carried out at Politehnica University Bucharest in spring 2019 and comprise answers offered by 545 de students with an average age of 21.2 years. Further the study will be carried out in all technical higher education institutions from the major university centres: Timisoara, Iasi, Cluj-Napoca and Bucharest, thus offering a comprehensive image of the Romanian technical youth. Data were collected through the online anonymous questionnaire, posted on Isondaje.ro (www.isondaje.ro/sondaj/693286480/). This platform allows for easy completion of the questionnaire, low costs, multiple crosstabulation possibilities. The questions have 5 scale response possibilities, 5 meaning “full agreement” and 1 – “complete disagreement” with the statement. The statements selected for the purpose of this study are related to the attitudes/positioning of the young students towards the job offers presented by future employers. The questionnaire aims at highlighting: features of the employer, considered by Gen Z when choosing the future workplace; types of platforms/apps used by students to identify a job opening; self-assessment of Generation Z youngsters, relevant for their future on the ideal labour market.

3. Results and discussion

Currently the Romanian labour market for highly skilled workers (having a higher education degree) is encountering a slight difficulty: there is a shortage of human capital, available for recruitment, and the competition among employers is raising in intensity (Cernicova-Buca et al., 2019). Thus, HR departments resort to employer-branding strategies and to recruiting young workers from the stage of their student years, with the aim of forming, recruiting and retaining the needed human capital. Students are offered a variety of (paid) internship, trainings, seminars, part-time jobs in companies, especially in multinational conglomerates. The research aims at highlighting the features that Gen Z pays attention to when choosing an employer. The responses are summed up in Table 1.

Table 1. Features of employers relevant for Gen Z

Nr	Aspects relevant for selecting an employer	To a very large extent	To a large extent	Sum of the positive choices from the scale
1	Area/domain of activity	56.1%	35%	91.1%
2	Reputation/Ethics	39.6%	32.8%	72.4%
3	Positioning on the market	22.2%	40.9%	63.1%
4	Name of the company	19.8%	32.7%	52.5%
5	Number of employees	12.3%	24.4%	36.7%
6	Presence in mass-media	9.5%	19.4%	28.9%

The results show that young people pay special attention to the area of activity for the future employer, the vast majority selecting an employer of choice according to their own specialization and early option. The second place – over 70% is occupied by a company's reputation and ethical standing. In our opinion, this is partly due to globalization forces, that made such features relevant and will result in the future multiplication of CSR activities in Romania. Also, employer branding strategies will pay additional attention to highlighting the ethical standing of organizations. The positioning of the company on the market refers to the degree to which the company is known and/or recognizable. A well-known brand name seems to guarantee the security of the position, stronger chances for career building and an implicit recommendation in the professional resume of the candidates. The least relevant features for students are the dimensions of the company and its presence in the media. The number of employees is not so important with the dramatic changes in the automation and digitization of economy, while media is less and less followed by young people, who, by contrast, use social media and online recommendations for shaping an opinion on a product, service, place or phenomenon.

Table 2. Channels and strategies for seeking employment used by Gen Z

Nr	Channels and strategies	To a very large extent	To a large extent	Sum of the positive choices
1	Recommendations	26.6%	34.1%	60.7%
2	Romanian specialized sites (myjob.ro, hipo.ro, ejobs.ro, bestjobs.ro, undelucram.ro, munca.ro, etc)	27.3%	31%	58.3%
3	Job fairs/career fairs	17.6%	28.6%	46.2%
4	LinkedIn accounts	13.2%	16.1%	29.3%
5	Career centres	7.5%	17.4%	24.9%
6	International specialised sites (indeed.com, careerbuilder.com, etc)	9.5%	13.4%	22.9%
7	Facebook accounts/Social media	8.6%	12.5%	21.1%

The highest positive response rate falls towards the item “recommendations”, with 60.7% of preferences (summing up the responses “to a very large extent” and “to a large extent”). We believe that the preference reflects the cultural and relational pattern, specific for this generation. Recommendations root, on one hand, on the Romanian centuries-old type of asking someone who is familiar or connected with another person or institution to “pass a good word” on behalf of the applicant (Murgeanu, 2008). On the other, in the virtual environment, recommendations and comments represent a sui generis way of consolidating the reputation and helping the choice in favour of a product, service or even job. Granovetter (2005, p. 33) highlighted the key role of social networks in predefining economic performance. According to this American sociologist, social networks are essential because: they define the flow and quality of information, represent a source of prizes and punishment and they lay the basis for trustworthy relations. As Mayo so adequately puts it, work life is immersed in a social relational context, and social factors impact to a large extent the individual performance (Mayo, 2005).

Other useful search instruments are the specialized websites; hence we investigated the popularity of Romanian and global platforms, offering information regarding job openings. The results presented in Table 2 show that at least for the first employment Romanian specialized websites are twice more popular than the international platforms (58.3 % for the first category vs. 22.9% for the latter). This result resonates with the following item, 42% of the polled students declaring that their intent is to remain in Romania, vs. 8.8% that clearly made up their mind to emigrate after graduation. The 31.7% representing the neutral zone, students that do not clearly have an image regarding their future country of residence is an area worth tapping into by recruiters. Young people falling in this category may be persuaded to open towards local possibilities, or to regard temporary displacement for work reasons as attractive. Globalization and digitization of economy opens new horizons for Gen Z. At this stage, however, it is safe to say that Romanian students are less inclined to emigrate for work reasons, since they have the option to work for multinational companies on site or remotely.

Job fairs and career fairs cumulate 46.2% - still quite high, while LinkedIn (29.3%) and Facebook (21.1%) accounts, as well as career centres (24.9%) share lower places in the preference of the polled students. When asked how many jobs/workplaces they anticipate having in their lifetime, most students indicated an average of 3-6.

Further we wanted to investigate the level of optimism, that the student anticipates finding job opportunities in his/her specialization and the human capital reserve for teaching positions. The findings are listed in the table below.

Table 3. Intentions of Gen Z

Nr	Statement	To a very large extent	To a large extent	Sum of the positive choices
1	I want to work in the field of my specialization (studies)	46.3%	27.1%	73.4%
2	I am optimistic that I will find the desired job	37.4%	29.9%	67.3%
3	I want to remain in Romania after graduation	24.9%	17%	41.9%
4	I am interested in a teaching position	7%	9.2%	16.2%

It seems that the level of optimism is high, since most students believe that their choice of specialization is right and that there is a high probability that they will be able to find their desired job in Romania. This group of youngsters can be called “the pluralist generation”, because while acknowledging their differences in race, religion, politics and interests, they believe that they can co-exist happily and will share a rather bright future (Klein, 2016).

The next set of items investigates the type of employment preferred by Gen Z. Students were invited to give details on the type of employer they envisage as a first option, again on a five-point scale, choosing among: multinational companies, small and medium sized companies (SMEs), education, public institutions, NGO sector, own firm. Results show that the less likely workplace for technical students is educational organizations, reinforcing the position already expressed in the response to the assessment "I am interested in a teaching position". NGOs (17.6%) and public institutions/sector (23.9%) also enjoy low shares. The absolute winner among the types of companies seem to be the SME, with 61.3%. J.M. Twenge reports that this generation is less entrepreneurial than the preceding Millennials at the same age and is not likely to challenge the management in search of leadership positions. Our results show, however, that 53% of the polled students imagine that they will own their firm and will be self-employed. Multinational employers are preferred by less than 50% of the students participating in the research (48.4%) (Twenge, 2018; Cernicova-Buca et al., 2019).

Table 4. Type of employing organization

Nr	Statement	To a very large extent	To a large extent	Sum of the positive choices
1	Private, small or medium enterprise (SME)	20.7%	40.6%	61.3%
2	(Future) own firm	30.1%	22.9%	53%
3	Multinational company	20.4%	28.1%	48.5%
4	Public institution	8.1%	15.8%	23.9%
5	NGO	4%	13.6%	17.6%
6	Educational institution	6.4%	9%	15.4%
7	Different option	4.4%	2.6%	7%

Further study will supplement the data with interviews asking for more details regarding the Gen Z employers of choice by type, in the group of three selected during the quantitative research (multinational companies, SMEs and own firms). Also, the expansion of the study to the other major university centres, Timisoara, Cluj-Napoca and Iasi aim at testing whether the opinions that SMEs dominate in preference is valid or there are variations by geographic region, gender, and place of provenance of the respondents. Before concluding this section, it is worth mentioning that focus groups will try to invite students elaborate and further explain how they portray their professional future. Under "different opinion" respondents answered: "I will work on my own, collaboration with a variety of organizations, public institutions or remotely for multinationals"; "in a family business"; "collaboratively"; "online company"; "own franchise"; "musical domain"; "own company, with international partners"; "freelancer"; "Start-up Company"; "maybe in a company where I hold shares, not necessarily entire my own"; "I'll have a totally new, un-named job, since most jobs that we know will disappear by 2030!"

The responses resonate with other studies that present Generation Z members as people accustomed to view themselves as brands and, as such, treat their presence on the labour market to validate and associate value to the personal brand. Further investigations will pursue this hypothesis, but within the scope of this study we did not find enough evidence to validate or discard the idea that personal branding is an issue with this generation, even for the Romanian current realities.

4. Conclusions and recommendations

This study aimed at measuring the perceptions of young students, belonging to the so-called Generation Z concerning their presence on the labour market as skilled human capital. For the polled sample, belonging to Politehnica University in the national capital city, the main relevant features of the future employer are (in order of importance, the highest results first): the domain of activity, the reputation/ethics of the company, its position on the market and its (recognizable) name. The number of employees and the presence in mass-media are not particularly relevant, when choosing a first employer. As channels and instruments for seeking employment students use recommendations, Romanian specialized websites, job/career fairs. Less important seem to be LinkedIn and Facebook accounts, career centers or other social platforms. This generation describes itself as optimistic, confident, ready to work and expecting to pursue careers in the area of selected studies. Despite prognoses, a large share of Gen Z young people anticipates remaining in Romania after graduation and working in SMEs, multinational companies or own firms. The public sector, NGOs and education seem less likely to attract this generation. The lack of interest in teaching is linked not only to the relatively low glamour or the sector and the low salaries in the field, but also to the perceptions of the young people that innovation and creativity are encouraged and compensated for in the private sector. Many students think that education is a routine, slow area, with repetitive tasks and little satisfaction, with low social prestige. To steer young workforce towards embracing teaching careers new strategies must be put in place, bot at the national level, and at the level of employers.

An employer that aims to maintain attractiveness on the labour market and appeal to Gen Z needs, according to the image projected by our results: to belong to a state-of-art level, to be in the top of employers, to work with the current employees, who can, in their turn, act as brand ambassadors for the company and recommend the workplace in a manner and language appealing to young people. Recruiters learnt their lessons and already implement employer branding strategies (Ionescu, 2008), but further efforts need to be made to promote the company brand to the young generation, via multiple channels. Hence the need to connect companies with opinion leaders and influencers.

The battle for the young generation is on and is fierce. The digitization of economy forces employers to add to the existing homepages advanced optimization features, to create experiences appealing and relevant for the Generation Z, eager to have immediate access to opportunities, responses, recommendations and tailored information kits.

New strategies need to be put in place, with messages that are optimistic, but fair, reliable and verifiable in action, challenging, yet manageable for this generation, open to experiment, engage and play. Among our recommendations for recruiters and employers is the necessity to strengthen the ties with university career centers and management, to initiate and build contacts with the Generation Z students at earlier stages than with the generation preceding this one. Millennials are already on the labour market. Generation Z is still a newcomer.

References:

Conference Proceedings:

Cernicova-Buca, M., Gherhes, V., Cismariu, L. (2019), Digital natives and their expectations regarding employment opportunities. A Romanian experience, In *Conference proceedings, 6th International Multidisciplinary Scientific Conference on Social Sciences and Arts* SGEM 2019.

Journal Articles:

Dolot A., (2018), The characteristic of Generation Z, "e-mentor", nr 2 (74). pp. 44–50, http://dx.doi.org/10.15219/em74.1351.

Journal Articles:

Duffett, R.G. (2017), Influence of Facebook commercial communications on generation z's attitudes in south Africa, Electronic Journal of Information Systems in Developing Countries 81(8):1-22

Journal Articles:

Granovetter, M (2005) The Impact of Social Structure on Economic Outcomes. *Journal of Economic Perspectives,* 19(1), pp.33-50.

Book:
Ionescu, M.A. (2008), *Brandingul de angajator*, Institutul European, Iasi, Romania.
Newspapers Or Magazines
Klein, B. (2016). How Brands Can Win with Generation Z
Book:
Mayo, E. (2005 [1933]). *The Human Problems of an Industrial Civilization*. Londra/New York: Routledge, Taylor and Francis
Book:
McCrindle, Mark (2019), *Understanding Generation Z: Recruiting, Training and Leading the Next Generation*,
Newspapers Or Magazines
Petersen, L. (2017). HDI Youth Marketeers' 2017 Youth Trends.
Journal Articles:
Prensky, M., (2001)Digital Natives, Digital Immigrants, On the Horizon, MCB University Press, Vol. 9 No. 5, October 2001
Newspapers Or Magazines
Rammopo, K. (2016). Generation Z: The New Generation Consumer
Symposium
Ruzsa, C. (2018). *Key characteristics of generation z and main challenges to be expected in the labor market*. Book Series: Medunarodni Znanstveni Simpozij Gospodarstvo Istocne Hrvatske-Jucer Danas Sutra. pp 251-259. 7th International Scientific Symposium Economy of Eastern Croatia - Vision and Growth.
Journal:
Schroth, H. (2019). *Are You Ready for Gen Z in the Workplace?* California Management Review. 61(3). pp 5-18. DOI: 10.1177/0008125619841006. WOS:000470763900001
Newspapers Or Magazines
Twenge, J. M., (2018). Meet iGen: The new generation of workers that is almost everything millennials aren't, New York, USA, London, UK, available on https://work.qz.com/1177712/

Generation Z and Social Media

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Abstract

Gen Z represents the first generation with direct access to smartphones, having radically influenced the dynamics and typology of communication. Social media is a constant presence in their lives, being the medium of choice for finding and sharing information, emotions, reactions and intentions. Almost everything happens instantly for Generation Z, making its members masters of using the digital technologies. According to a study carried on by Business Insider, around 80% of the young people already had a smartphone by the age of 13. This study purpose of identifying the most common platforms/social media apps used by Romanian Gen Z for communication, information, but also for content creation. The study has been carried out in May 2019 through an online questionnaire applied to 545 students with the average age of 21.2 years from Politehnica University of Bucharest. The results deepen the understanding of how Gen Z – a predominantly online generation, manifests its preferences and choices for platforms and apps. YouTube seems to take the upper hand over Facebook, which may result in changes on the market and a re-organization of how information is created, retrieved and shared by the young generation. Another important aspect for Gen Z seems to be the presence of influencers, which start to stand out in their lives.

Keywords: Generation Z (Gen Z), communication, social media, smartphones

1. Introduction

In the present social environment, over-saturated with technology and digital devices, it is no wonder that the Generation Z adores social media and prefers it over face-to-face encounters. Born after 1996, Generation Z members are the first fully immersed people, integrated with social media technologies, iPhones and mobile gadgets. They are used to devour information at high rate and speed of updating, they process information easily and the digital revolution outcomes integrates naturally and effortlessly with their lives. Their appetite for innovation, experimentation and digitization turns many of the state-of-art technologies obsolete even before they produce all the possible outcomes they can. New apps are born, new areas of social life are conquered for digital use, new social platforms occur and fight for the top levels of attention. The smartphones, incorporating a large number of technologies and functions, revolutionized the access to information, time management, social interaction, entertainment, space orientation and even personal training. Smartphone is the technological prop no longer merely a gadget or symbol of lifestyle, but the one-fits-all extension of the modern person for connecting to others, taking/sharing images, recording/reproducing sound and video, payments, health monitoring, access social networks and the list of functions is open. It simplifies but also complicates life, being indispensable and addictive due to its portability and connectivity. It makes task fulfilment easier and personal relationships tighter (Cho, 2015). However, these positive effects bear consequences that need special attention at a behavioural and social level. The smartphone brings power in the pockets of young people (Cooper, 2017), who take landlines as being as out fashioned as the Millennials took, for instance, floppy disks for PCs. Face-to-face interactions are drastically reduced, since the digital generation is captive in the Internet. Even if the smartphone is on silent mode, it maintains connectivity and many students cannot help themselves from keeping track of what is going on in the virtual world, versus the reality of the classroom, that of meeting with friends for an outing or even of a romantic date. This status of absence/presence (Katz and Aakhus, 2002) distracts their attention from face-to-face interactions.

Children are not born with an innate longing for technology but grow into considering it irreplaceable. By the time they reach college their social life migrates from the real world into the digital. Daily they share million images on Instagram and send billions of messages. They do not consider that they have the option of taking a break, because the online world is the place for confirmations, re-assessment, encouragement, friendship and knowledge in its multiple faces. (Alter, 2017). The online presence resembles a chase of wellbeing, since the quantity and especially the quality of social interactions play an essential role in the subjective perception of wellbeing (Ateca-Amestoy et al., 2014).

Hyper-connectivity brings along the viral spread of opinion, without filters to sort out information. Especially the young people, but not only them, engage in consuming enormous quantities of media messages in a spontaneous way, so familiar and easy that it seems natural. It is exactly this appearance of easiness and natural reflex that hinders critical analysis of the media messages and represents the main threat for the capacity of young people to consciously analyse and internalize messages found online, via the multiple platforms they use for information generation and sharing.

Mass-media colonized culture and transformed it into entertainment, show, simulacrum and/or hyper-reality, becoming the main supplier of identity resources for individuals, the depository of standards and benchmarks for the way in which humans perceive themselves and the world.

Media culture is increasingly one of for-profit use, developed and served to mass audiences alongside with other mass produces goods. Media culture can be considered as a vector of manipulation, covert lead-on, seductive and addictive. It reproduces concepts and behaviours consistent with a dominant ideology, thus posing a threat to deep thinking and autonomous decision-making.

The dominant medium of an epoch dominates the people of that epoch (McLuhan, 1969). McLuhan insisted that electronic mass media re-tribalize humanity and push everybody into the “global village”. Electronic mass media link us with the world, instantaneously but also act as levellers of the ground. Personal, family, social, and public aspects of an individual person it all its aspects, (values, habits, lifestyles, clothing preferences, musical, cinematographic tastes, political options, career decisions, micro- and macro-social environments etc.) are open for public scrutiny, comment, share and shaping via the numerous social platforms the individual engages with. The opinion leaders have already been replaced by a new category: influencers. Influencers are persons who succeeded in creating an important cohort of followers, who expect a constant flow of quality content, capable of inspiring, informing, educating, but above all amusing the audience. Influencers have a strong, well-shaped reputation and their on-line presence impacts niche categories of publics, united by a topic preference (travel, fashion, food, music, gaming, etc), by mood or lifestyle, without geographic, social or national boundaries.

According to a study published on ZeroCarter concerning the features specific for Z generation, 98% on these own a smartphone and 50% have an online presence over 10 hours per day. 70% watch YouTube at least 2 hours per day. 40% confess to be totally dependent on their phones and 80% say they become anxious when they do not have access to some sort of electronic device. In this context, describing generation Z, professor and keynote speaker Ryan Jenkins published on his blog studies according to which 45% of the American Gen Z own a phone by the age of 10-12; 72% have wireless access to voice and messenger services; 91% take their telephone in their beds at night; the majority received gaming devices at the ages 4 to 7; 66% places gaming highly as the hobby of preference; 92% access Netflix and 38% follow Netflix daily. 91% use YouTube, 75% Gmail, 66% Snapchat – as an essential part of their relational universe, 65% Instagram, 61% Facebook, and 82% are extremely careful with the content post on social-media.

In 2015 almost all teenagers had Facebook accounts, but even such an Internet colossus as Facebook needs to be alert and fight for maintaining the love and attention of its users, who are easily tempted to migrate away from the older generation (parents, teachers, employers) and into the ties of newer, more attractive interfaces (Valkenburg, Taylor Piotrowski, 2018).

Generation Z was raised by generation X, saw the financial sacrifices of the parents and the risks of economic realities, thus internalizing a sense of pragmatism and a sort of egoism in pursuing success, life-work balance, educational and social needs. McLuhan used to say that children perceive going to school as a disruption in education. Since teachers consider audio-visual devices as aids, and not instruments of instruction, children are not exposed to a level of informativity they may find from other sources. If professors would be willing to „dive into the technological vortex", they could transform the proverbial "ivory tower" into a mighty and modern "control tower".

The Gen Z youngsters easily see that by comparison to their parents and often to their teachers they are more technology savvy. They have the advantage of an easy, effortless use of technology and a confidence that they can find answers to any question posed to them, if left to search the response in the abundance of online information and advice. Therefore, we believe that teaching/learning need to radically chance, to consider the specificity of this challenging generation, its aspirations, perceptions and future. The present research deals with a deepening of knowledge concerning the features of the Gen Z in Romania, knowledge which is further useful for shaping new educational policies, strategies and contents to keep these students engaged, competent, employable and skilled to live up to real-life challenges, while using the vast online repository for routine jobs and tasks.

2. Methodology

This research is part of a larger project carried out at Politehnica Timisoara and financed by the Association of Romanian Technical Universities (ARUT) aiming to identify the values and motivations of the students facing educational, social and work life. The part presented in the present article deals with the way in which students from Romanian technical universities use social media for their virtual life. The results refer to the pilot phase of the study and sums up responses of 545 students from Politehnica University Bucharest, with an average age of 21.2 years. The research continues with surveys in the major academic centers or Romania: Timisoara, Iasi and Cluj-Napoca.

Data are collected though an anonymous online questionnaire, posted on the platform Isondaje.ro. We chose this instrument due to the fast access to data, low costs and immediate possibility to work with the data. The items contain both affirmative and negative assessments, as well as 5 scale questions, where 5 represents full agreement and 1 full disagreement with the statement. The survey aims at highlighting the attitude/position of Romanian Gen Z students toward the major platforms and most popular apps used for communication, content production and sharing, learning and task-solving activities in the context of their social life.

3. Findings and discussion

The results are interpreted though qualitative and quantitative lenses, to generate a clear image on the perceptions and uses of Gen Z of the instruments available online.

Table 1. Social platforms / apps used for communication/content sharing:

Nr.	Item	%	
1.	WhatsApp	Yes	99.3%
2.	Facebook	Yes	91.2%
3.	Messenger	Yes	87.8%
4.	YouTube	Yes	85.4%
5.	Instagram	Yes	81.2%
6.	Drive. Google	Yes	60%
7.	Skype	Yes	56%
8.	SnapChat	Yes	54%
9.	Dropbox	Yes	44%
10.	Pinterest	Yes	38.3%

99.3% brings WhatsApp at the top of the chart, higher that Facebook and Messenger. Although a newcomer, this app brings along a new communication style, swift, versatile, apt for multiple simultaneous contacts. It does not require a powerful Internet connection, yet allows for voice and video, instantaneous photo taking/sharing and recordings in real time. Facebook and Messenger still have very high percentages, most probably because Facebook was the first on the market and triggered the revolution of communication patterns and styles. It still maintains its high position for learning activities (Cernicova and Gherhes, 2019), but mainly for more elaborate tasks that information-sharing. Youtube with 85.4% and Instagram with 81.2% are trendy for Gen Z, who run away from their parents, that seemed to make a highly felt presence on Facebook. Instagram allows for a stronger control – or at least gives that impression, because it has such features as automatic deleting of a picture, once it was visualised by the receiver the automatic disappearance of a photo after 24 hours on an Instastory, better separation lines between public and private than on the Facebook. SnapChat (54%) is almost entirely dedicated for socializing/communicating, allows for immediate deletion of messages once a conversation is over, stimulates reciprocity (gaining flames) etc. It has an entertainment section that updates info on celebrities, opening the floor for comments, chit-chat/gossip.

Table 2. Social platforms / apps used for documentation/information

Nr.	Item	%		
1.	Youtube	yes	493	90%
2.	WhatsApp	yes	352	64.2%
3.	Facebook	yes	329	60%
4.	Drive. Google	yes	284	51.8%
5.	Messenger	yes	271	49.5%
6.	Instagram	yes	256	46.7%
7.	Wikispaces	yes	185	33.8%
8.	Books. Google	yes	178	32.5%
9.	Dropbox	yes	166	30.3%
10.	Reddit	yes	168	30.7%

Among the social platforms / apps used for documentation/information the highest percentage 90%, goes to YouTube, Gen Z resonating thus to the description that it is a highly visual generation. Video material offer exactly what this generation loves most: image, sound, practical demos, maxim information during minimal exposure. It allows for run/stop/rerun options, as many times as the viewer needs it. Although initially a music channel, YouTube rapidly integrated cooking demos, tutorials for "do-it-yourself" activities, video courses, inspirational material (e.g. TED Talks) etc. We run ahead in stating that for educational purposes YouTube can and should be better used than the current educational practice, at least in Romania, where few universities access this channel on a wide basis.

WhatsApp still ranks high – 64.2% but takes only the second place for documentation/information. Facebook (position 3, with 60% preferences) might maintain its position because teachers made the effort to develop and manage Facebook groups for educational purposes (see also Cernicova and Gherhes, 2018). Google Drive - with 51.8% seems to raise in the preferences of Gen Z, while other platforms rank lower 50%.

Apart from communication and documentation, students resort to a multitude of online platforms for content-production. The tools and apps available online encourage the growth of this tendency, especially with the advent of free options. Gen Z continues and amplifies the phenomenon started by the Millennials, of feeding content – textual, visual or multimedia to this apparently limitless space of the Internet.

Table 3. Social platforms / apps used for content creation

Nr.	Item	%		
1.	Facebook	yes	300	54.7%
2.	Instagram	yes	283	51.6%
3.	WhatsApp	yes	225	41.1%
4.	Youtube	yes	198	36.1%
5.	Messenger	yes	180	32.8%
6.	Drive.Google	yes	160	29.2%
7.	Snapchat	yes	155	28.3%
8.	Skype	yes	94	17.2%

Content creation seems to be a weaker aspect of Gen Z students in engineering. Only 7.5% confessed to blog. More commonly they link content creation with social platforms: Facebook 54.7%, Instagram 51.6%, WhatsApp 41.1%, YouTube 36.1%. YouTube lost part of its popularity due to the unclear policy regarding copyright and plagiarism, Generation Z, with its ethical standing, taking distance from grey areas of social life.

Having in mind the fact that YouTube ranks first for documentation/information with 90%, but takes only 36.1% for content creation, we investigated further the features of the respondents by gender and by type of engagement.

90.3% of the male respondents and 89.7% of the female respondents chose YouTube for documentation/information. 40.5% of the male respondents and 32.1% of the female respondents chose YouTube for content creation. Girls seem to be less inclined to use YouTube for content creation, while boys (gamers) are more engaged. They use YouTube to vlog, to share a variety of comments, discuss characters in movies or games, share knowledge regarding gaming etc.

Among the features of interest for the study there is the desire of young people to train/educate themselves outside the university formats. Hence the next question, regarding the types of educational experiences Gen Z seeks to access.

Table 4. Apart from university courses, what other formal/informal types of personal and professional experience have you accessed?

Nr.	Item	%	
1.	Tutorials	457	83.4%
2.	Trainings	342	62.4%
3.	Volunteering	327	59.7%
4.	On-Line courses	279	50.9%
5.	Forums	210	38.3%
6.	Interships	160	29.2%

Tutorials seem to be the most frequently sought for experience by Gen Z younsters, at a click away (e.g. on YouTube). Trainings and volunteering share similar percentages (62.4% and 59.7% respectively), since in academic contexts most student organizations stimulate volunteering and training sessions. This is the age of civic learning and engagement and it explains also the interest Gen Z takes for charitable and philanthropic action. Interestingly enough, outgoing mobilities to universities abroad obtain only a modest 8%. Further study will investigate the motives behind the low interest in this opportunity, despite the multitude of strategies and support universities offer to stimulate internationalization and experience exchanges for the young generation.

The on-line medium offers large possibilities for opinion sharing and for recommendation (like/dislike) of ideas, products, services or even people. This is the space for influencers and group-forming around a topic of interest. Hence our next investigation, regarding the perceived role of influencers in Gen Z's lives.

Table 5. What is the role of influencers in your life regarding…?

Nr.	Item	%		% sum up
1.	Professional orientation	Important very important	32.8% 15.9%	48.7%
2.	Education	Important very important	28.6% 15.3%	43.9%
3.	Expectations vs. a future employer	Important very important	30.5% 13%	43,5%
4.	Choice of communities/groups	Important very important	33.4% 9.5%	42.9%

All the four aspects of life enjoy less than 50% of the students' trust. A possible explanation is that Generation Z starts to understand the economic/financial interest behind many influencers, the monetization strategies and the marketing use of the online opinions. This may be a direct result of the efforts taken by educators to increase critical thinking and develop media literacy as a set of integrated skills enabling users to actively access, analyze, interpret and question (social) media messages (Ciurel, 2019).

Conclusions

In our „Media Age", as Bogdan Ghiu so adequately describes it, the capacity of individuals to decode and interpret complex messages is of utmost importance. As fully immersed in the online world, Generation Z students need a different educational and social approach than their predecessors, a reality that most university professors feel, but often cannot pinpoint and find the proper response. Our study shows that while this generation is highly skilled and hyper-connected, it needs guidance and educational approaches to critically understand the avalanche of information poured in by the multitude of platforms and apps they consume daily. While the task of previous generations was to integrate technology with education and everyday life, the task for Gen Z is to re-learn the capacity to step aside and lower the exposure to technical devices in favour of face-to-face encounters and collaborative real-life work. More efforts should be taken towards developing critical digital and media literacy skills, to help Gen Z users to adopt a critical stance, to recognize the persuasion techniques used in various media messages, to employ a multi-perspectival approach of media, recognize bias, propaganda, manipulation, misinformation, and disinformation, to skeptically examine the often-conflicting media messages based on the user's own experiences, abilities, beliefs, and values. On-line interactions may not necessarily be different from the face-to-face ones, but the fabric of society depends on the capacity of its members to be empathic, socially engaged, perceive information beyond words and posture or role and ignore the need to gather likes and smiles along every act or posting. Gen Z seems equipped to master the social platforms and apps but should be taught to follow what contemporary critics urge as "digital minimalism" and "prevention of dependence" on smartphones and addictiveness of gaming. Stronger emphasis should be placed on empowering our students to control, filter and interpret media messages, to becoming a sophisticated, media literate citizen and consumer. Further research will deepen the understanding of how this generation uses tutorials and other online learning opportunities and how higher education can profit from this appetite of students to embrace new formats of learning.

References

Journal Articles:

Ateca-Amestoy, V., Aguilar, A. C., & Moro-Egido, A. I. (2014). Social interactions and life satisfaction: Evidence from Latin America. Journal of Happiness Studies, 15(3), 527–554.

Journal Articles:

Cernicova, M., Gherhes, V., (2018). Perceptions of Romanian students on uses and value of educational resources shared via ICT. Case study: Politehnica University Timisoara, in BRAIN. Broad Research in Artificial Intelligence and Neuroscience, No. 9/1, 163-172.

Journal Articles:

Cho, J. (2015). Roles of smartphone app use in improving social capital and reducing social isolation. Cyberpsychology, Behavior, and Social Networking, 18(6), 350–35.

Manuscripts And Working Papers (Unpublished Material):

Ciurel, D. (2019) Media literacy: concepts, approaches and competencies communication.

Journal Articles:

Cooper, C. (2017), The Influence of the Mobile Pone on Young Adult, Communication in Professional Communication and Translation Studies, Vol. 10 / 2017 ISSN 2065 – 099X. Proceedings of the 10th International Conference, 30-31 March 2017 Timișoara, Romania, 12-20.

Newspapers Or Magazines:

Katz, J. E., & Aakhus, M. (2002). *Perpetual contact: Mobile communication, private talk, public performance*. Cambridge University Press.

Book:

Kellner,D (2001), *Cultura media*, traducere de Teodora Ghiviriză și Liliana Scărlătescu, prefață de Adrian Dinu Rachieru, Iași, Institutul European, p. 45.

Book:

McLuhan,M." *Playboy* Playboy Interview [*Galaxia Gutemberg – Scrieri esențiale*, Editura Nemira, București, 2016], martie 1969, p. 70.

Book:

Valkenburg,P. M., Taylor Piotrowski, J. (2018) *Generația digitală și dependența de media*, Editura Niculescu, cod: NIC978-606-38-0233-1.

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Virtual internship in higher education for transferring research and innovation through project based training

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Abstract

Virtual Internship is a new concept of traineeship carried out online that can provide students with an innovative internship experience. This is not a common method of training in higher education, especially in the technical field but is growing in popularity due to the IT developments. The paper presents how this new training methodology can be used effectively for transferring research and innovation in the textiles & clothng sector by developing projects made by students under guidance of company tutors in an entirely virtual environment. The virtual internship enables the linking and cooperation between companies and students with an aim to provide the latter with a deeper knowledge on real textile/clothing enterprise challenges focusing on research and development without the barriers of physical attendance. Companies participate in the form of tutoring teams of students and proposing a research project to be implemented. The new methodology and tools are developed within the project “Textile Strategy for Innovative Higher Education” (www.texstra.eu), funded by the Erasmus + Programme of the European Union.

Keywords: Engineering education, Virtual training, Internship, Textiles and Clothing

1 Introduction

In general, virtual internships involve specific activities that are carried out remotly, using the online environment.

For students, this means that they will participate in developing projects or solving other tasks proposed by the firm organising the internship without the physical presence in the company.

From the students’ point of view, the advantages of the virtual internships include:

- The activities are flexible and the students can set their own work rithm
- The students develop both professional and transversal skills
- The students are less depending on training grants and they can choose companies regardless of their location
- They can overlap their internship with other academic activities without affecting any of them.

In case of employers, the main advantages of the virtual internships are the following:

- Larger applicant pool. Virtual internships are not conditionned by distance or lack of funds.
- Space and equipment savings, as virtual interns do not require additional workspace.
- Cut-out costs, as training and supervising becomes less costly and less time consuming.
- Facilitate communication with students, (interns), as young people are more comfortable communicating online.

Virtual internships is not yet used in engineering training, including in the textiles & clothing (T&C) sector, but is rapidly growing in popularity due to IT developments.

The virtual internship enables the linking and cooperation between companies and students with an aim to provide the latter with a deeper knowledge on real textile/clothing enterprise challenges focusing on research and development without the barriers of physical attendance.

The new methodology and tools are developed within the project “Textile Strategy for Innovative Higher Education - TEXSTRA” (www.texstra.eu), funded by the Erasmus + Programme of the European Union.

2 Need Analysis for Virtual Training in the T&C Sector

The need analysis is part of the report “Need analysis and state of the art report: transferring research and innovation in the T&C manufacturing sector” has been made within the framework of the TEXSTRA project.

The report served not only as basis for designing and developing other project outputs but also as a starting point for further research in the field. It gave an European overview about the educational and training offer for textile and clothing manufacturing professionals, as well as the level of research and innovation within the textile and clothing manufacturing sector.

This report contains the results obtained from the field research implemented by all partner countries, targeting three groups from the T&C sector:

Group 1: Managers and professionals from T&C industries;

Group 2: Aspiring / potential managers (students) from T&C sector;

Group 3: Relevant experts (experts from HEIs, VET professionals, intermediary organizations belonging to textiles and clothing sector).

The research is based on specific questionnaires, developed in the Guidelines and discussed by the partners. The questionnaire included a chapter of questions reffering to the **cooperation between HEIs and companies,** designed according to the group of respondents.

A total of 237 respondents from the seven partners’ countries completed the survey. The distribution of all respondents by country of origin is presented in Table 1.

For **Group 1**, the questions were intended to identify the level to which companies are involved in academic educational programmes. While in the past 3 years few companies were involved in any activities of universities for the definition or validation of curricula, almost half of the respondents stated that their company provided places for students’ practice (internships). It is important to point out that a significant part of those internships (47%) included activities related to research and innovation.

Less than half of the companies cooperated, in the past 3 years, with HEIs for supporting students’ graduation thesis, both for B.Sc. and for M.Sc. level (43.6%). These values indicate that the T&C sector is opened to this type of cooperation with the academic environment and that HEIs could work more to increase this cooperation. The level of thesis supported by companies (B.Sc. or M.Sc.) is almost equal, as illustrated in figure below. A significant number of these companies declared to have supported graduation theses at both levels.

Table 1 Respondents' distribution by country

	Participating countries							Total
	Greece	Lithuania	Romania	Portugal	Italy	Spain	Bulgaria	
Group 1: Managers and professionals	11	15	14	7	15	11	5	78
Group 2: Aspiring / potential managers (students)	10	15	16	14	1	10	5	71
Group 3: Experts	14	15	20	13	11	10	5	88

Respondents were asked to state how they see the future implementing of internships in the companies, selecting from three possibilities:

- traditional
- virtual
- mixed (a combination between traditional and virtual internship)

The answers showed that a significant number of respondents preferred internships conducted in a traditional manner (48%), but they were also opened to a mixed approach to such internships, as 51% indicated that they are considering it as a viable option. The graph from the figure below presents the preferences expressed for the type of internship to be used in the future (Figure 1).

In case of **Group 2**, only 42% of respondents declared to have had internships in T&C companies, suggesting that this is a situation that has to be improved through a better, more efficient cooperation between companies and HEIs. Only 10 respondents (32% of the positive answers) had activities related to research and innovation during their internships.

With regard to the way internships should be implemented in the future, the answers are illustrated graphically in the figure below. Most of the respondents (72.6%) tend to favour the mixed approach, including both the traditional form of internship and the virtual one, while 20.5% of the respondents consider the traditional manner as preferable, while 6.9% think that virtual internship is better.

In case of **Group 3**, as for the manner in which future internships should take place, the respondents indicated they favoured the mixed internship (71%), as shown in Figure 1 below. Few of the answers indicated both traditional and mixed internship.

For comparison purposes, in Figure 1 the options of the respondents were expressed as percentage of the total number of participants from each group.

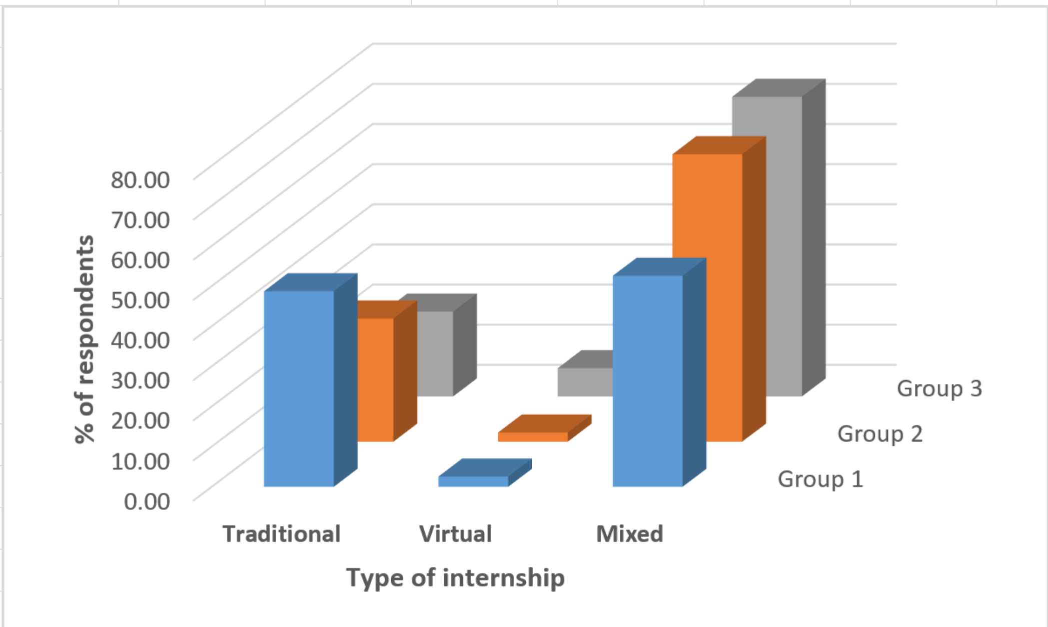

Figure 1. Options for implementing future internships

Figure 1 shows that the majority of the respondents from all groups preferred a mixed type of internship, combining the traditional manner with the virtual internship. This preference is specific to the engineering training in higher education, that requires a ‘hands-on’ approach, while being open to the idea of virtual activities that can be easily applied in project solving.

3 Study case - Organising a Virtual Internship within the TEXSTRA Project

The concept of virtual internship, that is new to the T&C sector will be applied by the TEXSTRA project in order to prove its validity and to understand how to improve such activity, so that companies and students and universities will benefit as much as possible.

The stages of the virtual internship organized by TEXSTRA are presented in Figure 2.

As a physical support for the activities to be carried out, an online platform for transferring research and innovation through project based training was developed by partner University of West Attica, UNIWA, Greece.

The virtual internship activities require the following stages:

STEP 1. RECRUITMENT

Recruitment will target both students and companies. The students will be selected by their universities – “Gheorghe Asachi” Technical University of Iasi, Romania, University of West Attica, Greece, University of Minho, Portugal and Kaunas University of Technology, Lithuania.

The virtual internship activities will be promoted among companies. Enterprises will be asked if they are willing to tutor a team of students and propose a research project to be implemented or a challenge to be solved.

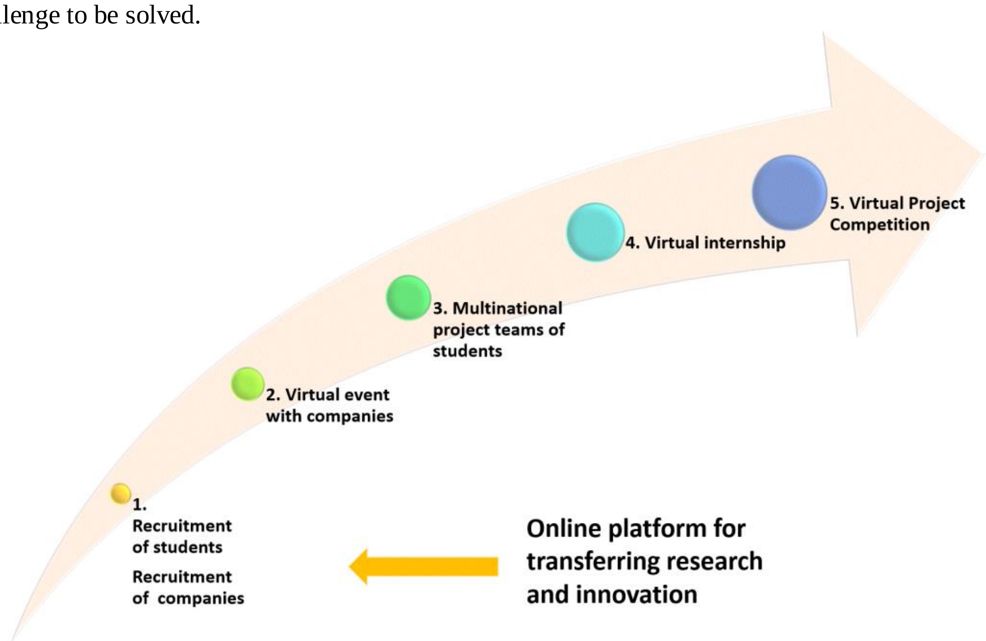

Figure 2. Stages of the virtual internship organized within the frame of the TEXSTRA project

STEP 2. VIRTUAL EVENT WITH COMPANIES

A virtual event will be organised between project partners and subscribed companies.

Teams of students will be assigned a project/challenge by a company and will work, under tutoring, to develop/solve it. At the end, a winner will be selected. The event will be extremely useful for guiding companies on how tutoring student teams.

STEP 3. ESTABLISHMENT OF MULTINATIONAL PROJECT TEAMS OF STUDENTS

Project/challenges will be published online and enrolled students will be asked to declare their preferences about the project they wish to work on. Teams of 3 or 4 students will be created accordingly and will be as transnational as possible. Equal opportunities, diversity issues will be also taken in consideration while creating the teams.

STEP 4. THE INTERNSHIP

Internships will be launched and implemented through the platform. Students belonging to the partner universities will be called to share ideas and brainstorm for implementing the research project and solve the company's challenge.

Groups will be called to present their project ideas together with a small business plan and PPT presentation to be posted online for evaluation. During the process they will be in strict contact with the company to whom they have been assigned (tutorship).

The project will enter a competition and the representatives of the companies (ambassadors) will be asked to judge and rank them.

4 Conclusions

In the conditions of the global computerization of the educational process, students in engineering field have the possibility of developing their digital skills while accomplishing certain tasks related to an internship stage (program). The virtual internship takes place in a remote company, while the students are in a different place (e.g. from dorm rooms to classrooms or from libraries to coffee shops etc.).

The proposed method of integration of the Virtual internship in the practical training modules in case of engineering education for the Textiles & Clothing sector will contribute to better understanding the needs and problems to be solved in the sector, facilitate a more practical view of the students on engineering education and increase their communication skills, as well as their team working skills for finding solutions and solving specific problems and tasks.

Such internships require a dedicated online platform to sustain the joint activities of students and companies.

The TEXSTRA project applies this concept to the T&C sector and develops a virtual internship with companies from all 7 participant countries, thus ensuring the diversity and relevance needed. The results will constitute a starting base for the implementation of virtual internships in the industry.

Acknowledgments

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References

Iryna, V., et.al. (2018): Educational Situation as a Tool for Communication Activity Motivation in the Virtual Learning Environment. In *Proceedings of The 13th International Conference on Virtual Learning.* December 1st 1918”University of Alba Iulia, Romania, 136-141

https://www.internships.com/employer/resources/setup/7-reasons-to-consider-the-virtual-internship, accesed 2019.

"Virtual Student Foreign Service". *The U.S. Department of State*. https://2009-2017.state.gov/vsfs/index.htm, accesed 2019

“All About Virtual Internships”, https://www.fastweb.com/career-planning/articles/all-about-virtual-internships, accesed 2019.

Development of microlearning courses for training personnel in the textile industry

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Abstract

The rapid evolution of science and technology, process automation leads to a decrease in the intensity of human work. In this situation, the importance of human intervention has not diminished because automation requires changing the profile of the worker, respectively, it requires trained professionals who are up to date with the latest technologies, policies and processes and who need adequate training. This paper presents the possibilities of using microlearning to train the training personnel in the textile industry. A Moodle cloud platform was used in which a course was developed that respects the principles of microlearning. The effect of using this interactive platform and the browsing by the students of the content consisted in the elaboration of them of content corresponding to the requirements for the staff training.

Keywords: Training, Textile industry, Moodle cloud, Microlearning

1 Introduction

It can be said that "people make an organization", which could be true in the case of manufacturing companies that operate mainly with the help of its employees, (Ashutosh Joshi, 2019). Nowadays, with the rapid evolution of science and technology, process automation leads to a decrease in the intensity of human work, especially in goods manufacturing companies. In this situation, the importance of human intervention has not diminished because automation requires changing the profile of the worker, respectively, it requires trained professionals who are up to date with the latest technologies, policies and processes and who need adequate training.

According to (Korn Ferry, 2018) the companies and economic organizations in the world will face a major crisis. By 2030, the demand for skilled workers will exceed supply, leading to a shortage of skilled workers of over 85.2 million people. These signs have already appeared in countries with low unemployment and booming production output, including the Czech Republic, Poland, Hungary and Slovakia, the labor shortage has already accelerated the automation and increased use of robotics. Automation and robotics do not replace people, but make up for the fact that there are not enough workers to fill factories. This phenomenon, left unchecked, will result in financial losses of $ 8.452 billion in unrealized annual revenues by 2030, equivalent to the combined GDP of Germany and Japan.

The reasons for this skills gap and talent shortage are:

• Changing the skill set due to the introduction of new advanced technologies and automation;

• The negative perception of their students / parents towards the manufacturing industry;

• Baby Boomer retirement complements these causes of today's skills shortage, according to production managers.

In this context, many organizations work hard to make skilled people available to companies, rethink work architecture, retraining people, and reorganizing the organization to use technology to transform businesses. Training plays a crucial role in filling the skills gap and if strategies such as higher salaries fail to retain employees, training in the workplace can help producers identify new employees with good attitudes that can adapt to the job's needs.

The evolution of technology and the demographic changes have required changes regarding the way the training is carried out. Digital disruption training has taken a different approach, while eLearning has generally outperformed traditional training when it comes to up-to-date training. Gone are the days when he went to the library to find out some information. Today's students are mobile and web savvy; I go straight to the internet for instant answers. Whether its Google News updates, YouTube videos or TED Talks, when we need information, they are within our reach, (Anubha Goel, 2018).

2 Adopting a microlearning approach for corporate training and training staff

Microlearning can be defined in different ways, but ultimately results in considerable behavioral changes. Students constantly interact with each bite of content, thus changing their learning behavior throughout the self-improvement career, (Anubha Goel, 2018).

Training for the online workforce is the main concern for organizations in different industrial fields. Today, R&D departments are under great pressure to provide short and efficient training. Meanwhile, the low-skilled workforce is also looking for ways to fit the perfect training into their busy work schedule.

2.1 Training workforce with microlearning

Microlearning can be an effective solution for training the modern workforce. It is a potential approach that harnesses the power of providing small segments of information to transform individuals and businesses. Microlearning can be defined in the following ways:

• Short and new content, as part of long training sessions that support long-term business goals.

• Providing targeted support to help strengthen knowledge, such as additional training courses that can be accessed whenever needed.

• Self-directed learning that allows learners to access courses at their own pace. For example, playing videos on specific topics on YouTube, or uploading them to your own learning platforms.

To understand how microlearning can help train staff, we need to take into account the areas where manufacturing companies require training, usually:

• Training in the field of safety and security at work;
• Training in the field of industrial security;
• Good manufacturing practices;
• Manufacturing processes and quality standards;
• First aid training;
• Anti-harassment training.

Training in these areas is usually boring for employees. For this reason, providing only essential information in an attractive form could increase the interest for them. The training can be carried out in different ways: traditionally (involves removing the personnel from the current activity, sending them to the training company where the courses are attended and exams are given), hiring specialized companies to provide these services within the company or training their own people offer these services.

The first two ways are quite costly for companies. In the case of the third mode, the costs decrease because only certain people participate in the initial training, and they will then establish their own training strategy for the company. These specialized persons will have to determine the needs in terms of the equipment and the eLearning platform used, and then, according to the needs of the moment, to prepare training courses for the personnel and to evaluate their results.

2.2 How to train your training staff?

The personnel who will provide the training must be selected so that they possess the skills needed to work with the digital technique and understand it. These people are usually young people whose attention is more limited. For this reason, long and monotonous courses, long training sessions, etc. should be avoided in order to motivate and increase the efficiency of the training. At the same time they have technological experience and therefore need the relevant information at their fingertips, which can also be obtained with the help of microlearning. It is one of the most effective ways to determine real-time behavioral changes and to embrace different learning techniques that have not yet been incorporated into traditional workplace training methods.

The training of the training personnel can be carried out in the universities or specialized companies. This article describes how training is done in the master program of "Quality Assurance in Textiles - Leather". Between the specialized disciplines, there is also the course "Modern Quality Training Systems". In this course the foundations of what a modern training system that can be used within a company.

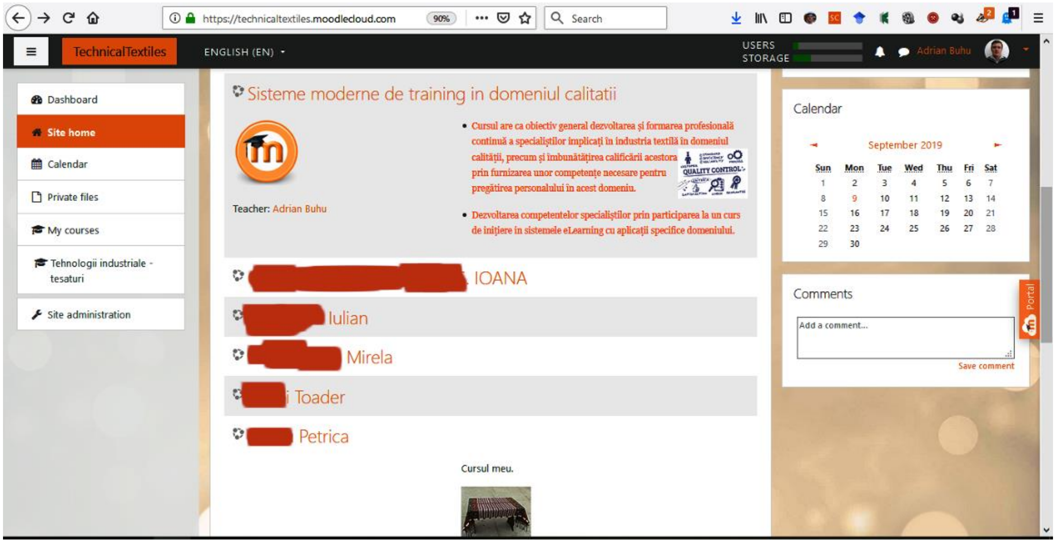

Figure 1. ”Modern Quality Training Systems” course for training staff

This course is carried out on an LMS Moodle cloud platform, and the students have access to their own space where they can practice the acquired knowledge. At the same time they understand how to structure the information and offered the students so the whole process to be effective, figure 1.

After completing the course content and adapting to its requirements, the students have practically completed a series of activities between the ones learned. Depending on different considerations, the material elaborated by them was more or less complex. For example, some of them made more use of the communication of the platform and uploaded different files, figure 2.

Another category of learners tested the various facilities offered by the platform, namely communication through the forum or announcements, the creation of pages (such as a short history of "jeans" - denim), surveys or tests, such as the examples in figure 3.

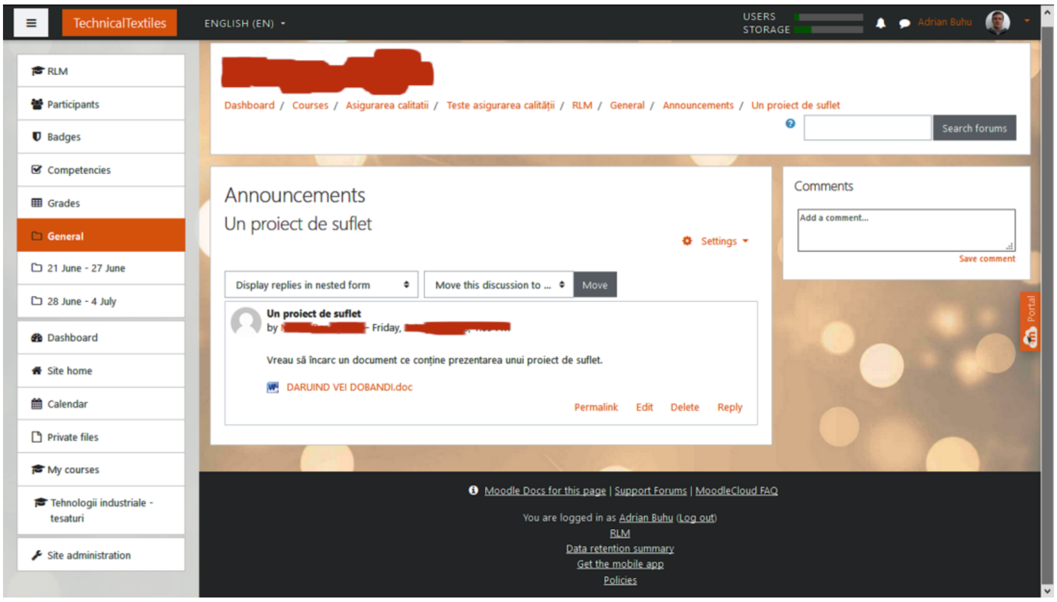

Figure 2. Using the platform for file distribution

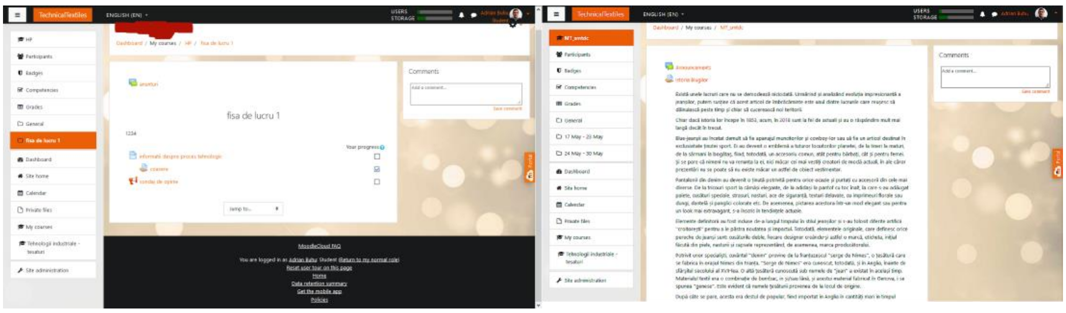

Figure 3. Developing complex content (URL, quiz, page, etc.)

Analysing how the students related to the activities carried out during the course it can be concluded that: such a course is interesting because it differs from the traditional way of learning with which they were accustomed, instead they are required to the maximum their abilities and knowledge, use of different devices (laptop, tablet and especially mobile phone), respectively dependence of Internet access. The development of microlearning content increases the interest for such a course due to the interactivity with the different types of activities.

The disadvantages, at this point, are the heavy applicability in practice. The reasons are related to the reluctance of companies to make such an investment in equipment and software for LMS. Another reason would be used to work in a certain way and fear to change this way of working.

3 Conclusions

This paper presents the possibilities of using microlearning to train the training personnel in the textile industry.

This training refers to different fields in the industry, such as: safety and security at work, industrial safety, the application of quality standards and processing processes, etc.

These areas where staff training is required have applicability not only in industry but also in education.

A Moodle cloud platform was used in which a course was developed that respects the principles of microlearning. The effect of using this interactive platform and the browsing by the students of the content consisted in the elaboration of them of content corresponding to the requirements for the staff training.

References

Ashutosh Joshi, What Makes Microlearning a Beacon for Training in Manufacturing Companies?, https://knowzieslearning.com/what-makes-microlearning-a-beacon-for-training-in-manufacturing-companies/, accessed august, 2019

Korn Ferry, Future of work – The global talent crunch, https://dsqapj1lakrkc.cloudfront.net/media/sidebar_downloads/FOWTalentCrunchFinal_Spring2018.pdf, accesed 2019

Anubha Goel, Adopting A Microlearning Approach For Corporate Training: Smaller Bites, Bigger Returns, https://elearningindustry.com/microlearning-approach-for-corporate-training-smaller-bites-bigger-returns-adopting, accessed 2019

The use of digital resources in modern parenting

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Abstract

The purpose of this study is to identify and analyse the importance of digital resources in modern parenting. The current social framework has become grounds for the rapid development of everything fallen under the umbrella of 'digital device'. For a large number of families, and parents implicitly, technology has grown into a prevalent part of their day-to-day lives. On these lines, an essential objective of the present research is to identify the advantages and disadvantages of Internet usage in modern parenting. The subjects of this study were 164 young parents, coming from urban areas, all of them graduates of higher education institutions. The research method used for this study was the questionnaire-based survey, which was applied online. The questionnaire included items with a Likert response-scale, as well as items with open-ended questions. The data obtained were processed in SPSS Statistics. The results showed a high level of Internet usage in nowadays parenting, in activities ranging from finding information on the web to even attending online courses.

Keywords: digital, resources, parenting, technology, education

1 Introduction

In modern world, it has become a fact that technology plays a significant role in our everyday lives. Now, in 2019, almost three billion people worldwide own a smartphone (Statista Research Department, 2019) and more than four billion people are Internet users (Internet World Stats, 2019). In comparison with three decades ago, when World Wide Web was just being born and most parents pertained to Generations W (1946-1964) or X (/Digital Immigrants, 1965-1976), today's parents moved up to Generations X, Y (/Digital Natives, 1977-1994) or even Z (/Net Generation, 1995-present) (Kinash et al., 2013). What this means is that parents are no longer considered 'digital immigrants', but rather 'digital natives' or members of the Net generation, which might have certain implications on the way they relate to technology or the way they use it in parenting activities.

According to Lasen (2010), the new technologies have reshaped the way in which families communicate, search and find information or even plan family activities. Modern family environments are now crowded with all sorts of digital devices, such as computers, smartphones, cameras, ipads and so on (Chou & Fen, 2014). Depending on their predilection for media use, families can thus be divided into three categories: traditional (low use), intermediate (average use), and multimedia (high use) (Rompaey et al., 2002 apud Romero-Ruiz et al., 2017).

Although it is well-known that excessive use of technology can have negative effects upon its users, such as low concentration, lack of attention, anxiety or even obesity and sleep disturbances (Mustafaoğlu et al., 2018), it is acknowledged, to the same extent, that a moderate and purposeful use of technology can provide multiple benefits for its users, including modern parents, such as access to a large amount of information and ease of communication. According to Genc (2014), the most frequent actions that parents perform on their digital devices are making phone calls, browsing the internet, sending messages and taking or editing photos. As concerns browsing the internet, in nowadays' digitalized society, 'parents have to face a variety of opinions, most often contradictory and of short duration' (Valkenburg & Piotrowski, 2018, p. 285). Nonetheless, the fact that they are granted permanent access to knowledge might determine a raise in their time spent online, in search of parenting ideas and solutions. What is yet to find out is what their attitude towards using the internet is, how much time they spend online and to what extent they do it for parenting activities or for personal interests.

2 Research Questions

2.1. There is a high level of openness on the part of parents regarding the use of digital resources for information in parenting activities.

2.2. There are statistically significant differences in the use of technology between parents of children under 10 years old and parents of children over 10.

2.3. There are differences between the time taken by parents to use digital resources for satisfying their own needs and the time taken for satisfying their children's needs.

3 Purpose of the Study

The present research aims to investigate parents' perceptions on the use of digital resources in parenting activities and targets their level of openness in using technology and the importance they attach to technology in everyday life. The objective of the research is to investigate the following:

- parents' perceptions regarding the importance of digital resources in modern parenting activities;
- the quality and variety of digital resources involved in parenting activities, depending on children's age;
- the time spent by parents in using technology for satisfying their own needs or their children's needs.

4 Research Methods

For this study we developed and conducted a questionnaire consisting of 32 items with two types of answers: Likert-scale answers and open answers. In developing the items, we considered identifying the importance that parents attach to the use of digital resources and identifying the reasons for which parents turn to technology in meeting certain needs. The questionnaire focuses on two directions: current trends in modern parenting regarding the use of technology, in general, and certain areas of parenting, in particular (such as online courses, online shopping, information on certain health-related topics or educational practices).

4.1. Subjects

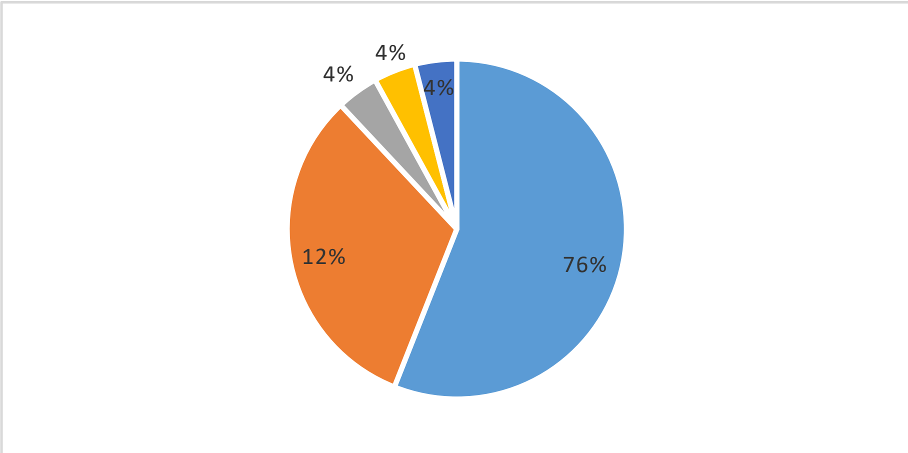
For this study we selected 164 parents of children aged between 3-14. The selected subjects were both male and female adults. For applying the questionnaire, we used Google forms, which allowed for an extended sample, which consists of parents from various geographic areas of Romania.

5 Findings

Technology and digital resources were proven to be essential tools for modern parents, that they use in day-to-day life, both for personal interests and in relation to their child's needs. After having analysed the data regarding parents' openness towards the use of technology and the importance they give to digital resources, we have obtained the results described below, accompanied by significant graphics. The results were processed in SPSS, where we used descriptive statistics and applied the *t* test for verifying the second hypothesis of the study.

In order to verify our first hypothesis, according to which there is a high level of openness on the part of parents regarding the use of digital resources for information in parenting activities, we built a specific set of items. One of the items, which provided important answers for identifying parents' perception on the use of technology, is the following: 'How much do you use the internet, on average, for parenting issues?' Participants' answers to this item reflect a proportion of 76% of internet use in parenting activities. This allows us to state that parents use computers, tablets or phones in a high percentage when they get informed on parenting topics or activities.

Figure 1. Parents' perception on the use of technology



In order to test our second hypothesis, we applied the *t* test for independent samples. The first group consisted in parents of children aged under 10 and the second group – in parents of children aged above 10. The differences between the two groups showed that parents of children aged under 10 use technology and the internet less than the other group of parents. Thus, parents of preadolescent or adolescent children use the internet to a greater extent and believe that technology simplifies parenting activities and represents a useful tool in their everyday life, both for themselves and for their children.

Table 1. Results *for* independent samples t test for unrelated data

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
technology	Equal variances assumed	,200	,656	2..649	68	.003
	Equal variances not assumed			2.649	67.07	.003

As regards our third hypothesis, this targeted the identification of the differences between parents in the use of digital resources, on the one hand, for getting informed on certain health issues or for shopping for themselves, and, on the other hand, for satisfying some of their children's needs (shopping for clothes or toys, getting informed on their children's health issues etc.).

Figure 2 shows a high percentage of parents' internet use for satisfying their own needs. Parents use the internet especially for getting informed on parenting courses, shopping for clothes or finding information on health-related issues. Therefore, the participants of this study use the internet for their own needs at a higher rate than for satisfying their children's needs.

Figure 3 shows the participants' results regarding their interest in using the internet for meeting their children's needs. 39% of the parents stated that they use the internet mainly for shopping for clothes or toys, although some of them prefer testing the products before purchasing them.

Considering the results obtained throughout this study, we may conclude that digital resources are an important part in nowadays' parenting activities and that none of the parents regards technology as an adversary, but rather as a useful assistant of the modern accelerated society they live in.

Figure 2. The use of digital resources for parents

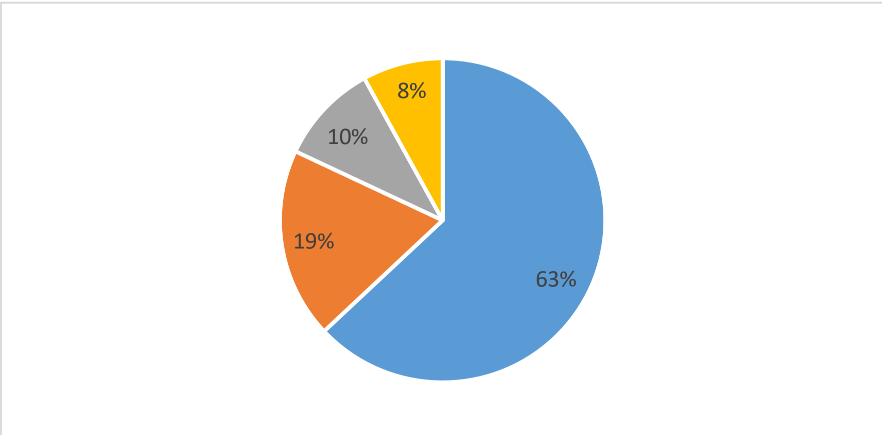
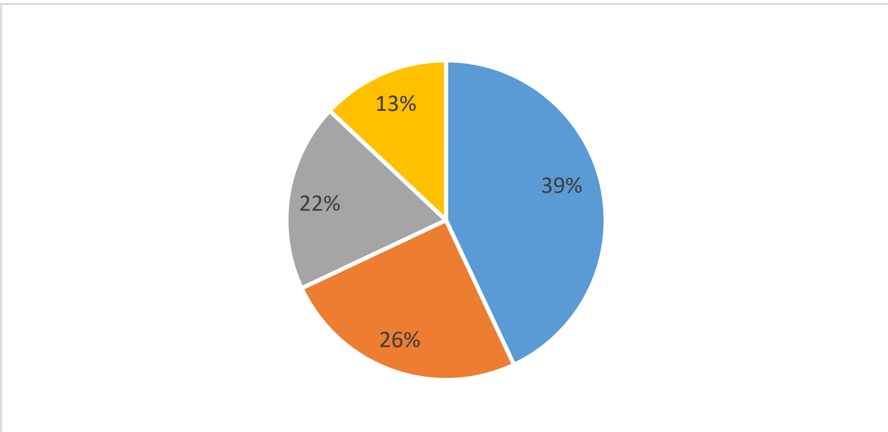


Figure 3. The use of digital resources for children



6 Conclusion

The role of digital resources in parenting activities is fundamental, especially when considering their level of accessibility for both parents and children. Meeting certain social needs or getting informed on certain key-topics for nowadays' parenting are some of the reasons for which the subjects of this study turn to technology. Most parents consider technology to be an indispensable tool in their day-to-day life. In the end though, for increasing the efficiency of digital resources, we believe that parents should develop an open and cooperative attitude not only towards technology, but also towards children themselves, whenever trying to put into effect what they have just learnt in the online environment.

References

Chou, M.-J., Fen, C.-F. (2014). Parent-Child Play within Information Technology: A Quest for Quality Family Atmosphere, *Procedia – Social and Behavioral Sciences*, 122, pp. 273-282

Genc, Z. (2014). Parents' Perceptions about the Mobile Technology Use of Preschool Aged Children. *Procedia – Social and Behavioral Sciences*, 146, pp. 55-60

Internet World Stats. Usage and Population Statistics (2019). Internet Users in the World by Regions – March, 2019., At: https://www.internetworldstats.com/stats.htm

Kinash, S., Wood, K., Knight, D. (2013). Digital immigrant teachers and digital native students: What happens to teaching?. *Learning and Teaching papers*. Paper 50, At: https://pure.bond.edu.au/ws/portalfiles/portal/27949592/Digital_immigrant_teachers_and_digital_native_students_What_happens_to_teaching.pdf

Lasen, M. (2010). Education and career pathways in Information Communication Technology: What are schoolgirls saying?. *Computers & Education*, 54(4), pp. 1117-1126

Mustafaoğlu, R., Zirek, E., Yasacı, Z., Razak Özdinçler, A. (2018). The Negative Effects of Digital Technology Usage on Children's Development and Health. *Addicta: The Turkish Journal on Addictions*, 5(2), pp. 13-21

Romero-Ruiz, K., Echeverri-Sánchez, L., Peña-Plata, J., Vásquez-Giraldo, S., Aguilera-Cardona, M., Herazo-Avendaño, C., Valencia-Arias, A., Bran-Piedrahita, L. (2017). Information and communication technologies impact on family relationship. *Procedia – Social and Behavioral Sciences*, 237, pp. 30-37

Rompaey, V., Roe, K., Struys, K. (2002). Children's Influence on Internet Access at Home: Adoption and use in the family context. *Information, Communication & Society*, 5(2), pp. 189-206

Statista Research Department (2019). Number of smartphone users worldwide from 2014 to 2022 (in billions), At: https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/

Valkenburg, P.M.; Taylor Piotrowski, J. (2018). *Generația digitală și dependența de media*. București: Niculescu

Technology Acceptance of a Hybrid Brain-Computer Interface for Instruction Manual Browsing

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Abstract

The aim of this research was to evaluate the participants' level of acceptance of a hybrid brain-computer interface (hBCI) for instruction manual browsing by using the Technology Acceptance Model (TAM). The evaluated application uses Tobii X120 for eye-tracking and the g.Nautilus biosignal amplifier with g.Sahara dry electrodes for electroencephalography (EEG) signal acquisition. Eye-tracking is used to navigate through the content of an instruction manual by selecting different types of buttons (next page, previous page, zoom in, zoom out, etc.), while the biosignals are used in an EEG-P300 speller interface to enter a text to be searched within the manual. The experiment consisted of three phases: system calibration, task familiarization and evaluation. The TAM results showed an above average acceptance of the proposed hBCI. The findings are encouraging as the users expressed high levels of interest towards the proposed interaction paradigm. In conclusion, it can be stated that the alternative input methods used in the present study can be used for interactive browsing and adaptive content in various applications.

Keywords: hybrid brain computer interface, eye-tracking, TAM

1 Introduction

Brain-computer interfaces (BCIs) represent in general an alternative communication and/or control system based on the user's electroencephalogram (EEG) signals. Such systems allow people to communicate by means of spelling devices, to command various robotic devices or to interact with virtual environments. Initially, these interfaces were solely based on the use of EEG, but recently several research groups developed novel approaches to classic BCIs namely hybrid BCIs (hBCI). A hBCI combines a BCI system with various other types of signals and/or devices. Thus, a hBCI may represent a combination of a classic BCI with one of the following systems: another BCI; a device that uses other types of biosignals such as EMG (electromyogram), EOG (electrooculogram) or heart rate; or various other input devices such as eye-trackers used to record eye movements or Leap Motion which can be used to track hand gestures, etc. (Allison, 2012).

Research on hBCIs lead to combinations of two BCIs, such as: EEG-ERD (Event Related Desynchronization) and EEG-SSVEP (Steady State Visually Evoked Potential) (Allison, 2010) or EEG-P300 potentials and EEG-SSVEP (Edlinger, 2011). Also, there are reported combinations of EEG and EMG (Leeb, 2011) or BCI and eye gaze (Zander, 2010). Eye movements have been widely used in various applications, for monitoring and identification of specific actions performed by users, or as a control signal to guide a wheelchair for disabled people or for navigation in virtual environments (Wijesoma, 2005).

Eye movements represent both the voluntary and involuntary movements of the eyes which are used to acquire, fix and track various visual stimuli. Multiple methods have been used so far to track and identify eye movements, among which can be mentioned video processing, magnetic coils or EOG (van der Geest, 2002).

Technology advances rapidly every year and it offers new and improved equipment and applications. However, not all technology is going to be accepted and should first be evaluated in terms of usability and ease of use. The technology acceptance model - TAM (Davis, 1989) is one of the most popular tools used in research to assess the users' perception of new technology.

In this paper a hBCI that uses eye movements and EEG-P300 potentials to navigate an instruction manual is proposed. The input methods work in a synchronous manner, based on eye movements the use can select the main commands of the application, while the EEG-P300 potentials are used to enter a text to be searched within the content of the manual. A series of experiments were conducted to identify both objective and subjective information related to the use of such an interface, in this paper being presented the subjective data obtained based on the TAM subjective questionnaire.

2 Architecture of the Hybrid Brain-Computer Interface

The proposed hBCI (entitled *Brainspace*) uses the movements of the eyes and biopotentials acquired from the users' scalp to navigate an instruction manual. The hardware architecture used in the application is presented in Figure 1. The architecture of the hBCI includes a g.Nautilus biosignal amplifier for electroencephalography signal acquisition and a Tobii X120 for eye movements recording. The application uses the two input methods in a sequential manner, the eye movements are used to navigate the main functions of the application, namely zoom in/out, next page, previous page, direct selection from the short content menu, go to home – first page and open the search window – P300 search) while the EEG-P300 potentials are used to enter a text to be searched within the instruction manual (Figure 2).

Based on the proprietary SDK available for Tobii X120, the eye movements performed by the user are recorded and transformed by the hBCI application into navigation commands. A command can be easily selected only by gazing at it. In order to avoid unintended selections, which can be performed when the user is only rapidly gazing at a button but without the intention the actually select it, a command is activated after the user gazes at a specific button for at least 2.5 s. Thus, each time the user gazes at a button a preactivation timer starts and activates the command only after the interval expires. In the case when the user changes the gaze from the preactivated button the timer resets and no command is selected.

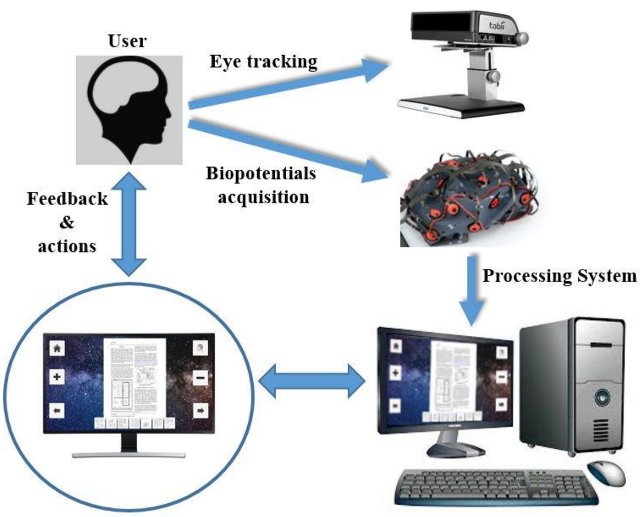

Figure 1. Hardware Architecture of the Brainspace Hybrid Human-Machine Interface for Instruction Manual Navigation

The EEG-P300 potentials are used to enter a text to be searched within the instruction manual. When a user decides to activate the virtual keyboard the P300 speller's items start flashing, thus allowing the user to select character by character the text to be searched in the manual. The proposed hBCI uses the row-column paradigm (RCP) which organizes the items as groups of rows and columns. Each flash assumes the highlight of a row or a column for an interval of 62.5 ms, while a short interval of 48 ms during which no items are highlighted is introduced between two consecutive flashes. Each row and column are flashed 10 times, resulting a total of 20 flashes for each item since each item belongs in the same time to a row and a column. By mentally counting each time an item flashes and focusing on it's position in the virtual keyboard, the P300 potentials should appear within the recorded EEG and the classification algorithm will determine which item is the one selected by the user. Counting helps the participants to remain focused on the given task.

The EEG data is recorded by the g.Nautilus device which features 16 channels, however only eight electrodes are used in this application. The electrodes are placed on the user's scalp at locations Fz, Cz, P3, Pz, P4, PO7, Oz, PO8 according to the 10-20 International System. The g.Nautilus device acquires the EEG signals with a sampling rate of 250 Hz, with a bandpass filter of 2-30 Hz and a notch filter at 50 Hz. The processing unit buffers the acquired data of each flash using 800 ms of the EEG signal starting from the moment when it was highlighted. Initially, each user performs a short P300 copy spelling session during which he/she is requested to spell the word FLOW with no feedback regarding the performed selections. The calibration data is acquired, and all the 800 ms trial epochs are used to determine the weighting parameters for the Support Vector Machine (SVM) classification algorithm. During the evaluation phase the procedure is similar, but the algorithm will select based on the previous obtained parameters the character/instruction (Figure 2) having the highest sum of the weighted coefficients.

3 Technology Acceptance of the Hybrid Brain-Computer Interface

3.1 Participants

Ten healthy subjects (8 men, 2 women; mean age = 22.9 ± 4.08 (SD); range 19-31) participated in the experiment. None of the subjects had previous experience with hybrid BCIs, and none reported any mental or physical disorders. Participation was voluntary, with no monetary compensation. All subjects gave an informed consent after they received information regarding the scope of the experiment and its procedure.

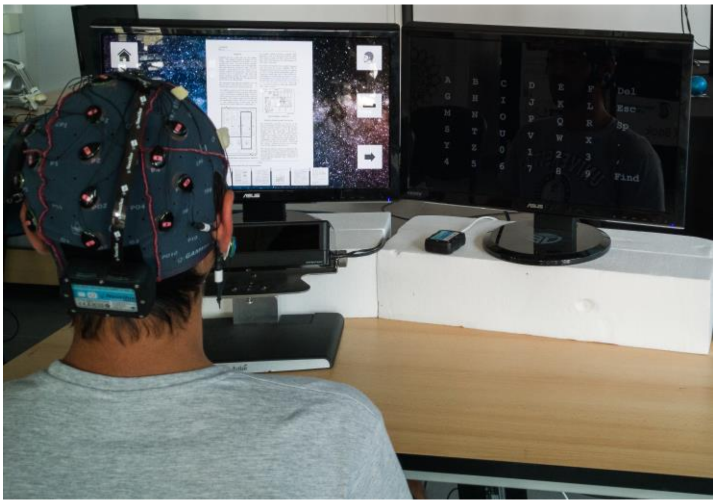

Figure 2. Experimental Setup of the Instruction Manual Application

3.2 Experimental Design and Procedure

The experiment consists of three phases: system calibration, task familiarization and evaluation. During the first phase the participant is informed about the scope of the experiment, the procedure and then calibration data are acquired. The second phase consists of a series of training tasks which aim to familiarize the user with all the functionalities of the application. Once the participant is confident in using the hybrid application, he is required to perform an evaluation task which consists of a series of complex mixed eye-tracking and EEG selections to navigate through the instruction manual. The operations requested to be performed during the evaluation phase are executed in the following order: select the third page from the short content menu (bottom of the left screen, Figure 2), next page, zoom in, zoom out, previous page, open P300 interface, spell word ISOLATION, select Find command, and choose second entry from the results. Following the experiments, the average accuracy rate obtained by the participants was of 92%, while all the selections based on eye movements were correctly performed by all users.

After the experiment was completed each participant was asked to evaluate the application by completing the TAM questionnaire.

3.3 Technology Acceptance Model Questionnaire and Results

The TAM questionnaire (Davis, 1989) in its original form contains two constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEoU). PU is the determining factor in evaluating the acceptance of a technology, while PEoU has a smaller effect with a direct and indirect influence on the intention to use a prototype. Perceived usefulness and ease of use are distinct parameters, but in an interdependent relationship.

Improvements to the PEoU can help improve performance. Because improved performance defines perceived usability that is equivalent to short-term usability, ease of use would have a direct, positive effect on perceived short-term usability. It should be borne in mind that perceived usefulness and ease of use are subjective assessments of people's performance and effort and do not necessarily reflect the objective reality.

The TAM questionnaire is used to assess the users' perception of the system, as well as their intention to use the system in the future. For questions 1-12 of the TAM questionnaire participants provided answers on a 7-point Likert scale, where 1 means "Completely disagree" and 7 represents "Completely agree". The first 6 items correspond to the PEoU construct, and the following 6 define the PU construct.

A statistical analysis was performed on the averages obtained for each item in the survey under PEoU and PU constructs. Constructs with a Cronbach's alpha value above 0.6 can be regarded as reliable (Hair, 2010). The reliability of the scales was confirmed as the values for Cronbach's alpha were above 0.6, more specifically 0.68 for PEoU and 0.79 for PU. A linear regression analysis was applied to reveal the correlations between PU and PEoU. The inter-correlations among PEoU and PU were found to be significant ($\beta = 0.87$, $p < 0.05$), therefore suggesting that the usefulness of the proposed application can be predicted by the perceived ease of use. The positive influence of PEoU on PU is supported by most studies, therefore implying that for a technology to be found useful it should first be perceived as easy to use.

Table 1 TAM Questionnaire and Results

No.	Item	Mean	SD
1	I find the Brainspace system easy to use	5.7	0.78
2	Using the Brainspace system does not require a lot of mental effort	5.8	0.75
3	I find it easy to control the Brainspace system	5.8	0.87
4	My interaction with the Brainspace system was clear and understandable	5.6	0.49
5	Given the knowledge and abilities required for using the Brainspace system, I found it easy to use it	5.8	0.75
6	Overall, I find it easy to get the system to do what I want it to do	5.9	0.83
7	By using the Brainspace system I was able to safely perform the tasks	6	0.77
8	I think the Brainspace system is useful for browsing a manual	6	0.77
9	I have the skills and knowledge to use the Brainspace system	6	1.00
10	The multimodal interface of the Brainspace system seems appropriate for navigating a manual	5.8	1.25
11	I feel motivated by the training tasks to develop the skills needed to use the Brainspace system (for example, the selection of the buttons with the eyes, the counting of the sequences of flashes of the characters, etc.)	6.1	0.70
12	Overall, the Brainspace system seems useful to me	6.3	0.64

4 Conclusions

The proposed hybrid brain-computer interface for instruction manual browsing was evaluated by using the technology acceptance model questionnaire. The subjective data from ten participants was analyzed for consistency and correlations. PEoU was found to significantly influence PU, which is in line with the literature. The findings are encouraging as the users expressed high levels of interest towards the proposed interaction paradigm. In conclusion, it can be stated that the alternative input methods used in the present study can be used with success in various types of application for content navigation.

Acknowledgements

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References

Allison, B. Z., Brunner, C., Kaiser, V., Muller-Putz, G. R., Neuper, C., Pfurtscheller, G. (2010): Toward a hybrid brain–computer interface based on imagined movement and visual attention. *Journal of Neural Engineering* 7, 2, pp. 9.

Allison, B. Z., Leeb, R., Brunner, C., Muller-Putz, G. R., Bauernfeind, G., Kelly, J. W., Neuper, C. (2012): Toward smarter BCIs: extending BCIs through hybridization and intelligent control. *Journal of Neural Engineering* 9, 1, pp. 7.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use and user acceptanceof information technology. MIS Q. 13 (3), 319–339, http://dx.doi.org/10.72307/249008

Edlinger, G., Holzner, C., Guger, C. (2011): A hybrid brain–computer interface for smart home control. *International Conference on Human-Computer Interaction*. Springer, Berlin, Heidelberg, 417-426.

Hair Jr, J. F., Black, W. C., Babin, B. J., Anderson, R. E. (2010): Multivariate data analysis. *Vectors, 7th Edition*.

Leeb, R., Sagha, H., Chavarriaga, R., del R Millán, J. (2011): A hybrid brain–computer interface based on the fusion of electroencephalographic and electromyographic activities. *Journal of Neural Engineering* 8, 2.

van der Geest, J. N., & Frens, M. A. (2002): Recording eye movements with video-oculography and scleral search coils: a direct comparison of two methods. *Journal of Neuroscience Methods* 114, 2, 185-195.

Wijesoma, W. S., Wee, K. S., Wee, O. C., Balasuriya, A. P., San, K. T., Soon, K. K. (2005): EOG based control of mobile assistive platforms for the severely disabled. *2005 IEEE International Conference on Robotics and Biomimetics-ROBIO* 490-494.

Zander, T. O., Gaertner, M., Kothe, C., & Vilimek, R. (2010): Combining eye gaze input with a brain–computer interface for touchless human–computer interaction. *International. Journal of Human–Computer Interaction* 27, 1, 38-51.

Usability Assessment of a Multimodal Hybrid Interface for Robotic Arm Command

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Abstract

This paper presents the usability assessment of a multimodal hybrid interface (MHI) that allows robotic arm manipulation based on movements of the eyes, the EEG biopotentials and hand gestures performed by the user. The key advantage of the proposed MHI is that it allows users to manipulate objects in a controlled environment using a 6-DOF Jaco robotic arm through a minimalist series of actions. The usability of the proposed MHI interface was evaluated by conducting a series of trials with subjects carrying out a standard robotic arm pick and place operation. The architecture of the MHI prototype includes a g.Nautilus biosignal amplifier with g.Sahara dry electrodes for electroencephalography (EEG) signal acquisition, Tobii X120 for gaze tracking and a Leap Motion controller for hand movements and gestures recognition. To assess the usability of the system the participants were asked to complete the System Usability Scale (SUS) 10 items questionnaire. The results showed an above average SUS score, the participants managing to successfully complete the required tasks. Such an interface could be used in the training of operators for remote robotic manipulation tasks.

Keywords: Multimodal hybrid interface, System usability, Robot Command

1 Introduction

Human-robot interaction requires knowledge regarding communication as well as performing mechanical processes (for example pressing buttons on the joystick). The interaction between the human cognitive system and the robotic system is achieved through the equipment and interaction techniques provided by the robotic system manufacturer (in most cases the joystick can also be used). One factor that leads to the increase of the cognitive effort of the current human-robot interfaces is the mismatch between the data transmitted through the interaction equipment and the perception of the actions in the working environment of the robot. Therefore, the user must mentally transform the necessary actions. These mental transformations can lead to an increase in the difficulty of performing a certain task especially during the learning process or to a decrease in productivity.

Multimodal interfaces offer a possible solution to the problems of the current human-interface because they allow the creation of different ways of accessing and transmitting the information to the robot by using several communication channels and, therefore, allow the decreasing in mental effort for the robotic operator.

Previous research has shown that multimodal interfaces represents the optimal solution for generating complex commands to control a device (Kumari, 2017). There are many research studies focused on multimodal hybrid interfaces (MHIs) for interaction with external devices, such as robotic arms, that are designed to help people with disabilities, but also for healthy ones. In (Achic, 2016), a brain computer interface (BCI) system for wheelchair navigation and robotic arm control through electroencephalography (EEG) signals was proposed. It was based on Steady State

Visually Evoked Potentials (SSVEP) generated by 4 LED modules of 1.0 W and 4000 mdc each. The LED modules had different colors (blue, red, yellow and green) and users could sequentially control the robotic arm or the wheelchair. A similar system used only for navigation tasks was presented in (Müller, 2015). EOG (electrooculography) was combined with EEG (event related potentials, like P300) for an assistive interface to help people with motor disabilities in daily tasks. Another BCI system used in rehabilitation robotics are highlighted in (Simonetti, 2016) and (Fall, 2018).

Healthy subjects were selected in (Chen, 2018a) to control a robotic arm using non-invasive 15-target SSVEP-based BCI system in order to realize moving, grasping and lifting tasks. A combination of SSVEP-based BCI and computer vision for object identification in the workspace was used to control a robotic arm for pick and place tasks (Chen, 2018b). Pick and place tasks were also performed in (Hortal, 2015) by combining EOG with EEG. In (Bastos-Filho, 2018) another system that combines SSVEP and modulated attention was used to control a robotic wheelchair. The presented studies demonstrate that a multimodal approach facilitates ease in the interaction with devices, improves the control performance, ensuring a more natural interface.

This paper explores how multimodal hybrid interface allow robotic arm manipulation based on the movements of eyes, the EEG-SSVEP biopotentials and hand gestures performed by the user. MHI can be used to enhance training for operators for remote robotic manipulation tasks. The main advantage of the proposed interface is that it allows users to manipulate objects in a controlled environment by using a 6-DOF Jaco robotic arm through a minimalist series of actions. In this paper, we specifically focus on the usability assessment of the MHI interface.

2 Architecture of the Multimodal Hybrid Interface

The hardware architecture shown in Figure 1 is used in the application for the control of a robotic arm through the biopotentials, the movement of the eyes and the gestures performed by the user. The user will have the possibility to select and manipulate objects using a robotic arm based on movements of the eyes, the EEG-SSVEP biopotentials and hand gestures. The architecture of the MHI prototype includes a g.Nautilus biosignal amplifier with g.Sahara dry electrodes for electroencephalography signal acquisition, Tobii X120 for gaze tracking and a Leap Motion controller for hand movements and gestures recognition. A webcam is used to video stream the robotic arm working environment on a computer monitor, the users being able to select an object from the scene by using an identification method based on the eye-tracking and biopotentials. The image processing module detects objects of interest selected by the user, through the OpenCV image processing library.

In order to make straightforward interaction between the user and the robotic Jaco arm, a visual interface for selecting objects from the working environment through SSVEP potentials has been proposed.

The user's eye movements information is received from Tobii X120 through its proprietary SDK software library. Based on the acquired information the application identifies whether the user's attention is focused on the monitor. The SSVEP flashing frequencies are only activated when the user is gazing at the monitor, therefore avoiding random selections of objects in the working scene. Another important reason for disabling the flashing icons is to allow the user to concentrate on the manipulation task, as the flickering can become disturbing.

SSVEP flashing on and off sequences will be automatically generated to highlight the locations of the objects identified from the video stream (Figure 2). The canonical correlation analysis (CCA) (Lin, 2006) is applied to analyze the frequency components of the SSVEP potentials in the EEG signal. By simply following these elements, the user is able to select one of the objects found in the working space and the robot arm is automatically positioned at the object location (the shape and location being known in the developed process of the robotic application).

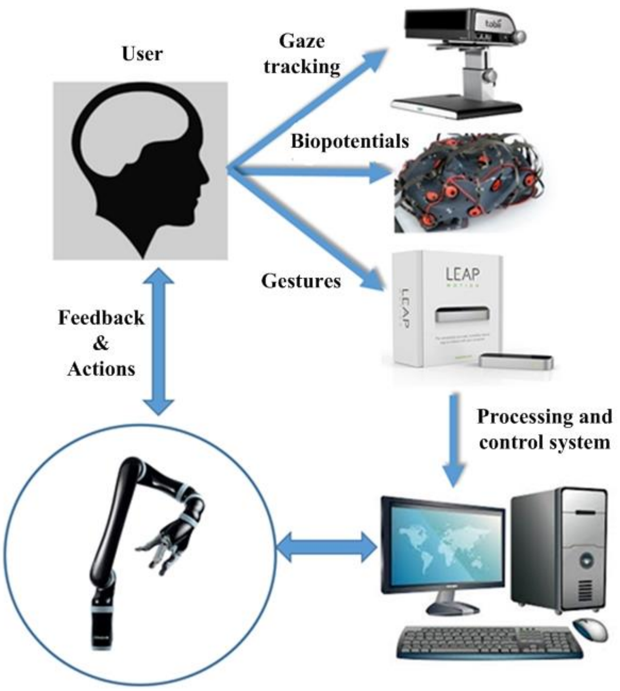

Figure 1. The Architecture of the Human-Machine Hybrid Interface for Robotic Arm Command

The user can manipulate the Jaco robotic arm by translating/rotating the right hand on the X, Y or Z axis. Grasping and releasing of an object is performed by closing and opening the right hand. The generation of the robotic arm movement commands is based on the Leap Motion SDK and Kinova SDK (Gîrbacia, 2019).

Figure 2. Components of the Hybrid Multimodal Interface

3 Usability Evaluation of the Multimodal Hybrid Interface

3.1 Participants

Seven healthy subjects participated in this study (6 men, 1 female, mean age = 24.43 ± 5.04 (SD), range 19-32). None of the subjects had any previous experience with BCI applications. Each participant gave informed consent prior to the experiment which took place in a controlled environment at the university.

3.2 Experimental Design and Procedure

The usability of the proposed MHI was evaluated by conducting a series of trials with subjects carrying out a standard robotic arm pick and place operation. The users initially had the opportunity to familiarize and use the MHI several times before the evaluation was carried out. They were familiarized with manipulating objects with the help of the Leap Motion controller and had the opportunity to repeat the robotic arm manipulation operation. Also, they performed a series of selections based on SSVEP to familiarize with this selection paradigm. After conducting the training scenarios, each user was requested to perform a series of evaluation tests through which the usefulness and robustness of the developed system was determined.

The steps performed by the users during the evaluation experiment were the following: (i) object selection based on EEG-SSVEP potentials followed by the automatic positioning of the robotic arm in the location of the selected object; (ii) grasping, manipulating and releasing of the object by using the Leap Motion controller. Each user repeated the action until he or she performed a total of 9 trials.

3.3 System Usability Scale Questionnaire and Results

The SUS was developed in 1986 by John Brooke (Brooke, 1996). It provides a quick and reliable tool that can be used to measure people's subjective perception regarding the usability of a system (Brooke, 2013). The standard SUS consists of ten items that are presented to the participants as 5-point scales, where 1 stands for "Strongly disagree" and 5 is for "Strongly agree". In the unlikely situation when a participant fails to respond to an item it will be assigned a 3 (which stands for neutral).

Table 1 System Usability Scale Questionnaire (Brooke, 1996)

No.	**Question**	Mean	Mean SUS
1	I think that I would like to use this system frequently	4.00	3.00
2	I found the system unnecessarily complex.	1.71	3.29
3	I thought the system was easy to use.	4.43	3.43
4	I think that I would need the support of a technical person to be able to use this system.	2.57	2.43
5	I found the various functions in this system were well integrated.	4.43	3.43
6	I thought there was too much inconsistency in this system.	1.43	3.57
7	I would imagine that most people would learn to use this system very quickly.	4.29	3.29
8	I found the system very cumbersome to use.	1.71	3.29
9	I felt very confident using the system.	4.14	3.14
10	I needed to learn a lot of things before I could get going with this system.	1.71	3.29
		Final SUS score	**80.40**

The interpretation of the results requires processing the data in order to obtain a score range from 0 to 100, with 2.5-point increments. The first step is to obtain each item's rating, which will transform the scores ranging from 1 to 5 into a new interval ranging from 0 to 4. To determine the score contribution for the positive items (1, 3, 5, 7 and 9), we need to subtract 1 from the participant's rating, while for the negative items (2, 4, 6, 8 and 10) the score contribution is 5 minus the participant's rating. Finally, the sum of all the items score is multiplied by 2.5. A high SUS score indicates a high perceived usability.

Products that score less than 50 are considered unacceptable and require significant changes. The next category includes products with SUS scores between 50 and 70 and is considered marginal acceptable, while products with SUS scores of above 70 are acceptable (Bangor, 2008). In this study, the mean SUS score for the 7 participants was of 80.40 and indicates that the multimodal hybrid interface for robotic arm command was generally perceived to be acceptable.

The averages for each of the 10 SUS items are presented in Figure 3. The values from the questionnaires are illustrated after calculating the SUS score according to the previously described method. The graphical representation is useful to visually observe the trends and averages for each item.

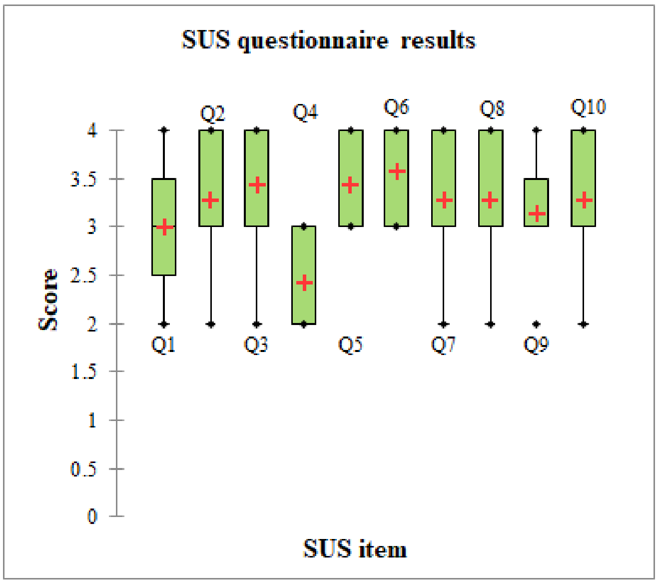

Figure 3 System usability scale questionnaire results

According to the obtained experimental data, users have generally managed to successfully make object selections through SSVEP potentials, obtaining an average of 8.57 correct selections and an average accuracy of 95.24%. Also, from the point of view of manipulating the objects with the help of Leap Motion and of the robotic arm, the users managed to correctly position the objects with an average of 8.43 out of 9, respectively an average accuracy of 93.65%.

According to the adjective rating scale defined in (Bangor, 2009) the application is between good and excellent. The participants didn't find the system too complex and reported that it was relatively easy to use it with the help of a technical person. The functions were well integrated, as a result the participants did not find any major inconsistency. The proposed natural interface does not require a large amount of new knowledge, therefore, most people would easily be able to learn how to use the system.

4 Conclusions

According to the results of the SUS evaluation, it can be concluded that the multimodal hybrid control interface for robotic arm command is robust and offers consistency throughout the operation. Even though the application is easy to use, it requires an initial assistance from a supervisor to learn the functionalities and to become familiar with the multimodal interaction interface. The proposed solution could be used in training operators for remote robotic manipulation tasks.

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References

Achic, F., Montero, J., Penaloza, C., Cuellar, F. (2016): Hybrid BCI system to operate an electric wheelchair and a robotic arm for navigation and manipulation tasks. *2016 IEEE Workshop on Advanced Robotics and its Social Impacts (ARSO)*, Shanghai, China, 249-254.

Bangor, A., Kortum, P. and Miller, J. (2009): Determining what individual SUS scores mean: Adding an adjective rating scale. Journal of usability studies 4,3, 114-123.

Bangor, A., Kortum, P. T. and Miller, J. T. (2008): An empirical evaluation of the system usability scale. Intl. Journal of Human–Computer Interaction, 24, 6, 574-594.

Bastos-Filho, T., Floriano, A., Couto, E., Godinez-Tello, R.J.M. (2018): Towards a system to command a robotic wheelchair based on independent SSVEP–BCI. In: Diez, P. (Ed.): *Smart Wheelchairs and Brain-Computer Interfaces*, Academic Press, 369-379.

Brooke, J. (1996): SUS-A quick and dirty usability scale. Usability evaluation in industry 189, 194, 4-7.

Brooke, J. (2013): SUS: a retrospective. Journal of usability studies, 8, 2, 29-40.

Chen, X., Zhao, B., Wang, Y., Xu, S., Gao, X. (2018a): Control of a 7-DOF Robotic Arm System With an SSVEP-Based BCI, *Int J Neural Syst.*, *28*, 8, 1850018.

Chen, X., Zhao, B., Wang, Y., Gao, X. (2018b): Combination of high-frequency SSVEP-based BCI and computer vision for controlling a robotic arm. *Journal of Neural Engineering*, *16*, 2, 1-15.

Fall, C.L., Quevillon, F., Campeau-Lecours, A., Latour, S., Blouin, M., Gosselin, C., and Gosselin, B. (2018): A multimodal adaptive wireless control interface for people with upper-body disabilities. *IEEE Transactions On Biomedical Circuits And Systems*, *12,* 3, 564-575.

Gîrbacia F., Postelnicu C., Voinea GD. (2019): Towards Using Natural User Interfaces for Robotic Arm Manipulation. In: Berns K., Görges D. (eds): Advances in Service and Industrial Robotics. RAAD 2019. Advances in Intelligent Systems and Computing, vol 980. Springer, Cham.

Hortal, E., Iáñez, E., Úbeda, A., Perez-Vidal, C., Azorín, J. M. (2015): Combining a Brain–Machine Interface and an Electrooculography Interface to perform pick and place tasks with a robotic arm, *Robotics and Autonomous Systems*, *72*, 181-188.

Kumari, P., Mathew, L., Syal, P. (2017): Increasing trend of wearables and multimodal interface for human activity monitoring: A review, *Biosensors and Bioelectronics*, *90*, 298–307.

Lin, Z., Zhang C., Wu, W. and X. Gao (2006): Frequency recognition based on canonical correlation analysis for SSVEP-based BCIS, IEEE Transactions on Biomedical Engineering *53*, 12, 2610–2614.

Ma, J., Zhang, Y., Cichocki, A., Matsuno, F. (2015): A Novel EOG/EEG Hybrid Human–Machine Interface Adopting Eye Movements and ERPs: Application to Robot Control. *IEEE Transactions on Biomedical Engineering*, *62*, 3, 876-89.

Müller, S.M.T., Diez, P.F., Bastos-Filho, T.F., Sarcinelli-Filho, M., Mut, V., Laciar, E., Avila, E. (2015): Robotic Wheelchair Commanded by People with Disabilities Using Low/High-Frequency SSVEP-based BCI. In: D.A. Jaffray (Ed.): *Proceedings of the World Congress on Medical Physics and Biomedical Engineering*, Toronto, Canada, Cham: Springer International Publishing, 1177-1180.

Simonetti, D., Zollo, L., Papaleo, E., Carpino, G., Guglielmelli, E. (2016): Multimodal adaptive interfaces for 3D robot-mediated upper limb neuro-rehabilitation: An overview of bio-cooperative systems. *Robotics and Autonomous Systems*, *85*, 62-72.

E-learning as a Service: Benefits of the Semantic Web and SOA for Virtual Learning

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Abstract

Despite a growing body of literature in the field, several challenges in designing open educational systems still remain. To achieve desiderata such as openness and flexibility, e-learning systems often make use of the semantic web and service oriented architecture (SOA) design principles. This paper offers a brief review of guidelines, standards, tools, and software solutions for the development of semantic web-based e-learning applications or platforms. Potential benefits of integrating additional, less commonly used models and tools are also discussed.

Keywords: e-learning, semantic web, service-oriented architecture, smart learning environment

1. Introduction

As the increasing complexity of e-learning systems warrants a modular, service-oriented approach, recent endeavors to develop smart learning environments (SLEs) share the cardinal goal of interoperability. Additionally, because interoperability calls for standardization, the educational technology community is in need of clearly defined and comprehensive ontologies to model learning knowledge (Hoel and Mason, 2018). These objectives are achievable via the *Service-Oriented Architecture* (*SOA*) and the *semantic web*.

Modular design based on reusable components is a trend that has long been governing software development. SOA provides a framework for smooth transition and seamless integration of such components. Two reusability issues SOA addresses are (1) *technological advancements* (upgrades, migration) and (2) *technological diversity* among developers. SOA enables implementation changes to software components (services) that do not affect the interactions of those components with other services, and interoperability between software components developed using different programming languages, on different infrastructures. In short, platform-independent functionality.

Semantic web enhances web services by enabling service discovery and composition based on meaning of the focal concepts and on their place in nomological networks. Among other benefits, ontologies and reasoning enable service matchmaking based on semantic similarity between a search template and candidate services (Verma et al., 2007).

By using semantic web and SOA, different web applications can communicate not only objects, but also functions. And, in this way, it will be possible to reach the stage where the development of a virtual learning software application consisted practically not in the creation, but in the combination of pre-existing functionalities (offered by other systems or applications) in a particular way, depending on the needs of the developer (Dagger et al., 2007).

The opportunity of the semantic web and SOA in education arises from the high dynamics of the field (warranting designs that facilitate changes), as well as from the need to align (i.e., provide a common vocabulary for) learner knowledge and skills, teaching and training prerequisites and outcomes, and job specifications in a globalized market and society.

Thus, if a first generation of e-learning platforms (ca. 1993-1999) were monolithic, black box, oftentimes proprietary solutions, the current solutions are modular, seeking to integrate exposed functionalities offered by external services, and move toward a separation and further refinement of content and administrative concerns (Dagger et al., 2007).

2. General Guidelines and Evaluation Frameworks

Various institutions and consortia provide guidelines, principles, best practices, etc. for e-learning developers. Some address administrative aspects, others focus on content, and others cover both in more general views.

2.1. Administration Guidelines

Avgeriou et al. (2001) recommended that learning management systems should integrate the following administrative functionalities:

- Course management (creation, customization, administration and follow-up of courses);
- Class management (management of users, groups, assignments, etc.);
- Communication tools (synchronous or asynchronous);
- Learning tools (which provide support for student browsing and resource management);
- School management (grades, attendence, financial administration, etc.).

A key administrative issue to which many scholars granted particular attention is user modeling. An important clarification related to semantic web-based architectures is that user models can be created either in a decentralized way (i.e., using the distributed system design principles originating in the agent-based systems research) or in centralized fashion (i.e., using a web server). The second variant was considered more appropriate and efficient by Brusilovsky et al. (2005), at least in the case of systems with a component-based architecture in which more than one component "knows" information about a particular user. A user modeling server will gather and integrate information from all components that hold user information and, based on all this information, will create a unique and comprehensive user model. Each component with which the student interacts has the responsibility to send to the user modeling server information about each user action performed on the respective component. The server will thus have two responsibilities: receiving information about the user's actions from all components and sending answers to user-related queries of any of the components, respectively.

2.2. Content

While some authors focus more on user modeling, others turn their attention to domain modeling. An example of this is provided by the *ITS Framework* (*ITS-FW*) developers (Ly and Lelouche, 2006). They have developed a conceptual framework for developing platforms for Intelligent Tutoring Systems (ITSs) so that they are as reusable, flexible, extensible and interoperable as possible. They start from the assumption that there are three types of knowledge that must be modeled in a virtual learning system, to which one of three independent components is associated: Domain Knowledge, *Problem-Solving Knowledge*, and *Tutoring Knowledge*. Each component has its own ontology, hence the need to define an additional component - the *Common Component Interaction* - to define the communication between different components. Suggestions for implementing mappings between ontologies include use of the knowledge adapter in Unified Problem-Solving Method Language (UPML) framework for knowledge-based systems.

Some authors (e.g., Bratsas et al., 2012) believe that true interoperability can be achieved by following the new orientation in the semantic web called the *Linked Data Web*. The Linked Data Web comes with standards for describing web resources so that they are connected not only with their semantic derivatives, but with the whole semantic web. In other words, the data cannot be defined without being included in a certain category (class), and implicitly having the relationships that the objects in that category (class) have with the objects of other categories (classes). Data connection is done via web technologies such as HTTP, RDF and URI. In e-learning, *Semantic Content Management Systems* (*SCMSs*) and *semantic wikis* are solutions for ensuring interoperability by connecting data. SCMSs allow the modeling of the content of the virtual education system in discrete classes, such as Person, Session, Course, etc., each class having a set of properties; wikis are web applications that allow users to collaboratively add, edit, or delete their content. In wikis, it is the user's responsibility to include content in a particular class. Unlike SCMSs, an object can belong to more than one class (Bratsas et al., 2012).

A more synthetic semantic approach, addressing the need to describe teaching content so as to increase the possibilities for reuse, is described in Verbert et al. (2004) and referred to as „global component architecture". It involves identifying categories of components that are valid for any type of resource and sufficient to describe a resource regardless of its type, as well as some categories of relationships that cover any possible relationship between any two components of any type (separation of structure from content). According to this vision, the structure of any resource in the field of virtual education is as follows: *content fragments* (which can be of several types, that may be defined using the Darwin Information Typing Architecture [DITA]); *content objects* (formed by aggregating content fragments), and *learning objects* (formed by aggregating content objects and adding an objective).

2.3. High-Level Recommendations

We mention that some researchers consider semantic sharing insufficient to achieve the objective of interoperability, recommending the development of tools that enable the identification and dynamic semantic mapping (Dagger et al., 2007; Naeve et al., 2005). In addition, semantic exchanges should not be limited to data flows but also to control flows (Dagger et al., 2007). Metadata should be written in more "human" formats to support users' autonomy in searching, accessing and using resources (Naeve et al., 2005). Also, it would be advisable to divide the architecture of web-based educational systems into *Learning Content Management Systems* (*LCMSs*) and *Learning Management Systems* (*LMSs*) and to implement communication between each of these two components and agencies for discovering specialized web services (in search of contents and in search of administrative resources, respectively), as well as communication between the two components (the "functional model") (Liu et al., 2003).

Other general recommendations worth mentioning are the IMS Global Learning Consortium (2001-2019) accessibility specifications, which include the following:

- Allowing user preference-based personalization
- Allowing user preference-based access to multimedia content
- Ensuring compatibility with assistive technologies and full keyboard access
- Providing context and orientation information
- Following as many relevant specifications as possible
- Using XML.

Finally, a design suggestion for SOA-based educational systems (Merriman et al., 2016) is to have an Enterprise Infrastructure System (EIS), specifying the abstract service suite it requires for the educational activities it is meant support (such as course management, assessment, messaging, etc.), as a backbone, and a selection of educational applications providing the concrete services that implement the desired functionalities.

2.4. The E-Learning Framework

Perhaps the most comprehensive framework for the development and evaluation of web-based learning systems is Badrul Khan's E-Learning Framework (Khan, 2012). It covers in detail a plethora of aspects from pedagogical and technological, to ethical and institutional issues. The interested reader is refered to the author's website (http://asianvu.com/bk/framework/), where a wide range of resources addressed to a diverse audience comprising the majority of the stakeholders in the education domain can be found.

3. Interoperability Standards and Tools

Interoperability creates the need for conceptual standardization and consistency, such that different instruction activities (e.g., teaching and assessment), different educators/instruction providers and employers can exhange information regarding, e.g., learning objectives, competences and competence levels, etc.

SOAs for learning environments benefit from efforts on the part of several institutions and consortia (such as the Massachussetts Institute of Technology [MIT], IMS Global or IEEE) to create open specifications.

Several of the oldest and most utilized interoperability standards focused on describing "learning objects". Notable examples are *Learning Object Model* (*LOM*) for metadata, *Dublin Core Metadata,* or *Sharable Content Object Reference Model* (*SCORM*) for encapsulating content units and dynamically accessing and modifying them ("communicating with content"), standards developed by Aviation Instruction CBT Committee (AICC) for content communication or the IMS *Content Packaging* and *Simple Sequencing* standards for encapsulation, describing the learner profile, and describing user registration (Liu et al., 2003; Butucea and Cervinschi, 2011; Bratsas et al., 2012).

Besides these well-known standards, the *Open Service Interface Definitions (OSIDs)* were published by MIT's Open Knowledge Initiative (OKI, 2006-2008). OSIDs are APIs specially created for service composition. They cover both administrative issues (authentication, course management, scheduling, etc.) and pedagogical aspects (e.g., content management, especially for assessment activities).

The IMS Global Learning Consortium (IMS Global Learning Consortium, 2001-2019) provides specifications and REST APIs (such as *Competencies & Academic Standards Exchange – CASE*, and *Learning Tools Interoperability - LTI*) meant to support interoperability between learning management systems.

The IEEE *Standard for Learning Technology-Data Model for Reusable Competency Definitions* is particularly relevant for interoperable competence-based learning systems (IEEE Standards Association, 2007). This standard proposes a model of essential, context-independent competency information. Unlike the other standards mentioned in this section, the IEEE standard is not publicy available. It can be purchased or accessed via subscription to the IEEE Xplore Digial Library.

Last but not least, the ADL *Total Learning Architecture* (*TLA*; Smith et al., 2018) is an ongoing research and developement project which aims to develop specifications for „accessing and making use of learning-related data". TLA can be described as learner-centric, tracking user data across learning activities and using this data to deliver a personalized learning activity flow through specifications such as xAPI. Unlike the previously mentioned specifications, TLA is data-driven and self-organizing (Hoel and Mason, 2018), promoting the use of a recommender system to suggest learning activities based on learner abilities and emotional states.

Reference implementations of some of the aforementioned specifications may be used, analyzed or extended. An example is the Okapia implementation of the OSIDs (Okapia, 2014). Developers should also note that work on specification implementations has been partly disseminated in scientific outlets, therefore simply searching scientific databases for a specific standard or specification using its name may prove insighful.

Finally, for educational technology beneficiaries, it is worth mentioning that, if educational technology developers do not adhere to a certain standard or specification, consumers could request such adherence.

4. Opportunities for Future Research and Practice

In what follows, we outline four promising ways in which existing learning system functionalities may be extended or refined.

4.1. "LMX"

Merriman et al. (2016) proposed a distinct class of educational applications, designed to manage content presentation according to a modeled learning methodology. The authors named the proposed type of service "Learning Method eXperience" (LMX) and suggested a recursive decomposition of the learner screen according to the content units and their organization as imposed by the modeled methodology. Implementations of LMX would offer more flexibility to the instruction process by allowing educators to manipulate teaching and assessment methods so as to achieve desired goals or possibly to adapt to student profiles.

4.2. Fuzzy logic

Another aspect that may be worth more attention that it is currently being given is vagueness. Standard Boolean (crisp) logic for ontological concepts, relationships, and reasoning may be an oversimplification of the educational domain. More realistic models could be obtained by using fuzzy logic (see, e.g., Sangineto et al., 2008), and tools for such an approach already exist. For example, FuzzyDL (Bobillo and Straccia, 2016) extends classical $\mathcal{SHIF}(D)$ DL to fuzzy logic (with concrete fuzzy concepts). It supports translations to OWL and vice-versa and provides a Java API for creating and querying knowledge bases, and is publicly available (but has the Gurobi MILP solver as a dependency, which requires an academic license).

4.3. Data-driven service/system evaluation

For SLEs to increase their „smartness", they should capitalize on the advances in data analytics and data mining and become more data-driven (Hoel and Mason, 2018). The efficiency and effectiveness of resources, components, and of software systems as a whole can be inferred from explicit user feedback (e.g., reviews) and implicit usage data (user interactions with the system) (Maalej et al., 2015). When applied to education, these techniques should be used (and adapted, if necessary) to extract knowledge about pedagogical efficiency and effectiveness.

4.4. Making sense of contexts and interaction modalities

We also suggest that, as the ubiquitous computing paradigm (Quigley, 2018) is rapidly expanding, context-aware multimodal SLEs may also extract pedagogically relevant information from implicit multimodal input data (i.e., context data, both sensed and inferred). What interaction modalities are prefered for what resource and under what conditions, what patterns of multimodal interactions can be identified for a specific resource or system, etc., are questions that may lead to more accurate detection of learning styles and other learner characteristics.

5. Conclusions

For educational technology developers, the service-oriented paradigm brings about the necessity to separate the desired functionalities from their matched concrete implementations. This means that the management component(s) of educational software systems should be designed such that extant candidate web services may fulfill the abstract functional blocks, and educational web services should be designed so as to match the data models of common functional blocks (fig. 1). Adherence to extant relevant standards, as well as continous improvement of extant and, if necessary, development of new standards is also important for developer communities.

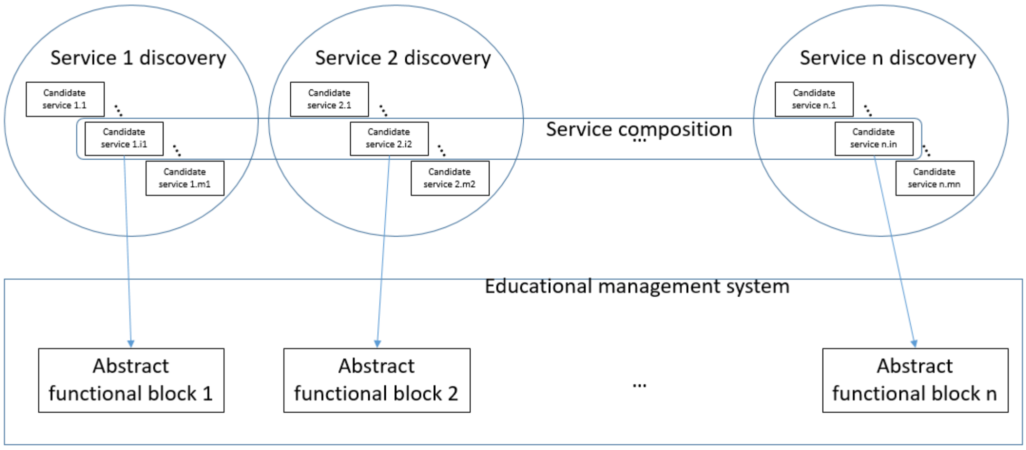

Figure 1. SOA in E-learning

For educators and learners, this trend calls for an increased involvement in educational software analysis and testing. More active teaching/training communities and fora for discussions regarding the expectations and desires instructors and learners have for educational software, as well as their difficulties in using existent software, would also be beneficial, contributing to an informed educational software development.

To conclude with a general future direction, as Hoel and Mason (2018) noticed, more standardization efforts are required to provide guidelines for developing features representing high levels of smartness in learning environments. This process should be informed by the latest developments in fields such as knowledge-based systems, machine learning techniques, and soft computing.

References

Avgeriou, P., Retalis, S., & Skordalakis, M. (2001): An architecture for open learning management systems. In *Proceedings of the Panhellenic Conference on Informatics*, Springer, Berlin, Heidelberg, 183-200.

Bobillo, F., Straccia, U. (2016): The fuzzy ontology reasoner fuzzyDL. *Knowledge-Based Systems 95*, 12-34.

Bratsas, C., Dimou, A., Ioannidis, L., Bamidis, P., Antoniou, I. (2012): Semantic CMS and Wikis as Platforms for Linked Learning. In *Proceedings of the 2nd International Workshop on Learning and Education with the Web of Data*, Lyon, France.

Brusilovsky, P., Sosnovsky, S., Shcherbinina, O. (2005): User Modeling in a Distributed E-learning Architecture. In *User Modeling 2005. Lecture Notes in Artificial Intelligence (Proceedings of 10th International User Modeling Conference)*. Springer-Verlag, Berlin, Heidelberg, 387-391.

Butucea, C., Cervinschi, C. L. (2011): Building Robust E-learning Software Systems Using Web Technologies, *Informatica Economică 15*, 2, 107-118.

Dagger, D., O'Connor, A., Lawless, S., Walsh, E., Wade, V. P. (2007): Service-Oriented E-learning Platforms. From Monolithic Systems to Flexible Services. *IEEE Internet Computing, 11*, 3, 28-35.

Hoel, T., Mason, J. (2018): Standards for smart education–towards a development framework. *Smart Learning Environments, 5*, 3.

IEEE Standards Association (2007): https://standards.ieee.org/content/ieee-standards/en/standard/1484_20_1-2007.html, accessed 2019.

IMS Global Learning Consortium (2001-2019): https://www.imsglobal.org, accessed 2019.

Khan, B. H. (2012): *A framework for e-learning.* http://asianvu.com/bookstoread.com/framework, accessed 2019.

Liu, X., Saddik, A. E., Georganas, N. D. (2003): An implementable architecture of an e-learning system. In *Proceedings of the Canadian Conference on Electrical and Computer Engineering (IEEE CCECE)*, 717-720.

Ly, T. T., Lelouche, R. (2006): Introducing a framework-oriented approach to develop an intelligent tutoring system. In *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications*, Chesapeake, VA: AACE, 775-782.

Maalej, W., Nayebi, M., Johann, T., Ruhe, G. (2015): Toward data-driven requirements engineering. *IEEE Software*, *33*, 1, 48-54.

Merriman, J., Coppeto, T., Santanach Delisau, F., Shaw, C., Aracil Díaz, X. (2016): *Next generation learning architecture*.

Naeve, A., Nilsson, M., Palmér, M., Paulsson, F. (2005): Contributions to a public e-learning platform: Infrastructure; architecture; frameworks; tools. *International Journal of Learning Technology*, *1*, 3, 352-381.

Okapia (2014): https://okapia.atlassian.net/wiki/spaces/OSID/pages/3080194/Maven+Repository, accessed 2019.

Open Knowledge Initiative (2006-2008): http://okicommunity.mit.edu/filemgmt/index.php, accessed 2019.

Quigley, A. (2018): From GUI to UUI: Interfaces for Ubiquitous Computing. In J. Krumm (Ed.): *Ubiquitous Computing Fundamentals*. Chapman and Hall/CRC, 251-298.

Sangineto, E., Capuano, N., Gaeta, M., Micarelli, A. (2008): Adaptive course generation through learning styles representation. *Universal Access in the Information Society, 7*, 1-2, 1-23.

Smith, B., Gallagher, P. S., Shatz, S., Vogel-Walcutt, J. (2018): Total learning architecture: Moving into the future. In *Proceedings of the Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC)*.

Verbert, K., Klerkx, J., Meire, M., Najjar, J., Duval, E. (2004): Towards a global component architecture for learning objects: An ontology based approach. In *OTM Confederated International Conferences "On the Move to Meaningful Internet Systems"*. Springer, Berlin, Heidelberg, 713-722.

Verma, K., Sheth, A., Oundhakar, S., Sivashanmugam, K., Miller, J. (2007): *Allowing the use of Multiple Ontologies for Discovery of Web Services in Federated Registry Environment. Department of Computer Science*. Technical Report: University of Georgia, Athens, Georgia, UGA-CS-LSDIS-TR-07-011.

Section

SOFTWARE SOLUTIONS

Software Solutions (SOFT):

- **New software environments for education & training**
- **Software and management for education**
- **Virtual Reality Applications in Web-based Education**
- **Computer Graphics, Web, VR/AR and mixed-based applications for education & training, business, medicine, industry and other sciences**
- **Multi-agent Technology Applications in WBE and WBT**
- **Streaming Multimedia Applications in Learning**
- **Scientific Web-based Laboratories and Virtual Labs**
- **Software Computing in Virtual Reality and Artificial Intelligence**
- **Avatars and Intelligent Agents**

An E-Learning Application for the Study of Data Compression Based On Delta Transformation

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Abstract

This paper proposes a study on the online learning process of applying Delta transformation, Delta compression and remote file synchronization. The e-learning application was developed in the Matlab R2008b working environment and treats both Delta transformation and Delta compression. For Delta compression, the chosen implementation is original, with a detailed documentation of the algorithm at the level of description and implementation. Because the purpose of the e-learning application is a didactic one, highlighting the mechanisms of operation and interpretation of the algorithms, it was developed the possibility to enter input data from both the keyboard and from text files, as well as the detailed display of the tables for transformation, compression and histograms for the texts used. The category of input data has been restricted to text data because they are the most intuitive and can be easily analyzed. The compression performance obtained is not exceptional, but the role of the application is purely didactic, of study and online learning.

Keywords: Data Compression, Remote File Synchronization, Collaborative Work Systems, E-learning Application, Software Tools, Advanced Web Technologies, Online Management, Virtual Learning Platform, Delta Transformation

1 Introduction

Data compression is an area of interest in information technology, as researchers from the early 20th century, such as Claude E. Shannon, David Huffman, Newton Faller, Michael Burrows, have contributed to the development of compression algorithms. The need for data compression comes from the natural tendency towards communication speed and storage efficiency. The limitations imposed by the transmission media with regard to the transfer rate, the physical restrictions, as well as those brought by the storage media have led to detailed studies in this field (Saywood, 2003; Salomon, 2007; Rădescu, 2003).

The developed algorithms have been implemented under various programming languages (MSDN, 2019), with optimizations for working with different file types. In general, real-time applications generate a large amount of data, and transmitting them to a network can pose major problems in terms of network efficiency (Suel et al, 2001).

The compromise accepted by these methods appears in the computing power because the compressed data must be decompressed to the recipient, often in real time. However, technological advances in computing power are far more noticeable than those in the transmission media, for example, so this tradeoff becomes far too insignificant compared to the compression advantages. Also, in the case of using a compressed file in a program, although the execution instructions are multiplied by the introduction of the coding and decoding ones, the calls to the hard disk are significantly reduced, calls that are much slower, which eventually leads to increasing the execution speed of the program.

1.1 Paper Contributions

The main purpose of the present paper is to illustrate in a didactic purpose the principles of applying Delta transformation and Delta compression to use the benefits of text compression in collaborative working systems and remote file synchronization. The paper deals with these two methods of transformation and compression from the perspective of integrating their methodology and results into an e-learning system, offering some details of the implementation process: transformation and compression tables, histograms associated with the processed texts. The algorithms implemented are not optimal as they are restrictive as to the type of input data or the size of the resulting files. The execution time is a good one and the computing power is not a problem in this regard. In order to optimize the execution time, the reallocation of resources was performed before the loop instructions in which the variable could increase. Matlab provides fast data processing instructions, which have made the algorithms even more efficient (Matlab, 2019).

2 Delta Transformation

Delta transformation (MacDonald, 2001; Trendafilov et al, 2002; Soroiu, 2003; Microsoft, 2004; Delta, 2019) meets the following conditions:

- The complexity order of the transformation algorithm is as small as possible;
- The length of the symbol string obtained after applying the transformation is as small as possible (most often the length of the symbol string obtained after applying a transformation is greater than or equal to the length of the initial string);
- The length of the symbol string obtained after the application of a compression algorithm on the result of the transformation is, in most cases, less than or equal to the length of the symbol string obtained after applying the same compression algorithm on the non-transformed string;
- The transformation is reversible.

The Delta transformation does not lead to loss of information after its application and is a method that can be used to make data more compressible without losing information.

For an entropic (statistical) compression algorithm, a string of symbols generated by an information source is better compressed (becomes more compressible) if its entropy decreases as a result of a transformation.

The data source alphabet is not limited to a certain number of symbols, as is the case with some methods that use special characters to transmit various signals; the current implementation compresses ASCII text, but can also be modified and used for Unicode type compression (Calgary, 2019; Gutenberg, 2019).

3 Delta Compression and Decompression

Compression techniques are widely used in computer networks and data storage systems to increase the efficiency of data transfers and reduce space requirements on the receiving device. Most techniques focus on the problem of compressing individual files or data streams of a certain type (text, images, audio). However, in today’s network-based environment it is often the case that files and content are widely replicated, frequently modified, and cut and reassembled in different contexts and packaging.

The process of Delta compression and decompression (Saywood, 2003; Salomon, 2007) based on Delta transformation is summarized in the diagram depicted in Figure 1.

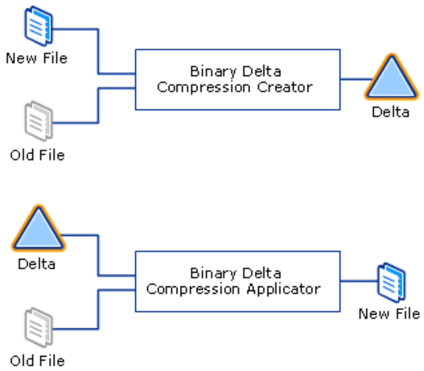


Figure 1. The binary Delta compression and decompression

4 The E-Learning Application

In the following, the structure of the application, the menus and the way of use will be presented. As it is an application made in Matlab R2008b, it requires the previous installation of the software offered by MathWorks (Matlab, 2019). All files must be in the same directory, and this must be in the working directories of Matlab (MSDN, 2019).

The main menu contains three buttons that open the applications that deal with three situations: delta transforming with data from the keyboard, delta transforming with data entered from a text file and deletion compression, as can be seen in Fig. 2.

Figure 2. The main menu of the application

4.1 Delta Transformation with Keyboard Input Data

The application for Delta transformation with input data from the keyboard has the menu represented in Fig. 3.

In the input field, write the text that you want to be transformed into Delta, and when you press the Enter key the input alphabet and the number of letters in this alphabet will be calculated automatically, as shown in Fig. 4.

In order to give an idea of the distribution of characters in the given text, one can use a histogram, which shows the probability of the appearance of the characters in the given source.

To apply the Delta transformation to the input text, use the transform button. When pressed, the transformation table, the output field, as well as the alphabet and the number of letters in the output alphabet, as shown in Fig. 5.

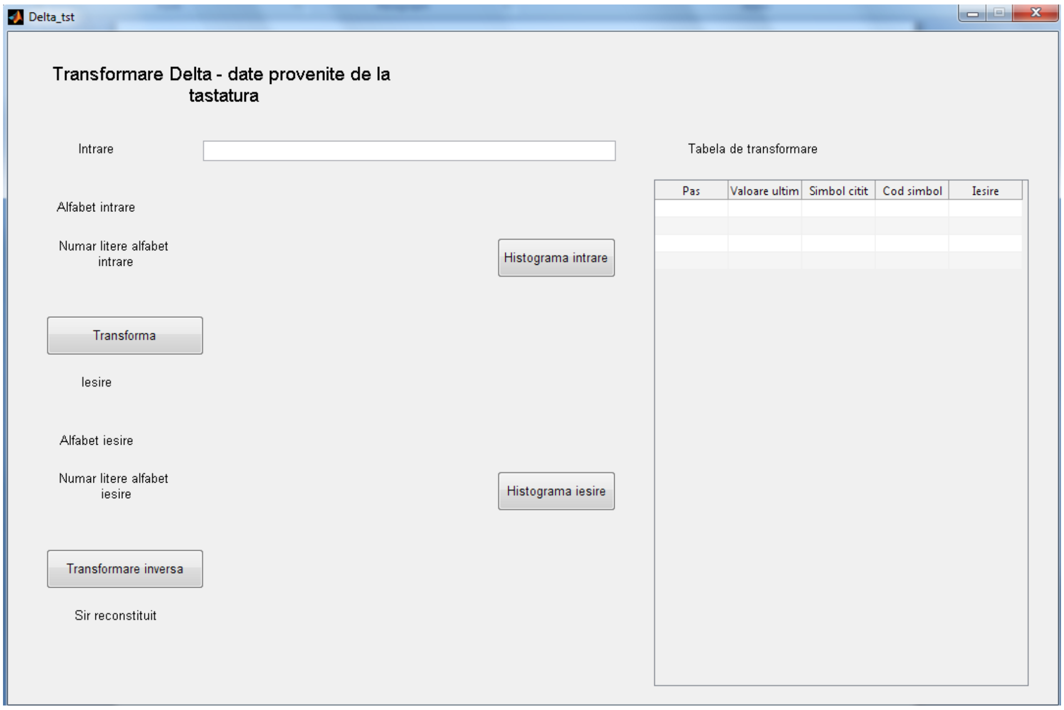


Figure 3. The menu of the Delta transformation application with keyboard data

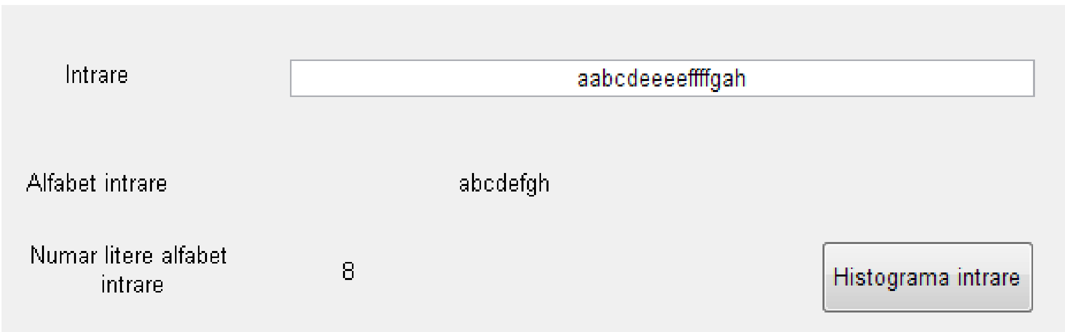


Figure 4. Example of keyboard input text

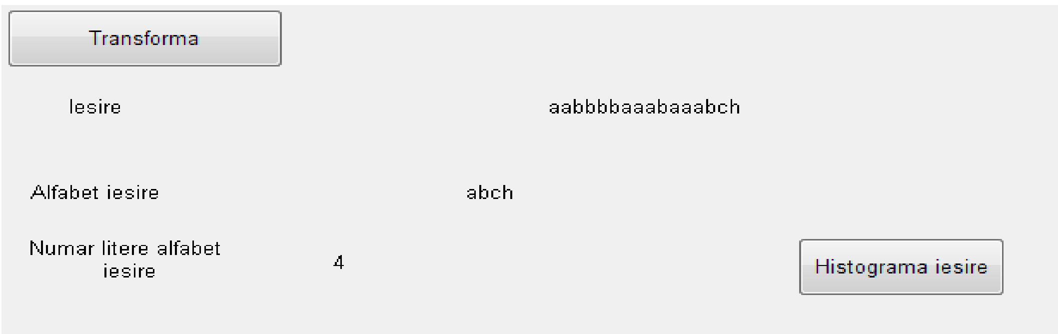


Figure 5. The result of the Delta transformation with keyboard input data

To apply the inverse transformation to the output string, press the inverse transform button, which leads to the display of the resulting string, as shown in Fig. 6. This is like a method of verifying that the algorithm works correctly, given that the inverse transformation does not make sense in the absence of the initial alphabet.

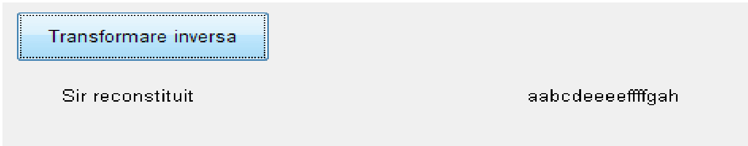


Figure 6. The inverse transformation

To view the histograms of the two texts (input and output), press the corresponding buttons, the result being of the form represented in Fig. 7.

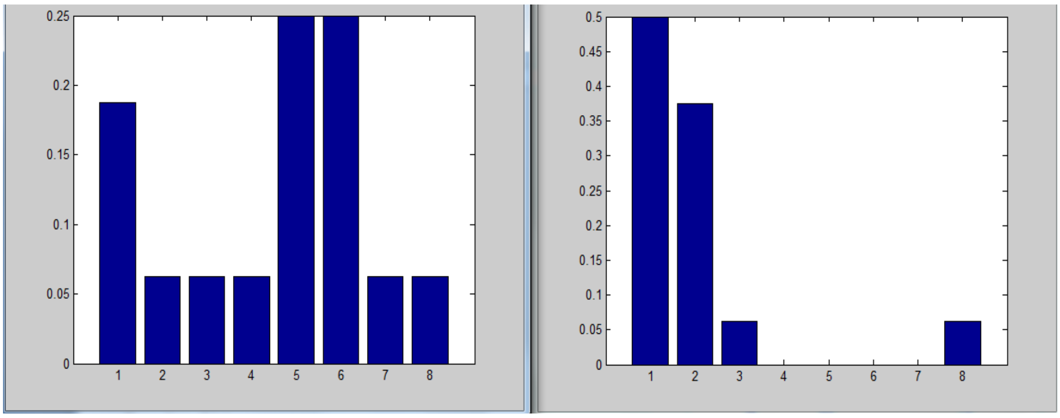


Figure 7. The input histogram (left) and the output histogram (right)

\Also, to the right of the graphical interface is the transformation table, in which the steps for transforming each character can be seen in detail, as shown in Fig. 8.

Step	Last value	Read symbol	Code symbol	Output
Pas	Valoare ultim	Simbol citit	Cod simbol	Iesire
1	0	a	0	a
2	0	a	0	a
3	0	b	1	b
4	1	c	2	b
5	2	d	3	b
6	3	e	4	b
7	4	e	4	a
8	4	e	4	a
9	4	e	4	a
10	4	f	5	b
11	5	f	5	a
12	5	f	5	a
13	5	f	5	a
14	5	g	6	b
15	6	a	0	c
16	0	h	7	h

Figure 8. The transformation table

4.2 Delta Transformation with Text Files Input Data

The part of the application that handles the Delta transformation with input data from a text file is accessed from the main menu by pressing the corresponding button. When the button is pressed a new interface will open, as shown in Fig. 9.

Figure 9. The interface of Delta transformation with input data from a text file

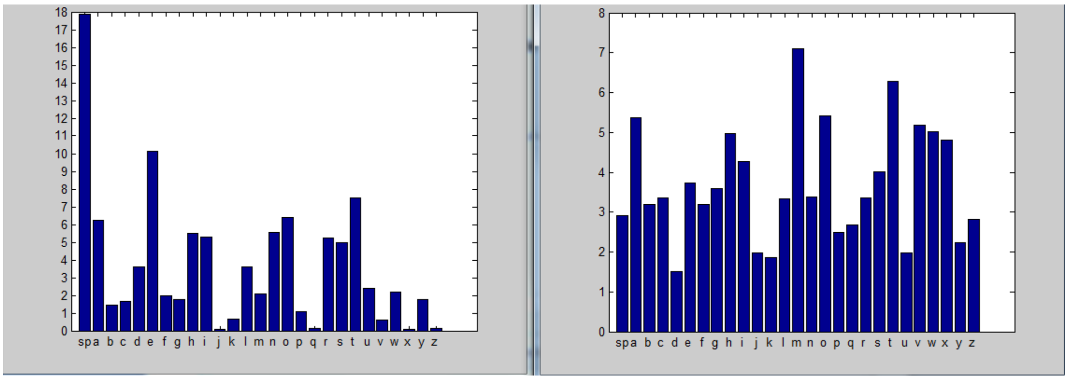


Figure 10. The input text histogram (left) and the output text histogram (right)

To apply the inverse Delta transformation to the encoded text, choose the file named output.txt from the working directory and press the inverse transformation button. It is also possible to view the text of the files in separate windows by pressing the output file button and the reconstructed file button, respectively, as shown in Fig. 11.

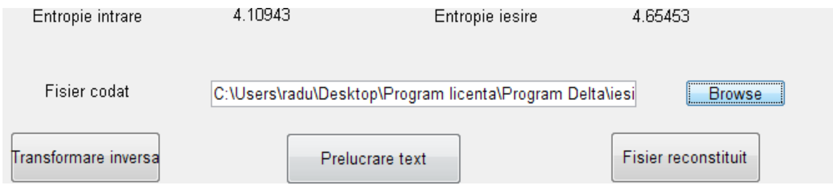


Figure 11. Uploading the encoded file and the entropies of the two text files

4.3 Delta Compression

The last part of the application addresses the problem of Delta compression. Input data is represented by text files. The two files, the old one and the new one, will be uploaded. Compression consists of constructing the Delta file and the compression table from the two file versions, as shown in Fig. 12.

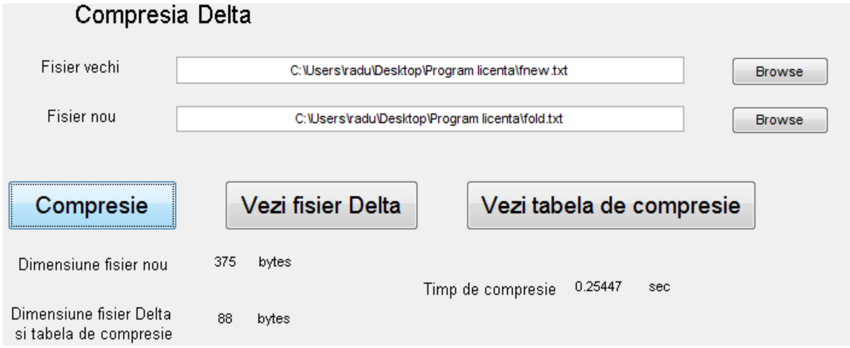
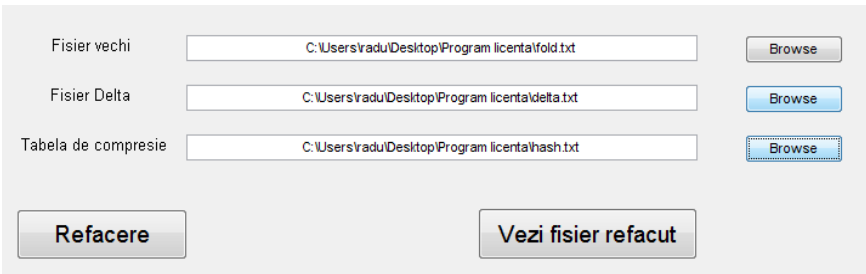


Figure 12. The Delta compression interface

When you press the compression button, the file sizes will be calculated and the time required for compression will be displayed. The contents of both the Delta file and the file in which the compression table is saved can be viewed.

To restore the new file, it is necessary to upload the old file, the Delta file and the compression table. The last two can be found in the working directory of Matlab, and for the decompression the reset button will be pressed, as shown in Fig. 13.



5 Conclusions

The objective of this paper was to create an e-learning application for learning how to use Delta transform and compression in an online studio for lossless compression of text files. The application aimed to obtain a versatile algorithm, which can be successfully adapted to any type of file in order to obtain the best compression ratio, but also a reasonable working time, both for compression and decompression. Choosing the right utility for the type of text file you want to compress is left to the user's decision. The application offers the transparency of analyzing in detail the transformations that take place in the processes of transforms (direct and inverse), compression and decompression, which can be used successfully in collaborative working systems for synchronizing remote files.

References

Sayood, K. (2003): *Lossless Compression Handbook*. Elsevier Science.
Salomon, D. (2007): *Data Compression, The Complete Reference, 4th Ed*. Springer.
Rădescu, R. (2003): *Compresia fără pierderi, metode şi aplicaţii*. Matrix Rom, Bucharest.
Suel, T. and Memon, N. (2001): *Algorithms for Delta Compression and Remote File Synchronization*, Polytechnic University Brooklyn, New York.
MacDonald, J. P. (2001): *File System Support for Delta Compression*, University of California at Berkeley, Department of Electrical Engineering and Computer Sciences.
Trendafilov, D., Memon, N. and Suel, T. (2002): *zdelta: An Efficient Delta Compression Tool*, Polytechnic University Brooklyn, New York.
Soroiu, Cl. (2003) Compresia datelor, *Gazeta de informatică*, 1, Libris, Târgu Mureș.
Microsoft Corporation (2004): Binary Delta Compression, Whitepaper.
MSDN: http://msdn.microsoft.com, accessed 2019
Delta: http://dev.romsystems.com:8081/CompresiaDelta/, accessed 2019
Matlab, http://www.mathworks.com/, accessed 2019
Calgary Corpus: http://corpus.canterbury.ac.nz/descriptions/#calgary, accessed 2019
Gutenberg Corpus: http://www.gutenberg.org/etext/28700, accessed 2019

E-Work Platform for Automatic Creation and Intelligent Management of Tasks in Collaborative Applications

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Abstract

The purpose of this paper is to describe the design of a Web application for the study of management for the activities of an IT company, in order to facilitate the work of the students in practice, the trainees and the employees, as well as to improve the process of internal development of human resources. The proposed system is focused on planning, organizing and improving performance in collaborative and learning work applications. The management application is built in such a way as to provide a friendly interface and to be as easy to use, considering that teamwork is an important factor for the success of any project. As a result, developing an efficient and well-trained team is one of the essential responsibilities of project managers. Teamwork enhances the results of each member, so that the overall result is better than the individual contributions of each member. In order to promote high performance and efficient teamwork, it is necessary to clearly define the project objectives for all its members and to create the conditions ensuring that all participants understand the assigned tasks. Last but not least, it is important to encourage collaboration within the project, represented by feedback. As a result, a compact application is required, which has functionalities for managing tasks and improving performance. The main objective of the project is to provide a software solution for an IT company with educational tasks. This solution has the role of facilitating the teamwork through the complex functionalities that it provides.

Keywords: Collaborative Work Systems, E-Work Application, Software Tools, Advanced Web Technologies, Online Management, Web Application Design

1 Introduction

Task management tools are used by individuals, teams and organizations to help more effectively complete projects by organizing and prioritizing related tasks. These tools come in many forms, such as tables or online project management applications.

Task management tools help end users to work smarter and to be more successful in their business plan (Riss et al, 2005; Cutting 2017; Task Management Tools, 2019).

When applied correctly, task management tools achieve the following goals (PM, 2019):

- Management and organization of workload – It is known what needs to be done and which elements have priority;
- Increased efficiency and production – Applying an optimal amount of resources and time for a task is equivalent to reducing the time allocated in the activities cycles:
- Improving the quality of work – Quality is never sacrificed in favor of speed of work when tasks are well organized and information is used correctly;
- Managing collaboration – Teams work best when there is a common understanding of what needs to be done and ideas can be easily communicated through a visual task management system;

- Reducing unnecessary information – It eliminates the time spent thinking about what needs to be done or done again because the tasks were not properly completed at the first attempt.

2 Implementation Mode of the E-Work Platform

Before the practical implementation of the software platform implementation, a diagram was created in which are placed the hardware components that run the software components of the system, but also how these components are interconnected. The components of the diagram are also called system artifacts. The purpose of this diagram is to present the necessary hardware structure for running the system. The components required for running the system are the following:

- Client – this component requires a Desktop or Laptop to access a Web browser.
- Web Server – this component contains the Web application.
- SQL Server – this server supports the application database.

Communication between the specified components is done through the HTTP protocol, which provides data transfer in combination with a request for a resource or data transfer. Figure 1 shows the system implementation diagram.

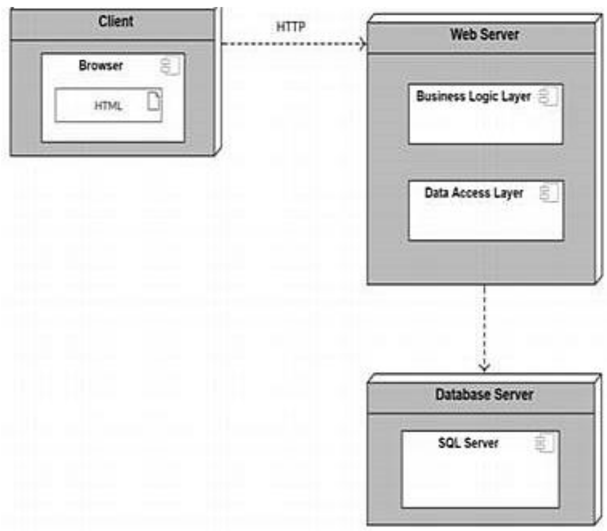

Figure 1. E-work platform implementation diagram (Web Technologies, 2019)

3 Software Tools

The software tools are modeling tools, programming languages and development media used for the practical implementation of the project, including the user interface, and they are at the designer's choice. Following the analysis and comparisons made on the functionalities of the software applications similar to what the e-work platform proposes, but also after documentation on the technologies, tools and languages used by them, the decision was taken to (Web Technologies, 2019):

1. Technologies: Spring Boot, Maven (Java SB & Thymeleaf, 2019), MySQL (Database, 2019), Hibernate, (Hibernate, 2019), Thymeleaf (Thymeleaf, 2019), Bootstrap, and jQuery (Hibernate, 2019):
2. Modeling tools: IntelliJ IDEA, Xampp, and Google Chrome (Redmine, 2019);
3. Programming languages: Java, HTML, CSS, and JavaScript.(Java SB & Thymeleaf, 2019).

4 The Objectives and Functionalities of the E-Work Platform

The objectives proposed for this project can be achieved by building an e-work platform that offers the possibility of managing projects, tasks, processes of assignment to projects and tasks, as well as the possibility of carrying out the feedback process between participants (Gitlab, 2019). For analyzes on projects and feedback, reports can be viewed that help to draw conclusions and make appropriate decisions (Microsoft Project, 2019).

4.1 Comparative Analysis of E-Work Platforms for Project Management

In Fig. 2 is presented a comparison of current applications that deal with project management in e-work applications (Basecamp, 2019). The analysis was performed on the basis of a set of criteria identified as relatively common, so that later the attention is directed to the functionalities to be implemented in the application of this e-work project.

Project Management Software Suite Comparison

There are huge numbers of project management software offerings, ranging from smartphone apps to deep and sophisticated platforms. Here is a sampling.

NAME	URL	USER COST PER MONTH	FREE VERSION/ TRIAL VERSION	SIZE OF TARGET CUSTOMER	CLOUD/ ON PREMISE/ BOTH
Wrike	https://www.wrike.com	$9.80 for pro license; other options available	To 5 users	All size organization	Cloud
Assembla	https://assembla.com	$13.29 and up	Two week free trial enterprise	Mid-size and	Cloud
ProjectManager.com	https://www.projectmanager.com	$15/$20/$25	30 day free free trial	All	Cloud
Podio	https://www.podio.com	Starts at $9/month; $7.20/month annually	Yes	All	Cloud
Conductor	https://senseilabs.com	up to $49 per user	No	10 users and up	Cloud
VersionOne Lifecycle	https://www.collab.net		V1: Agile Community version for 5 or less users	No, but trends to larger	Both
Trello	https://www.atlassian.com			All	Cloud
Mavenlink	https://www.mavenlink.com	Starts at $19	No	SMBs/Enterprises	Cloud
Paymoapp.com	https://www.paymoapp.com	Free to $18.95	Yes	SMBs-20 users	Cloud
Zoho Projects	https://www.zoho.com/projects	Free to $100	Yes	All	Cloud
Teamwork Projects	https://www.teamwork.com	$9	Yes	All	Cloud

Figure 2. Comparison between project management systems (PM, 2019)

4.2 Description of the Functionalities of the E-Work Platform

In each of the pages of the application, at the top, it is important to have a main menu. Through it you can easily navigate through the application.

The functionalities implemented in the platform are the following:

- A home page with details on the current status of the user's ongoing projects;
- A page with a history of user activities;
- A page with reports on the status of the projects and the activities of the other members of each project;
- A page with feedbacks about projects already completed or in progress.

To implement the desired model, a database is needed in which the following information is stored (see Fig. 3):

1. About users: Users table;
2. About projects: the Projects table;
3. The table with the history of actions on projects, the Project_History table;
4. The feedback storage table, both for the members of each project and for the project itself:

A. with a rating system from 1 to 5, which in the interface is visible in the form of a star (*) table;

B. with a Top 10 of the best projects;

5. The connection table between the users of the application and projects, in which there is also the status of each project, according to the project members, its complexity, and the deadline for completion and, thus, diagrams or reports on projects can be displayed on the interface and the contribution of each member of the project.

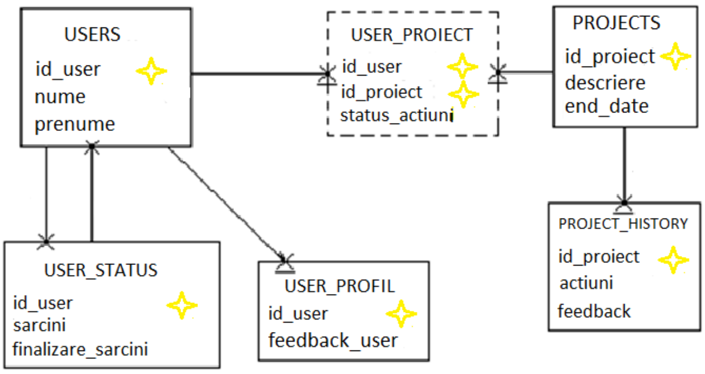

Figure 3. The interface of Delta transformation with input data from a text file

From the comparative analysis presented in the previous section, it is emphasized that it is necessary for the development of software architecture to resort to the analysis of existing architectures and platforms, as design patterns and "turnkey" solutions: libraries, framework- tools, technologies, databases, etc.

After this analysis, the architecture of the e-work platform was built, in the first phase, the architecture of the functionalities that are to be implemented and, subsequently, the system architecture, for the actual development.

The data structuring model is separated by the processing mode (application control, business logic) and the presentation mode (Web interface) according to the principle of separation of concerns, which is why most Web applications are developed according to MVC (Model-View-Controller).

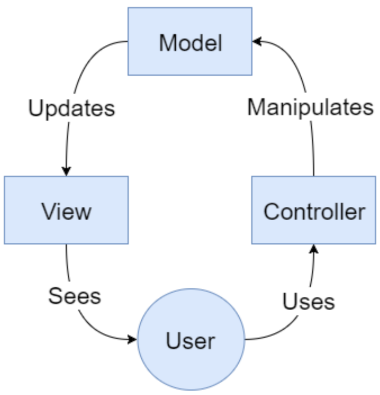

Figure 4. Model-View-Controller design pattern (Asana, 2019)

The generic architecture of the Web application consists of a set of resources related to the controller, the model and the usual view, and the Web framework used requires an intelligent structure (Branscombe, 2018) of the implemented application files, as shown in Fig. 4.

The controller is responsible for taking requests from the client (GET/POST requests issued based on user actions) and manages the resources necessary to satisfy the requests. Usually, it calls a template according to the requested action and then selects an appropriate view.

The model represents the resources managed by the software (users, messages, products, etc.), which have specific models and designate the data together with the rules (restrictions) regarding the data, resulting in the concepts manipulated by the Web application. The model provides the controller with a representation of the requested data and is responsible for validating the data intended to be stored.

The view provides various ways of presenting the data provided by the model via controller. There can be multiple views, the choice being made by the controller (Web Technologies, 2019; Gitlab, 2019).

Typical stages of MVC-based development and implemented in the application are (see Fig. 5):

- The request sent by the client, e.g., web browser;
- Routing the request to the controller;
- Using a model;
- Providing the desired data;
- Selecting a view;
- Transmission of content to the client.

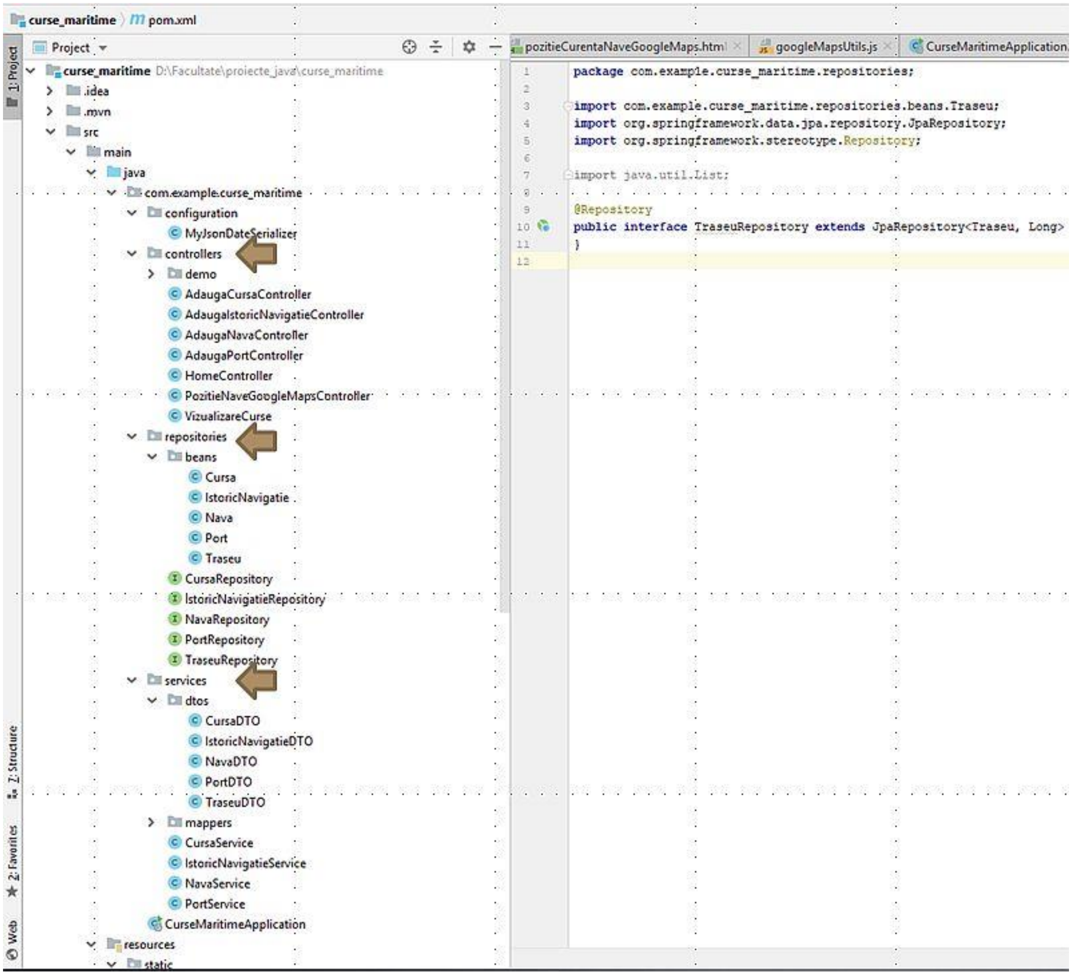

Figure 5. The structure of the MVC-based platform

5 Conclusions

The application architecture that underlies the e-work platform is designed to provide users with an intuitive, user-friendly and easy-to-learn graphical interface, by building it with the help of the technologies and tools presented, which can meet the development requirements desired in this project. The tools are easy to use, open source and well-designed documentation.

In conclusion, it can be said that the application is designed with the purpose of giving the users the opportunity to do their work more easily and to obtain better performances as a result of the team work.

Project management and e-work platforms have a huge impact on the way projects are carried out within an organization and, knowing that computer systems of this type are frequently subject to extensions, the system is designed in such a way as to allow any further development.

References

Riss, U. V., Rickayzen, A., Maus, H. and M. P. van der Aalst, W. (2005): Challenges for Business Processes and Task Management, *Journal of Universal Knowledge Management*, Volume 0, Issue 2, 77-100.

Cutting, Th. (2017): Relationship vs. Task Oriented Management, http://www.pmhut.com/relationship-vs-task-oriented-management, accessed 2019

Task Management Tool (2019), https://leankit.com/learn/project-management/task-management-tool/, accessed 2019

PM (2019), https://www.itbusinessedge.com/articles/best-project-management-software.html

Java SB & Thymeleaf (2019), https://www.baeldung.com/spring-boot-crud-, accessed 2019

Web Technologies (2019), https://profs.info.uaic.ro/~busaco/teach/courses/web/presentations/web04DezvoltareaAplicatiilorWeb-InginerieWeb.pdf, accessed 2019

Database (2019), http://www.scritub.com/stiinta/informatica/baze-de-date, accessed 2019

Hibernate (2019), https://www.baeldung.com/hibernate-one-to-many, accessed 2019

Thymeleaf (2019), https://www.baeldung.com/thymeleaf-list, accessed 2019

Asana (2019), https://asana.com/, accessed 2019

Redmine (2019), https://www.redmine.org/, accessed 2019

Microsoft Project (2019), https://www.microsoft.com/, accessed 2019

Basecamp (2019), https://basecamp.com/, accessed 2019

Gitlab (2019),
docs.gitlab.com/ee/development/architecture.htmlabout.gitlab.com/handbook/engineering/infrastructure/production-architecture/, accessed 2019

Branscombe, M. (2018): How AI could revolutionize project management, *CIO.com Digital Magazine*, https://www.cio.com/article/3245773/how-ai-could-revolutionize-project-management.html, accessed 2019

Tomuș, A. (2018): Aplicație software pentru managementul activităților din cadrul unei companii IT (Eng.: Software application for the management of activities within an IT company), Technical University Cluj-Napoca, Faculty of Automation and Computers, http://users.utcluj.ro/~civan/thesis_files/2018_ATomus.pdf, accessed 2019

Fire simulation software

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Abstract

This paper presents few software tools for fire simulation environment, like FDS, Blender FDS and Pyrosim. FDS is the standard fire simulation software that many other software programs refer to. The program developed with FDS is a text written tool, that sometimes presents difficulties to the beginner user.Blender FDS is an open source GUI interface for FDS program. This program facilitates the combination of the free Blender program with the fire simulation program. Thus, the operator does not have to be concerned about text defining parameters of the simulated environment.Pyrosim is a commercial GUI for the FDS fire simulation tool.

Keywords: Pyrosim, FDS, NFPA, Proceedings

1 Introduction

There is a great interest in all the world for a better understanding of fire dynamics. This is due to the fact that better understanding of it, will help to provide safer living environment.

Huang et all (Huang et al., 2019) have studied the burning evolution of a cable tray with loose and dense arrangements. The authors conclude that time of ignition for the top and bottom surfaces is similar in the case of loos arrangement. Nevertheless, for dense cable installation, the cable on the bottom tray is ignited first. They also conclude that the length of cable tray influence the cable tray flame spread in the dense installation on the contrary of the loose disposal. At the same time, the cable arrangement has significant effect on the burning pattern of the cable tray fire.

Hadden at all (Hadden et al., 2017) study the impact of combustible cross laminated timber linings on the compartment behavior. Their conclusion is that auto-extinction was observed in compartments with two surfaces of exposed timber. They attribute this to the heat transfer between the exposed surfaces preventing the critical heat flux for extinction to be reached.

McCoy at all (McCoy et al., 2019) developed a two-zone flame heat flux model. For model validation, they used ThermaKin software combined with well-established pyrolysis parameter sets. In their model flame heat fluxes were partitioned into radiative and convective components. This was based on the materials' radiative fractions analysis.

Xin and Huang (Xin and Huang, 2013) studies a fire risk analysis for a building and its application in fire risk management. They say that building risk analysis is the process of understanding of the fire hazards, the unwanted outcomes, the probability of fires.

Bal and Rein (Bal and Rein, 2015) have studied the influence of the model complexity on the calibration process by inverse modelling. In their calibration study they considered the surface temperature and mass loss rate from high-fidelity experiments.

Roman (Roman, 2019) presents a requirement for the space between a fire door and its frame – the door gap that is required in the "NFPA 80, Fire Doors and Other Opening Protectives" code. According to Roman there are many facilities that does not comply with the code requirements, and to get aligned to it might mean very high costs even for such a "simple" mention as the door gap.

1.1 Paper Contributions

This paper presents few software tools for fire simulation environment, like FDS, Blender FDS and Pyrosim.

"Fire Dynamics Simulator (FDS) is a computational fluid dynamics (CFD) model of fire-driven fluid flow. The software solves numerically a form of the Navier-Stokes equations appropriate for low-speed, thermally-driven flow, with an emphasis on smoke and heat transport from fires."("FDS and Smokeview," n.d.). This is a free software developed by the National Institute of Standards and Technology – US Department of Commerce. This is the standard fire simulation software that many other software programs refer to. The program developed with FDS is a text written tool, that sometimes presents difficulties to the beginner user.

Blender FDS ("BlenderFDS," n.d.)is an open source GUI interface for FDS program. This program facilitates the combination of the free Blender program with the fire simulation program. Thus, the operator does not have to be concerned about text defining parameters of the simulated environment.

Pyrosim ("Simulation Software for Science and Engineering Manage Geometry, Specify Parameters, Deliver Results," n.d.)is a commercial GUI for the FDS fire simulation tool. This program provides the user a very easy to use tool for the simulated space and material parameters.

2 Case study

The application of the study is a typical hospital room composed of:

- two beds
- one door
- one window

It is presented in Figure 26 in Pyrosim representation, and in Figure ***27*** in FDS representation.

The study supposes that there are 3 ignitors located in the bed close to the door that are cylindrical whose temperature is 1000^0 C, LENGTH=0.15 cm and RADIUS=0.01 cm.

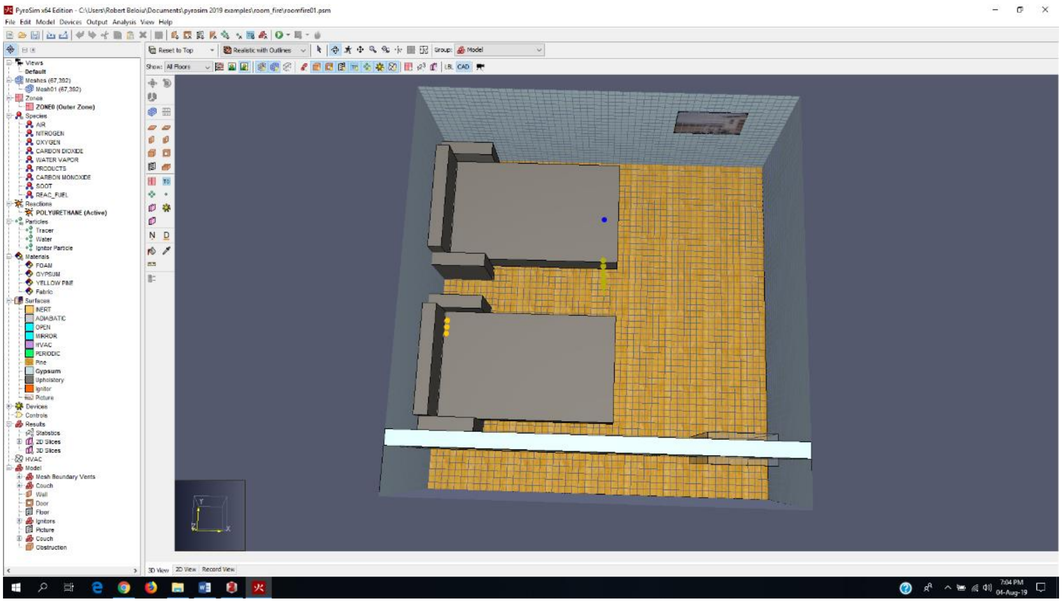

Figure 26. Hospital room case study – Pyrosim implementation

```
roomfire01.fds
Generated by PyroSim - Version 2019.1.0515; Aug 4, 2019 7:07:10 PM

&HEAD CHID='roomfire01', TITLE='Room fire'/
&TIME T_END=150.0/
&DUMP RENDER_FILE='roomfire01.ge1', COLUMN_DUMP_LIMIT=.TRUE., DT_RESTART=300.0,
DT_SL3D=0.25/

&MESH ID='Mesh01', IJK=52,54,24, XB=0.0,5.2,-0.8,4.6,0.0,2.4/

&SPEC ID='WATER VAPOR'/

&PART ID='Ignitor Particle',
    STATIC=.TRUE.,
    SURF_ID='Ignitor'/
&PART ID='Water',
    SPEC_ID='WATER VAPOR',
    DIAMETER=500.0,
    MONODISPERSE=.TRUE.,
    AGE=60.0,
    SAMPLING_FACTOR=1/

&REAC ID='POLYURETHANE',
    FYI='NFPA Babrauskas',
    FUEL='REAC_FUEL',
    C=6.3,
    H=7.1,
    O=2.1,
    N=1.0,
    SOOT_YIELD=0.1/

&PROP ID='Generic Commercial Link_Generic Residential Spray',
    QUANTITY='SPRINKLER LINK TEMPERATURE',
    ACTIVATION_TEMPERATURE=68.33,
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    FLOW_RATE=49.05,
    PARTICLE_VELOCITY=5.0,
    SPRAY_ANGLE=60.0,75.0/
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&DEVC ID='THCP03', QUANTITY='THERMOCOUPLE', XYZ=2.6,2.3,1.2/
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&DEVC ID='THCP05', QUANTITY='THERMOCOUPLE', XYZ=2.6,2.3,0.6/
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&DEVC ID='LAYER->LTEMP', QUANTITY='LOWER TEMPERATURE', XB=2.6,2.6,2.3,2.3,0.0,2.4/
&DEVC ID='LAYER->UTEMP', QUANTITY='UPPER TEMPERATURE', XB=2.6,2.6,2.3,2.3,0.0,2.4/
&DEVC ID='Sprinkler', PROP_ID='Generic Commercial Link_Generic Residential Spray', XYZ=2.6,2.8,2.3/

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    FYI='NBSIR 88-3752 - ATF NIST Multi-Floor Validation',
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    CONDUCTIVITY=0.17,
    DENSITY=930.0/
&MATL ID='Fabric',
    SPECIFIC_HEAT=1.0,
    CONDUCTIVITY=0.1,
    DENSITY=100.0,
    HEAT_OF_COMBUSTION=1.5E4,
    N_REACTIONS=1,
    HEAT_OF_REACTION=1000.0,
```

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    SPEC_ID(1,1)='REAC_FUEL',
    NU_SPEC(1,1)=1.0,
    REFERENCE_TEMPERATURE=280.0/
&MATL ID='FOAM',
    FYI='NIST - Completely made up',
    SPECIFIC_HEAT=1.0,
    CONDUCTIVITY=0.05,
    DENSITY=40.0,
    HEAT_OF_COMBUSTION=3.0E4,
    N_REACTIONS=1,
    HEAT_OF_REACTION=800.0,
    SPEC_ID(1,1)='REAC_FUEL',
    NU_SPEC(1,1)=1.0,
    REFERENCE_TEMPERATURE=300.0/
&MATL ID='YELLOW PINE',
    FYI='Quintiere, Fire Behavior - NIST NRC Validation',
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    CONDUCTIVITY=0.14,
    DENSITY=640.0/

&SURF ID='Gypsum',
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    THICKNESS(1)=0.013/
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    RGB=120,116,110,
    BURN_AWAY=.TRUE.,
    BACKING='INSULATED',
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    MATL_ID(2,1)='FOAM',
    MATL_MASS_FRACTION(1,1)=1.0,
    MATL_MASS_FRACTION(2,1)=1.0,
    THICKNESS(1:2)=2.0E-3,0.1/
&SURF ID='Pine',
    RGB=146,202,166,
    TEXTURE_MAP='psm_wood2.jpg',
    TEXTURE_WIDTH=0.6096,
    TEXTURE_HEIGHT=0.6096,
    BACKING='VOID',
    MATL_ID(1,1)='YELLOW PINE',
    MATL_MASS_FRACTION(1,1)=1.0,
    THICKNESS(1)=0.01/
&SURF ID='Ignitor',
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    TMP_FRONT=1000.0,
    GEOMETRY='CYLINDRICAL',
    LENGTH=0.15,
    RADIUS=0.01/
&SURF ID='Picture',
    TEXTURE_MAP='motorcycle.jpg',
    TEXTURE_HEIGHT=0.675/

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&OBST ID='Right armrest', XB=4.440892E-16,0.8,0.05,0.25,0.0,0.9, SURF_ID='Upholstery'/
```

```
&OBST ID='Left armrest', XB=8.881784E-16,0.8,1.85,2.05,0.0,0.9, SURF_ID='Upholstery'/
&OBST ID='Back cushio', XB=8.881784E-16,0.2,0.25,1.85,0.6,1.2, SURF_ID='Upholstery'/
&OBST ID='Wall', XB=0.0,5.2,-0.2,-1.94289E-16,0.0,2.4, SURF_ID='Gypsum'/
&OBST ID='Seat Cushion', XB=8.881784E-16,2.8,2.7,4.3,0.2,0.6, SURF_ID='Upholstery'/
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&VENT ID='Mesh Vent: Mesh01 [ZMAX]', SURF_ID='OPEN', XB=0.0,5.2,-0.8,0.0,2.4,2.4/
&VENT ID='Floor', SURF_ID='Pine', XB=0.0,5.2,-0.8,4.6,0.0,0.0/
&VENT ID='Picture', SURF_ID='Picture', XB=3.6,4.6,4.6,4.6,1.2,1.875, TEXTURE_ORIGIN=3.6,4.6,1.2/

&BNDF QUANTITY='WALL TEMPERATURE'/

&SLCF QUANTITY='TEMPERATURE', PBX=2.6/
&SLCF QUANTITY='VISIBILITY', PBX=2.6/
&SLCF QUANTITY='VELOCITY', VECTOR=.TRUE., PBX=2.6/
&SLCF QUANTITY='TEMPERATURE', PBX=4.45/
&SLCF QUANTITY='VISIBILITY', PBX=4.45/
&SLCF QUANTITY='VELOCITY', VECTOR=.TRUE., PBX=4.45/

&TAIL /
```

Figure 27. Hospital room case study – FDS implementation

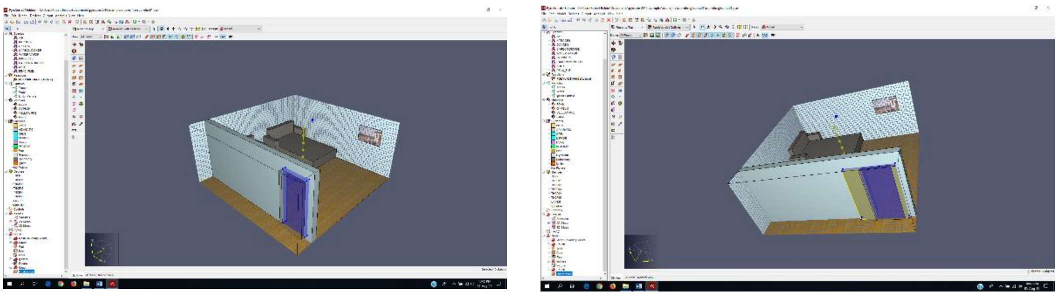
The study supposes that the room has two types of doors:

- hinges door, that rotates for opening and closing
- sliding door, that moves along X axis for opening and closing

In the study it is varied the distance:

- around the door and its frame
  - 0 – 325 mm on X and Z axis
- the distance between the door and the wall
  - 0 – 500 mm

The purpose of the study is to indicate the evolution of Heat Release Rate (HRR) (Icove and Haynes, 2018). This parameter indicates the power of a fire.

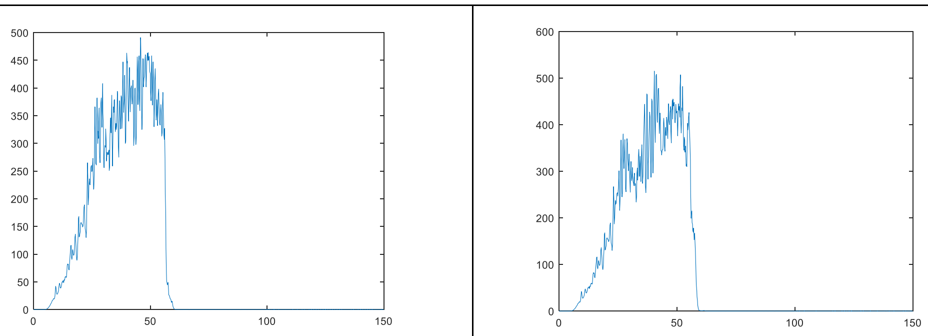


a. Hinges door b. Sliding door

Figure 28. Room simulation

2.1 Hinges door simulation

For the hinges door simulation, the door is included in the frame. It is attached to two or three hinges and it rotates with 90^0 for closing/opening.



a. 0 mm on X and Z axis b. 325 mm on X and Z axis

Figure 29. Hinges door simulation

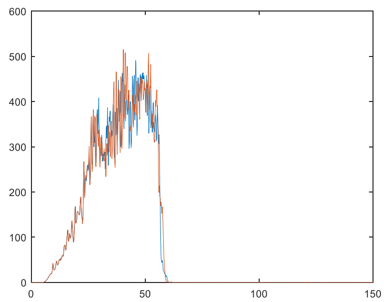
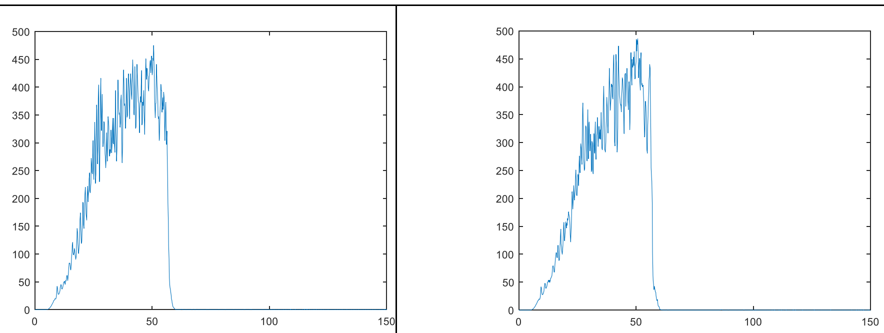


Figure 30. Hinges door comparison simulation

2.2 Sliding door simulation

For the sliding door, this slides along the wall to cover the door hole. For the simulation the distance from the door to the wall varies.



a. 0 mm b. 500 mm

Figure 31. Sliding door simulation

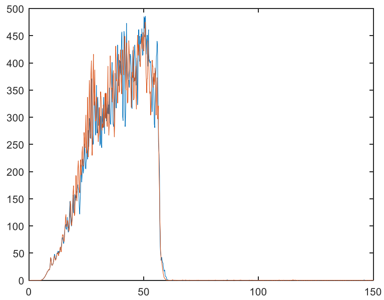


Figure 32. Sliding door simulation comparison

3 Conclusions

This article presents the fire simulation possibilities using the Pyrosim simulation software. The problem that started the study was the NFPA article where it was questioned the influence of the gaps between the door and its frame for a hospital facility. Using simulation software, it is possible to study the evolution of fire in certain conditions without the need for actual experiments to be done.

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References

Bal, N., Rein, G., 2015. On the effect of inverse modelling and compensation effects in computational pyrolysis for fire scenarios. Fire Saf. J. 72, 68–76. https://doi.org/10.1016/j.firesaf.2015.02.012

BlenderFDS, n.d. URL https://firetools.github.io/blenderfds/ (accessed 8.4.19).

FDS and Smokeview, n.d. URL https://www.nist.gov/services-resources/software/fds-and-smokeview (accessed 8.4.19).

Hadden, R.M., Bartlett, A.I., Hidalgo, J.P., Santamaria, S., Wiesner, F., Bisby, L.A., Deeny, S., Lane, B., 2017. Effects of exposed cross laminated timber on compartment fire dynamics. Fire Saf. J. 91, 480–489. https://doi.org/10.1016/j.firesaf.2017.03.074

Huang, X., Zhu, H., Peng, L., Zheng, Z., Zeng, W., Bi, K., Cheng, C., Chow, W., 2019. Burning behavior of cable tray located on a wall with different cable arrangements. Fire Mater. 43, 64–73. https://doi.org/10.1002/fam.2669

Icove, D., Haynes, G., 2018. Kirk's Fire Investigation, 2018th ed. Pearson Education, Inc., USA.

McCoy, C.G., Tilles, J.L., Stoliarov, S.I., 2019. Empirical Model of flame heat feedback for simulation of cone calorimetry. Fire Saf. J. 103, 38–48. https://doi.org/10.1016/j.firesaf.2018.11.006

Roman, J., 2019. Mind the Gap. Mag. Natl. Fire Prot. Assoc. 52–55.

Simulation Software for Science and Engineering Manage Geometry, Specify Parameters, Deliver Results, n.d. URL https://www.thunderheadeng.com/pyrosim/ (accessed 8.4.19).

Thunderhead Engineering, n.d. URL https://www.thunderheadeng.com/ (accessed 8.5.19).

Xin, J., Huang, C., 2013. Fire risk analysis of residential buildings based on scenario clusters and its application in fire risk management. Fire Saf. J. 62, 72–78. https://doi.org/10.1016/j.firesaf.2013.09.022

Structure Design of the Control Test Examples in Solving Programming Tasks

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Abstract

The report presents a software tool suitable for programming training. A description of a part of the implemented environment of the type of Virtual Laboratory for Teaching Programming, related to the design of data input and output, as structure and functionality. Designing the structure of input and output data is an essential element when writing code, and designing specific values of input and output data for validation. Moodle Virtual Programming Lab can be used to automatically test and evaluate a computer program code in programming training, and to design and evaluate the structure of input and output data and to create a file of specific input and output values in the format used in this Moodle module to use in the created website.

Keywords: Input and output data, Testing programs, Programing tasks

1 Introduction

Structure design of input and output data is an essential element when writing program code, and designing specific values of input and output data when verifying the correctness of a program. Therefore, these activities should be present in programming training (Zlatev, 2016).

Testing is a dynamic method for verifying software. It analyzes and evaluates the properties of computer programs based on the results of their implementation. This verification method is one of the most commonly used (Todorova, 2010).

Testing is a main phase in software development. A new profession called Quality Assurance Engineer has emerged for its implementation (Stoykova et al., 2016; Dineva et al., 2011).

Structure design of the input and output data must be done before writing the program, and the control test rows should be used in the verification of the correctness of the task. For branching algorithms, there must be at least one test example for each of the clones.

Students need to be able to find inputs and outputs with a given program code and design control lines with specific values for validation. In order to cope with such a task, they need to know the syntax of the programming language and be able to track and comprehend the algorithm it implements (Mihaela, 2018; Zlatev et al., 2018).

The purpose of this work is to provide a software tool suitable for training and evaluation of programming tasks.

2 Material and methods

The Moodle Virtual Programming Lab (VPL, 2019) was used. A code for evaluation module with the following functions, was used to accomplish the purpose of this work: Writing, editing, and storing code; Program testing; Run a program in a browser.

It is implemented as a plugin for the Moodle eLearning system and can be used to test programs in more than ten languages.

Testing and evaluating code in its application is performed using scripts that can be set to run, debug, or evaluate, or through a series of control examples saved in the specified format in the text file "ut_evaluate.cases".

To facilitate the creation of files that can be used in the Moodle Virtual Programming Lab, as well as to create a file with the structure of the input and output data for a specific programming task, this work has created a website http://vltp.atwebpages.com/en.html.

3 Results and discussion

The structure of the created web site consists of: module for designing the structure and specific values of input and output data and module for evaluating the student-designed structure and realizes the following functions:

- ✓ Designing the structure of input and output data and storing it in a text file;
- ✓ Designing specific values of input and output data and automatic generation of the file ut_evaluate.cases (a text file in a format for use in the Moodle VPL module) based on the values of the control examples provided by the student or teacher;
- ✓ Based on the text file with the structure of the input and output data from the student and an analogous one created by the teacher, an automatic evaluation of the designed data structure is performed;
- ✓ On the basis of the text file with the values of input and output data (utr_evaluate.cases), set by the teacher through the VPL module of Moodle (installed in TEU), an automatic evaluation of the program code is performed.

3.1 Structure design of input and output data

In order to create lists for selecting the type of input and output data, an analysis of over one hundred tasks, suitable for initial programming training, was analyzed.

The list for selecting the type of output is presented in Table 1.

Table 1. List of choosing the type of output data

Type	Description	Type	Description
int	Integer	*nxn int*	Two dimensional integer array with nxn rows and columns
double	Real number	*nxn double*	Two dimensional real number array with nxn rows and columns
char	Symbol (character)	*nxn char*	Two dimensional character array with nxn rows and columns
string	Text string	*nxm int*	Two dimensional integer array with nxm rows and columns

Table 1. Continued…

list int	List of integers	*nxm double*	Two dimensional real number array with nxm rows and columns
list double	List of real numbers	*nxm char*	Two dimensional character array with nxm rows and columns
list string	List of strings	*mxn int*	Two dimensional integer array with mxn rows and columns
list	List	*mxn double*	Two dimensional real number array with mxn rows and columns

3.2 Design module

In the design module, the student sets test input and output data by performing the following actions:

- ✓ Selects the input type from the drop-down list;
- ✓ Enter the specific values for each of them;
- ✓ From the drop-down list selects the type of output data corresponding to the selected input;
- ✓ Enter the specific values for each;
- ✓ The "+" is used button to add a new test case.

Two text files are created. The first one with the type of input and output data for each test case, stored as the order number of the items in the corresponding lists, and the second with the specific values of the input / output data from the test examples in a format suitable for testing with the Moodle VPL module.

Files can be downloaded to the personal computer by pressing buttons - one button to download the first file and a second button to download the second. (The first file is named inoutt.txt and the second file is affect_evaluate.cases).

The JavaScript program snippet presented in Figure 1 is used to generate the second file.

```
document.getElementById("dwn-btn2").addEventListener("click", function(){
  var text2="";
  var filename2 = "vpl_evaluate.cases";
  var elements3 = document.getElementsByClassName("in");
  var elements4 = document.getElementsByClassName("out");
for(var i = 0; i < elements3.length; i++) {
    var v1 = elements3[i].value;
    var v2 = elements4[i].value;
    var text="case = Test " + (i+1)+ "\r\n" + "grade reduction = 100%" + "\r\n"
    text2= text2 + text + "input = " + v1 + "\r\n" + "output = " + v2 + "\r\n";}
  download(filename2, text2);}, false);
```

Figure 1. JavaScript program snippet to create a test file in the Moodle VPL module format

The control data rows are stored in files and can be used many times to test different program codes that solve a given task. Files created by a teacher or student can be used to check the programs of other students. Storing the designed input and output data in text files provides an advantage over testing by repeatedly typing test data from the keyboard.

To test the program through the Moodle VPL module, the input and output tests must be sequentially located - output after the appropriate input test. When testing a program with a racing system such as Open Judge System (BGCoder) (Shivacheva et al, 2016), each input and output test is in a separate file and the same input name is denoted by the same file name in the file name. To use such a system, a program code can be written to store the corresponding input and output test files.

3.3 Evaluation module

A comparison of files with the type of input and the type of output for the same student and lecturer task and evaluate the design of the input and output as a structure.

The text file with the number and type of data is compared with the lecturers's previously created one and is estimated as a percentage that is calculated based on the private number of matches and the total number of test cases set by the lecturer.

The evaluation of the file with the type of input and the type of output of the student is done by automatically comparing it with a file prepared by the lecturer. The two files, selected from hard disk or flash memory, should be arranged in the following order - first the student file and then the teacher file. The two files are selected simultaneously using the Ctrl or Shift keys.

The following implementation procedure is used:

- ✓ The student records the two files created and downloaded through the design function in their e-learning system profile;
- ✓ The teacher prepares a text file in the same way as a student or uses a ready-made one;
- ✓ The lecturer downloads the two files recorded by the student in the eLearning system and evaluates the first through the "evaluation" function and the second through the Moodle VPL module (this test requires the student to have also written the program code) and records the assessment results in student profile.

The algorithm for estimating the type of input and the type of output data works in the following order:

- ✓ The two arrays obtained from the student file and the lecturer's file are sorted, each element of the array representing the corresponding row of the file;
- ✓ Compare each of the elements of the first array with each of the elements of the second one. In a match, the element from the second is deleted and the corresponding iteration is interrupted by counting the matches.

The result of the evaluation is obtained as points of formula [1], rounding off to an integer.

[1] $$Number\ of\ cases\ .100$$

The result of the evaluation is obtained as an estimate according to formula [2].

[2] $$A = 2 + \frac{Number\ of\ true\ answers}{Number\ of\ cases}\ .4$$

The function that implements the evaluation algorithm is represented as JavaScript in Figure 2.

```
function evaluate(l1,n1,l2,n2){
  var st=l1.valueOf();
  st.sort();
  var t=l2.valueOf();
  t.sort();
  var count=0;
  for(var ii = 0; ii < n1; ii++)
              for(var j = 0; j < n2; j++)
                    if(st[ii]==t[j]){count++;delete t[j]; break;
document.write(Math.round(count/n2*100),"<br>");}
```

Figure 2. JavaScript function code for the students evaluation function

3.4 Application in programming training at the Faculty of Technics and Technology at the Trakia University

In the Virtual Laboratory for Teaching Programming (VLTP) course, the Moodle e-learning system used by the Trakia University, Bulgaria (TEU, 2019) is installed and added as a new activity by the Moodle Virtual Programming Lab. URL added to site (http://vltp.atwebpages.com/en.html)

In the e-course, the following resources and activities are specified for a specific programming task: task condition file, assignments, and files related to the I / O design function.Creating files of this kind can be accomplished by using the "design input/output" feature of the web site created by the author.The web site created by the author is used to prepare the test data in the Moodle Virtual Programming Lab format, which is stored in a text file and can be reused afterwards.With a given program code, the student or teacher checks to see if it solves a given task by designing test input and output data and testing it in a programming environment.

Figure 3 presents a screen from the site related to the design of the structure and the specific values of the input and output data.

In Code::Blocks programming environment, in clipboard mode it is possible to paste clipboard contents. To transfer to the clipboard, a copy from a projected input file is used.

With program code set, it checks whether it solves a given task by designing test inputs and outputs, sets them to a VPL Moodle format, and tests them using it. The web site created by the author is used to implement this scenario.

For the design of the input and output data, the function realized in the website is also applied.

The lecturer checks the task by looking at the code and/or testing it with pre-designed control lines of input and output.

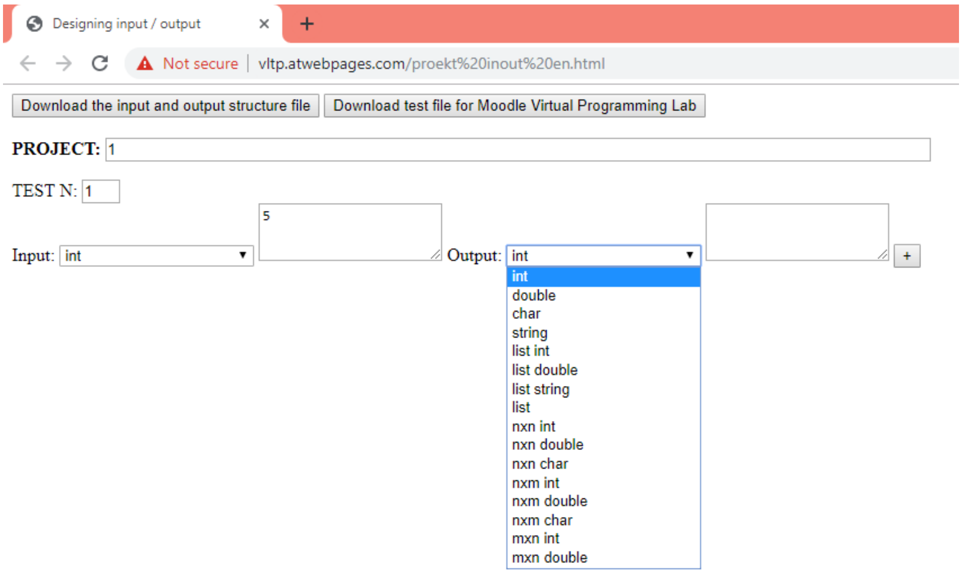

Figure 3. Design module for the structure and specific values of input and output data

Flowgorithm (2019) is a free application that allows you to create a program in more than 10 programming languages using a block diagram language. Flowgorithm can be used to automatically generate a program file based on a flowchart created with the same computer application. This file can be tested in a programming environment or stored in a Moodle VPL module where it can be tested with pre-designed input and output data.

The relevant module implemented on the site is used to evaluate the student-designed input and output structure.

4 Conclusion

Adapted, researched and used are software tools for express, automated assessment of students' work in programming training, including modules for designing the structure and specific values of input and output data and automatic evaluation of structure and program code.

The developed software allows storing the designed input and output data in two files - one in the format for automatic testing of program code through the Moodle VPL module and the second in a text file for automatic evaluation of the designed input and output data and realizes the evaluation itself.The software tool is suitable for conducting experiments on automatic testing of student programs in the Moodle VPL module.

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References

Dineva, S., Stoikova, V. (2011): Application of Interactive Devices and Virtual lab in Chemistry Learning. *Proceedings of the 6th International conference on virtual learning* (ICVL), Romania, 261-267.

Flowgorithm, http://flowgorithm.org, accesed 2019.

Mihaela, O. (2018): An OWL Prototype Educational Ontology for Functional Programming. Proceedings of the 13th International Conference on Virtual Learning (ICVL), 51-56.

Shivacheva, G., Nedeva, V., Bochev, V., Dimova, E. (2016): An Innovative Approach for Training in Programming Using Virtual Laboratories. *Applied research on technics, technology and education (ARTTE)*, 4, 3, 203-210.

Stoykova, V., Zlatev, Z., Baycheva, S. (2016): Possibilities for application of document cameras and webcams in the lecture halls and laboratories of the universities. *Applied research on technics, technology and education (ARTTE)*, 4, 2, 2016, 125-132.

TEU. Thracian electronic University, https://edu.uni-sz.bg/?lang=en, accesed 2019.

Todorova, M. (2010): Formal Methods and Means for Verifying Software. *Yearbook of the Informatics Section Union of Scientists in Bulgaria*, 3, 26-36. (in Bulgarian)

VPL. The Virtual Programming lab for Moodle, http://vpl.dis.ulpgc.es, accesed 2019.

Zlatev, Z. (2016): Integration of additional device to a multimedia presentation system. *Proceedings of the 11th International Conference on Virtual Learning (ICVL)*, 209-213.

Zlatev, Z., Baycheva, S. (2018): Application of optical device in methodology for teaching analysis of essential oils. *Proceedings of the 13th International conference on virtual learning (ICVL)*, Romania, 124-129.

Domain Testing Applied with Emphasis on Variable Constraints

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Abstract

Domain testing is a test design technique that focuses on the variables the program uses. It emphasizes a systematic sampling approach to the test case design that provides powerful test cases while keeping the number of test cases acceptable. The paper details the aspects required to accomplish domain analysis on variables. The domain testing schema is applied to GnuCash Reconcile Account function with focus on the existing constraints among variables.

Keywords: domain testing, notional variable, variable constraints, equivalence class, domain boundaries, best representatives

1 Introduction

Software testing is the activity performed in order to assess product quality. Usually, software testing follows a testing strategy that aims established testing goals. In order to identify appropriate test cases, test design techniques need to be identified. This is achieved by considering the testing goals and the selected testing strategies. The tester cannot afford to run all possible tests, so test cases that are best suited to reach the testing goals should be designed.

Domain testing is a test design technique that focuses on the variables the program uses. It emphasizes a systematic sampling approach to the test case design that provides powerful test cases while keeping the number of test cases manageable. The program uses variables to process data in order to obtain new information required by the end user. These variables are connected by various relationships constraining each other. Therefore, testing one variable needs to consider its context, which consists of all relevant variables that affect or are affected by the former one.

This paper is structured as follows: *Section 2* reminds the concepts of software testing and test design technique. Domain testing is briefly presented in *Section 3* together with the corresponding schema. Details on variables considering data types and types of variables are depicted by *Section 4*. *Section 5* shortly lists the types of constraints that will be investigated. GnuCash finance application is used a case study and the function analysed is introduced in *Section 6*. The results on the case study are presented in *Section 7* focusing on the existing relationships between variables. The paper concludes and states further research directions based on domain testing schema in *Section 8*.

2. Software Testing. Test Design Techniques

This section briefly introduces the concepts of software testing and test design technique as they will be understood by the upcoming analysis.

2.1 Software testing

There any several definitions for the concept of *software testing*. Myers defines it in (Myers, 2004) as *the process of executing a program with the intent of finding errors*. Later, C. Kaner provided a more complex and updated definition of software testing. In (Kaner and Fiedler, 2013a) this is defined it as *an empirical and technical investigation conducted to provide stakeholders with information about the quality of the product or service under test*. The idea of such complex activity will be used throughout this paper.

2.2 Test Design Techniques

A *technique* is defined in (Lexico, 2019) as *the body of specialized procedures and methods used in any specific field, especially in an area of applied science*. It represents a method of performance or a way to accomplish something.

C. Kaner and R. Fiedler (Kaner and Fiedler, 2016) describe a *test design technique* as *a method of designing, running and interpreting the results of tests*. The meaning this last definition that will be used throughout this paper.

Test design techniques are classified in seven categories, according to different dimensions of interest, as: scope, coverage, person who achieves testing, associated risks, activities, evaluation and desired results. These categories correspond to black box testing (behavioural testing) approach, where testing is performed without using knowledge about the source code. (Kaner and Fiedler, 2016) describes over fifty techniques that include: function testing, specification-based testing, tours, equivalence class analysis, boundary testing, best representative testing, domain testing, test idea catalogs, quick-tests, scenario-based testing, etc. This paper focuses on domain testing technique only.

3 Domain Testing

This section reminds several details on domain testing test design technique together with an improved schema consisting of steps to be applied when using this technique.

3.1 Domain Testing Definition

Domain testing is a test design technique that focuses on the program's variables. It allows designing effective (i.e., powerful) test cases based on an efficiently approach (i.e., to find the bugs designing as few tests as possible) (Kaner and Fiedler, 2013b). The domain analysis allows partitioning the variable domain into equivalence classes and designing tests with best representatives from these classes. Domain testing enforces a systematic sampling approach to test case design. As the tester cannot afford to run all tests, he divides the entire population of possible values for the tests into subpopulations and picks one or a few representatives of each such equivalence class. This helps to keep the number of tests manageable. The following section lists the steps required to perform a thorough domain analysis.

3.2 Domain Testing Schema

The below schema provides a complex approach on domain testing. This schema can be very easily adapted to the testing information objectives. Moreover, some steps can be omitted when performing domain analysis when specific variables are investigated or they can be achieved in a different order.

The domain testing schema presented in (Kaner and Fiedler, 2013b) is an extensive version that improves the classical equivalence/boundary analysis with the study of the existing relationships among variables, risks associated with input and result variables or other issues that may come up but are not related to the variables of interest.

The domain testing schema (Kaner and Fiedler, 2013b) consists of the four parts which require applying steps A to R as depicted in Table 4:

Table 4. Domain Testing Schema

Part 1. Characterize the variable
A. Identify the potentially interesting variables.
B. Identify the variable(s) you can analyse now. This is the variable(s) of interest.
C. Determine the primary dimension of the variable of interest.
D. Determine the type and scale of the variable's primary dimension and what values it can take.
E. Determine whether you can order the variable's values (from smallest to largest).
F. Determine whether this is an input variable or a result.
G. Determine how the program uses this variable.
H. Determine whether other variables are related to this one.
Part 2. Analyze the variable and create tests
I. Partition the variable (its primary dimension)
a. If the dimension is ordered, determine its sub-ranges and transition points.
b. If the dimension is not ordered, base partitioning on similarity.
J. Lay out the analysis in a classical boundary/equivalence table. Identify best representatives
K. Create tests for the consequences of the data entered, not just the input filter.
L. Identify secondary dimensions. Analyse them in the classical way.
M. Summarize your analysis with a risk/equivalence table.
Part 3. Generalize to multidimensional variables
N. Analyze independent variables that should be tested together.
O. Analyze variables that hold results;
P. Analyze non-independent variables. Deal with relationships and constraints.
Part 4. Prepare for additional testing
Q. Identify and list unanalyzed variables. Gather information for later analysis.
R. Imagine and document risks that don't necessarily map to an obvious dimension.

4 Variables

This section discuss the variable concept from the tester's perspective. It provides the variable definition and lists the data types encountered during testing together with a variable classification on how the data is provided to the variable.

4.1 Definition

A *variable* used in computer programming describes a storage location (usually identified by a memory address) that is paired with an associated name (an identifier) and a value (quantity of information that may be known or not) (Knuth, 1997; Kaner and Fiedler, 2013b). In general, variables defined by programmers have a data type.

4.2 Data Types

Variable's *data type* is an important study element during testing. The data type provides information about the variable in terms of how it is stored and whether its values can be compared to other values of the investigated variable.

There are various data types associated to variables as: integers, fixed point, floating point, strings, pattern-based types (e.g., file name strings), boolean (i.e., 0 or 1, true or false), character (1 or 2 bytes for each), date, time, date and time (that are often represented internally in several fields or as a huge counter of elapsed time), enumerated (that takes one value from a specific list of possibilities), array (a set of variables of the same type that are stored together and organized in a sequence), record (a variable that contains other variables, class (a programmer-defined data type), list (an ordered collection of values, stored so that an element points to the one before and/or after it) (Kaner and Fiedler, 2013b).

Another aspect related to the data is the scale. The *scale* of the variable indicates the way the actual stored data should be interpreted. (NCHRP, 2019; Kaner and Fiedler, 2013b) present in great detail the scales used in scientific research. The possible scales are: nominal, ordinal, interval, and ratio. Table available in (MResearch, 2019) summarizes the attributes of these scale measures.

4.3 Types of Variables

In this section variables are classified according to two different criteria. The first criterion considers how a variable gets its value. This is denoted by the *user perspective* approach. The second criterion deals with the possibility of whether relationships exist, should exist or not between program's variables, denoted by the *dependency perspective*.

User perspective

There are several types of variables that are used in software testing. *Input variables* allows the user, i.e., tester, to enter data in. The actual input value may come from various sources, as: the keyboard, values saved on disk, another process or somewhere on the network (Knuth, 1997; Kaner and Fiedler, 2013b).

A particular type of variables is represented by constants. These are set by the program, e.g., when it starts as part of its initialization process. They may be considered input for some function, but they cannot be set by the user. Therefore, they are not input variables.

Result variables are set based on other variables values. Their values are not set by direct input. Usually, they are the result of several computations performed by the program based on the user input and/or constant and/or other result variables.

Output variables are a special type of result variables. Their particularities are represented by the fact they are displayed in some way, on the screen, within a report or sent to some other process. Output variables analysis is relevant as it may indicate additional risks compared to the result variables (Kaner and Fiedler, 2013b).

All the above variables are used by both programmers and testers. Another type of variable that is used in black-box testing is represented by the *notional variable*. Kaner and Fiedler (Kaner and Fiedler, 2013b) emphasizes that the tester analyses the program as if these variables were part of the code, but they may or may not actually exist or be used in the way the tester assumes.

Dependency perspective

In (Kaner and Fiedler, 2013b) two variables are considered *independent* if the value of one has no impact (effect) on the range of valid values of the other. This is defined as *value independence*. Scientific literature provides a *statistical independence* concept (Durrett, 2010) meaning the occurrence of one does not affect the probability of the other.

In software testing variable independence refers to the term of value independence as the tester is not interested about the probabilities, but whether combinations are possible or not.

5 Constraints

This section lists the existing relationships between variables. Consequences are only reminded as special elements while applying domain schema. They are out of the scope of the current paper.

5.1 Constraints

There are several types of constraints that need to be investigated during domain analysis. The list below summarizes the types of constraints presents and detailed in (Kaner and Fiedler, 2013b):

- a variable causally affects another variable, i.e., a result variable;
- a variable constrains the other;

- some variables operate together and have a joint effect on other variable;
- some variables are subject to a common risk, including loss of access to a common resource or competing for a common resource;
- historical relationship among the variables;
- the tester has a suspicion on some variables and he decides to test them together.

Section 6 provides specific information on constraints for a particular case study.

5.2 Consequences

Consequences are defined in (Kaner and Fiedler, 2013b) as the impact of an action, e.g., setting the value of a variable. Some action consequences include variables that change their values, enabling and disabling some program features. All these are consequences of some initial action. Result variables that change their values are a special case of consequences.

6 Case Study

This section introduces the case study for the domain testing schema usage. It shortly presents the GnuCash (GnuCash, 2019) purpose and describes the function used to apply domain testing schema on.

6.1 GnuCash

GnuCash is a free finance application that can be used for personal and small business purposes. Its functionalities allow to record income and expenses that correspond to different account types, register types of loans and schedule their payments, reconcile an account to an issued statement, organize budgets, generate different reports, etc.

6.2. Investigated Function with Domain Testing Schema

Reconcile Account function helps the user to check the accuracy of transactions operated through other accounts, e.g., bank accounts. Therefore, missing transactions, duplicated transactions, misplaced transaction or not-cleared checks can be tracked and handled accordingly such that the ending balance on the statement matches the GnuCash account reconciled balance.

7 Applied Domain Testing Schema

This section presents the results of applying domain testing schema to the Reconcile Account function in GnuCash.

The variables identified and described during *Part I.* of the domain testing schema are listed below:

1. Account List Size: integer;
2. Starting Balance: floating point number;
3. Ending Balance: floating point number;
4. Amount in Transaction record, Funds In list: fixed point number (2 digits after decimal point);
5. Total_In for Funds In list: floating point number;
6. Reconciled Balance: floating point number;
7. Description in Transaction record: string;
8. R (Reconciled) in Funds In list: Boolean type (checked and not-checked);
9. Status in Transaction record: enumerated variable with values: n, c, y.

Due to the space limitation, a summary on relationships identified among the investigated variables is presented only. They are cast to the constraint types presented in (Kaner and Fiedler, 2013b):

(1) the value of one is passed to another:

- values of Statement Date, Starting Balance and Ending Balance variables in *Reconcile Information Window* are passed to the corresponding Statement Date, Starting Balance and Ending Balance variables in *Summary Pane* in *Reconcile Window*; their values are not changed;

(2) one constraints the other;

- *constrained to a range;*
  - $Amount_i$ variable is part of $Transaction_i$ record in Funds In list; where i=1 to n, n is the number of records in Funds In;
  - Total_In = Sum of $Amount_i$; $Amount_i$ constraint each other such that their sum does not overflow MAXFLOAT;
  - in *Reconcile Window* there is a relationship among several variables: Reconciled Balance = Starting Balance – Total_In + Total_Out;
  - Starting Balance, Total_In, Total_Out constrain each other such that Reconciled Balance does not exceed MAXFLOAT;
  - R (Reconciled) value in Funds In list constrains the Status value in *Account Register Window*:
    - R = checked ==> Status in {y};
    - R = not checked ==> Status in {n, c};
  - Vice versa, Status in *Account Register Window* constrains R (Reconciled) value in Funds In list:
    - Status = y or Status = c ==> R in {checked};
    - Status = n ==> R in {not checked};
- *must calculate to a constant value;*
  - in order to complete Reconcile Account function, Finish button must be enabled; this means the expression Ending Balance – Reconciled Balance must be assessed always to 0, i.e., the account is reconciled, which is equivalent to Difference = 0;
- *variables must be equal;*
  - an account can be reconciled to a statement only if, Ending Balance and Reconciled Balance are equal;
- *selection from a list;*
  - when opening an account from Accounts List, the *Account Register Window* is filtered to the corresponding transactions only;
  - when reconciling an account from Accounts List, the *Reconcile Information* allows to achieve reconcile on the current account including sub-accounts only;
  - when reconciling an account from Accounts List, the *Reconcile Window* is filtered to the corresponding transactions only, in Funds In or Funds Out;

(3) causal effect;

- each input variable has a causal effect on the variable that constrains, e.g.:
  - Starting Balance, Ending Balance have a causal effect on Reconciled Balance;
  - Status has a causal effect on R (Reconciled) and vice versa;

(4) joint effect;

- $Amount_i$ and R_i ($Reconciled_i$) variables, where i=1,n have a joint effect on Total_In; by themselves, they don't have an expressive consequence on Total_In; but together they have a meaningful impact on this result variable;

- Total_In, Total_Out and Starting Balance have a cumulated impact on Reconciled Balance;

(5) variables are subject to a common risk;

- all variables that are related through various types of constraints are subject to the same risk, e.g., overflow on Starting Balance means overflow on Reconciled Balance;

(6) variables compete for a common resource;

- *Account Register Window* and *Reconcile Window* compete for the same resource, in this case the transaction list of a specific account;
  - while opening *Reconcile Window* the user can update the Status of a transaction in *Account Register Window*; still, *Reconcile Window* is not updated/notified by this change; the account reconcile action becomes inaccurate in this case;

(7) historical relationships among variables;

- while performing domain testing on Loan/Mortgage Assistant function, 9,223,372,036,854,775,807.00 value proved to be the upper valid boundary for Loan Amount variable;
  - while testing Ending Balance as input variable it resulted that GnuCash has several issues on handling such large values in *Reconcile Account* function; therefore, these two variables have a common history of bugs, even if they are independent variables; their historical relationship is determined by their type, i.e., floating point type, not by some established constraints.

The analysis on **Reconcile Account** function followed the subsequent steps and classical equivalence/boundary table was provided to **Ending Balance** as input variable together with a risk analysis. For the assumed independent variables ACTS tool (ACTS, 2019) was used in order to emphasize combination testing. The analysis on result variables was performed for **Total_In** and **Reconciled Balance** variables. The risk-based study for the result variables was achieved considering valid values for input variables. Relationships and constraints previously identified were used to pursue with the failure modes investigation.

Conclusions and Further Work

The paper presents the domain testing technique used in black-box software testing. It shortly lists the four parts approach consisting of 18 steps that can be applied to the investigated variables. The approach considers relationships and risks associated to the studied variables.

Further work emphasizes required formalization on the constraint types. Current approach may benefit from the identification of possible relationships that exist among the listed types of constraints. The investigation of variables that are not subject of domain testing, i.e., boolean and enumerated variables, may indicate the possibility to identify equivalence classes based on similarities and follow the analysis by spotting new risks and consequences.

References

ACTS (2019), Automated Combinatorial Testing for Software (ACTS) from National Institute of Standards and Technology, https://csrc.nist.gov/projects/automated-combinatorial-testing-for-software, accessed July 2019;

Durrett, R. (2010). *Probability: theory and examples* (4th edition), Cambridge University Press;

GnuCash (2019), GnuCash finance application, http://www.gnucash.org/, accessed July 2019;

ISTQB (2018), ISTQB Exam Certification, https://www.istqb.org/downloads/send/51-ctfl2018/208-ctfl-2018-syllabus.html, accessed in July 2019;

Kaner, C. and Fiedler, R. (2013a), *BBST – Fundamentals of Testing*, Context Driven Press;

Kaner, C. and Fiedler, R. (2013b), *BBST – Domain Testing*, Context Driven Press;

Kaner, C. and Fiedler, R. (2016), *BBST – Test Design*, Context Driven Press;

Knuth, D. (1997), *The Art of Computer Programming*. 1 (3rd ed.). Reading, Massachusetts: Addison-Wesley. p. 3-4. ISBN 0-201-89683-4;
Lexico (2019), *Lexico dictionary*, https://www.lexico.com/en/definition/technique, accessed July 2019;
Myers, G. (2004), *The Art of Software Testing* (2nd edition), John Wiley & Sons;
MResearch (2019), http://www.mymarketresearchmethods.com/summary-of-data-types-and-scales/, accessed July 2019;
NCHRP (2019), National Cooperative Highway Research Program, *Identification of Empirical Setting*, Transportation Research Board.

Use of semantic web technologies for interactive learning

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Abstract

The first steps of becoming proficient in any field present a great challenge to any aspiring student. There is usually a considerable amount of new, connected concepts and terms present in the literature that slow down the learning progress. Lectures almost always require familiarity with prior terms used in the course materials. That is precisely why there is a strong motivation for introducing modern teaching technologies. Applied semantic web represent a prominent way to ease some of the burden put on students. In this paper we present a new solution to the beforementioned problem. Our solution is based on the use of ontologies for explaining related terms in an intuitive way. We combine three computer science ontologies and created a tool to make learning computer science as effortless as possible. The same principles presented here can be applied in any field where it's main concepts and knowledge can be represented as an ontology.

Keywords: Ontology, Semantic web, Computer science, Learning, Speech recognition

1 Introduction

The main premise of semantic web is that resources or addresses on the internet (HTTP links) should be understood not only by machines but also by humans. Semantics itself is a science that deals with the study of the meaning of words, and in broader sense of concepts. In the context of the semantic web, this means that the resources and concepts within it are organized using semantic relations. This allows computers to better understand the meaning of data on the web. In order to realize the idea of semantic web, there is no need to create a completely new system, it is enough to upgrade the existing web with appropriate concepts.

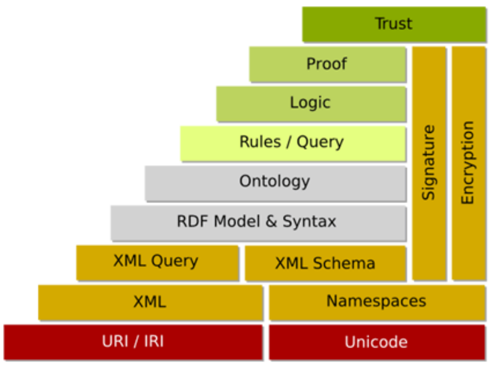

Figure 1: Layers representing semantic web concepts

The most commonly used technology in the semantic web is RDF (Resource Description Framework). RDF is primarily used to describe resources and metadata. The information described by RDF may be resources on the Internet, however, they do not have to be but rather they can be real-world objects. The data in RDF is organized into so-called triplets (triplets).

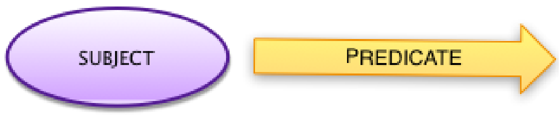

Figure 2: The basic RDF format

Whether it makes sense to use semantic web for a field depends primarily on whether there is a well-made ontology for that specific field. In this paper, we will examine the application of semantic web to aid in the first steps of learning new concepts in computer science. We used several ontologies for computer science concepts that we will describe in more detail later. The idea is to apply such ontologies in the teaching process, as a teaching aid, to help students in the identify connections between new and complex concepts. In the last chapter of this paper, we will briefly walk through our proposal of an application solution that could be used for such a use-case. (Allemang, 2012)

2 Existing ontologies

To enable the search of related terms, it was necessary to create an ontology. Before diving in deep and creating our own ontology from scratch we examined the existing solutions in the field of computer science as well as related topics. Three useful ontologies have been identified, UCO (Unified Cybersecurity ontology), CSO (Computer science ontology) as well as SWO (Software ontology). Each ontology contains classes and concepts that are useful for students of all types of information technology studies.

2.1 Unified Cybersecurity ontology (UCO)

The UCO - Unified Ontology (Syed, 2019) for electronic security incorporates and integrates data and knowledge schemas from various cybersecurity systems and commonly used cybersecurity standards. The UCO ontology has also been mapped to a number of existing e-security ontologies as well as to cloud-related concepts. It is designed to support the integration of information on cyber situations as well as electronic security systems.

2.2 Computer science ontology (CSO)

Computer Science Ontology (Salatino, 2018) is a large ontology of research fields that is automatically generated by the Klink-2 algorithm (Osborne. 2015) on Rekpor's data set, consisting of about 16 million publications, mainly in the field of informatics. The Klink-2 algorithm combines semantic technologies, machine learning and knowledge from external sources to automatically generate a fully populated ontology of research areas. Some links were also manually revised by experts during the preparation of two ontologically supported studies in the semantic web and software architecture fields. CSO's main area of interest is computer science, but the ontology also includes several secondary areas, such as linguistics, geometry, semantics ...

2.3 Software Ontology (SWO)

Software Ontology (Malone, 2014) describes the types of software used in bioinformatics. SWO covers areas such as software type, software maker, types of input and output data, and used software. SWO intends to use BFO (Basic Formal Ontology) (Arp, 2015) as a higher-level ontology and subclass from the biomedical research ontology.

3 Creating our own ontology

To get the most use from ontologies, we have created a special RDF ontology based on UCO, CSO and SWO ontologies. As no data was added to the ontology, all the labels and classes from the existing ones were exploited, removing parts that were less useful for computer science. Stanford's Protege tool was used to view existing as well as create a new ontology. The created ontology uses the RDF format and satisfies the OWL syntax.

3 Solution

The created application is intended to assist students while learning various areas of computer science. The initial stages of learning play a critical role in the learning process and often even determine the later levels of understanding of a new field or subject. During their studies, the professors have a very important influence on the adoption of any new material. However, not everyone is able to attend all of the classes which later leads to a much shallower level of knowledge. Also, there is a dilemma even for the students that are present, whether it is wiser to take notes or actively listen and participate in the lecture. From such dilemmas, the idea for such an application was created. The first part of the application converts the voice to text, thus obtaining a transcript of the lecture. Second, it shows the influence and connection between the terms used in the lecture. By doing this, it solves an even bigger problem. Subjects are often very connected and students who have not fully mastered all of the material from the previous subjects or lectures have a problem with keeping up with the current lecture. By using semantic web technologies, it is possible to at least partially solve this problem.

3.1 Converting audio to text

The first step is to convert the recording of the lecture into text format. Most modern web browsers have direct support for voice recording and using various APIs to recognize words as well as convert them directly to text. This project uses Google's webkitSpeechRecognition to convert speech to text. The conversion is performed in real time, where the user can see words and sentences that are already completely translated as well as those that are currently being translated. Figure 4 shows the conversion from speech to text. The conversion itself has support for a variety of languages, however, since the ontologies are in English, this is the only language we used. Words are converted not only based on what the microphone has detected, but also based on some context. The context is created by examining the previous and even waiting for future words. Only after a few words have passed can the algorithm sufficiently secure that the text is well translated and it switches it from gray to black. The text shown in black is not taken into account for further translations and it cannot be modified.

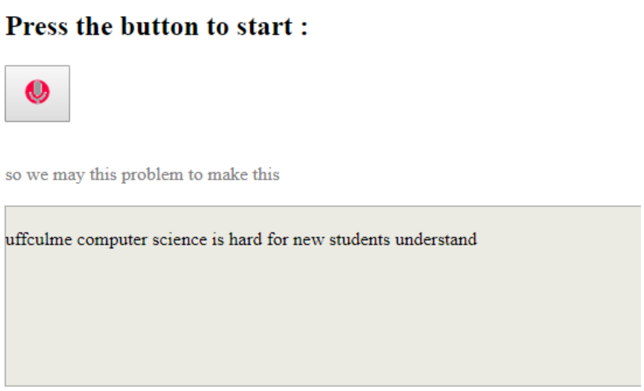

Figure 3: Example of generating text based on sound

3.2 Analyzing terms

After generating text based on the sound of the lecture, the user has the ability to select the desired word or phrase, and search ontology terms for the selected word. Since verbs can be in different tenses while nouns can be plural, it is useful to pre-process the words before executing the query. In this paper, we decided to apply word lemmatization. We used the StanfordNLP library for pre-processing.

The terms in the selected ontologies have the predicate *rdfs:label*, which connects the words to their human readable labels. After we have lemmatized the desired word or phrase, we search all labels containing the desired lemmatized word with SPARQL query (Figure 4).

```
String sprql =
        "PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>" +
        "PREFIX owl: <http://www.w3.org/2002/07/owl#>" +
        "PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>" +
        "PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>" +
        "select * where " +
        "{ " +
        "     ?concept rdfs:label  ?label " +
        "     FILTER regex(?label, \"" + str + "\", \"i\")"+
        "}"
        ;
```

Figure 4: Query for getting all relevant labels

The number of labels found with previous query can be large, and often may contain labels distantly related to searched term, which can represent unwanted behavior. To avoid this, it is necessary to determine which label has the most similar meaning to the text that user has selected. To solve this problem, we created a Python script, using a difflib library, which analyzes the labels and returns the label that is most similar to term searched, as well as its URI.

```
String sprql =
        "PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>" +
        "PREFIX owl: <http://www.w3.org/2002/07/owl#>" +
        "PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>" +
        "PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>" +
        "select * where " +
        "{ " +
        "<" + uri + "> <http://www.geneontology.org/formats/oboInOwl#hasDefinition> ?y " +
        "}"
        ;
```

Figure 5: Query for retrieving term definitions

Since we obtain URI of related terms, it’s quite simple to further perform inference on the ontology and extract details about the term. Ontologies we used in this paper were in RDF format, so we used SPARQL language to create queries. Some terms might have appropriate definitions that would be useful to show to student in case he or she didn't remember them. This use case is solved by query in Figure 5, which returns the definition of the term for corresponding URI.

Often the terms that are being searched don't have any definitions, but they may have comments that explain it further. Comments for relevant URI were retrieve using query in Figure 5, where we searched the ontology by *rdfs:comment* predicate.

```
String sprql =
        "PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>" +
        "PREFIX owl: <http://www.w3.org/2002/07/owl#>" +
        "PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>" +
        "PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>" +
        "select * where " +
        "{ " +
        "<" + uri + "> rdfs:comment ?y " +
        "}"
        ;
```

Figure 5: Query for retrieving comments

Knowing synonyms of a term is often useful while learning. The ontologies used have several predicates that represent word synonyms such as *hasRelatedSynonym*, *hasExactSynonym* and *hasBroadSynonym*. Query in Figure 6 is used to search for synonyms using these predicated. For word to be considered a synonym it's enough for it to be connected with at least one of mentioned predicates.

```
String sprql =
        "PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>" +
        "PREFIX owl: <http://www.w3.org/2002/07/owl#>" +
        "PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>" +
        "PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>" +
        "select * where " +
        "{ " +
        "<" + uri + "> " +
        "<http://www.geneontology.org/formats/oboInOwl#hasRelatedSynonym>|"+
        "<http://www.geneontology.org/formats/oboInOwl#hasExactSynonym>|" +
        "<http://www.geneontology.org/formats/oboInOwl#hasBroadSynonym> ?x " +
        "}"
        ;
```

Figure 6: Query for retrieving synonyms

4 Results

After the user selects desired word or phrase, all of the mentioned queries in the previous subsection are being executed. When the execution is complete all information that is retrieved (including the original term, its definition, comments and all potential synonyms) is being displayed to the user via a dialog (Figure 6). Definitions represent short and formal explanation of a term. While comments often offer more detailed explanation. Synonyms are also given as recommendations for possible further search.

5 Conclusion

Presented solution demonstrate a potential way to make learning process more streamlined especially in the field of computer science. A similar method could be applied to other fields, assuming that there are appropriately created ontologies for those fields. The effectiveness of this approach depends primarily on quality of the ontologies used. Research and development of new and better ontologies is an obvious direction for further research. Furthermore, collecting survey data on what kind of data is most relevant to students while learning can also improve this method.

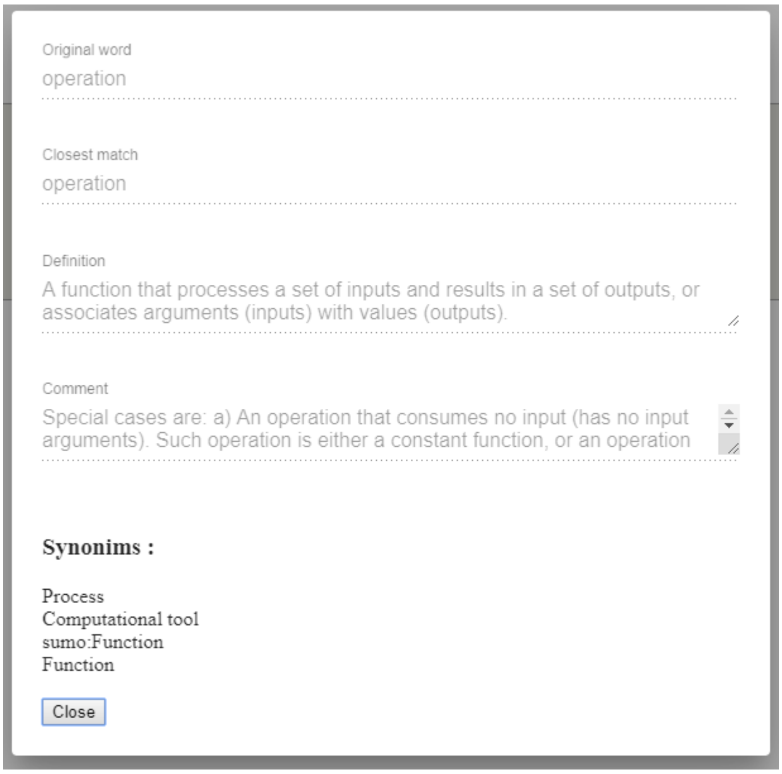

Figure 7: Example of displayed results

Acknowledgments

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References

Angelo Antinio Salatino, Thiviyan Thanapalasingam, Andrea Mannocci, Francesco Osborne and Enrico Motta (2018): The Computer Science Ontology: A Large-Scale Taxonomy of Research Areas

Dean Allemang and Jim Hendler(2012): Semantic Web for the Working Ontologist Effective Modeling in RDFS and OWL, Morgan Kaufmann Publishers, Waltham,

James Malone, Andy Brown, Allyson L Lister, Jon Ison, Duncan Hull, Helen Parkinson and Robert Stevensen, (2014): The Software Ontology (SWO): A resource for reproducibility in biomedical data analysis, curation and digital preservation, Journal of biomedical semantics.

Osborne, Francesco, and Enrico Motta, (2015): Klink-2: integrating multiple web sources to generate semantic topic networks, International Semantic Web Conference.

Robert Arp, Barry Smith and Andrew Spear, (2015): Building Ontologies With Basic Formal Ontology, MIT Press

Zareen Syed, Ankur Padia, Tim Finin, Lisa Mathews and Anupam Joshi, (2016): UCO: Unified Cybersecurity Ontology, AAAI Workshop on Artificial Intelligence for Cyber Security.

COMSOL model for simulating the mine natural ventilation to power a wind turbine

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Abstract

The aim of this work is to explore the possibility of using wind energy as a power solution for communities that had developed around mining. The intensity of the natural air flow established inside a mine in Valea Jiului (Romania) was analysed, as the depression in altitude of the inputs of the mine is significant. A simple theoretical model was used and the values characterizing the air current were confirmed by the measurements done in the field and by the simplified simulation in specialized computer software. A value of wind speed in the gallery of around 3.7 m /s was obtained by simulation which allows a wind turbine mounted at the mine opening to produce energy of up to 770kWh. Modelling using Comsol Multiphysics software is a useful way to simulate wind flows in order to evaluate resources for the implementation of wind turbines, as less time consuming and cheaper than a measurement campaign. Such a numerical model developed using COMSOL Multiphysics 5.1. software, could be very efficient for the physics education generally and in renewable energies field particular. COMSOL Multiphysics software provides a lot of possibilities for the modern education of our students.

Keywords: Simulation of airflow, Wind power, Mine natural ventilation, Renewable energy, Physics education

1 Introduction

The main issues of the progress of civilization are the insurance of the energy needed to develop basic activities of the earth's population and in the meantime the environmental protection. An energy source that has been used since antiquity and whose use has been preserved intensely until now, is the energy of the wind. The wind is a clean and renewable source of energy and although it is irregular and relatively diluted compared to traditional or nuclear fuels, it is a rich and practical source energy (Boccard, 2009). Wind energy is an efficient energy, as it can be transformed directly into electricity. An interesting direction in the wind development would be the use of the natural depression of air from a mine to produce electricity. Air flows into underground mines due to pressure differences. There are two causes that can cause such pressure differences: mechanical and natural. Mining fans can mechanically provide a pressure difference, while natural currents are caused and maintained by thermal energy due to the temperature difference between the inside and outside (Ghoreishi-Madiseh et al, 2017).

The pressure depends both on the height and the differences in the vertical depth from the surface to underground work. The coalfield in the Jiu Valley is the most important coal area in Romania, taking into account the coal deposits per unit area, the quality of coal and experience gained over time. Due to the geological structure, this area displays the most complicated mining conditions that need to be properly resolved. A lot of the mines are in process of reorganization and will be decommissioned by 2020 (EU Directive on Grants for Coal Exploitation, 787/2010). Only 4 mines will be operational in 2020. In the near future, the perspective is that all the mines will close. It will be an important challenge to reintegrate these spaces in the environmental or to explore for other utilities. For this reason, we analysed the natural ventilation of mines in order to power a wind turbine to produce electricity. In this paper we are modelling the mine and simulating a natural airflow for an existing mine, Lonea, situated in the Jiu Valley. The results of the model were validated with experimentally measured velocity airflow data.

Airflow modelling can provide significant cost benefits for the engineering design solutions related to the environmental issues (Houda et al, 2017; Xueqiu et al, 2017; Liu et al, 2019). Several of simulations of wind flows over buildings were done in order to perform a resource assessment for the application of small wind turbines over the roof of a building and around buildings (Tabrizi et al, 2014, Dilimulati et al 2018, Toja-Silva ey al, 2018). In our research we extend this kind of study to the mine field which is less explored till now. Such modelling based on COMSOL Multiphysics 5.1. software is an important way to improve the physics education of students and also to motivate them to understand the fluid mechanical principles and wind turbine functioning. The present paper joins the other modern physics teaching works, that used principles of STEM education in order to dynamize the physics courses. (Ion and Voinea, 2018; Dinu et al 2019; Pantazi et al, 2019; Grigore et al, 2017; Mihalache, Berlic 2018; Marciuc and Miron 2018).

2 Data and theoretical considerations

2.1 Mine description

The basin of the Jiu Valley lies in the lower mountain area in the Petroşani depression, geographically located in the central-western part of the Southern Carpathians, between the Retezat and the Sebes in the north, the Parang Mountains in the east and the Valcan Mountains in the south.

The ventilation network of the Lonea mine is quite complex. The special geometry of the galleries of the Lonea mine network consists in the great difference of altitude between the entrances of the mine, which is a very important factor in the presence of a constant natural airflow over the year (Cioclea et al, 2016). The caloric depression of natural circulation depends on the variation of air pressure, temperature and humidity, as well as changes due to the technological process. The final effect is a possible good natural airflow.

The airflow generated at this exit of Lonea mine has an impact on the power generation capacity of wind turbines and operating characteristics. Generally, the wind speed required to start rotating the smallest wind turbines is 2 m/s and the typical threshold speed is 3.5 m/s when a small turbine starts generating energy. For wind speeds of 10-15 m/s the turbine generates maximum power and at maximum 25 m/s the turbine is switched off or braked (shut-off speed) (Nfaoui H. et al, 2012).

We can conclude from the speed air flow values obtained at the 840 level Lonea Gallery, that once installed a wind turbine at the opening of gallery (Fig 1.a), it will produce energy due to the value of airflow speed exceeding wind threshold speed every month of the year (Fig 1.b).

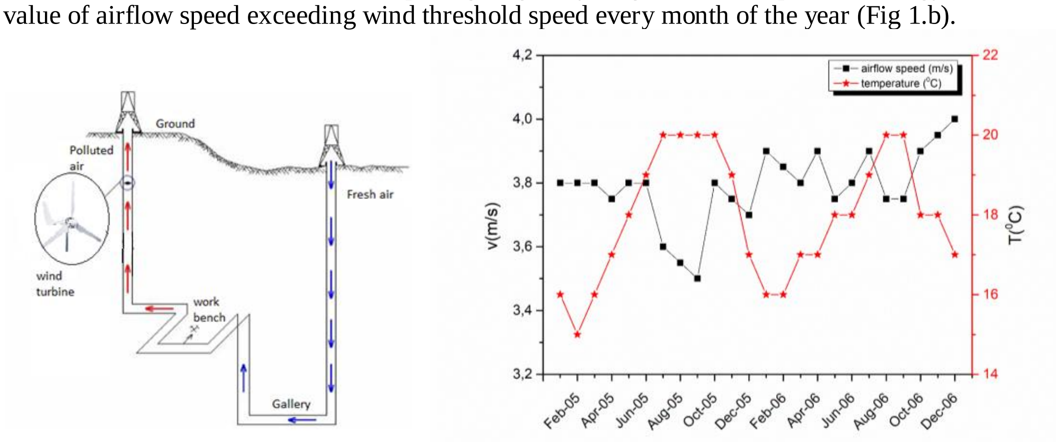


Figure 1. a) Schematic installation of a wind turbine at the opening mine, b) Monthly averages of airflow speeds and temperature measured in the field, at opening of level 840 m at Lonea Gallery (adapted from Foren, 2008)

2.2 Theoretical calculation for the natural airflow rate

In order to realize the calculation of the airflow rate through the mining network, we consider a mine open at both openings as in figure 2, consisting of a ventilation shaft (marked 3-4) connected to a horizontal gallery (marked 2- 3). In the case of an airflow through this ventilation grid a column of air is considered at the end of the horizontal section an imaginary column (marked 1-2), having a height (z_0) equal to the height of the shaft (z_1). The air in ventilation shaft has average density ρ_1, the air in the horizontal gallery has average density ρ'_0, and the air in the imaginary column has the average density ρ_0. We marked the pressure before the exit with p_1 and after the exit in atmosphere with p_2.

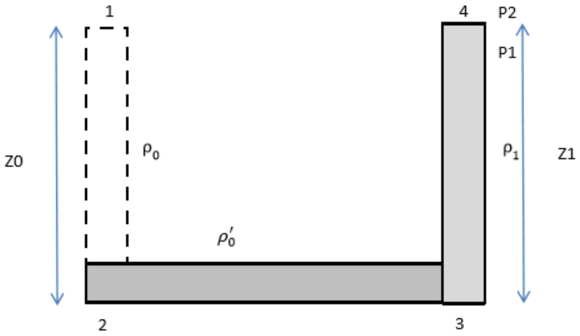


Figure 2. Basic scheme of the simplified mining network

The energy conservation equation, given by Bernoulli's formula, applied to the network described above, is present in equation [1].

$$g(z_0\rho_0 - z_1\rho_1) + (p_1 - p_2) + (\frac{v_2^2\rho_0}{2} - \frac{v_4^2\rho_1}{2}) = P_{2-4} \qquad [1]$$

We can calculate the pressure drops, and finally we are interested in the air flow from the column to the surface at the level 840 (3-4). The theoretically calculated flow from Atkinson equation has a value of 8.25 m^3/s for standard parameter values (ρ_0= 1,17 kg/m^3, ρ_1 = 1,28 kg/m^3, ρ'_0 = 1,2 kg/m^3, P_2= 91193.93 Pa at the temperature of 2ºC , k= 0.0200 Ns^2/m^4, where k is the friction coefficient)

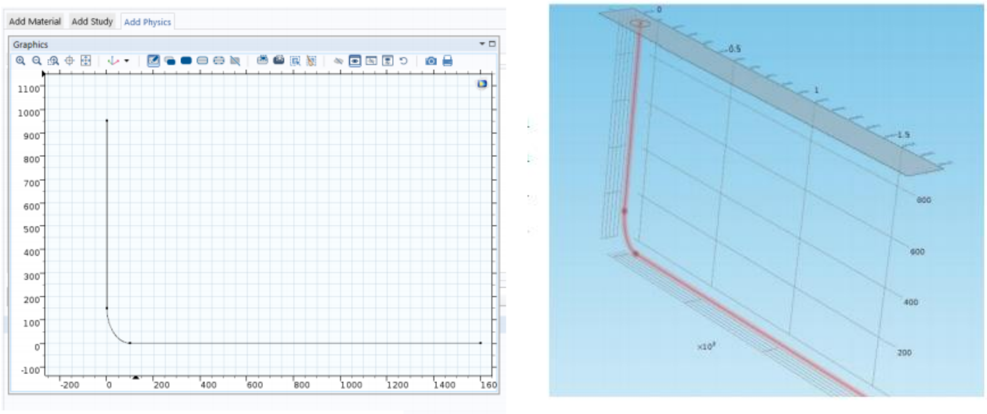
3 Airflow simulation

3.1 Mine modelling

For modelling the mine, we used the geometry interface from COMSOL Multiphysics. In order to represent the mine with the coastal exits, by the different operations performed in COMSOL as: defining, Boolean operations, partitioning a simplified model of a mountain has been achieved. The mountain is represented through a semi sphere and the cylinders that penetrate it simulated the galleries. A xy type plane, named Work Plane 1 is defined within the Geometry1 component.

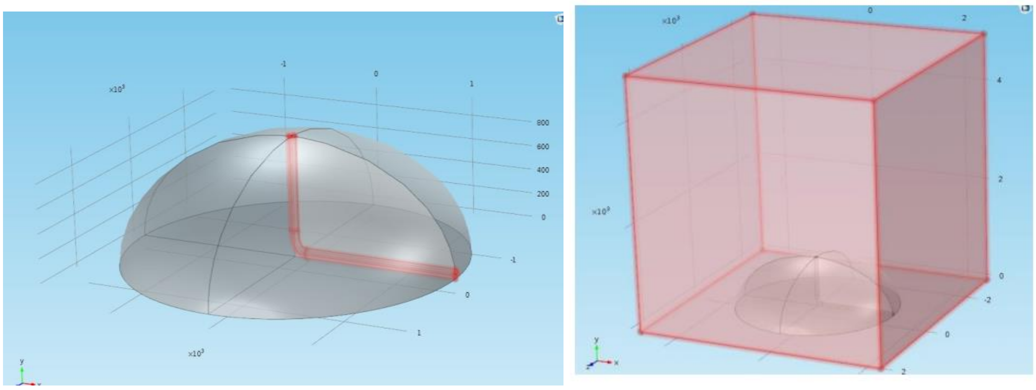
On this plane we placed three Bezier curves, two linear and one of square type, respecting the magnitude order of dimensions specific to the mountain and mine (Fig.3a).

To actually create tunnels, a Secondary Work Plane 2, type zx has been used. The plane has been moved to the beginning of the first Bezier curve, where a circle was drawn, representing the circumference of the gallery (Fig. 3b). To define the gallery, the circle from the second plane is dragged along the Bezier curves by the Sweep operation within the geometry interface. To form the semi sphere section, we defined three other Bezier curves in a xy type plan that have been merged by" Solid Union" operation. The semi sphere was obtained by the operation" Revolve section" from the section previously defined. From the geometry package of the Boolean and partitions operations we used the operation that made the geometrical difference between the semi sphere (the mountain) and the cylinder (the gallery) thus the semi sphere effectively remaining with the empty tunnels, as shown in figure 4 a. An air block has been added over the semi sphere to finish the mine modelling like in figure 4b.



a) b)

Figure 3 a. Bezier polygons for modelling mine; b) the circumference of gallery modelling



a) b)

Figure.4 a) Semi - sphere section with tunnels; b) Model of the coastal mine

3.2 Simulation of natural airflow

Started to the designed geometric model of the mine, we realized the natural airflow simulation. First, the materials are added to the defined domains, and any physical property can be written analytically according to certain defined parameters.

Thus, two materials were used mainly: granite and air with the properties imported from the COMSOL material library. The *k-ε* turbulent flow equilibrium, heat transfer in solids and fluids set up have been used from the interface, applied appropriately across domains and domain boundaries. The turbulent flux interface *k*-ε *(spf)* is used to simulate number flows High Reynolds. The physical interface is suitable for incompressible streams and compressible streams at Mach small numbers (usually less than 0.3). The parameters of the turbulence model are optimized to match as many types of flows as possible, and for better performance, the parameters of the model can be adjusted.

The *u*-field and its components, the pressure *p*, the turbulent kinetic energy *k*, the turbulent dissipation rate *ep* are defined for this physical interface. The "Inlet" (the fluid inlet), "Walls"(the mine walls), “Outlet” (the fluid outlet) borders are selected geometrically, and the appropriate equations will be applied.

Similarly, the equations will be selected to determine how heat transfer is transferred into the solid inside the mountain, the contact surface, and heat transfer to the air, and then the kinetic evolution is followed in time.

Heat Transfer Through Tubes and Heat Transfer in Fluid and Solids are used to model the heat transfer through conduction and convection. These heat transfers borrow the velocity values and pressure fields from the flow fluid defined previously by the fields: "Inlet", “Outlet” and "Walls”. By defining the initial temperatures on each domain and boundary of the domain, the system is then left to evolve itself, following of course the laws of fluid flow and heat transfer.

4 Results and discussion

For analyse the flow of the natural current in mine based on the laws of the flow and transfer of heat, we defined a mesh (fig. 5 a). The mesh divided the model into finite elements, and each of the elements is calculated. An interface study is added in order to monitor the air speed and temperature.

The mountain is a cold thermostat and the outside air is a warm thermostat and due this, we considered different temperatures initially. The study found that due to the difference in temperature there is a heat exchange between these thermostats inside the mine gallery and practically a current of air occurred. As a result of this heat transfer, the air temperature varies as shown in Fig. 5b. There is therefore this thermal gradient and its existence has been highlighted and proven practically by the direct measurements of the wind velocity variation (Fig. 1b). Therefore, an air current is established and its flow calculated by COMSOL in the given situation is 12.06 m^3/s, a value consistent to the theoretical value (8.25 m^3/s) determined at paragraph 2.2 of the paper. The value of wind speed in the gallery obtained from COMSOL was set around the average of 3.7 m /s.

Knowing the wind speed, the radius of the gallery, the air density, we can calculate from the Betz equation, how much electric power would be produced by means of turbines with different coefficients of efficiency. For a wind speed of 3.7 m/s, the radius of turbine of 2 m and turbine efficiency coefficient of 0.5, we obtained an electric power of 213.1W.

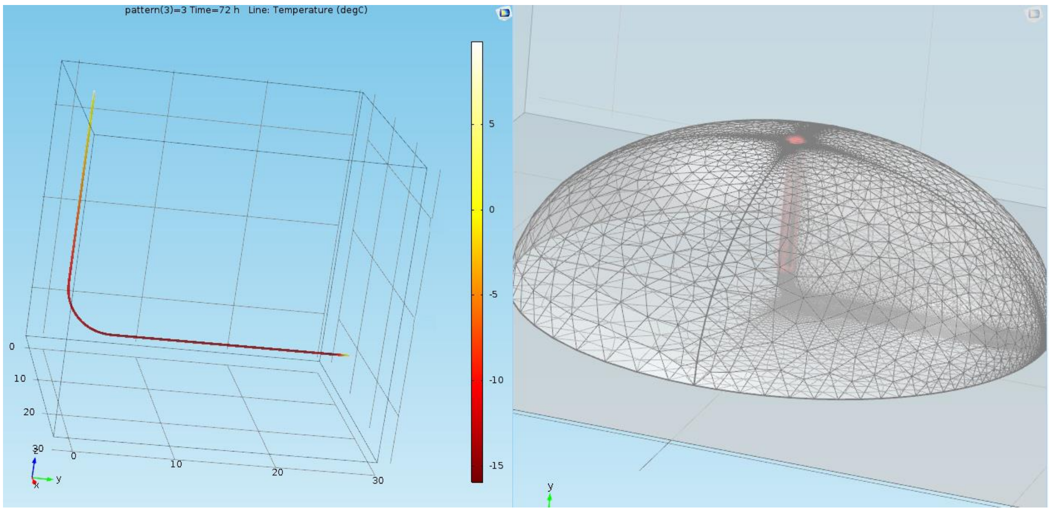


Figure 5 a) Mesh with finite elements in the domain; b) Temperature variation inside the mine

In order to increase the airflow speed at the outlet and correspondingly the electric power generated by turbine, further we intend to analyse the possibility to close some of the tunnels and to smooth the walls of the gallery for avoid turbulence. Another possibility of improvement the energetic performance is to use a Venturi narrowing to concentrate the airflow into a smaller space and to obtain a higher velocity of the current.

5 Conclusions

This paper offers a feasible way to generate renewable energy in a mine, using the natural airflow that power the wind turbine. In the studied case of Lonea mine, which has a coastal exit, the measured airflow velocity at the opening of level 840 m, always exceeded 3.5 m/s, which practically confirms the operation of a wind turbine.

We realised a geometric model for the mine by boolean, partitioning, and domain definition operations from geometric package of Comsol Multiphysics. Based on this model of mine, using specific equations of Comsol package the natural airflow has been simulated. The thermal gradient along the gallery was calculated and consequently the average speed of 3.7 m/s for the generated airflow. Another important result of simulation is the airflow rate calculation with about the same value as the theoretical flow. The results from simulation by Comsol are validated by the field measurements and also the theoretical calculation. The electric power produced by the wind turbine placed at the opening of the mine, in accord with the speed of the airflow obtained by modelling is up to 200W, as thus the energy reaches around 770 kWh. This type of simulation may be a good example for modern physics education, in order to understand the basic principles of physics with application in engineering and renewable sources.

References

Boccard N. (2009): Capacity factor of wind power realized values vs. estimates, *Energy Policy 37,* 2679–2688

Cioclea D., Lupu C., Gherghe I., Radoi F., Boanta C. (2016): Rezolvarea retelelor complexe de aeraj, *Revista Minelor, Universitatea din Petroșani, 22,* 1, 20-24.

Dilimulati A., Stathopoulos T., Paraschivoiu M. (2018): Wind turbine designs for urban applications: A case study of shrouded diffuser casing for turbines, *Journal of Wind Engineering & Industrial Aerodynamics 175,* 179–192.

Dinu S., Dobrica B., Voinea S. (2019) Educational laboratory system based on electrochemical devices, *Romanian Reports in Physics 71,* 4, in press, http://www.rrp.infim.ro/inpress.html

Ghoreishi-Madiseh S.A., Amiri L., Sasmito A. P., Hassa F. P. (2017): A conjugate natural convection model for large scale seasonal thermal energy storage units: application in mine ventilation, *Energy Procedia 105,* 4167 – 4172.

Grigore, I., Miron, C. and Barna, E. S. (2017) Exploring Excel spreadsheets to simulate the projectile motion in the gravitational field, *Romanian Reports in Physics 69,* 1, 901.

Houda S., Belarbi R., Zemmouri N. (2017): A CFD Comsol model for simulating complex urban flow, *Energy Procedia 139,* 373-378.

Liu Y., Xia Y. Chen J., Augenbroe G., Zhou T (2019): A network model for natural ventilation simulation in deep buried underground structures, *Building and Environment 153,* 288-301.

Marciuc, D. and Miron, C. (2018) Understanding multiple reflections in two plane mirrors by building computer simulations. *Romanian Reports in Physics 70,* 3, 902.

Mihalache, B. and Berlic, C. (2018) Using Excel spreadsheets to study the vibrating string behavior. *Romanian Reports in Physics 70,* 2, 901.

Nfaoui H. and Mohammed V. (2012): Wind Energy Potential, *Comprehensive Renewable Energy 2,* 73-92.

Pantazi D, Dinu S, Voinea S. (2019): The smart aquaponics greenhouse – an interdisciplinary educational laboratory, *Romanian Reports in Physics 71,* 902.

Tabrizi A. B, Whale J., Lyons T. Urmee T. (2014): Performance and safety of rooftop wind turbines: Use of CFD to gain insight into inflow conditions, *Renewable Energy 67,* 242-251.

Toja-Silva F., Kono T., Peralta C., Lopez-Garcia O., Chen J (2018): A review of computational fluid dynamics (CFD) simulations of the wind flow around buildings for urban wind energy exploitation, *Journal of Wind Engineering & Industrial Aerodynamics 180,* 66–87.

Xueqiu D. Cui, H., Baisheng N. (2017): Numerical simulation of airflow distribution in mine tunnels, *International Journal of Mining Science and Technology 27,* 663–667.
Conference Proceedings:
Ion R.E., Voinea S. (2018): Experimental Design of Passive House, *Proceedings of the 13th International Conference on Virtual Learning, ICVL,* 447-451.
Internet Sources:
Foren 2008 Neptun Forumul regional al energiei: Posibilităţi de producere a energiei electrice cu ajutorul turbinelor eoliene (2008),
https://www.naturenergy.ro/forumul-regional-al-energiei-foren-2008, accesed April 2019
2010/787 EU Directive on Grants for Coal Exploitation, https://publications.europa.eu, accesed January 2019

Software Application for Automatic Correction of Tests with Multi Choice Answer

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Abstract

In this paper, I have presented the design and the implementation of a software application for the automatic correction of choice tests. After the standard forms filled in by the students are scanned, the resulting files are presented as input to the software application, which generates each student's score and saves the information in a database. The primary advantages of this app are: the significant reduction of time allocated to the test correction, the elimination of human error and the simple management of all scores using a database that allows data search and sorting operations.

Keywords: Software application, Automatic correction, Database

1 Introduction

One of the most actual aspect in the development of the education system is the way students are being tested according to the style and criteria teachers apply in the evaluations. These evaluations are generally used for rewarding and motivating the students and for improuving their learning.

The evaluation assisted by the computer presents a multitude of benefits, the most important being the one that test results are immediatly available and included in a report, and the students can provide the feedback on the evaluation. Analysing the students scores included in the report, the teacher can quickly get an idea about the part not covered or not well understood of his course, and he can take measures accordingly.

In order for a report to be relevant, it is necessary that the standard choice test forms is digitalised so that it could be ran on a computer. The computer-assisted evaluation not only automates the process of choice test exams, but also could upgrade the student's knowledge in the same time. (Hendriks R. , 2012)

Through the automation of choice tests correction using the presented application, another stage of systematic development of the evaluation process is reached. The automation of choice tests creates a major change upon the way in which the checking and correcting of these tests is conducted, not only from the perspective of the test taker but also from the perspective of the one that corrects it.

This application offers the following advantages:

- The time for correction process is shortened;
- The final score of a test is generated very quickly;
- le Is eliminated the human effort and related time as well as the number of human resources is decreased;
- The error rate is almost null.

In order to realize the automated evaluation of the choice tests, the number of questions and answers must be clearly defined. For example, we have 10 questions with 4 answer options each. We could define different types of answers (single choice, multiple choice) or different types of answer options (true/false, etc) which could accelerate a lot the speed of tests' correction.

In order to do that, it is necessary that the template of the choice tests includes different fields for the following data:

- the student's identification data;
- exam session;
- the title and time of the exam;
- the resulted score of students before appeals;
- the final score of students after appeals;

Choice test examination represents the evaluation method that allows the maximum objectivity and increases the fairness of results in the same time with decreasing the time allocated to this.

The use of choice tests is necessary especially in the education system because eliminate some disruptive factors of evaluation process related to the personality and califications of the professor/teacher involved in the exam. (Hirschhorn. , 2011)

2 Aplicatia software

The software application was created starting Visual Studio programme using C# programing language. The application functions according to the following next steps: (Conger D., 2009)

- The student's tests are scanned with an appropriate scanner, compatible with the computer;
- The tests are saved on device in a database;
- The template of test is loaded in the software application
- The template of test from software application is compared with the students' tests from the previously set database;
- The student's score results are validated;
- The results are saved in the database.

For this process, we need a scanner that digitalizes the student's choice tests in an electronic format, the software component which recognizes the responses, a component that compares the students responses to the ones in the provided template and display the scores for each test and a component that assures the printing of the results.

The application is tolerant to identification errors such as: the quality of the print paper and the defective ticking method used by the candidates.

The creation of the questions and their order in the test could be realized only by designated users, that have to authenticate themselves in order to receive these rights. The app could be used in many domains because the questions included in the tests can be grouped in categories with hierarchical organization.

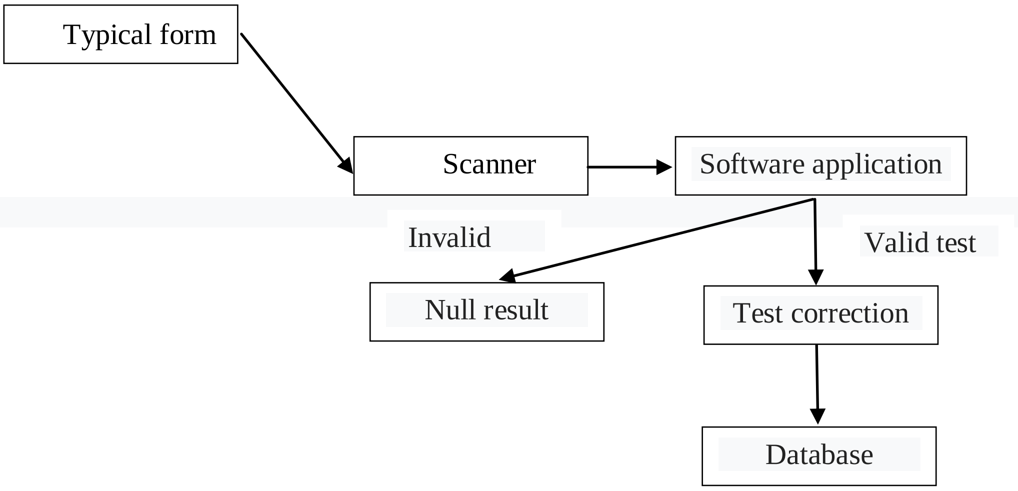


Figure 1. The flow chart of automatic processing of choice tests

The flow chart of the application is presented in figure 1.

As example, assume we have a typical form (choice test) with 10 questions, each of there with 4 possible answers of simple choice type (only one answer is correct). (figure 2)

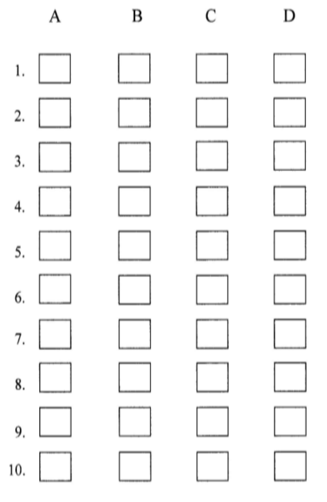


Figure 2. Typical form

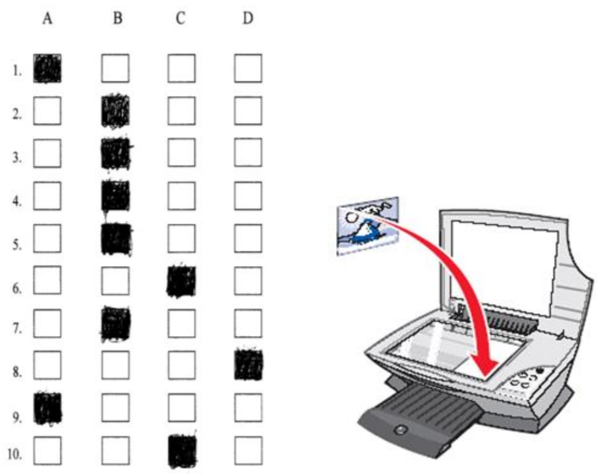


Figure 3. Acquisitions of the choice test filled in by the students

The scanned form is sent as input for the software application (Figure 3).

3 The experimental results

Figure 4 presents the graphical inteface of the application. On the left side, there is an area where the correct template is loaded and next to it a similar area where the scan of the student's test is loaded.

Once the chosen test version is speciefied, the application begins the corection process. On the right side of the interface, each line of the student test is compared to the standard test and the score is provided by question.

In the design stage of the application, it was established that the response is considered correct if 80% from surface analyzed is marked.

If on a line there were multiple choices provided, even if one of them is correct, this response is declared incorrect.

For each correct response by question it is assigned 1 and for incorrect response a 0.

After the analysis of each response, the test is vadidated and, in the correction step, it is established the final score of the test.(Cupic M., Brkic K., Hrkac T., Mihajlovic Z., Kalafatic Z. , 2014)

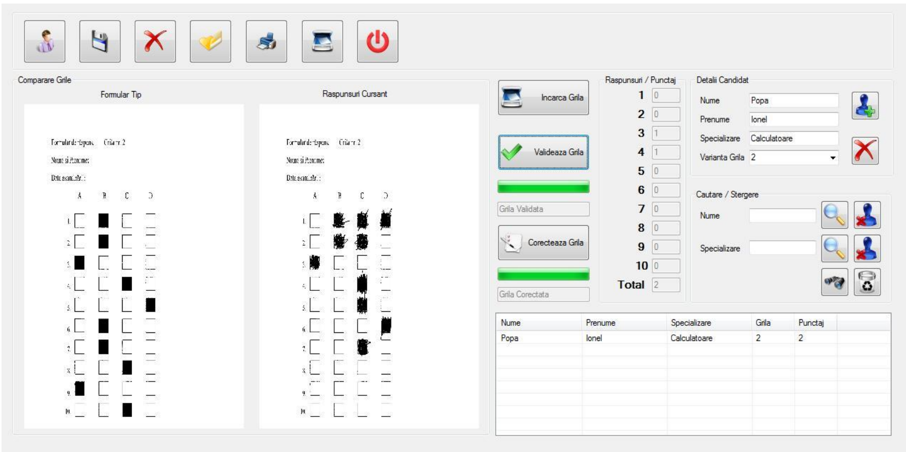
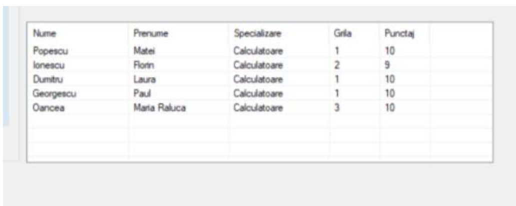


Figure 3. The graphical inteface of the application

The information about name, specialization, the test version taken and final test's score are saved in a database. The software application enable a lot of actions with the stored data: sorting by name and specilization, adding additional lines. However, the application does not allow deleting of data in order to assure the data security.



Nume	Prenume	Specializare	Grila	Punctaj
Popescu	Matei	Calculatoare	1	10
Ionescu	Florin	Calculatoare	2	9
Dumitru	Laura	Calculatoare	1	10
Georgescu	Paul	Calculatoare	1	10
Oancea	Maria Raluca	Calculatoare	3	10

Figure 4. Presentation of stored data

3 Conclusion

In this paper, it is presented a software application that can be useful in any educational environment because it shortens the time for choice test's corection. It can be adapted for any type of tests, with simple or multiple choice type of questions.

The scanner is connected with the computer by an USB port which allows high-speed images' capture and gives the client application the possibility to use other systems resources in parallel. aThe implementation of this method is very useful for students who are being examined, but also for the teachers/professors correcting tests because no discrimination is made between the evaluated students.

References

Hendriks R. (2012): Automatic exam correction. Bachelor Informatica.

Hirschhorn. (2011) Using the exam document class Department of Mathematics, Wellesly College.

Conger D. (2009): Programarea în C#. Ed. Big ALL, București.

Smeureanu I., Dârdală M., Reveiu A. (2004): Visual C# .Net, Ed. CISON, Bucureşti.

Grimes R. (2002): Dezvoltarea aplicatiilor cu Visual Studio .NET, Ed. Teora.

Templeman J., Olsen A., Visual C++ .NET, Ed. Teora.

Cupic M., Brkic K., Hrkac T., Mihajlovic Z., Kalafatic Z. (2014): Automatic recognition of handwritten corrections for multiple-choice exam answer sheets. MIPRO 2014/CIS

Cupic M., Mihajlovic Z. (2010), "Computer-based knowledge, self- ´ assessment and training," International Journal of Engineering Education, vol. 26, no. 1, pp. 111–125

Teaching cultural heritage with emerging technologies

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Abstract

In an era dominated by technology, the way we learn has changed. There are various tools that teachers can use in the classroom or outside the classroom to enhance student learning. These tools need to be properly exploited to make learning experiences more accessible, meaningful and engaging for students struggling to acquire specific knowledge. In spite of the available technology, it remains challenging for teachers to create engaging lessons and to get students interested in a certain domain. A successful lesson must be well prepared, it should focus on the strategies that work at the level of each student and, at the same time, it must be motivating, in order to maintain a positive mind-set and a stimulating class environment. This article aims to offer practical guidelines for creating multidisciplinary lessons in a responsive and interactive way, merging modern tools such as educational games and multimedia tools with digital resources provided from free and innovative learning resources, such Europeana Collections that offers ready-to-use learning scenarios and stories. The authors present a practical example on how teachers can design a creative and experiential learning activity, combining the metadata provided by the Europeana Collection with the power of modern tools and visual storytelling.

Keywords: Educational game, Digital resources, Lesson design, BEACONING

1 Introduction

We often hear about the importance of cultural heritage as a vital expression of our identity, which shapes our everyday life and define us as a society. Cultural heritage is often seen as a mosaic that blends cultural identity, our inheritance from previous generations and what we leave behind for next generations.

In the era of individuality, it is important for the educational institutions to insert cultural heritage representations in the teaching environment, mainly to bring it to the attention of as many students as possible, to enrich the learning processes and to enhance civic education by encouraging active involvement and critical thinking.

Teaching cultural heritage implies using the cultural heritage to achieve learning experiences that can help students to become more aware of their own roots and of their social and cultural identity. It does not mean necessarily learning about the heritage itself, but to develop social skills and to contribute to a change in attitudes.

Compared to other teaching methods, an important feature of the concept teaching cultural heritage it is that it promotes active exchange between teachers and students, where both learn, set ideas and perspectives, question and reflect on the subject studied.

Cultural heritage teaching aims to achieve different learning objectives that can contribute to an experiential learning, such as: *learn to understand and recognize,* where student are helped to understand why cultural heritage is important for their community, seen as a representative trace in the history, identity, values and traditions; *learn to protect and enhance*, where student learn how to develop an active and responsible attitude towards their cultural heritage; *learn to involve,* where the adoption of critical consciousness is encouraged by the active involvement of students based on their experiential learning, but this involvement can be hardly achieve today through the traditional learning methods.

2 Co-design of the Cultural heritage

Most of the time, students find learning about culture in general less interesting and less motivating because the information presented are difficult to understand and to remember.

Starting from this premise, to engage student to learn about important events that took place in the past, important personalities that changed the world, valuable tourist objects and objectives for humanity, etc., teachers must prepare their lessons in an interactive way, focusing on strategies that work at the level of each student and, at the same time, the lessons must be motivating, in order to maintain a positive mind-set and a stimulating class environment.

Having as a central point teaching about cultural heritage, teachers might consider the following aspects when creating the lesson plan:

- If it is possible, teachers must use different forms of heritage: tangible, intangible and digital, when creating educational content and teaching scenarios, which in effect will make the learning process more engaging for students.
- The lesson must offer multiple perspectives of that heritage, in order to present it with different socio-cultural backgrounds;
- The lesson must stimulate interaction between teachers and students using open questions, debate and self-reflection rather than offering simple answers;
- Cultural heritage can be included in narratives, connecting the specific heritage with beliefs and ideas that are meaningful and important for the students;
- The information about a specific heritage that the teachers want to promote among student must be well selected in order to stimulate openness-to-change values and self-transcendent;
- Engage the curiosity of the students to establish connections between the lesson presented and the real facts about the heritage, to help them understand the importance of that heritage and its value to their lives;
- Offer rewards so that student will find out things they did not know, in places they did not expect and have ideas they would not have otherwise had.

Under these premises, the authors present the development process of a gamified lesson plan, combining the metadata provided by the Europeana Collection with the power of modern tools and visual storytelling, offered by the BEACONING project.

The BEACONING project offers an authoring pipeline that enables the development of location-based meta-games and mini games, combined in gamified lesson plans, while the Europeana Collection offers ideas for classroom activities that are linked to different subjects, from history to chemistry and from maths to languages.

2.1 Lesson design process

Using the content generator of the Europeana Collection platform and the emerging tools provided by the BEACONING project, combined with multimedia supporting tools, the authors offer a perspective of how cultural heritage can foster knowledge acquisition and create a collaborative and interactive student – centred learning environment, bringing cultural heritage to life - in classroom and beyond.

The design process of the ready-to-use learning scenario focused on three stages:

- Content collection and classification using the metadata provided by the Europeana platform;
- Designing the lesson plan scenario and mapping the content into the narrative flow of the location based activities and mini games;
- Offering an overview of the real game play using multimedia tools;

The content classification and collection process focused on the identification of the domain of knowledge to be explored. The search targeted STEM subjects and history, respectively presenting the life and the achievements of an inspirational figure in engineering worldwide, Elisa Leonida Zamfirescu. The main objective for the classification was to identify less known information about Elisa Leonida Zamfirescu, one of the first women to graduate with a degree in engineering.

It was crucial to identify the metadata elements from the dataset, and to proceed with the classification of the content: for the narrative flow of the location based, for the content of the mini games, and for the creation of a presentation movie.

As a reference, we used the data exchange model defined by Europeana, known as the Europeana Data Model/EDM, as it offered meaningful links to Europe's cultural heritage data and allowed us to find more associations between Europe's cultural data and the stories surrounding Elisa Leonida Zamfirescu.

Using the EDM pilot system we could extract the following information from each digital resource identified and the information were used subsequently in the presentation video and in the narrative flow of the game:

- *Title* given to the resource;
- *Description* of the digital resource.
- *Identifier*, the entity responsible for making the resource. This was a key reference for further search;
- *Provider*, the entity who added the resource on the collection;
- *Type* of the resource as recorded by the provider. This includes values such as manuscripts, letters, photographs, etc.;
- *Subjects*, the topic of the resource;
- *Rights* for using the resource.

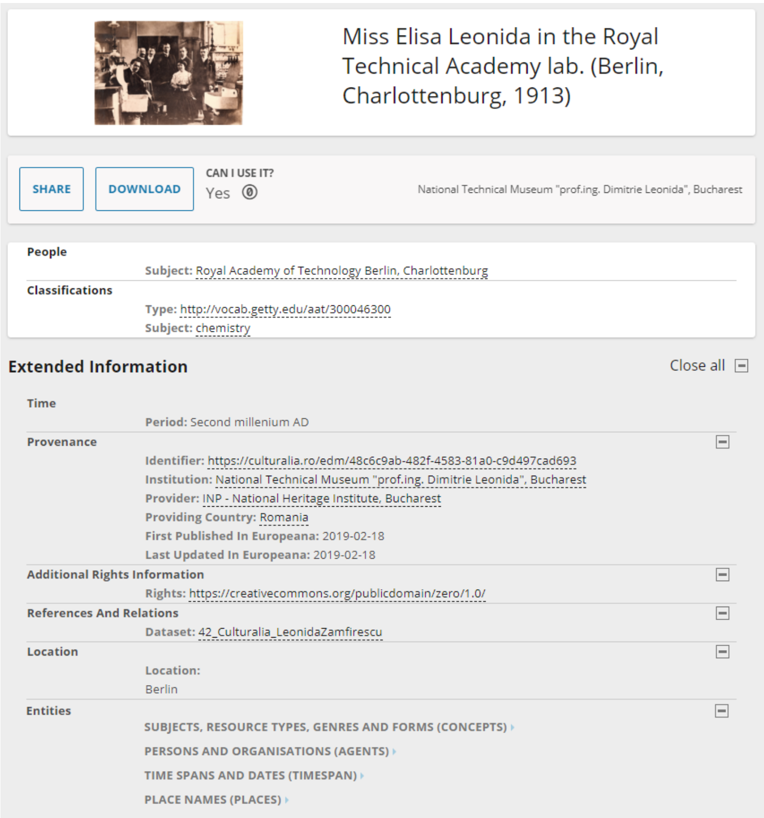

Figure 33 Metadata from digital resources

The EDM pilot system offered us the possibility to identify other external libraries, to search for other information about Elisa's life and career that were not presented on the platform, using the three core classes provided by the framework:

- *edm:ProvidedCHO* – the provided object of the cultural heritage, which include all the metadata of the object, embedded in this class;
- *edm:WebResource* – representation of the digital objects identified, in our case, scanned documents, photos and music to include in the background of the movie presentation;
- *ore:Aggregation* – this class linked the previous classes with the class *edm:isShownAt*, which represents the provider's website, thus we could extract external information.

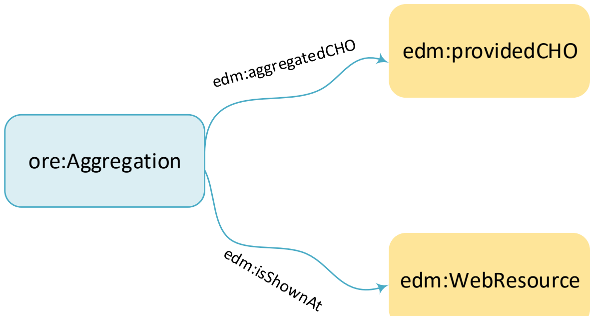

Figure 34 Europeana EDM workflow

After collecting the information and structuring it for the two components of the lesson plan - location based game and mini game, we proceeded to create the location based game, using a tool provided by the BEACONING project – the Authoring Tool for Context Aware Challenge (ATCC). This tool allows teachers to act as a learning designer, and to create pervasive experiences for the students. The ATCC tool facilitates learning processes outside the classroom and has its' narrative flow built around physical Points of Interests (POIs), defined by the teacher.

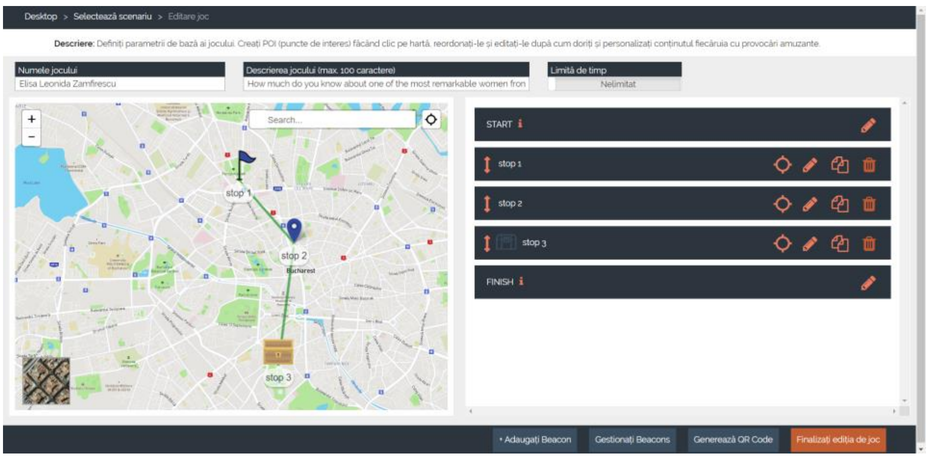

Figure 35 Location-based game interface

The narrative flow of the location-based game has includes as the main challenges to discover Elisa Leonida Zamfirescu contribution in the field of engineering and the institutions where she worked and dedicated her whole life. For the location-based game, we used three POIs, related to the professional life of Elisa Leonida Zamfirescu: the National Geological Museum and the Professor Eng. Dimitrie Leonida National Technological Museum, the places where she spent most of her life and the Pitar Mos School of Girls, the school where she taught physics and chemistry, inspiring young girls to pursue a career in STEM. The information collected in the first step, from the Europeana platform and other libraries has been divided for the five frames of the game: Start, Finish and 3 POIs:

- In the Start frame, the first screen that the player sees and which does not depend on the location of the player, we included relevant information such as terms of use, what is the purpose of the game and other relevant information, such as Clue for the first POI;
- In the Finish frame, we included a congratulation text for the students who finished the game and other relevant information. In addition, in this screen, the system will display the total number of points earned and the time used to complete the game.

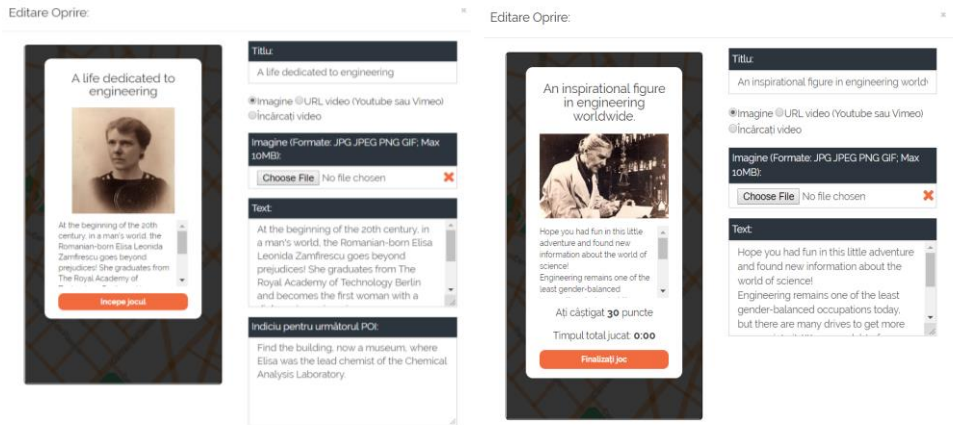

Figure 36 Start screen and Finish screen

- The POIs frame is divided in three screens: the Screen before challenge, the Screen for challenge and the Screen after challenge. They contain information collected from the Europeana platform, information that represented the places where Elisa Zamfirescu worked and studied information about her contributions to engineering and information about her personal life. In the screen for challenge, we linked the content of the other screens with a representative mini game.

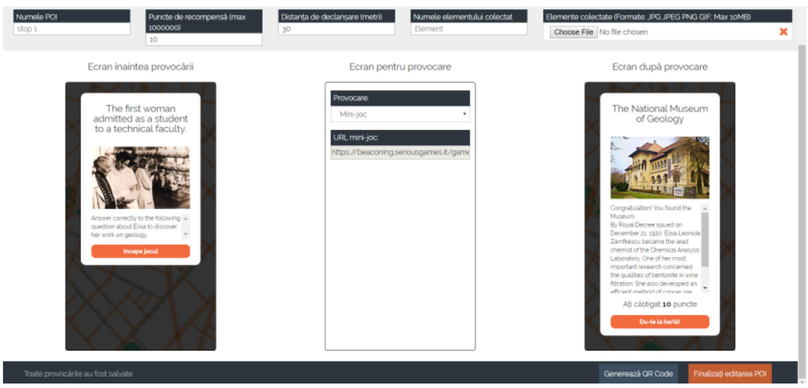

Figure 37 POIs screens

2.2 Mini games

We have created three mini games, using two of the fifteen games developed within the BEACONIG project, respectively Generic Quiz – a typical quiz type game and Swipe and Seek – a drag a line between letters to for the answer game. The content of the mini games referred to Elisa's professional activity and published scientific work.

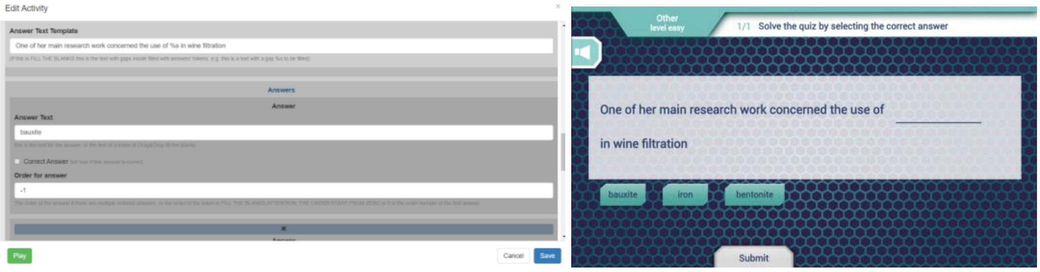

Figure 38 Generic Quiz game Edit screen and Play screen

Bringing together historical information in a real environment, with of the location based game and the mini games, we tried to offer a perspective of how a lesson plan can be brought outside of the classroom, offering the students the opportunity to directly experiencing, analysing and evaluating cultural heritage such as buildings, monuments, landscapes, personalities, historical events and traditions. Thus, the students will gain knowledge and critical thinking skills, but also the interaction with cultural heritage will enhance the appreciation for what the ancestors left behind.

2.3 An interactive presentation of cultural heritage with multimedia tools

The process of collecting information and creating engaging learning experiences has been materialized also with the creation of a short clip. The movie was structured in ten frames as an interactive presentation of the real game play in conjunction with other information about Elisa Leonida Zamfirescu, and more detailed information about her life and career. The players who helped to record the game play, declared at the end that the whole process that the game play was a well-defined and the instructions were clear and concise and that they found out interesting information about a lesser-known Romanian.

Highlighting the contributions of women to STEM, the video aimed to offer a visual representation of an emblematic woman, famous for her pioneering research in geology and chemistry, and also to enable a better understanding of the life and of the significance of the work of Elisa Leonida Zamfirescu that acted as a role model and an inspiration to the next generation of female innovators.

3 Conclusions

The main goal of the lesson plan created was to offer perspective for the teachers who feel the challenge of turning heritage education into something that goes beyond transferring knowledge about historical objects, persons or facts, but also for those who wish to make use of cultural heritage, to inspire students to learn about heritage and to develop a number of key competences for lifelong learning.

Using the emerging tools provided by the BEACONING project, we tried to offer a sense of realness, as a first-hand experience, merging historical facts with real heritage sites such the museums included in the game scenario and in the movie presentation. Furthermore, we tried to show that the cultural heritage could be presented in different ways that reveal its many facets and can be interpreted from different perspectives.

References

McGookin, D., Tahiroğlu, K., Vaittinen, T., Kytö, M., Monastero, B., Vasquez, J. C. (2019): *Investigating tangential access for location-based digital cultural heritage applications.* In *International Journal of Human-Computer Studies*, Volume 122, 196-210.

Mah, O. B. P., Yan, Y., Tan, J. S. Y., Tan, Y-X., Tay, G. Q. Y., Chiam, D. J., Wang, Y-C., Dean, K., Feng, C-C. (2019): *Generating a virtual tour for the preservation of the (in)tangible cultural heritage of Tampines Chinese Temple in Singapore*. In *Journal of Cultural Heritage*, Volume 39, 202-211.

Vrettakis, E., Kourtis, V., Katifori, A., Karvounis, M., Lougiakis, C., Ioannidis, Y. (2019): *Narralive – Creating and experiencing mobile digital storytelling in cultural heritage*. Digital Applications in Archaeology and Cultural Heritage, Volume 15, e00114.

Stanik, N., Aalders, I., Miller, D. (2018): *Towards an indicator-based assessment of cultural heritage as a cultural ecosystem service*. Case study of Scottish landscapes, Ecological Indicators, Volume 95, Part 1, 288-297.

Borissova, V. (2018): *Cultural heritage digitization and related intellectual property issues*. In *Journal of Cultural Heritage,*Volume 34, 145-150.

Stanescu, I. A., Gheorghe, A. F., Ștefan, A., Arnab, S., Loizou, M., Morini, L., Hauge, J. B. (2018): *Location-based Games for Learning*. In *Proceedings of the 14th International Scientific Conference eLearning and Software for Education: eLSE 2018*, Bucharest, Romania, 234-241.

Bourazeri, A., Arnab, S., Heidmann, O., Coelho, A., Morini, L. (2017): *Taxonomy of a gamified lesson path for STEM education: The Beaconing approach*. In *Proceedings of the 11th European Conference on Game-Based Learning: ECGBL 2017*. FH Joanneum University of Applied Sciences, Graz, Austria, 29-37.

Internet Sources:

https://pro.europeana.eu/resources/standardization-tools/edm-documentation

http://www.ecco-eu.org/documents/publications/

https://europa.eu/cultural-heritage/european-year-cultural-heritage_en

Data Science Analysis of Examination Results on Biophysics at Trakia University Stara Zagora

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Abstract

Data Science methods and tools were used to analyze the medical students' achievements in the Biophysics course at Trakia University, Stara Zagora, Bulgaria. Data from the examination results collected from 2012 to 2018 were processed with the python programming language and its libraries pandas, matplotlib and seaborn. The different components that participate in the formation of the final grade, as well as, the achievements of different groups of students on these components were analyzed. The performed analysis reveals the trends in the achievements and allows to make some conclusions about the reasons behind these trends.

Keywords: Data Science, Python programming language, Pandas library, Matplolib library, Seaborn library, Multiple Choice test

1 Introduction

In recent years, the development of computer science, along with the accumulation of vast amounts of raw data, has led to the emergence of three new interconnected scientific and applied fields. These are the so-called "Data Science", "Machine Learning" and "Artificial Intelligence". All three deal with the processing and analysis of large data sets. Data science is primarily concerned with the statistical processing and visualization of data for subsequent analysis (Grus, 2015). Machine Learning and Artificial Intelligence largely overlap, especially concerning the applications currently claiming to use Artificial Intelligence (https://www.newgenapps.com/blog/artificial-intelligence-vs-machine-learning-vs-data-science). In particular, Machine Learning is about developing computer programs capable of analyzing large amounts of some process' data and finding the most appropriate model and algorithm to make predictions and decisions about future events of the same process (https://en.wikipedia.org/wiki/Machine_learning).

In this study, we have used some of the methods and tools of Data Science to analyze the trends in the medical students' achievements in the Biophysics course at Trakia University, Stara Zagora, Bulgaria.

2 Methods

The data from the examination results were processed with the python programming language and its libraries pandas, matplotlib and seaborn. Pandas is a library for reading, sorting, and statistically processing results in tabular form, and matplotlib and seaborn are visualization libraries (Grus, 2015).

The examination results have been collected for 7 years thanks to an Assessment System and an electronic logbook for the marks. The electronic logbook is a macro-enabled Excel-based spreadsheet. Using the Visual Basic for Applications programming language a software code was developed to ensure the input, calculation and storing of all students’ marks and grades.

3 Results and Discussion

The Biophysics course in the Faculty of medicine at Trakia University ends with a theoretical exam. The theoretical exam grade is multi-component. During the exam, the students must answer questions from a predefined questionnaire based on the Biophysics course syllabus. The first 5 years of the discussed period, the exam consisted of two written-answered questions in the form of an essay (Q1-written and Q2-written) and one orally answered question (Q3-oral), all of which are equally weighted. However, all components must be passed, i.e. must be above mark 3. In the last two years, the first essay question has been replaced by a multiple-choice test (Q1-MCQ test). The grading scale is from 2 (week) to 6 (excellent). In Figure 1 are shown the students' theoretical exam grades in the period 2012 - 2018. The graphs are histograms of the grades by number.

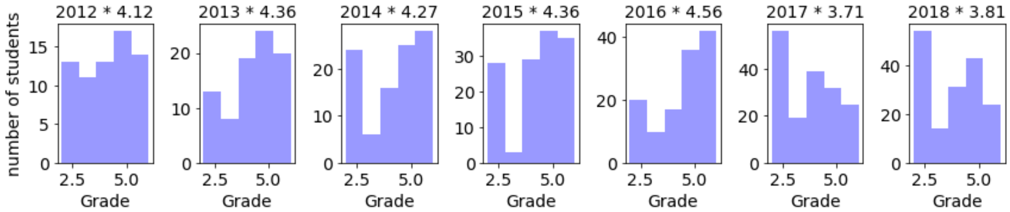

Figure 1. Histograms of grades from the Biophysics Theoretical Exam for the years 2012 to 2018. Above each histogram, the average grade for the respective year is shown

Looking at the results in Fig.1 one can notice a drastic deterioration in the achievements for the last two years, 2017 and 2018. It is expressed by the decrease of the average grade, as well as, by the increase of the portion of weak grades. Unlike the first five years, the number of weak grades (2 or FX) is predominant. The logical question is whether this is related to the introduction of the Multiple-choice test as a component of the exam. To check this assumption, we performed a more detailed component analysis of the examination results over the last four years. During these four years, Trakia University also provides education for medical students in the English language to citizens from different European, as well as non-European, countries. Therefore, we have further analyzed the results of Bulgarian students and separately of International students from other countries. The results for 2015, 2016, 2017 and 2018 are presented in Figure 2, Figure 3, Figure 4 and Figure 5.

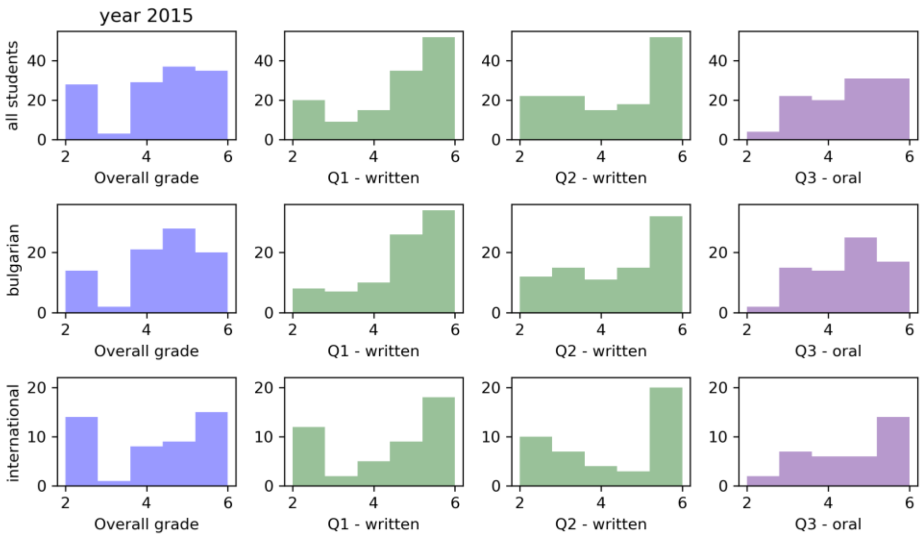

Figure 2. Assessments of the Biophysics Theoretical Exam in 2015. The overall grades presented in the first column are averages of the marks for the three components Q1, Q2 and Q3 when each of the thre have mark at least 3. When some of the marks Q1, Q2 or Q3 is 2, the grade is also 2. The first line of figures presents the results for all students, the other two lines present the Bulgarian and international students' achievements.

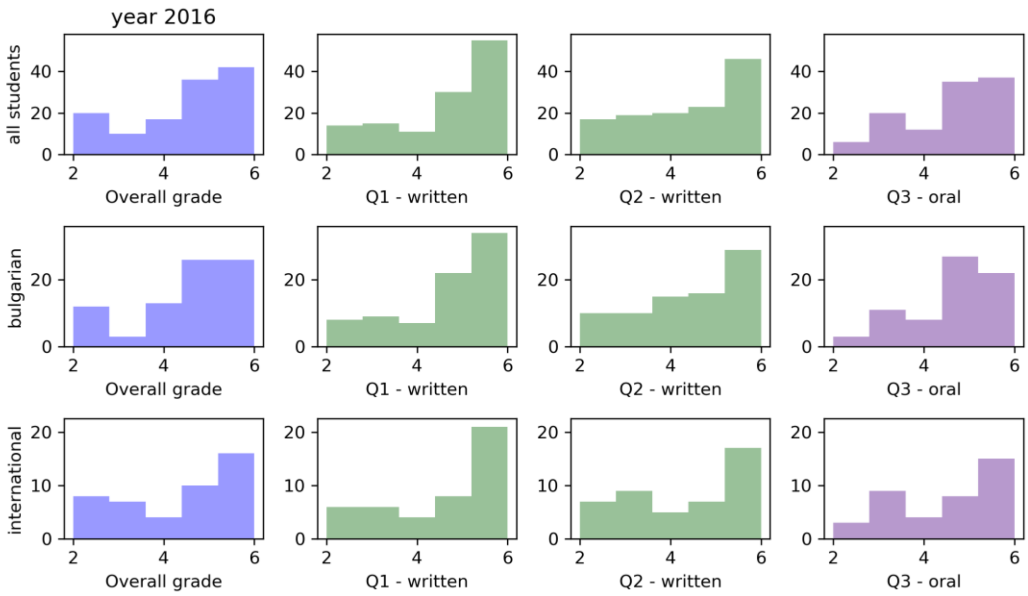

Figure 3. Assessments of the Biophysics Theoretical Exam in 2016. The explanations for the individual figures are the same as in Fig. 2.

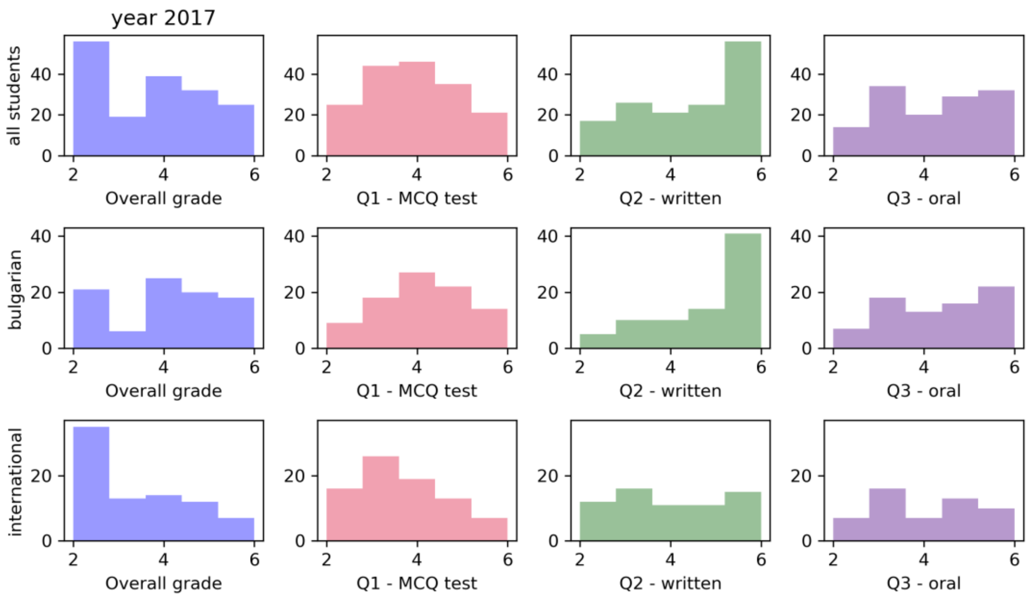

Figure 4. Assessments of the Biophysics Theoretical Exam in 2017. The explanations for the individual figures are the same as in Fig. 2.

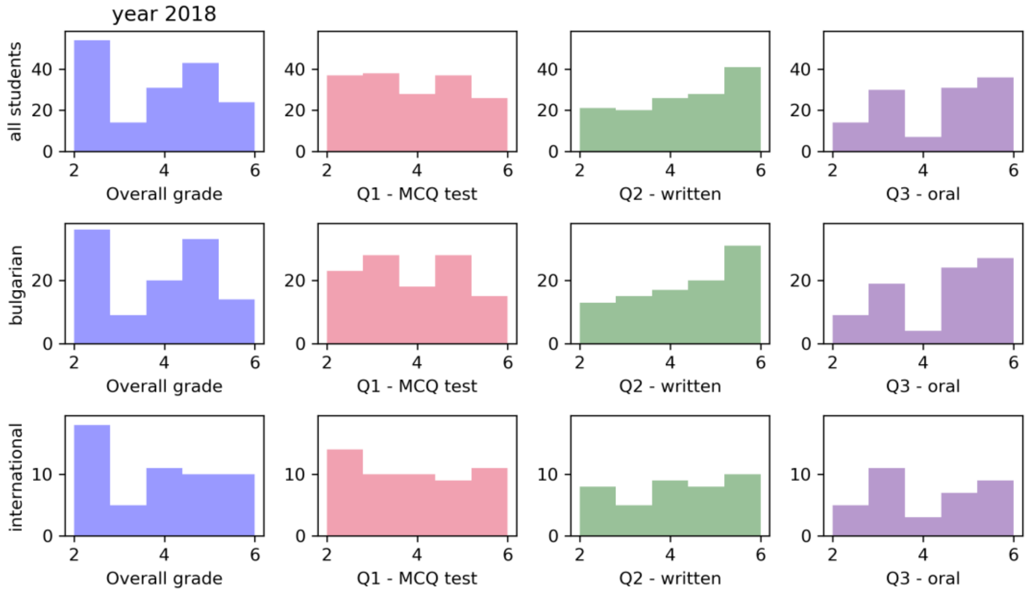

Figure 5. Assessments of the Biophysics Theoretical Exam in 2018. The explanations for the individual figures are the same as in Fig. 2.

Figure 2 and Figure 3 show that in 2015 and 2016, excellent and very good grades (grades 5 and 6) are the predominant ones for both the written and orally answered questions. There is no significant difference between the results of Bulgarian and international students. In 2015, the International students' written answered questions have a slightly higher number of poor marks, which has led to a relatively high number of low grades for this year. In 2016, there is no difference between Bulgarian and International students and the number of low grades (grade 2 or FX) this year is the lowest and the average grade is highest.

In 2017 and 2018, the introduction of the Multiple-choice questions test (MCQ test) as component of the exam significantly affected the results, which can be seen from Figure 4 and Figure 5. The profiles of the histograms of the MCQ test marks differ significantly from the profiles of the written answered questions marks from the previous years (Q1-written and Q2-written) in 2015 and 2016), as well as, from the written answer marks (Q2-written) in the same year.

In 2017, the distribution of MCQ test marks (Q1-MCQ) is close to normal, but international students' marks are slightly lower. Despite this normal distribution, the number of poor MCQ test marks was increased compared to the marks on the written questions from previous years. The international students' marks on the Q2-written question this year (2017) are also significantly lower than their marks on written questions from the previous two years. The portion of poor marks of their written question is also much higher in comparison with Bulgarian students and this increases the final number of low grades (grade 2 or FX) this year.

The results of 2018 are qualitatively like those of 2017 but even lower. The MCQ test proved again very difficult for the International students, but this year the Bulgarian students had very poor results too. The MCQ test marks distributions for both kinds of students are almost uniform (i.e. rectangular). Bulgarian students, however, predominantly have mark 3 and mark 5, while International students have predominantly mark 2. Assessments of the written-answered question of International students (Q2-written) again show a distribution close to rectangular, with a large number of marks 2, FX. This leads to an increase in the portion of grade 2 in the final grade of the theoretical exam.

It should be noted that the MCQ test is generated automatically on a random basis from a database of questions that have not changed for the two years. The questions of International and Bulgarian students are the same. Also, most questions are given to students during the semester as smaller quizzes. Comparison of the MCQ test marks and the written questions marks, especially of the Bulgarian students, can be interpreted in the context of learning and training traditions of the medical students in Bulgaria. The Biophysics exam takes place in their first year in University. During their high school education, future medical students were emphasizing chemistry and biology to prepare for the applicant exams. They have experience in reproducing learned topics. Although the MCQ test comprises familiar material, the students make it difficult to answer questions that require "combining" the accumulated knowledge.

4 Conclusion

The answer to the initial question about the reasons for the poorer achievements in 2017 and 2018 is not straightforward. Introducing the MCQ test as a component of the exam results partly in lower grades as it increases the portion of poor marks compared to marks on written answered questions. The other reason is the achievements of international students in these two years. Unlike 2015 and 2016, when they show similar performance with Bulgarian students, in 2017 and 2018 the achievement of international students is very poor. This conclusion is extremely important as it is relevant to the quality of the recruitment process for international students studying in English.

Data Science methods and tools can be successfully applied to analyze results in a particular subject. The analysis allows to show obvious trends and to extract hidden trends. The last one is extremely important for the overall management of the educational and learning process.

References

Grus, J. (2015): *Data science from scratch: first principles with Python*. O'Reilly Media

Internet Sources:

https://www.newgenapps.com/blog/artificial-intelligence-vs-machine-learning-vs-data-science, accessed 2019

https://en.wikipedia.org/wiki/Machine_learning, accessed 2019

Enhanced Elearning Application for Data Mining in a NoSQL Distributed Database Management System

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Abstract

The evolution of data acquisition systems, communication technologies, artificial intelligence techniques and computing power has generated a world that is dependable on knowledge. Knowledge represents useful information extracted usually from raw data that is stored in centralized or distributed database management systems(DBMS). Because of the explosion of raw data extracted by IoT devices(consumer, enterprise and industrial), storing data only in classical relational database management systems became unfeasible. This paper presents the second version of an experimental Elearning application that allows students to mine data with an Distributed Committee Machine architecture not only in classical relational DBMS but also in a NoSQL DBMS(in this version we introduced the support for the MongoDB DBMS). The implemented application works both in a centralized manner and in a distributed way. The synchronizing data across multiple servers was made using the replication process offered by MongoDB. The students can select one of the three classical data sets: iris1, wine1 and conc1. They have also the option of classifying data with the classical multilayer perceptron, an autoresetting multilayer perceptron or with an adjustable pulsating perceptron. Because of the replication process the data sets will be safe and available without having downtime for maintenance. The application will function in such a manner that if a node from the system fails all the classifying results that were obtained prior to the failure will be saved on all other nodes.

Keywords: Elearning, Distributed Data Mining, Distributed Database Management Systems, Machine Learning, NoSQL, Non-relational

1 Introduction

Nowadays people are overwhelmed with data acquired from multiple sources. Moreover, with the development of IoT devices the amount of data seems ever-increasing. The gap between the actual storing data capacities and the benefits that we get from extracting useful information from the mined data is increasing. Although everyone tries to obtain knowledge from big data sets nowadays we find another trend: the returning to the small data field. Many researchers prefer to have specialized small data sets that are obtained from good sources rather than big data sets obtained from unreliable and uncontrolled sources. Another problem is that the development of enterprise applications in the industry involves the use of several types of database systems: homogeneous database systems, multi-database systems and federated database systems. Almost all of these systems involve working with different data models: relational, non-relational, object relational and object oriented.

In this paper we show the improvements that have been made to the application presented in previous works (Pupezescu, V., Dragomir, M., 2018). Now, in the enhanced version, the application allows the same functioning that we had with a classic relational DBMS(MySql) but with a non-relational DBMS(MongoDB). The application uses different variants of the multilayer perceptron(classical version, pulsating multilayer perceptron and an autoresetting multilayer perceptron) that will work in a distributed manner in order to achieve the classification task. The new version of application can now work with a real non relational DBMS - in our case we choose to add MongoDB because of its good scaling capabilities. Because of this approach, students will have the opportunity to work with small, medium and large data sets on a scalable architecture.

2 Application Architecture

In Figure 1 we present the current architecture of the application that uses MongoDB. In the presented structure we have the primary MongoDB node that is on the same computing machine with the combiner module of the Distributed Committee Machine(DCM). The secondary nodes contain their local copy of data sets and results and the neural structures that run locally. In this structure, the primary node receives all write operations (as seen in "Replication in MongoDB").

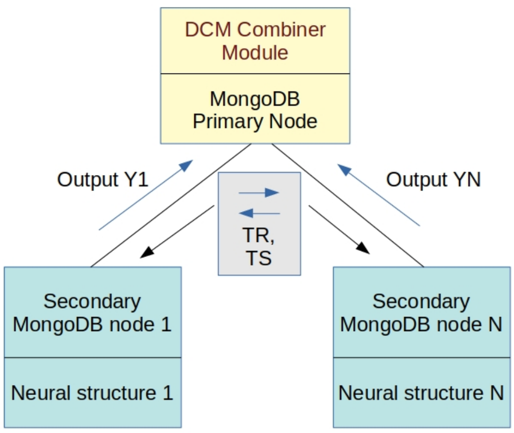

Figure 1. The implementation of DCM architecture with the MongoDB DBMS

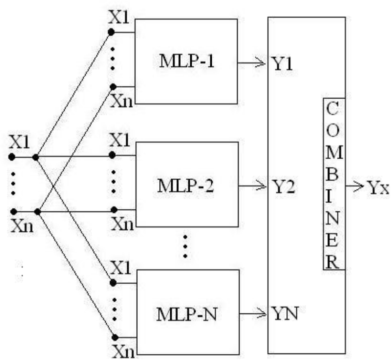

Figure 2. Distributed Committee Machine (Pupezescu, V., Rădescu, R., 2016)

In Figure 2 we show the theoretical representation of a DCM.

In the implemented version of this architecture there are TCP Java servers that run on port 3001. All these servers wait for the initial setup parameters for the neural networks. The combiner module sends the initial data to all the distributed nodes. All the nodes contain a multilayer perceptron(or a variant) that will achieve the classification task. The neural structure type is chosen by the students that work on the machine which contains the combiner module. The secondary nodes will write the classification results on the combiner module and through the replication process all the results will be available to the distributed nodes. This DCM works with the "winner takes all" policy.

All the application was developed in the Ubuntu Linux 18.04 Operating System in Java. The implementation was done in Eclipse IDE 2019-06. All the server instances of MongoDB run also in Linux.

3 Data Preparation for the MongoDB DBMS

The data sets that can be mined by the students/users using the application are iris1, wine1 and conc1 data sets (http://mlr.cs.umass.edu/ml/datasets/Iris, http://mlr.cs.umass.edu /ml/ datasets/Wine).

On of the most time consuming part of the Knowledge Discovery Process is the data preparation for the data mining task(in our case - classification).

Since we had from our previous version of the application the data stored in MySql we had to migrate that data to MongoDB DBMS.

First we exported with the MySql Workbench tool the data sets in JSON format. Secondly, we imported the resulted files with MongoDB commands such as this:

mongoimport --db iriswineconcrepl --collection iris1trrtsr --file /home/JSON_Path/iris1trrtsr. json --jsonArray

In the previous command we see that the data will be stored in “iriswineconcrepl” database in the “iris1trrtsr” collection.

The data sets are arranged and stored in the MongoDB DBMS in the following format(just like in our previous work):

Table 1. iris1, wine1 and conc1 data sets (Pupezescu, V., 2016)

iris1	trr	tsr	trs	tss
Lines	100	50	100	50
Columns	3	3	4	4
wine1	trr	tsr	trs	tss
Lines	90	88	90	88
Columns	3	3	13	13
conc1	trr	tsr	trs	tss
Lines	200	100	200	100
Columns	1	1	2	2

In MongoDB the data is stored in this format:

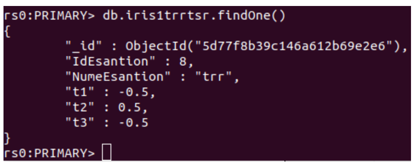

Figure 3. Data format for the iris1trrtsr collection

After the import of all data we implemented the replication process for all the distributed machines. One advantage of the MongoDB DBMS is that we can configure multiple server instances on the same machine on which runs the primary node. So everything can be run on the same machine. This is a very important feature of this DBMS because students can run the entire application(if they wish so for development purposes) on the same computing machine(as seen in “Deploy a Replica Set for Testing and Development”) - the execution will work just like if there was a distributed run. It is important to have this ability for the students in class because everyone can completely control their primary and secondary nodes.

In the following section we present the implementation of the replication process in MongoDB(as seen in “Deploy a Replica Set for Testing and Development”) for the application.

In the first step we created the necessary data directories for each member:

sudo mkdir -p /srv/mongodb/rs0-0 /srv/mongodb/rs0-1 /srv/mongodb/rs0-2

In the second step we started the mongod instances in their own shell windows:

sudo mongod --replSet rs0 --port 27017 --dbpath /srv/mongodb/rs0-0

sudo mongod --replSet rs0 --port 27018 --dbpath /srv/mongodb/rs0-1

sudo mongod --replSet rs0 --port 27019 --dbpath /srv/mongodb/rs0-2

In the third step we connect to the first node in a new Linux terminal with the command:

mongo --port 27017

In the forth step we configure the replication parameter rsconf:

rsconf = {_id: "rs0", members: [{_id: 0, host: "localhost:27017"}, {_id: 1, host: "localhost:27018"}, {_id: 2, host: "localhost:27019"}]}

For experimental purposes we configured all MongoDB server instances on the same computing machine. Every instance works on a different port (27017 - primay node, 27018 - secondary node and 27019 - secondary node).

The configuration is initiated with the following command:

rs.initiate(rsconf)

The students can see the replication configuration with the command:

rs.conf()

In the fifth step, the students can enter in other terminal window on the secondary server instances:

mongo --port 27018

mongo --port 27019

On every secondary node they must run the following command:

rs.slaveOk()

At this stage, every MongoDB node should have the same data sets replicated.

We can test this by running the command “use iriswineconcrepl” on all secondary nodes, followed by verifying the data on all nodes (including the primary node) with the next command(with this command we search a certain document in the collection):

db.iris1trrtsr.find({"_id":ObjectId("5d77f8b39c146a612b69e2e6")}).pretty()

In Figures 4, 5 and 6 we see the query results which were obtained on each mongodb server instance. As we observe, the replication process was successful.

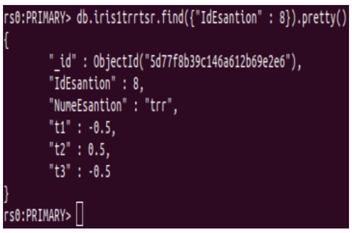

Figure 4. The query result on the primary node

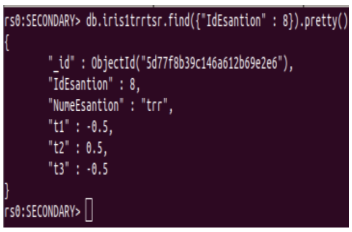

Figure 5. The query result on the first secondary node

Figure 6. The query result on the second secondary node

4 Experimental Distributed Committee Machine v1.1

In this section of the paper we present the enhancements that were made for the existing application.

We extended the existing web interface to include a new page named “Distributed execution in MongoDB”.

The user can navigate to it by using the left side menu, which was updated to include the new navigation link(see Figure 7).

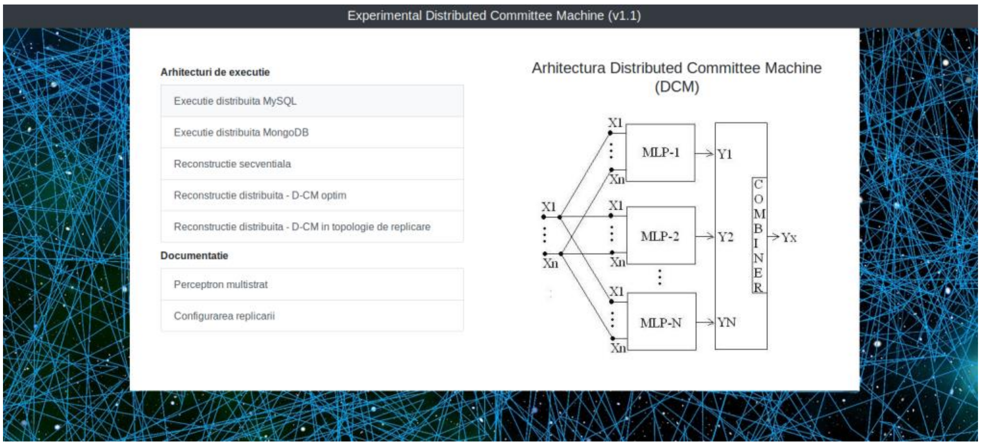

Figure 7. The index.jsp page

The main image on the homepage was updated to display the theoretical Distributed Committee Machine architecture.

The new page allows to configure the parameters described below, which are mandatory for running the classification experiment, in the context of replicating the available data sets by using the MongoDB DBMS.

The type of the neural network parameter can be selected from a dropdown list, with the following possible options: classical multilayer perceptron (MLP), Pulsating Perceptron (PP) and Autoresetting perceptron (Pupezescu, V., 2017). Although the default option for the neural network is classical multilayer perceptron, we chose for our experiments to work with the autoresetting perceptron(Figures 8, 9).

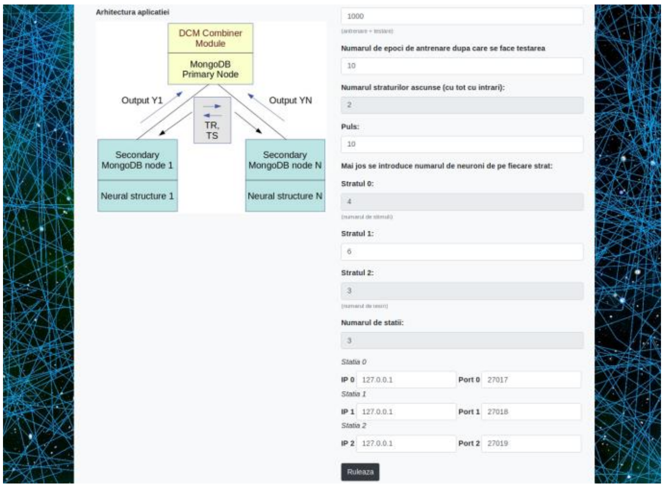

Figure 8. Setting the parameters in the start_mongo.jsp page

The other parameters are: Eta - the gradient descent step size, Lambda - the slope of the activation function, the number of epochs used for training and testing, the number of training epochs after which testing is performed, number of hidden layers, the number of distributed computing machines, protocol that was used for communication (TCP/UDP), Pulse - the maximum number of epochs after which the MLP resets itself if it gets blocked on a minimum value.

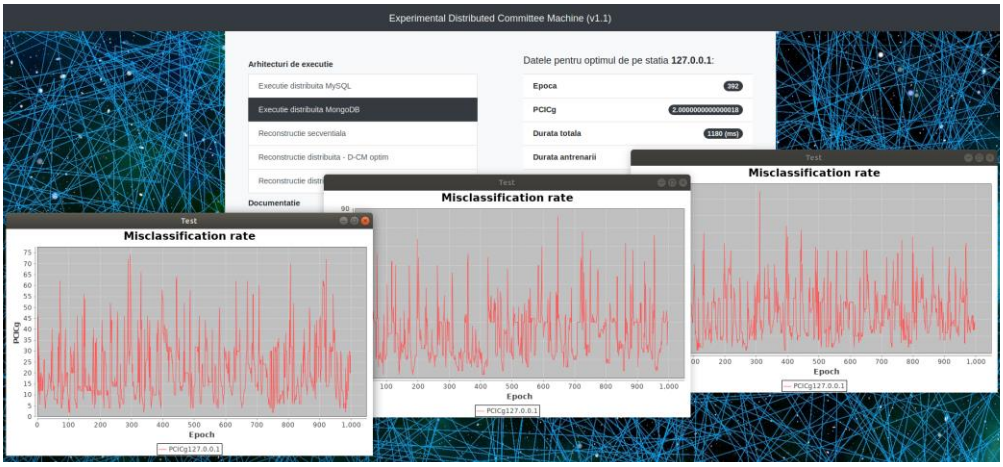

Figure 9. Distributed execution on three MongoDB server instances

To ensure a thorough understanding of the experiments we expanded the theoretical information on the parameter configuration pages (for MongoDB and MySQL DBMSs) by including figures that depict the application architecture for each of the two DBMS.

5 Conclusions

In this paper we presented the enhancements that were made for the previous version of application. The newest version allows the students to work with a distributed DBMS(MongoDB). All the data sets and classification results were replicated among the distributed working nodes through the replication process. The replica sets that were configured on the MongoDB DBMS provide redundancy and high availability for data. This is also achieved in the connectivity part of the project: the Java application was connected to the replica set; we specified the members of the replica set in the connection string.

In the next version we will work on securing the application. The main goal of this work is to allow students to understand in an experimental manner research fields such as Elearning, Data Mining, Knowledge Discovery in Distributed Databases and Machine Learning.

References

Pupezescu, V., Dragomir, M. (2018), *Experimental Elearning Application for Distributed Data Mining Systems* , 13th International Conference on Virtual Learning (ICVL-2018), pp.397-402, Romania, 2018.

"Replication in MongoDB," Mar. 13, 2019. Accessed on: Aug. 2, 2019. [Online]. Available: https://docs.mongodb.com/manual/replication/

Pupezescu, V., Rădescu, R. (2016), *The Influence of Data Replication in the Knowledge Discovery in Distributed Databases Process*, ECAI 2016 – International Conference – 8th Edition, 30 June – 02 July, Ploiești, ROMÂNIA, 2016.

http://mlr.cs.umass.edu/ml/datasets/Iris

http://mlr.cs.umass.edu /ml/ datasets/Wine

Pupezescu, V., (2016), *Distributed neural structures in adaptive eLearning systems*, Proceedings of the 11th International Conference on Virtual Learning(ICVL-2016), 2016.

"Deploy a Replica Set for Testing and Development". Mar. 13, 2019. Accessed on: Aug. 2, 2019. Available: https://docs.mongodb.com/manual/tutorial/deploy-replica-set-for-testing/

Pupezescu, V., (2017), *Auto Resetting Multilayer Perceptron in an Adaptive Elearning Architecture*, Proceedings of The 12th International Conference on Virtual Learning (ICVL-2017), pp.311-317, Octomber 28, Sibiu, ISSN: 1844-8933, 2017.

Design of Web Database Applications with Interfaces Containing Grids with Multiple Data Querying Possibilities

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Abstract

In the case of client interfaces for database applications, the grids are the central element for data control, they are complex for desktop applications but they are becoming more complex for WEB applications. Usually the grids display information from the databases and the information taken initially, are further refined by further filtering, or the query of the databases is resumed. Lately, repeated queries of web-based interfaces are increasingly being done using Object-Relational Mapping (ORM) techniques, which tend to increasingly replace the SQL code in WEB applications.ORM techniques have the advantage of standardizing access to databases regardless of DBMS but limit the complexity of the queries. In order to refine the data obtained in the grid, both processing can be used on the client side on the data already obtained or processing can be done on the server side, at the DBMS level. A simple filtering on the data already obtained can be achieved either at the client level by searching the uploaded data or on the server side by re-querying the database server. In the case of large volumes of data, these operations become critical. One solution could be to distribute tasks between client and server depending on the nature of the queries and the expected volume of data. In the present paper, a solution for optimal distribution of these tasks is proposed.

Keywords: DBMS Design; WEB Client ; Grid Interface.

1 Introduction

Database applications involve the existence of a client interface capable of retrieving data transmitted by the DBMS and possibly allowing the client to update this data. The most common control used to display data from databases is the grid. Regardless of the type of client interface, descktop or web, the final form of the information that is displayed within the cells is text type.

Often on the data received in the grid the user will perform various filtering or sorting in order to find certain data. These operations can be performed both at the client interface level, through javascript functions that process the received block of data in json format, as well as at server level by repeating the database query.

Also techniques from Object Relational mapping (ORM)[1] can be used, but for complex queries, the commands and functions specific to each DBMS are used. The analyzed cases are customized for relational databases.

2 Common architectures

For desktop applications the grids are more efficient, the implementation of the grid being closer to the machine code. In this case, the grid can retrieve data directly from the DBMS (figure 1).

Further developments; allowed for persistent links with databases to develop classes that would ensure a continuous connection between the grid and the corresponding table in DBMS (figure 2). For desktop applications, the grids have implemented a virtualization mechanism which builds only the grid for the data of interest given by the position of the scrollbars. Thus it is drawn only the grid of interest keeping the feeling of a compact grid with hundreds of thousands of recordings or even more.

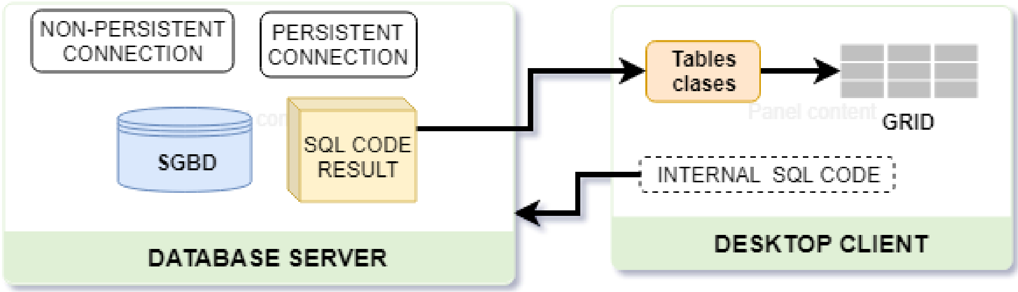

Figure 1. Simple desktop interface grid

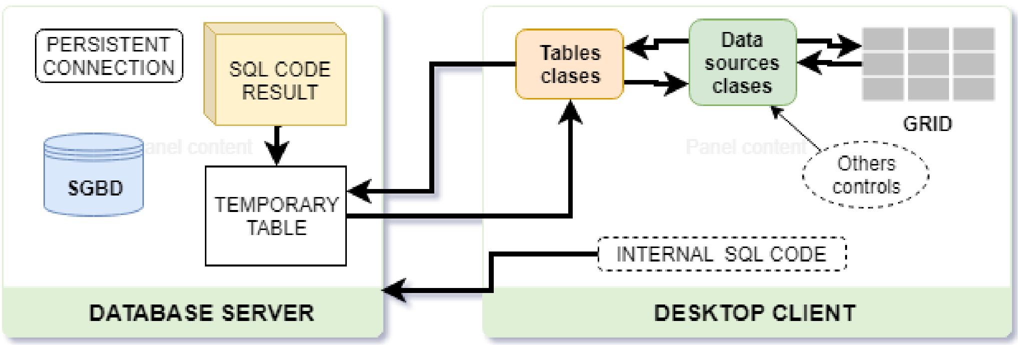

Figure 2. Desktop interface grid with datasources classes

In the case of the web applications the simplest grid, it is built according to a structure with HTML nodes of type table in a static page and supplemented with values from a DBMS (figure 3).
Due to the easy disconnection of WEB client applications, many connections with DBMS are non-persistent.

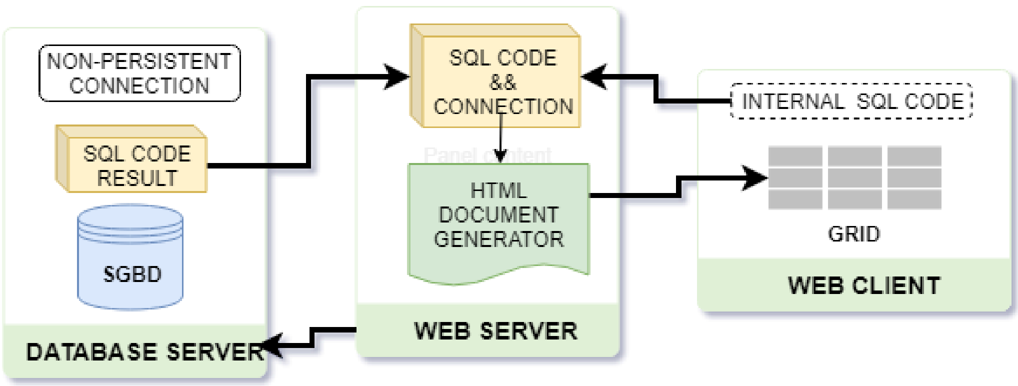

Figure 3. Simple grid interface for client web

However, the grids can be built dynamically on the client page based on the data received from the DBMS.

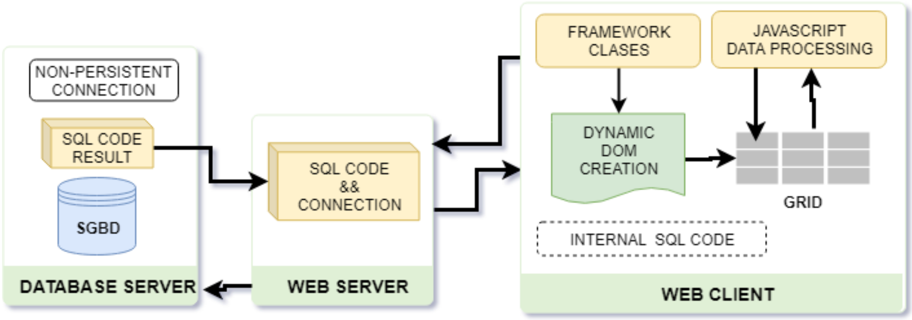

Figure 4. Grid in dynamic client web interface

The Model View Controller architecture [2] is one of the representative ones for the client graphical interfaces, the data representing the central point (the model)[3].

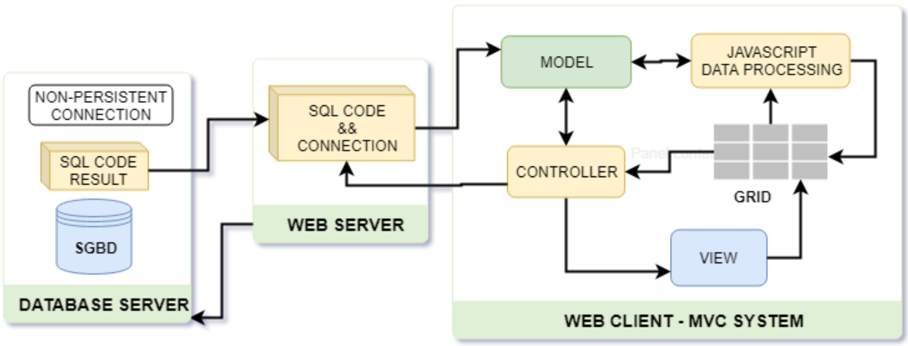

Figure 5. Grid in MVC client web arhitecture

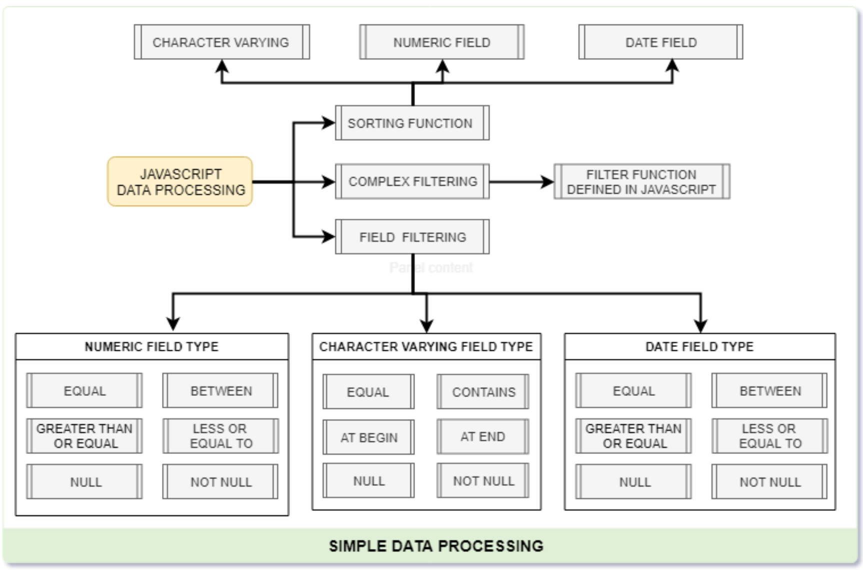

Figure 6. Simple data processing on a data block

Once the data is retrieved, the user performs additional refining of the data already obtained. Through these operations the user narrows the area of interest data search. Figure 6 shows the main types of operations that the user performs after he has taken the data.

3 Proposed architecture

The operations performed on the data by the DBMS are more precise and faster than the ones performed at the client interface level in javascript.

Tabl1 1. Choosing the query method

Field Type	Operation	Possible Problems	Choice
Character varying	sort	-	Client- Javascript
	Filter without pattern	-	Client- Javascript
	Filter with pattern	Possible errors due to the encoding compatibility on the client side	Server - SQL
Numeric	sort	Possible errors due to the regional numeric representation	Client- Javascript
	filter	Possible errors due to the regional numeric representation	Server - SQL
Date	sort	Possible errors due to the regional date setting	Client- Javascript
	filter	Possible errors due to the regional date setting	Server - SQL
Complex filter with dedicated function			Server - SQL

The speed of transfer between client and server and the volume of data can influence the choice of solution. The functions on the server side of the DBMS allow a dynamic implementation of the queries, so the operations of refining the obtained data can be implemented on the server side, the client only transmits the selections made, the query is dynamically built on the server side. In this case, the old result in the client area is replaced entirely with the new result. In case of client-level query, the data block was kept. Also the number of clients can influence choice of solution, it directly influencing the speed of data transfer.

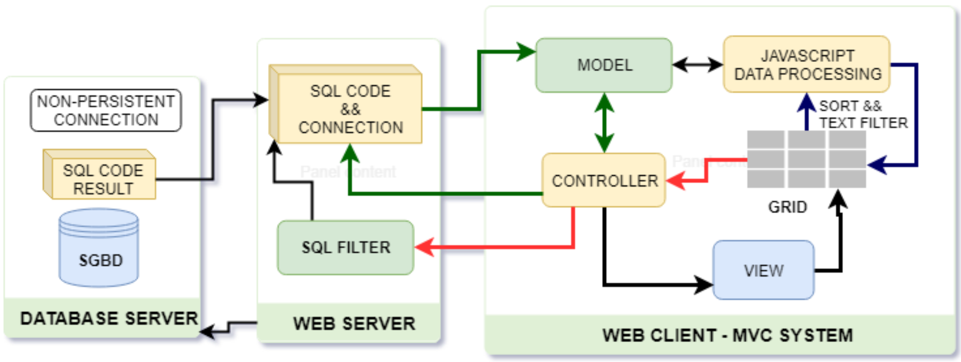

Figure 7. One possible solution

In figure 7 it is proposed that only the sorting and filtering of text type remain on the client side the rest of the operations being on the server side.

4 Conclusions

By using subsequent filtering on the server side, the total number of accesses on the server increases and at the same time the access times on the server increase, but the server-level queries are faster and more precise than those on the client side. If this is the case, you can opt for a distributed system on the server side to reduce access times.

For high transfer speeds, a solution closer to the server is preferred.

As for the editing of the grids, this is preferable to be done in a separate form. Direct grid editing implies the existence of both a unique grid control key and a marker for modified records and is justified only if you want to create a single transaction at the whole grid level.

References

[1] Contiu A., https://www.todaysoftmag.ro/article/73/analiza-mecanismului-object-relational-mapping-orm-cu-exemplificari-hibernate (active 2019)

[2] https://www.yiiframework.com/doc/guide/1.1/ro/basics.mvc (active 2019)

[3] https://www.guru99.com/mvc-tutorial.html (active 2019)

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Mathcad interactive didactic tools for calculating the magnetic force

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Abstract

This paper describes two interactive didactic tools, made with Mathcad worksheets, for the calculation of the magnetic force acting on a current-carrying wire, placed in a uniform magnetic field. The first tool deals with the case of a straight wire whereas the second one deals with the case of a wire in the shape of a circular arc. The wire-magnetic field configuration is specified in the input data by means of a Cartesian coordinate system. It shows how the Mathcad vectorial computing facilities can be explored, and in particular the use of the cross product. The orthogonality of vectors the length-wire, magnetic induction and magnetic force are verified and some particular cases of guiding the wire to the magnetic field are analyzed. The paper also highlights the friendly interface of Mathcad and its ease of use in solving Physics problems. The classroom use of these tools helps students develop their skills of vector calculus and mathematical analysis in the study of electromagnetic phenomena. Thus, students can clarify the concept of cross product and can make a first step towards understanding the concept of line integral.

Keywords: Mathcad, didactic tools, magnetic force, cross product, Physics Education.

1 Introduction

The ways of teaching and learning the fundamental concepts of Electromagnetism with the help of the computer are the subject of study of numerous articles and papers in the literature. The basic chapters of Electromagnetism have been approached alternatively with a wide range of computer resources and programs, such as conceptual mapping programs, animation programs, Excel spreadsheets, the Matlab, Mathcad, SMath Studio programs, etc.

It has been shown that the Mathcad program, due to an easy-to-use interface, can be an effective tool for learning Electromagnetism and concrete examples have been given for the use of this program in solving electrostatic problems, wave propagation and antennas (DeLyser, 1996) . The use of both Mathcad and other programs such as Visual Basic, Matlab, Femlab has been described as an interactive integrated environment for virtual experiments to effectively teach both the theory and practical aspects of Electromagnetism (Mukhopadhyay, 2006). Excel and the associated VBA code have helped exemplify the calculation of the electrostatic field for a linear distribution of electric charge, the numerical solution of Poisson’s equation with axial symmetry and the calculation of the magnetic field generated by a circular loop of electric current (Assimakopoulos, 2000). With the help of the Matlab program there have been described interactive tools for teaching and evaluating knowledge in Electromagnetism. With these tools the students were able to explore, at their own pace, relevant equations of electrostatics, magnetostatics, electromagnetic field and transmission lines (Espinosa and Thiel, 2017). The approach to physics problems with SMath Studio was also discussed. The computing power and facilities of this program have been exemplified in the study of the diffraction network (Atkin, 2019 a). Also with SMath Studio, an example of mathematical modeling of the interaction forces between atomic and subatomic particles was shown through an analogy with the interaction between small magnetic disks placed in certain configurations in relation to each other (Atkin, 2019 b).

Various tools for teaching and learning Electromagnetism have also been developed by the authors of this paper. Thus, using the IHMC Cmap Tools program, a conceptual map with resources was presented in order to facilitate the teaching of fundamental concepts in Electromagnetism starting from Maxwell's equations (Grigore et al, 2013). Tools with Excel spreadsheets have been described for simulating the RLC series circuit of alternating current (Grigore, 2013), for studying the relativistic transformation of the electromagnetic field (Grigore and Barna, 2014) and for studying the transient regime in the RC circuit (Grigore et al, 2016).

In this paper we describe two Mathcad interactive teaching tools for the calculation of the magnetic force acting on a wire crossed by electric current, placed in a uniform magnetic field. The first tool deals with the case of a straight wire whereas the second one deals with the case of a wire in the shape of a circular arc. The direction of the electrical current from the wires as well as the dimensions and orientation of the wires with respect to the magnetic field are specified in the input data using a Cartesian reference system.

The respective tools explore the vector computing facilities of the Mathcad program and, in particular, the use of the cross product operation for the calculation of electromagnetic force. The orthogonality of the vectors of length-wire, the magnetic induction and the magnetic force are verified and several particular cases of current guiding towards the magnetic field are analyzed.

2 Theoretical background

Considering a straight wire through which a current I flows, placed in a uniform magnetic field, the magnetic force $\vec{F}$ acting on the wire is given by the equation (Serway and Jewett, 2013):

[1] $\vec{F} = I(\vec{l} \times \vec{B})$

where $\vec{l}$ is the wire length vector and $\vec{B}$ is the magnetic induction vector. The wire length vector has the direction and sense of the current in the wire and the magnitude equal to the length of the wire in the magnetic field.

In the case of a wire of arbitrarily shape, with uniform cross section in a magnetic field, the magnetic force, $d\vec{F}$, acting on the infinitesimal element of wire dl, is:

[2] $d\vec{F} = I(d\vec{l} \times \vec{B})$

The vector $d\vec{l}$ has the magnitude equal to the elementary length dl, but the direction and sense of the current from the infinitesimal element of the wire.

By making the line integral along the length of the wire in equation (2), we obtain the magnetic force acting on the entire curved wire:

[3] $\vec{F} = I\int_C d\vec{l} \times \vec{B}$

For a uniform magnetic field, the magnetic induction vector is constant and equation (3) becomes:

[4] $\vec{F} = I\left(\int_{P_1}^{P_2} d\vec{l}\right) \times \vec{B} = I\vec{l}' \times \vec{B}$

where P_1 and P_2 represent the points delimiting the wire placed in the magnetic field and the vector $\vec{l}'$ unites the point P_1 with the point P_2.

We observe the similarity between equations (1) and (4) with the difference that the vector $\vec{l}$ has been replaced by the vector $\vec{l}'$. Therefore, in a uniform magnetic field, for the calculation of the magnetic force, we can replace the curved wire with a straight wire specified by the vector $\vec{l}'$.

3 Organization of Mathcad worksheets

The didactic tools for the calculation of the magnetic force are made up of two Mathcad documents which are presented below.

Figure 1 shows the Mathcad window of the first tool that deals with the case of the straight wire. The Mathcad window comprises three sections, namely, Input Data, Solution and Results. The magnetic field-wire configuration, relative to the reference frame, is rendered by a drawing inserted next to the input data, on the right side of the window.

The Input Data section includes, in its turn, three subsections. In the first subsection, the value of the current through the wire is introduced, I. The second subsection specifies the geometry of the wire with respect to the reference frame. For this we have introduced the length of the wire, l, the angle θ between the wire and the axis Oz and the angle ϕ between the projection of the wire in the plane Oxy and the axis Ox. The third subsection specifies the orientation of the magnetic field with respect to the reference frame. For this we introduced the magnetic induction vector magnitude, B, the angle between the magnetic induction vector and the axis Oz, θ_B, and the angle between the projection of the magnetic induction vector in the plane Oxy and the axis Ox, ϕ_B. Each value entered in the input data is accompanied by the corresponding unit of measure in SI.

In the Solution section, on the first two rows, we have written the calculation relations for the components of the wire length vector, l1, l2, l3 and for the components of the magnetic induction vector, B1, B2, B3, on the axes of the reference frame:

[5] $l1 := l \cdot \sin(\theta) \cdot \cos(\varphi) \qquad l2 := l \cdot \sin(\theta) \cdot \sin(\varphi) \qquad l3 := l \cdot \cos(\theta)$

[6] $B1 := B \cdot \sin(\theta\_B) \cdot \cos(\varphi\_B) \qquad B2 := B \cdot \sin(\theta\_B) \cdot \sin(\varphi\_B)$

$B3 := B \cdot \cos(\theta\_B)$

In the third row we have written the computation relations for the length-wire vectors, denoted by Vec_l, magnetic induction, denoted by Vec_B, and the magnetic force, denoted by Vec_F.

The length-wire and magnetic induction vectors were represented, using their components, by two 1x3 transposed matrices. For the force vector, we have transcribed in the Mathcad window the equation (1) taking into account the previous notations:

[7] $Vec\_l := (l1 \quad l2 \quad l3)^T \qquad Vec\_B := (B1 \quad B2 \quad B3)^T$

[8] $Vec\_F := I \cdot (Vec\_l \times Vec\_B)$

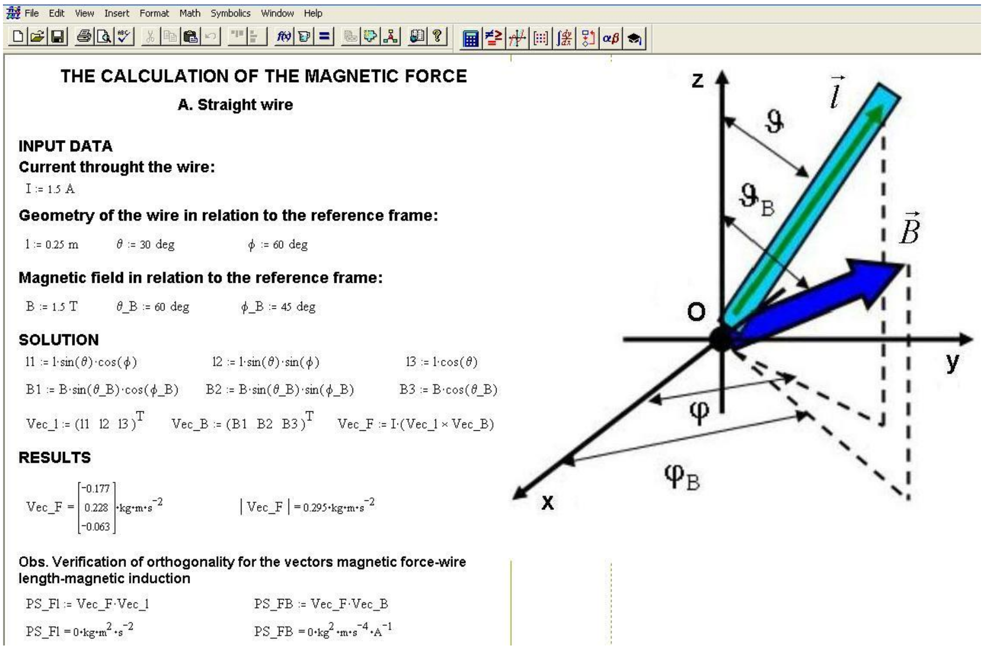

Figure 1. The Mathcad window of the tool for the calculation of the magnetic force acting upon a straight wire

The Results section includes the numerical evaluation of the calculation relationships in the Solution section with the values from the input data. Thus, in this section, the magnetic force vector is displayed as a 1x3 column matrix and the magnetic force magnitude. The display of the units of measure in SI after the values of the final results can be observed.

As an addition, after the Results section, we have verified the orthogonality of the vectors magnetic force, wire-length and magnetic induction. For this we have written the calculation relations for the dot product between the force vector and the wire-length vector, denoted by PS_Fl, and, respectively, the dot product between the force vector and the magnetic induction vector, denoted by PS_FB:

[9] $PS\_Fl := Vec\_F \cdot Vec\_l \qquad\qquad PS\_FB := Vec\_F \cdot Vec\_B$

In the following row, we have calculated the two dot products with the values of the vectors components from the input data and observed that they are null. As a result, it is verified that the magnetic force, magnetic induction, and wire-length vectors are perpendicular to each other.

If the electric current through the wire is in the direction and sense of the axis Ox and the magnetic field in the direction and sense of the axis Oy, then, taking into account equation (1), the magnetic force will be in the direction and sense of the axis Oz. In order to verify this situation we have set in the input data the values θ=90°, ϕ=0 and θ_B=90°, ϕ_B=90°. The Results section of this particular case is shown in Figure 2. It is observed that the force vector has a component only on the Oz axis.

$$Vec\_F = \begin{bmatrix} 0 \\ 0 \\ 0.563 \end{bmatrix} \cdot kg \cdot m \cdot s^{-2} \qquad\qquad |Vec\_F| = 0.563 \cdot kg \cdot m \cdot s^{-2}$$

Figure 2. The Results Section of the Mathcad window in the particular case when the current through the straight wire is in the direction and sense of the Ox axis and the magnetic field in the direction and sense of the Oy axis

If both the current through the wire and the magnetic field are in the same direction, then the magnetic force vector is zero. We can easily verify this particular case by considering the wire and the field, for example, on the Ox axis. For this we set in the input data θ=90°, ϕ=0 and θ_B=90°, ϕ_B=0. In the Results section, the force vector represented by the column matrix with null components will be displayed.

Figure 3 shows the Mathcad window of the second tool which deals with the case of the wire of arbitrarily shaped as a circular arc. The Mathcad window of this tool was organized in a similar way to the Mathcad window of the first tool, comprising the same sections and subsections. In addition to the first tool, an alternative solution to calculate the magnetic force is presented after the Results section. As with the first tool, the wire-magnetic field configuration is rendered by a drawing inserted next to the input data on the right side of the window. We have considered the wire as being the quarter of a circle placed in the Oxy plane of the reference frame.

In the input data, after the current through the wire, we have specified the geometry of the wire with respect to the reference frame by the radius of the circle, R, and the polar angles ϕ1 and ϕ2 that delimit the arc of the circle in the Oxy plane. In the same way as with the first tool, we have specified the magnitude and orientation of the magnetic field in relation to the reference frame.

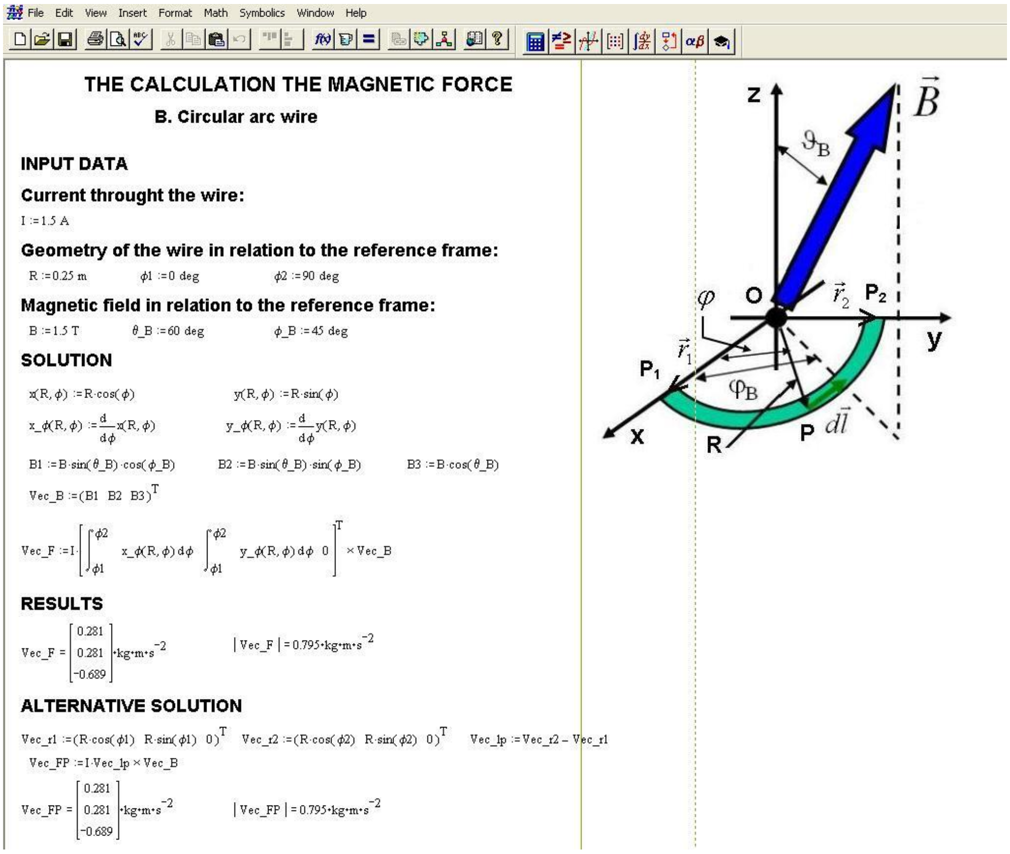

Figure 3. The Mathcad window of the tool for the calculation of the magnetic force acting upon a wire in the shape of a circular arc

For the calculation of the magnetic force using equation (3), in the case of a wire of arbitrarily shape, we first express the Cartesian coordinates x, y of the infinitesimal element of the wire, dl, depending on the radius R and the polar angle ϕ:

[10] $x = R\cos\varphi \qquad y = R\sin\varphi$

Because the radius R remains constant and only the angle ϕ varies, we can write:

[11] $$d\vec{l} = dx\cdot\vec{i} + dy\cdot\vec{j} = \frac{dx(R,\varphi)}{d\varphi}d\varphi\cdot\vec{i} + \frac{dy(R,\varphi)}{d\varphi}d\varphi\cdot\vec{j}$$

where dx and dy represent the infinitesimal length elements of the wire on the axes Ox and Oy of the reference frame and $\vec{i}$ and $\vec{j}$ represent the unit vectors of the two axes.

As a result, the line integral from equation (3) will be reduced to an integral defined on the variation range of the polar angle ϕ between the integration limits ϕ_1 and ϕ_2 which delimit the arc of the circle:

[12] $$\vec{F} = I\left(\int_{\varphi_1}^{\varphi_2}\frac{dx(R,\varphi)}{d\varphi}d\varphi\cdot\vec{i} + \int_{\varphi_1}^{\varphi_2}\frac{dy(R,\varphi)}{d\varphi}d\varphi\cdot\vec{j}\right)\times\vec{B}$$

In the Mathcad window, after writing the calculation equations for x and y in relation to R and ϕ, we have calculated the derivatives of the measures x and y according to the polar angle, denoted by x_ϕ(R,ϕ) and y_ϕ(R,ϕ). Transposing equation (12) in the Mathcad window, it becomes:

[13] $$Vec\_F := I\begin{bmatrix}\int_{\varphi 1}^{\varphi 2} x\_\varphi(R,\varphi)d\varphi & \int_{\varphi 1}^{\varphi 2} y\_\varphi(R,\varphi)d\varphi & 0\end{bmatrix}^T \times Vec\_B$$

In the Results section, the magnetic force vector and its magnitude are displayed.

The section Alternative solution equation (4) was explored for the calculation of magnetic force. Thus, after writing the position vectors $\vec{r}_1$ and $\vec{r}_2$ of the points P_1 and P_2 which delimit the wire, we have calculated the difference vector $\vec{l}\,'$ between $\vec{r}_2$ and $\vec{r}_1$ and then transposed equation (4) into Mathcad. It can be noticed that the same results are obtained.

$$\text{Vec\_F} = \begin{bmatrix}0\\1.125\\0\end{bmatrix}\cdot\text{kg}\cdot\text{m}\cdot\text{s}^{-2} \qquad |\text{Vec\_F}| = 1.125\cdot\text{kg}\cdot\text{m}\cdot\text{s}^{-2}$$

Figure 4. The Results Section of the Mathcad window in the particular case when the wire is a semicircle in the Oxy plane, the electric current through the wire is counterclockwise and the magnetic field is in the direction and sense of the Oz axis

As with the first tool, we can verify some particular cases. For example, suppose we extend the wire to a semicircle in the Oxy plane and the current through the wire is counterclockwise. For a magnetic field in the direction and sense of the axis Oz, the magnetic force will be in the direction and sense of the axis Oy. This particular situation can be easily verified if we set in the input data the values ϕ1=0, ϕ2=180° and θ_B=0, ϕ_B=0. The Results section of this particular case is shown in Figure 4. It is observed that the magnetic force vector has a component only on the Oy axis. For a circular loop wire, regardless of the orientation of the magnetic field, it can be verified that the magnetic force vector is zero.

4 Conclusions

The use of the tools described in this paper in the classroom can help students develop the skills of vector calculus and mathematical analysis necessary in the study of electromagnetic phenomena. Thus, the analysis of the various wire-magnetic field configurations with the respective tools can contribute to a better understanding of the properties of the cross product. At the same time, by calculating the magnetic force acting on a curved wire crossed by electric current placed in a magnetic field, students have the opportunity to clarify the concept of line integral.

Because the vector operations in Mathcad involve matrix computing, students can be encouraged to efficiently transfer various pieces of knowledge from Mathematics to Physics. Moreover, taking into account the facilities of the Mathcad program, students can check their abilities of working with the units of measurement that accompany the physical measures involved in the calculations.

References

Serway, R.A., Jewett, J.W. Jr. (2013): Physics for Scientists and Engineers with Modern Physics, 9th Edition, Thomson Brooks/Cole, ISBN-13: 978-1-133-95405-7.

Assimakopoulos, P.A. (2000) A Computer-Aided Introductory Course In Electricity And Magnetism, *Computing In Science & Engineering*, November/December, 2000, 88-93.

Atkin, K. (2019-a) Using SMath Studio in physics teaching, *Physics Education*, *54,2*, 025012.

Atkin, K. (2019-b) Using small disc magnets to model particle interactions, *Physics Education*, *54,3*, 035013.

DeLyser, R.R (1996) Using Mathcad in Electromagnetics Education, *IEEE Transactions On Education*, *39, 2*, 198-210.

Espinosa, H.G., Thiel, D.V. (2017) MATLAB-Based Interactive Tool for Teaching Electromagnetics, *IEEE Antennas & Propagation Magazine*, 140-146.

Grigore, I., Miron, C., Barna, E.S. (2016). The Study of the Transient Regime in Electric Circuits with Excel Spreadsheets, *Romanian Reports in Physics*, *68, 3*, 1281-1295.

Mukhopadhyay, S.C. (2006) Teaching electromagnetics at the undergraduate level: a comprehensive approach, *European Journal of Physics*, *27*, 727-742.

Grigore, I., Miron, C., Barna, E. S. (2013): Using the Conceptual Map Method in the Teaching of Fundamental Concepts of Electromagnetism, *In Proceedings of the 8th International Conference On Virtual Learning, Bucharest,* 2013, 66-72.

Grigore, I. (2013): Using Excel Spreadsheets to simulate the Electric Circuits of Alternating Current, *In Proceedings of the 8th International Conference On Virtual Learning, Bucharest,* 2013, 306-312.

Grigore, I., Barna, E.S. (2014): Excel Spreadsheets - Didactic Interactive Tools in the Exploration of Certain Properties of the Electromagnetic Field, In *Proceedings of The 10th International Scientific Conference eLearning and Software for Education*, Bucharest, April 24-25, 2014, **2**, 225-231.

Mathcad 7.0

Examples of using Excel spreadsheets to calculate the gravitational force

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Abstract

This paper describes two didactic tools made with the help of Excel spreadsheets that allow the calculation of the gravitational attraction force between two bodies. With the first tool we can calculate the gravitational force between a point mass and a thin uniform rod. With the second tool, built by modifying and expanding the first tool in the spreadsheet, we can calculate the gravitational force between two thin uniform rods. The spatial configuration of the bodies in the two situations is specified in the input data. The results are obtained both analytically and numerically in order to be compared to each other. The advantage of the classroom use of these tools lies in the ability to easily solve a gravitational field problem with a higher degree of difficulty through the facilities provided by the spreadsheet. The calculation of the gravitational force in the spreadsheet also provides a good opportunity to familiarize students with the concept of definite integral. Thus, by using the first tool, students can get acquainted with the simple integral, while by using the second one with the double integral.

Keywords: Spreadsheets, didactic tools, gravitational force, definite integral, Physics Education.

1 Introduction

Numerous specialized papers are dedicated to the teaching and learning of the theory of the gravitational field. From an educational point of view, the papers related to gravity fall into several main directions of study.

A first direction of study includes the critical analysis of the main teaching-learning problems and difficulties encountered by students in assimilating the concept of field. It has been investigated how students operate with the concept of field, especially in the field of Electromagnetism, when solving problems or answering questions (Greca and Moreira, 1997). The existing difficulties in defining the weight were discussed and the conceptual distinction between weight and gravitational force was analyzed (Galili, 2001). There have also been discussed problems related to the representation of the field by force lines, the difference between field and force, the connection between the field and its sources (Bradamonte et al, 2006). The efficiency of a new educational perspective for the learning of gravity was evaluated based on a presentation analogous to Einstein's theory of space-time deformation (Baldy, 2007).

Another direction of study regarding gravity includes the elaboration of tools for the simulation of the motion in the gravitational field. Thus, the simulation of the motion of a planet by solving Kepler's problem with Excel spreadsheets has been described (Benacka, 2014). Also with the help of spreadsheets, the motion of a projectile in the gravitational field was simulated in the presence of a resistive medium, in the case of the oblique launch (Grigore et al, 2017 a) or in free fall (Grigore and Barna, 2015; Grigore et al, 2017 b). With the GeoGebra programs, for the analytical modeling, and VPython, for the numerical modeling, the motion of the projectile in a uniform gravitational field was analyzed when, in addition to the gravitational force, an additional horizontal force acts (Marciuc et al, 2016).

In this paper we describe two didactic tools made with the help of Excel spreadsheets to calculate the gravitational attraction force between two bodies. Using the first tool, the gravitational attraction between a point mass and a thin uniform rod can be calculated. With the second tool, the gravitational attraction between two thin uniform rods can be calculated. The spatial configuration of the bodies in the two situations is specified in the input data. In the first case, the point mass is placed on the straight line determined by the thin uniform rod at a given distance from one of the ends of the thin rod. In the second case, the two thin uniform rods are in the same direction and the distance between the neighboring ends of the thin rods is specified.

The results are obtained both analytically and numerically so that they can be compared. The respective tools explore the Excel spreadsheet computing facilities in order to find the gravitational attraction force between bodies of different shapes. It is verified that when the dimensions of the thin uniform rods tend towards zero, we obtain the force of gravitational attraction between two point masses.

2 Theoretical Background

Let us consider a straight thin uniform rod of mass M and length l and a point mass m located at the distance a from the end of the thin rod, as shown in Figure 1. According to Newton's law of gravitational attraction, the gravitational attraction force dF between the m body and an infinitesimal mass element dM of the thin rod is (Halliday et al, 2013):

$$[1] \quad dF = k\frac{mdM}{r^2} \qquad dM = \frac{M}{l}dx \qquad r = a + x$$

where x represents the distance at which the element dM is in relation to the end of the thin rod and k represents the gravitational constant.

The gravitational interaction force between the bodies m and M is obtained by integrating equation (1) along the length of the thin rod of mass M:

$$[2] \quad F = \int dF = \int_0^l k\frac{mM}{l(a+x)^2}dx = k\frac{mM}{a(a+l)}$$

It can be noticed that if length l tends towards zero in equation (2), we obtain the expression of the gravitational attraction force between two point masses m and M placed at a distance from each other.

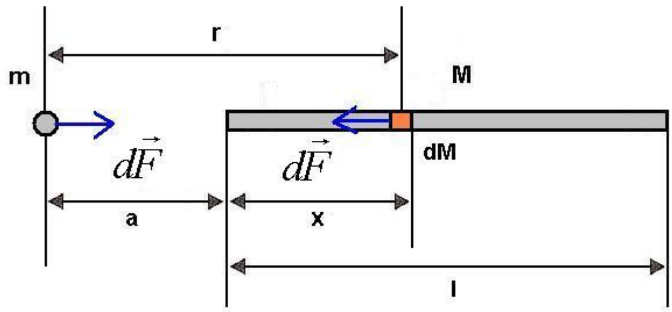

Figure 1. The gravitational interaction between a point mass m and a straight thin uniform rod of mass M

Let us now consider two thin uniform rods of masses M_1, M_2 and lengths l_1, l_2 so that the distance between their neighboring ends is a, as shown in Figure 2. The gravitational attraction force dF between two infinitesimal elements of masses dM_1 and dM_2 of those two thin uniform rods is:

[3] $$dF = k\frac{dM_1 dM_2}{(l_1 + a + x_2 - x_1)^2} \qquad dM_1 = \frac{M_1}{l_1}dx_1 \qquad dM_2 = \frac{M_2}{l_2}dx_2$$

where x_1 and x_2 represent the distances at which the elements dM_1 and dM_2 are in relation to the ends of the two thin rods.

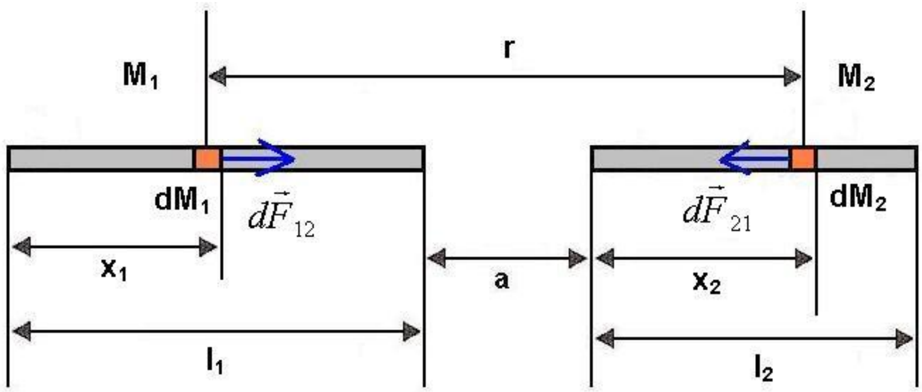

Figure 2. The gravitational interaction between two straight thin uniform rods of masses M_1 and M_2 placed on the same direction

The force of gravitational interaction between the bodies M_1 and M_2 is obtained by integrating equation (3) along the lengths of the two thin uniform rods:

[4] $$F = \iint_{1,2} dF = \int_0^{l_1}\int_0^{l_2} k\frac{M_1 M_2}{l_1 l_2}\frac{dx_1 dx_2}{(l_1 + a + x_2 - x_2)^2}$$

Performing the calculations, by solving the double integral in equation (4), results:

[5] $$F = k\frac{M_1}{l_1}\frac{M_2}{l_2}\ln\frac{(a+l_1)(a+l_2)}{a(a+l_1+l_2)}$$

If lengths l_1 and l_2 tend towards zero, then equation (5) is reduced to the expression of the gravitational attraction force between two point masses M_1 and M_2 located at distance a from each other.

3 Organization of spreadsheets

The first didactic tool described in this paper consists of a single spreadsheet whereas the second one of two spreadsheets.

Figure 3 shows the spreadsheet of the first tool with which the gravitational force between a point mass and a straight thin uniform rod is calculated. The spreadsheet comprises three sections, namely, Input Data, Results and an area for generating the table of values used in the numerical calculation of the gravitational force, entitled Numerical Approach.

GRAVITATIONAL FORCE		
DATA INPUT		
Gravitational constant, k [10^{-11} Nm^2/Kg^2]		6.67
Mass point, m [Kg]		0.50
Mass thin rod, M [kg]		1.00
Length thin rod, l [m]		0.80
Distance a [m]		0.60
RESULTS		
	Analytical	Numerical
F [10^{-11}N]	3.97	3.97
Numerical approach		
Number of intervals, n		100

No.	x_i [m]	r_i [m]	F_i [N]
1	0.008	0.604	0.0914
2	0.016	0.612	0.0890
3	0.024	0.620	0.0868
4	0.032	0.628	0.0846
5	0.040	0.636	0.0824
6	0.048	0.644	0.0804
7	0.056	0.652	0.0785
8	0.064	0.660	0.0766
9	0.072	0.668	0.0747
10	0.080	0.676	0.0730
11	0.088	0.684	0.0713

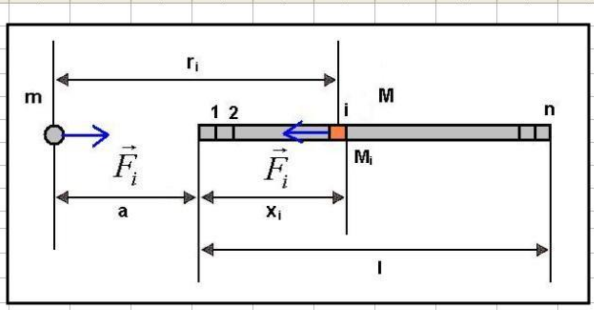

Figure 3. The spreadsheet of the tool for calculating the gravitational force between a point mass and a straight thin uniform rod

In the Input data section, delimited by the domain A3:D9, we enter the numeric values for the following measures:

- Gravitational constant, k, in cell D4, denoted Constant_G;
- Mass of the point mass, m, in cell D6, denoted Mass_MO;
- Mass of the thin uniform rod, M, in cell D7, denoted Mass_M;
- Length of the thin uniform rod, l, in cell D8, denoted Length_L;
- Distance between the point mass and the end of the thin rod, a, in cell D9, denoted Distance_A.

In the Results section, delimited by the domain A11:D13, the gravitational attraction between the bodies m and M is calculated both analytically and numerically. Thus, in cell C13 the analytical result is presented and in cell D13 the numerical one.

In order to obtain the value of the gravitational force analytically, we have transposed equation (2) into the spreadsheet. Thus, with the cell names from the input data, we have written in cell C13 the following Excel formula:

"=Constant_K*((Mass_MO*Mass_M)/(Distance_A*(Distance_A+Length_L)))".

In order to obtain the value of the gravitational force numerically, we have divided the thin uniform rod of mass M into n equal parts and explored the table facilities of the spreadsheet. If we denote M_i the mass of the element (i), x_i the distance at which the element (i) is relative to the end of the thin uniform rod and r_i the distance between the point mass m and the center of mass of the element (i), we can write:

$$[6] \quad M_i = \frac{M}{n} \qquad x_i = i\,\frac{l}{n} \qquad r_i = a + \left(x_i - \frac{1}{2}\frac{l}{n} \right)$$

where the index i takes values from 1 to the number of intervals n. We have considered n=100 and the respective value was entered in cell D17.

The force of gravitational attraction F between the two bodies m and M is calculated by adding up the interaction forces F_i between m and the mass elements M_i:

[7] $F_i = k\dfrac{mM}{nr_i^2}$ $\qquad F = \sum_{i=1}^{n} F_i$

To explore equations (6)-(7) in the spreadsheet we have built a table with four columns from A to D, partially rendered in Figure 1 from line 19 to line 30. Generating the values in the table has been done starting with line 20. Thus, in column A, we have generated an increasing series with the step of a unit from 1 to n, for the values of the index i. In column B we have generated the values for the distance x_i and in column C we have generated the values for the distance r_i. In column D we have generated the F_i values of the gravitational attraction force between the body of mass m and the mass elements M_i of the thin uniform rod. In order to generate the values from columns B and C, we have transposed the equations (6) in Excel. In order to generate the values from column D, we have transposed in Excel the first relation from the equations group (7). By summing all the values from column D of the table, according to the second relation of (7), we have obtained, by numerical means, the value of the gravitational force. For this, in cell D13, we have applied the SUM function in Excel to the value domain in column D of the table. It can be observed that the two results, analytical and numerical, coincide.

Figure 4 shows the spreadsheet of the second tool with which the gravitational attraction force is calculated between two thin uniform rods.

It can be noticed that the spreadsheet of this tool can be obtained by modifying and extending the corresponding spreadsheet of the first tool accordingly. Thus, in the input data, compared to the spreadsheet of the first tool, we introduce the numerical values for the masses and lengths of both thin rods, M_1, M_2, respectively l_1, l_2. The cells in which the values for M_1, M_2, l_1, l_2 are entered were denoted Mass_M1, Mass_M2, Length_L1, and Length_L2. In the Results section, as with the first tool, the gravitational force is calculated both analytically, in cell C14, and numerically, in cell D14.

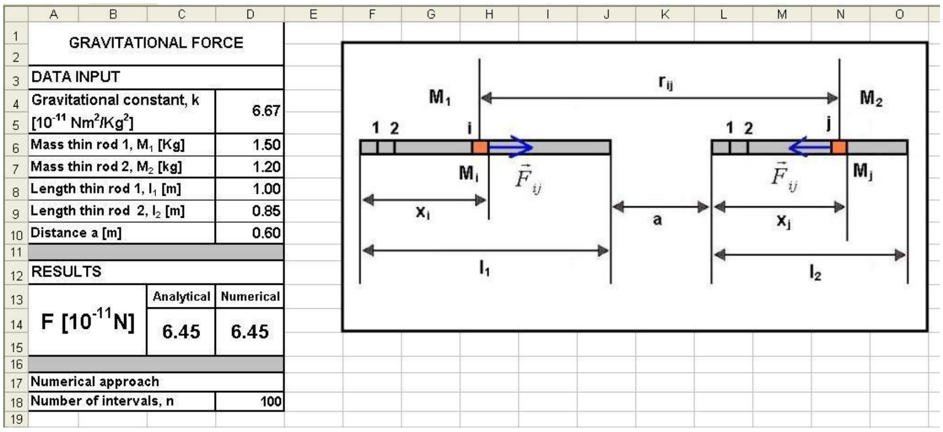

Figure 4. The spreadsheet of the tool to calculate the gravitational force between two thin uniform rods

To obtain the value of the gravitational force analytically, equation (5) was transposed into the spreadsheet. Thus, with the cell names from the input data, we have written in cell C14 the following Excel formula:

"=Constant_K*(Mass_M1/Length_L1)*(Mass_M2/Length_L2)*LN(((Length_L1+Distance_A)*(Length_L2+Distance_A))/(Distance_A*(Length_L1+Length_L2+Distance_A)))"

In order to obtain the value of the gravitational force by numerical means we have extended and adapted the procedure from the first tool. This time we have divided both thin uniform rods into n equal parts. If we note with M_i the mass of the element (i) of the thin rod 1, M_j the mass of the element (j) of the thin rod 2, x_i the distance between the end of the thin rod 1 and the element (i), x_j the distance between the end of the thin rod 2 and the element (j), r_{ij} the distance between the elements i and j, we can write:

[8] $$M_i = \frac{M_1}{n} \quad M_j = \frac{M_2}{n} \quad x_i = i\frac{l_1}{n} \quad x_j = j\frac{l_2}{n} \quad r_{ij} = l_1 + a + x_j - x_i$$

where the indices i and j take values from 1 up to the number of intervals n=100 stated in cell D18.

To calculate the gravitational attraction force F between the thin rods M_1 and M_2, we sum up all the interaction forces F_{ij} between the elements M_i and M_j. We have:

[9] $$F_{ij} = k\frac{M_1 M_2}{n^2 r_{ij}^2} \qquad F = \sum_{i=1}^{n}\sum_{j=1}^{n} F_{ij}$$

To explore equations (8)-(9) we have built a double table in a separate spreadsheet. Choosing the number of intervals n=100, the table covers the domain A1:CX102. Figure 5 partially shows the table for the calculation of the gravitational force between the thin uniform rods.

In column A, starting with cell A3, we have generated the values of index i through an increasing series, with the step of a unit, from 1 to n. Similarly, on the first row, starting with cell C1, we have generated the values of index j through an increasing series, with the unit step from 1 to n. In column B, starting with cell B3, we have generated the distances x_i for the mass elements M_i of the thin rod 1. In line 2, starting with cell C2, we have generated the distances x_j for the mass elements M_j of the thin rod 2. In order to generate the values x_i and x_j we have taken into account the third and the fourth relation from (8).

In the cells of the table, starting with cell C3, we have calculated the interaction force between the mass elements M_i of the thin rod 1 and the mass elements M_j of the thin rod 2. For this we have considered the last relation in (8) and the first relation in (9), which we have transcribed in Excel. Thus, using the relative cell references, we wrote in cell C3 the Excel formula:

"=Constant_K*(Mass_M1/Number_N)*(Mass_M2/Number_N)*(Length_L1+Distance_A+C$2-$B3)^(-2)".

The Excel formula written in cell C3 was propagated on both columns and rows so that the indices i and j would cover all the values from 1 to n. With the help of the SUM function from the spreadsheet we have added all the values F_{ij} from the table, thus obtaining the interaction force between the two thin uniform rods. The coincidence between the analytical result and the numerical one is observed.

	A	B	C	D	E	F	G	H	I	J	K	L
1		**No2**	1	2	3	4	5	6	7	8	9	10
2	**No1**	**x_i, x_j**	0.009	0.018	0.027	0.036	0.045	0.054	0.063	0.072	0.081	0.090
3	1	0.012	0.00012	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
4	2	0.024	0.00012	0.00012	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
5	3	0.036	0.00012	0.00012	0.00012	0.00012	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
6	4	0.048	0.00012	0.00012	0.00012	0.00012	0.00012	0.00011	0.00011	0.00011	0.00011	0.00011
7	5	0.060	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00011	0.00011	0.00011	0.00011
8	6	0.072	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00011	0.00011
9	7	0.084	0.00013	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00011
10	8	0.096	0.00013	0.00013	0.00013	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012
11	9	0.108	0.00013	0.00013	0.00013	0.00013	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012
12	10	0.120	0.00013	0.00013	0.00013	0.00013	0.00013	0.00012	0.00012	0.00012	0.00012	0.00012

Figure 5. The partial rendition of the table for the numerical calculation of the gravitational interaction force between two thin uniform rods

The development of tables with values generated on both columns and rows for the numerical resolution of some physics problems has been described by the authors in other papers (Grigore et al, 2018).

5 Conclusions

The construction and use in the classroom of the tools described in this paper has a series of advantages. A gravitational field problem with a higher degree of difficulty can be easily solved by students through the facilities provided by the spreadsheet. The calculation of the gravitational force between the thin uniform rods in the spreadsheet is also a good opportunity to familiarize students with the concept of definite integral. Thus, with the help of the first tool, students can become familiar with the simple integral, and with the help of the second one, with the double integral.

References

Halliday, D., Resnick, R., Walker, J. (2013): Fundamentals of Physics, 10th Edition, John Wiley & Sons., Inc., ISBN-13: 978-1118230725.

Baldy, E. (2007). A New Educational Perspective for Teaching Gravity, *International Journal of Science Education, 29, 14,* 1767-1788.

Benacka, J (2014) On planetary motion - a way to solve the problem and a spreadsheet simulation , *European Journal of Physics, 35, 4*, 045016.

Galili, I. (2001). Weight versus gravitational force: Historical and educational perspectives, *International Journal of Science Education*, *23, 10,* 1073-1093.

Greca, I.M., Moreira, M.A. (1997). The kinds of mental representations-models, propositions and images-used by college physics students regarding the concept of field, *International Journal of Science Education*, *19, 6*, 711-724.

Grigore, I., Miron, C., Barna, E.S. (2017). Exploring Excel Spreadsheets to Simulate the Projectile Motion in the Gravitational Field, *Romanian Reports in Physics*, *69, 1*, 901, 1-14.

Marciuc, D., Miron, C., Barna, E.S. (2016). Using GeoGebra and VPython software for teaching motion in a uniform gravitational field, *Romanian Reports in Physics*, *68, 4*, 1603-1620.

Bradamante, F., Michelini, M., Stefanel, A. (2006) Learning Problems Related to the Concept of Field, *Frontiers of Fundamental Physics, 6th International Symposium on Frontiers of Fundamental and Computational Physics*, 367-379.

Grigore, I., Barna, E.S. (2015). Using Excel Spreadsheets to Study the Vertical Motion in a Gravitational Field, *6th World Conference on Educational Sciences*, Malta (WCES-2014). Published in *Procedia-Social and Behavioral Science* 191, 2769-2775.

Grigore, I., Miron, C., Stoica, D. (2017). The free fall in gravitational field treated analytically and numerically with Excel spreadsheets, In *Proceedings of The 12th International Conference On Virtual Learning,* Sibiu, October 28, 2017, 455-462.

Grigore, I., Stoica, D., Miron, C. (2018). The study of the Simple Gravitational Pendulum with Excel Spreadsheets, In *Proceedings of The 14th International Scientific Conference eLearning and Software for Education*, Bucharest, April 19-20, 2018, 412-419.

Excel 2010.

CMAP Tools and Tracker used for studying the harmonic oscillator

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Abstract

We propose a high school level method of study of the harmonic oscillations using two free of charge software. This method can be useful for understanding and learning of the concepts and physical notions involved in the oscillatory movement. The first software is Cmap Tools, a free application used for creating the conceptual maps. These are very useful instruments in establishing hierarchies between physical measures and to create causality connections between them. The assembly of a conceptual map involves a good knowledge of the phenomenon and therefore leads to a conceptualization of the given notions. The conceptual map can be used as an instrument for presenting the information for both teaching and evaluation stages. Another instrument is the open-source program called Tracker. With its help, different filmed oscillatory movements can be tracked. With Tracker software, we can calculate specific physical quantities, while analyzing the body movements, modelling the obtained experimental data and plotting associated graphics. By observing the movements produced by laboratory devices and the oscillatory movements from daily life and shaping the collected data by Tracker software, we can compare the real and ideal motion, we can draw conclusions that can lead to the clarification of the studied physical concepts and the connections between them.

Keywords: Conceptual map, Tracker, Oscillatory movement, Physics education

1 Introduction

Oscillatory movement study in secondary education needs a continuous adaptation to the needs of the new generation. The working strategies need to be adapted and correlated all the time with the students' needs aiming for a better effectiveness of the teaching-learning-evaluation process. Using different applications and software accessible by the new technologies offers a great advantage, allowing for the development of new methods and strategies for perfecting this process, being meanwhile adapted to the tech world where the students (as “natives”) feel very comfortable.

In this manuscript we present how it’s possible, by combining two free of charge software - CmapTool and Tracker - with other software such as GeoGebra, Inkscape etc., to ease the experimental part of a physical study and learning-fixing the theoretical notions, facilitating the creation of logical connections between these notions.

The learning process consists of identifying the significant notions and explaining it on a scientific basis. At the foundation of this process we find aspects based on student-centered learning, interactive learning, active learning, teamwork learning, independent learning centered on the individual needs of the students, by using multimedia elements and critical thinking. We present a way for using CmapTool for the construction of conscious learning, starting from the already accumulated knowledge that can clarify and complete, reflecting at the meaning and logic chain of the studied elements. This kind of approach kindles the students' interest in the topic as well as for the learning process in general.

Various laboratory experiments prove that Tracker software is a powerful instrument that can be used for measuring and illustrating different physical phenomena (Hurtado-Velasco and all, 2017). In this way, some very difficult to study and follow experiments (both from the qualitative and quantitative point of view) can be easily tackled by means of this software (Onorato and all, 2012). Moreover, using Tracker software is a lot cheaper than other alternatives - for most of the experiments a video camera and a computer are the only requirements. From the qualitative point of view by visualizing of the variation curves of different physical measures may contribute to a better understanding of the involved phenomenon. From the quantitative point of view the software offers a set of potential physical units that can be determined. In this way, a whole range of costly and difficult to manipulate instruments is replaced. Obviously, the measurements done by using Tracker are not completely precise, but for school level laboratory they can be considered quite accurate. Along with teaching physical concepts we aim to offer to the students instruments and attitudes that will help them further in their development. Being "native" in this hi-tech world they will find easier to use this kind of instruments in the teaching process and inquiring the environment.

2 Tracker software used for experimental analysis of oscillatory movement

Oscilatory movements are very often found in daily life. The video analysis using Tracker software is a didactic instrument that can make the connection between the theoretical notions studied in the classroom, the experiments made with the laboratory instruments and the devices and phenomena that we can find in the environment, correlations that otherwise are not so easy toachieve . Tracker software is specially designed for modelling and video analysis for physics study, built on Open Source Physics (OSP) platform, by using Java programming (https://www.compadre.org/osp/?).

This software can be downloaded free of charge from the internet and runs under any operating system. Being an open-source software it is continuously updated and improved. The software is user-friendly and easy to be used by any kind of users from beginners to the advanced ones. One can also find website instructions and tutorials, that can further help the novice user (Kinchin, 2012; Hockicko et al, 2015; de Jesus et al, 2018; Aguilar-Marín et al, 2018).

In this case, when analyzing different oscillatory movements from daily life we can compare with models from the laboratory or from didactic materials that are found on the internet or other educational platforms. Therefore, the limitations of a physical model and the factors that influence the movement (such as the friction) can be identified and also can be discussed how these factors can be reduced, how the mechanisms can be improved etc.

Firstly, we recorded an elastic pendulum of a mechanical wall mounted clock (Figure 1). The shooting was made by using a low budget (widely available) 120 fps rate ultra HD video camera. The physical dimensions were calibrated by means of a 15 cm length tape of, glued near the clock in a way to be visible on the video. We picked a point on the pendulum that was spotted with a red mark and tracked using the software. For this point, Tracker determines, for each frame, specific physical units. In the given example, the vertical coordinate and the position vector are observable. From the graphics, the movement periodicity can be noticed, along with the fact that both measures are harmonic functions.

A gravitational pendulum (a small object suspended by a string, in this case, a hematite pendant) was also investigated (Figure 2). We can observe the periodicity of the movement and the harmonic variation of both linear and angular coordinates.

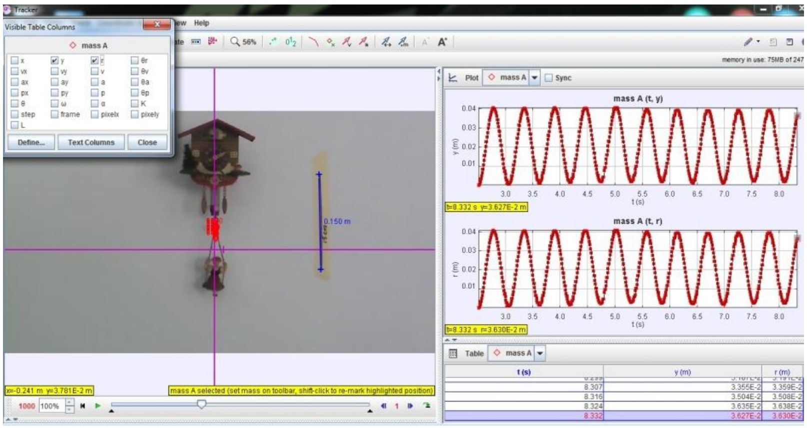

Figure 1. An illustration of Tracker software being used for an elastic pendulum system

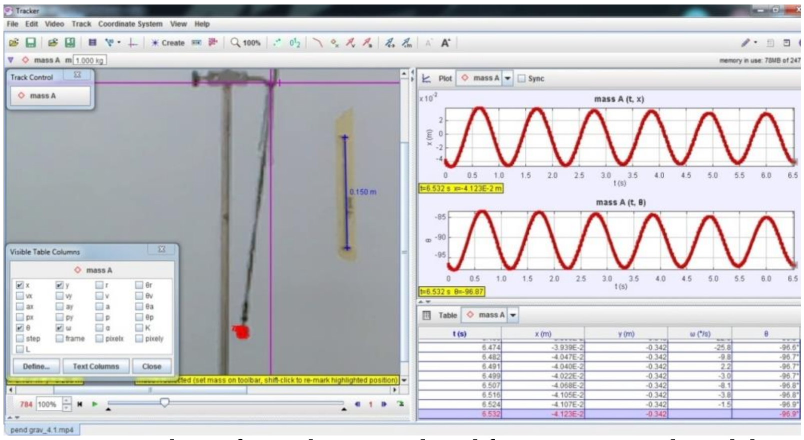

Figure 2. Tracker software being employed for a gravitational pendulum

Many physical units and properties can be determined: coordinates, velocity, angular velocity, acceleration and its components, momentum etc. Based on what we wish to show to the audience we can choose the measures of interest and we can start a dialogue with the students. We shall then lead the discussions in a specific direction such that that the students will deduce by themselves the movements' characteristics that we want to demonstrate during the particular lecture (in the example above we consider the periodicity and the harmonic type variation of the physical units).

Since Tracker is a free, easy to use software, we can then ask the students to develop their own experiments, to record and afterwards analyze different oscillations as part of a personal project. As a result, the pupils can reason many concepts while initiating individual or group study projects. In this way, the quality and efficiency of the learning process increases considerably.

3 Harmonic oscillatory movement presented by using a conceptual map

Oscillatory movement is a complex topic and appeals to specific notions from mechanics. By employing in the same context physical units that can be found in different types of movements one can create confusion in the students' minds. Therefore, by presenting the information as a scheme and using a conceptual map can ease the understanding of the concepts and the connexions between them. A conceptual map is a scheme that allows arranging the notions according to different ordination criteria. In this way, critical thinking among the students is highly developed. They will have to analyze the connections between the studied concepts and as a consequence to reflect on their learning process (Pangestuti and Zubaidah, 2017). Conceptual maps can be created in many ways, from the simple method - i.e. make schemes with the pencil on paper, to the use of templates and employing dedicated software. On of this software that can be used for free, is CmapsTool. (https://cmap.ihmc.us/cmaptools/). This allows the construction of conceptual maps from the basic to complex ones, interactive, to create connexions with different kind of resources - images, videos, gif or even other conceptual maps. The software is easy to use, possessing an user-friendly interface, having also very clear user instructions on the CmapTools website. It is also possible to distribute the maps to the working group or even offers cloud space to upload the products (Iofciu et al, 2011; Iofciu et al, 2010; Dias et al, 2017; Rofiuddin and Feranie, 2017; Hidayati and Ramli, 2018).

The map that we present can be used both in the teaching and learning processes. It can be offered to the students on the school's computer network or in the cloud and thus it can be accessed anytime from the personal devices.

The map is built starting from introductory, basic elements to more complex notions that require mathematics calculus. There are three regions:

- the introduction region that presents definitions, periodicity characteristics, examples
- the characteristic measures/units region where the definitions and mathematic expressions of the main specific measurements of oscillatory movement are defined
- the region where the linear ideal harmonic oscillator is introduced; it is exemplified by the elastic pendulum and the gravitational one

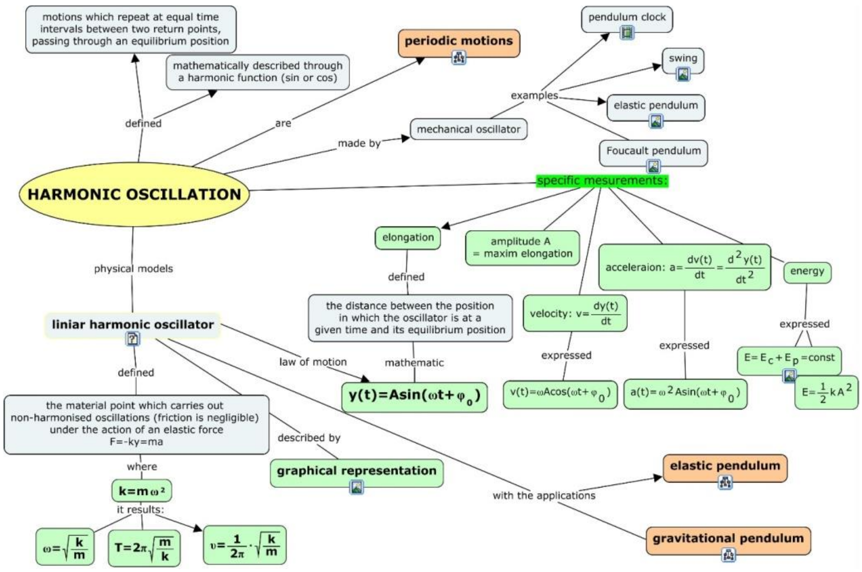

Figure 3. Conceptual map for harmonic oscillations – main screen

It can be noticed that the map is interactive; starting from the main screen (Figure 3) three other conceptual maps can be accessed: one that explains the notions specific for periodical movement (Figure 4), one that explains the elastic pendulum (Figure 5) and the gravitational one respectively (Figure 6). Moreover, we included links to images, graphic representations, and experimental results. Consequently, the studied notions can be very well explained by means of the experimental data obtained by Tracker. They can be accessed anytime along with simulations and graphics, using the practical part at maximum. We used the Geogebra software to make a simulation of the oscillatory movement and also a comparison to the circular movement (Figure 7) (Marciuc et al, 2016). The Inkscape software was employed for making the images. Both these software are free of charge.

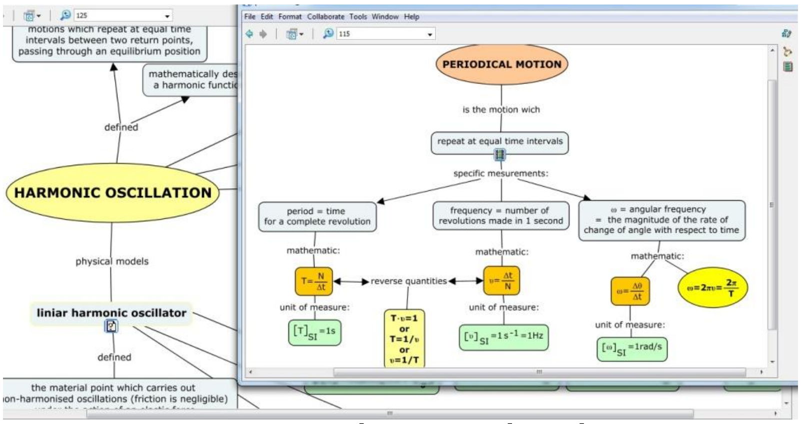

Figure 4. Conceptual map – periodicity elements

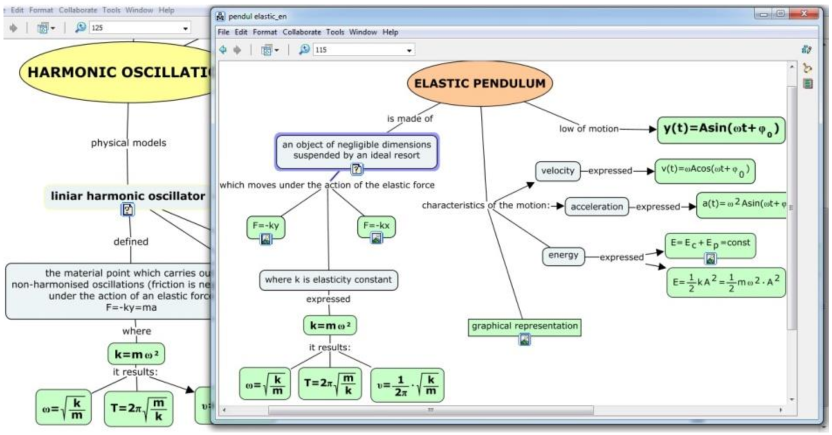

Figure 5. Conceptual map – Elastic pendulum

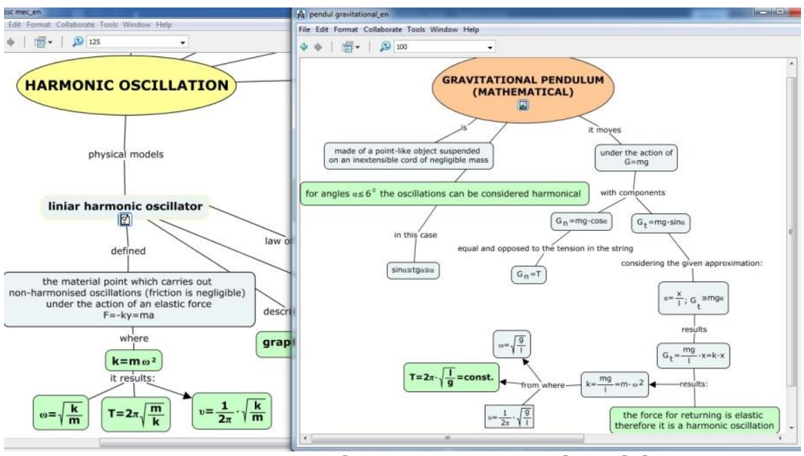

Figure 6. Conceptual map – Gravitational pendulum

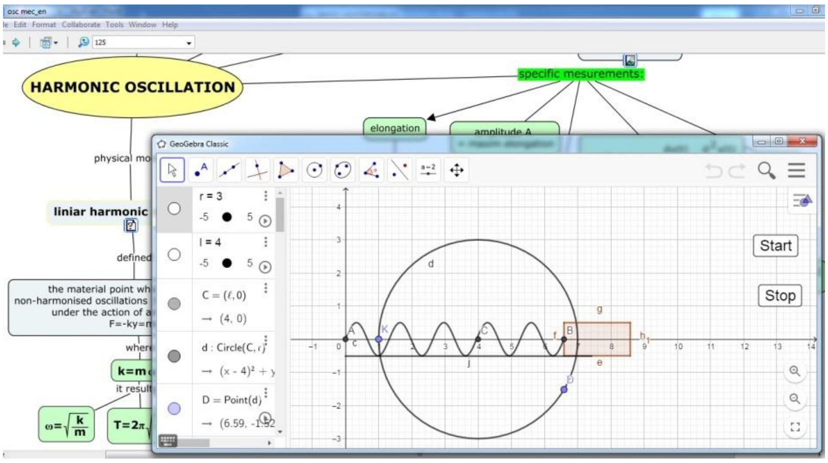

Figure 7. Simulation made by using Geogebra software that emphasizes the connection between the elastic oscillator and the circular movement

4 Conclusions

Employing online resources (and mostly the open-source ones) can bring obvious advantages in the teaching-learning-evaluation process and can definitely attract the students towards the Natural sciences and Physics study. This represents an adaptation to the IT environment to which the students are very familiar, loving it. In addition, this environment offers the tools that can be successfully used in the didactic process. Among these, we presented herein the Tracker and CmapTools, but many more can be found. For instance, for the presented project we used also the Geogebra software for making a simulation of the oscillatory movement and Inkscape for drawing the images. This leads to a better understanding, developing the students' competences as well as the technological ones (to design and implement a scientific experiment, to collect and analyze the data), active learning, critical thinking and the capacity to solve emerging problems.

In the scientific literature there are various studies which prove that the use of simulations virtual experiments and technology in general can lead to an easier and deeper understanding of the concepts in physics (Pantazi, 2019; Grigore, 2017; Mihalache, 2018; Marciuc, 2018; Bleotu, 2019).

References

Aguilar-Marín, P, Chavez-Bacilio, M. and Jáuregui-Rosas, S. (2018) Using analog instruments in Tracker video-based experiments for understanding electricity and magnetism phenomena in physics education. European Journal of Physics 39, 3, 035204.

Bleotu, P., Mihai, L. and Sporea, D. (2019) Setup for quantum cascade lasers characterisation using the Labview programming environment. *Romanian Reports in Physics 71*, 1, 901.

de Jesus, V L B, Haubrichs, C., de Oliveira, A. L., Sasaki, D. G. G. (2018) A low-cost experiment to visualise the Fourier series: video analysis of a real plucked coiled spring. European Journal of Physics 39, 2, 025704.

Dias, S. B., Hadjileontiadou, S .J., Diniz, J. A., Hadjileontiadis, L. J. (2017) Computer-based concept mapping combined with learning management system use: An explorative study under the self- and collaborative-mode. Computers & Education 107, 127-146.

Grigore, I., Miron, C. and Barna, E. S. (2017) Exploring Excel spreadsheets to simulate the projectile motion in the gravitational field, *Romanian Reports in Physics 69*, 1, 901.

Hockicko, P., Kristak, L., Nemec, M. (2015) Development of students' conceptual thinking by means of video analysis and interactive simulations at technical universities. European Journal of Engineering Education, 40, 2, 145-166.

Hurtado-Velasco, R., Villota-Narvaez, Y, Florez, D., Carrillo, H. (2018) Video analysis-based estimation of bearing friction factors. European Journal of Physics 39, 6, 065807.

Kinchin, J. (2011) Tracker demonstrates circular motion. *Physics Education 47*, 15-17.

Marciuc, D. and Miron, C. (2018) Understanding multiple reflections in two plane mirrors by building computer simulations. *Romanian Reports in Physics 70,* 3, 902.

Marciuc, D., Miron, C., Barna, E. S. (2016) Using GeoGebra software in the teaching of oscillatory motions. *Romanian Reports in Physics 68,* 3, 1296–1311.

Martinez, G., Perez, A. L., Suero, M. I., Pardo, P .J. (2013) The Effectiveness of Concept Maps in Teaching Physics Concepts Applied to Engineering Education: Experimental Comparison of the Amount of Learning Achieved With and Without Concept Maps. *Journal of Science Education and Technology 22*, 2, 204-214.

Mihalache, B. and Berlic, C. (2018) Using Excel spreadsheets to study the vibrating string behavior. *Romanian Reports in Physics 70*, 2, 901.

Onorato, P., Mascheretti, P., DeAmbrosis, A. (2012) Investigating the magnetic interaction with Geomag and Tracker Video Analysis: static equilibrium and anharmonic dynamics. *European Journal of Physics 33*, 2, 385-395.

Pantazi, D., Dinu, S., Voinea, S. (2019) The Smart Aquaponics Greenhouse – an Interdisciplinary Educational Laboratory. *Romanian Reports in Physics 71*, 3, 902.

Conference Proceedings:

Hidayati, H. and Ramli, R (2018): The Implementation of Physics Problem Solving Strategy Combined with Concept Map in General Physics Course. In *Proceedings of The 2nd International Conference on Mathematics, Science, Education and Technology,* Padang, Indonesia, UNSP 012077.

Iofciu, F., Miron, C., Antohe, S. (2010): Interactive Conceptual Maps Part of Constructivist Environment for Advanced Physics Teaching. In *Proceedings of The 5th International Conference on Virtual Learning,* Târgu Mureș, 95-100.

Iofciu, F., Miron, C., Antohe, S. (2011): A constructivist approach of advanced physics concepts: using a cognitive map for the study of magnetoresistive materials, In *Proceedings of The 3rd World Conference on Educational Sciences*, Istanbul,.461-465.

Pangestuti, A. A., Zubaidah, S. (2017): The Characteristics of Concept Maps Developed by the Secondary Schools and University Students. *In Proceedings of The First International Conference on Science, Mathematics, and Education,* Malang, 210-216.

Rofiuddin, M. R. and Feranie, S. (2016): The impact of CmapTools utilization towards students' conceptual change on optics topic. In *Proceedings of The 3rd International Seminar on Mathematics, Science, and Computer Science Education, Bandung,* UNSP 060011.

Whiteboard Animation – A Way to Ease the Understanding of Special Theory for the Relativity Principles Consequences

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Abstract

The Special Theory of Relativity is a very interesting study topic, both at high school and university level. On the other hand, understanding the physical notions involves a great deal of abstraction and a solid mathematic apparatus. Therefore, even if the considered concepts are exciting, the previously named factors can discourage the students in studying this topic. To prevent these difficulties, a conceptual approach for the theoretical notions is more agreeable. This means the analysis of the physical phenomenon from a qualitative point of view, without a quantitative approach that involves very complex mathematical calculus. Meanwhile, using an audio-visual method such as Whiteboard Animation can clearly contribute to a better understanding of the phenomenon and, most of all, catching the students' interest for a more profound study of the presented concepts. In this paper the authors are suggesting this interesting kind of study for the Special Theory of Relativity, by means of animations and a conceptual approach. The efficiency of the animation consists of tackling many sensorial elements - seeing and hearing; the conceptualization leads to a better understanding of the phenomenon. The result is a greater interest for the study of Physics in general and of the Relativity in special. The discussed theoretical part is referring to the consequences of Einstein's postulates, especially the relativity of simultaneity.

Keywords: Whiteboard animation, Relativity, Physics education

1 Introduction

The Relativity Theory is one of the theories that changed scientific thinking and opened new opportunities for interpretation of physics phenomena from a new perspective. The beauty of this theory consists of a different approach than Classical Physics and the consequences that comes along with it.

Even though spectacular, understanding the Special Theory of Relativity (STR) involves mastering advanced knowledge in mathematics and the ability to build mentally abstract models of physical phenomena. These aspects may rise problems to students that investigate this particular chapter of Physics. This bipolarity - an interesting theory, with spectacular applications can be issued from Science Fiction literature and the high level of difficulty makes teaching STR a real challenge for the teacher.

In order to ease the teacher's efforts and to facilitate understanding of STR by the students the authors of this paper propose a combination of slightly uncommon approaches:

a. presenting the theoretical notions in a conceptual, phenomenological fashion. First appeared in "Conceptual Physics - Matter in Motion", (Ballif and Dibble, 1969) the notion of conceptual physics obtained notoriety after Paul G. Hewitt issued "Conceptual Physics: A New Introduction to your Environment" (Hewitt, 1971), followed by added editions (Hewitt, 1985;

Hewitt, 2009; Hewitt, 2014). Lewis Carroll Epstein in "Relativity Visualized" presents this kind of approach, where he explains STR elements strictly phenomenological (Epstein, 1996). The advantages of this kind of approach are obvious: necessitates a basic level of mathematics (in many cases just arithmetical calculus are needed or the mathematics are completely eliminated) and it aims directly at the core of the phenomenon by examples and analogies.

b. a more dynamic fashion of presentation, appealing to graphical presentations that can easily be recognized and interpreted by students (Dangur et al, 2014; Moreno and Mayer, 2007). In this way, the previously mentioned analogies can be translated into a visual language that aims at the symbols that are already into the minds of the students. Therefore, the process of understanding the notions is highly facilitated. Whiteboard Animation is evidently a way of presenting new information. The method combines three elements: a visual representation as schematic / simplified as possible, transmitting new ideas and using a story as a way of transport and also the voice of the narrator (that via the story) explains the studied notions. Consequently, a simple presentation is realized by touching two perspectives: the transmitted notions are conceptualized and the way of displaying is closer to the "receiver" - the student (Mayer, 2002). Touching more sensorial experiences, the efficiency of learning definitely increases (Lasry et al, 2007; Magana and all 2019).

2 STR consequences – relativity of simultaneity

As an example of the method, we chose to discuss the STR Postulates and its consequences regarding the simultaneity. As an icebreaker, the animation starts with presenting the narrator: "The Professor" (see Fig. 1).

Einstein's Postulates are well known:

1. The speed of light in vacuum is the same for all observers, regardless of the motion of the light source or observer. (See Fig. 2)

Figure 1. Image from the start of the animation with the introduction of the narrator

Figure 2. Illustration of the first Postulate - for all the observers the speedometer shows the same speed of the car that runs with the speed of light (c)

2. The laws of physics are invariant (i.e. identical) in all inertial frames of reference (i.e. non-accelerating frames of reference) (see Fig. 3);

Figure 3. Illustration of the second Postulate. All the observers, regardless of the frame of reference, perceive the phenomenon in the same way

One of the main consequences of the Postulates is the relativity of simultaneity. It means that, according to one of the Postulates, simultaneous events in a frame of reference are not simultaneous according to another frame of reference that is moving.

As an example, we issued in Whiteboard Animation the following story: a cat and a mouse are abducted by aliens to be scientifically analyzed (see Fig. 4).

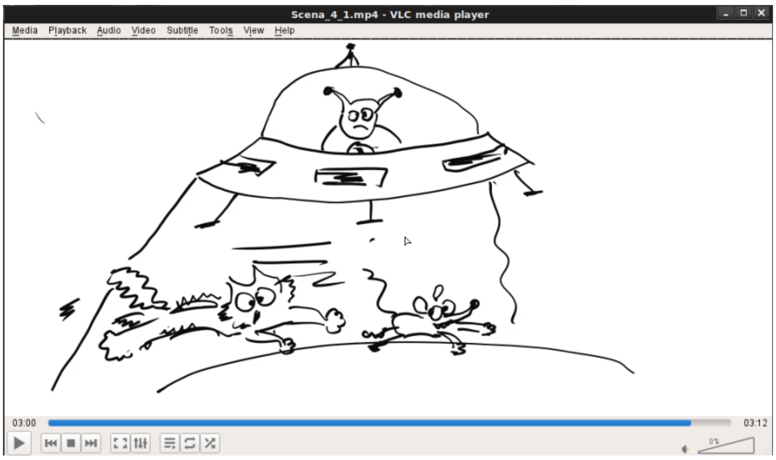

Figure 4. Image from the animation showing the abduction of our "heroes"

Following the abduction, the alien spaceship recedes from the Earth with high speed in the interstellar space.

Fortunately, the event does not escape to Supercat, a superhero resembling with Superman. As any superhero, he gives chase for rescuing his animal friends (see Fig. 5).

Among the superpowers of Supercat we find the capacity to fly at a very high velocity through the cosmic space and the ability to throw lightning bolts.

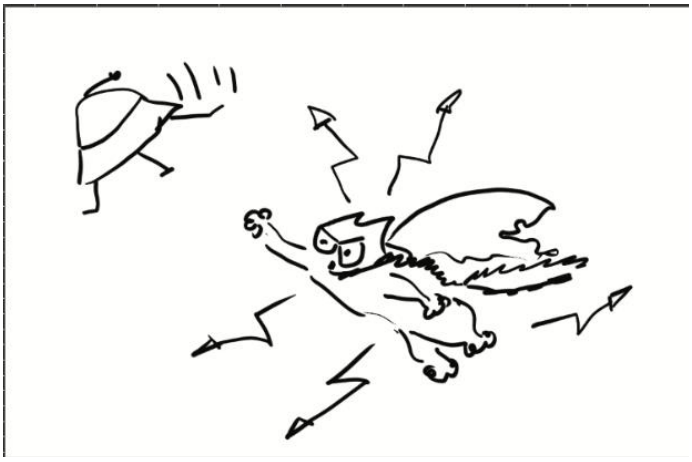

Figure 5. Supercat on the rescue, chasing the alien spaceship

When he reaches the spaceship, after stopping from his chase (staying still), Supercat throws two lightning bolts that reach the front and the backside of the spaceship in the same time (see Fig. 6).

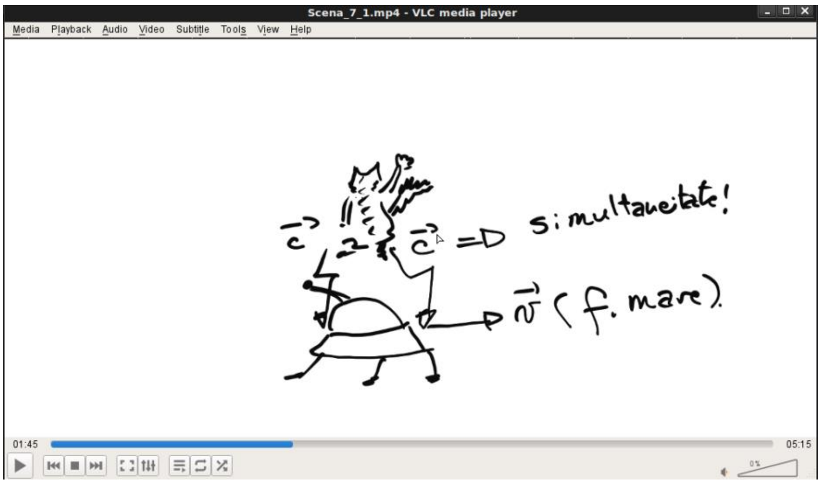

Figure 6. Slide from Whiteboard Animation – Supercat, standing still, throws the lightning bolts. They reach simultaneously the front and the back side of the alien spaceship

According to the point of view of the alien that is located in the spaceship, the events have a different course of action. He will firstly observe the lightning bolt that strikes the front side of the spaceship and then, after a while, the second bolt that reaches the backside of the spaceship. It means that the two events that were simultaneous according to Spacecat's frame of reference occur in different moments from the spaceship point of view. Due to the movement of the spaceship, between the moment of observing the first lightning bolt the craft moves and the second bold is actually "chasing" the ship (see Fig. 7).

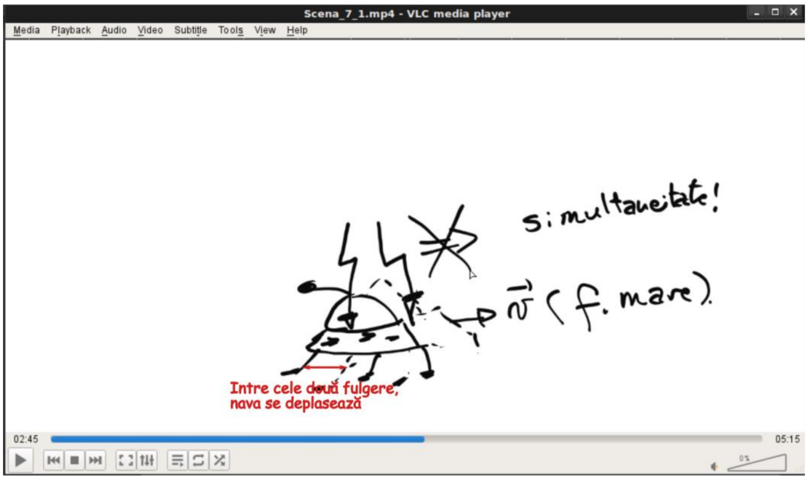

Figure 7. Illustration for the spaceship point of view: between the two lightings bolts the spacecraft moves.

Even though peculiar, the explanation of this difference is according to the STR Postulates. Since light speed is the same, regardless of the frame of reference, for the observer outside the spaceship (considered standing still), the bolts arrive at the same time at the spaceship. Meanwhile, for the observer that is located right in the middle of the spaceship, the light reaches firstly the front side of the ship (in the moving direction) and only then the backside. A good analogy is used by Carroll Lewis Epstein in his book "Relativity Visualized" (Epstein, 1996). He compares the above described things with a person that stands in the rain: if that person stands still, the rain falls vertically; if the person is moving quite fast (let's say he is riding a bicycle) than the rain will not be perceived as falling vertically, but oblique. Rain velocity is combining with the velocity of the moving person.

3 Whiteboard Animation – a way to ease the understanding of STR consequences

As stated in the introduction, the authors choose to present the phenomenon by means of the Whiteboard Animation. This presents several clear advantages:

1. The presentation can be run as many times as necessary; therefore, we make sure for the understanding of the phenomenon by the students is. After the first observation of the presentation (without pause), giving an overview of the story, replaying the video and pausing it during the key points is highly recommended. During these pauses, discussions, explanations, questions and answers can be offered. In this way, comparing to the classical methods where just one passing through the information and explanations are given, by means of the Whiteboard Animation multiple transitions through the material ensures a better understanding, even by the students having a slower learning style.

2. Is a dynamic method that, by using simple, schematic drawings, leads to increased attention from the public and a better understanding of presented notions. It is known that perceiving the environment is based on many patterns; appealing to those visual patterns, Whiteboard Animation can facilitate the learning process (Mayer, 2002).

3. The narration plays a very important role. Along with the fact that telling a story during the classes ensures a more pleasant mood, a story is much easier to remember than a theory text from Physics. And this clearly leads to a better absorption of the notions.

4. Conceptual presentation of an otherwise complex phenomenon has its benefits because tends to bring in many cases an increased interest for a more profound study of that phenomenon.

Once the interest kindled, the student will search for more explanations, a motivation for study, aiming more detailed information, and that's a thing that any teacher desires.

5. Being a creative method, it stimulates students' creativity and imagination. It's well known that the power of the example is very high so, a drawing (even not perfectly realised) can stimulate the student's desire to try such a way of expression. Once again, that's a kind of result that any teacher would expect from his students.

Technically, there are several ways of realizing a Whiteboard Animation:

1. Using a dedicated software such as Doodly (https://www.doodly.com/) or Toonly (https://www.toonly.com/). These are easy to use programs that include many graphical features and other resources while containing wide databases of ready to be used libraries of images and animations,. Unfortunately, these software are quite expensive commercial versions. The authors of this paper are encouraging the use of free software when it comes to recommendations for students.

2. Drawing "the action" on a whiteboard and, in the meantime, using a video camera, recording the process. It's a cheap way to do it, basically available to anyone. Once the recording process is completed, the "post-production"/ editing process and taping the narration follows up.

3. Very similar to the previous method, it is that used by the authors of this paper, where, instead of using an actual board as support for drawing, a graphics tablet is employed and, as a replacement for the video camera, a screen capture software is utilized during the drawing process. Next steps also included the recording of the narration and video editing, adding the background sound and everything necessary for a high-quality video.

In the video-making process, the following software was used:

1 Kazam software for the screen capture (https://launchpad.net/kazam). It is free software dedicated to screencast. The advantage of using it is that a custom area of the screen can be selected to be recorded. The program runs under Linux OS, but there are also alternatives for Windows or Mac users (commercial versions).

2 Krita software for drawing and the interaction with the graphical tablet (https://krita.org/en/). It's a software dedicated to drawings, it's free of charge and operating under Linux OS. There are alternative programs for other operating systems.

3 Audacity software for recording and audio editing (https://www.audacityteam.org/). It is free software and it can run under any operating system. Very easy to use for audio editing and recording.

4 Kdenlive for video editing (https://kdenlive.org/en/). It's a nonlinear video editing software that runs under Linux OS. For other operating system, users can find alternative solutions.

For the musical background, we used songs that are offered for free on various websites.

It's good to know that for a video that is less than ten minutes long, several hours of hard work are required, including the preparation, recording and the most difficult process - the editing. Having in mind the positive things, we consider that this effort is clearly meaningful.

4. Conclusions

Whiteboard Animation represents a good alternative for the classic educational methods when it comes to teaching notions and concepts as complex as STR and its consequences. The method can be used at any level of teaching, from lower secondary until university level.

Yet, we recommend combining this method with others (like the classic ones). Whiteboard Animation does not intend to replace entirely the classical methods, but it's designed to complete them during the teaching process.

References

Ballif, J. R. and Dibble, W. E. (1969): *Conceptual Physics: Matter in Motion*. Wiley, New York.

Epstein, L. C. (1996): *Teoria Relativității în imagini*. All Educațional, București.

Hewitt, P. G. (1971): *Conceptual Physics: A New Introduction to your Environment*. Little, Brown, First Edition Second Printing edition, Boston.

Hewitt, Paul G. (1985). Conceptual Physics (5th ed.). Little, Brown.

Hewitt, Paul G. (2009): *Conceptual Physics: The High School Physics Program* (3rd ed.). Pearson / Prentice Hall.

Hewitt, Paul G. (2014). Conceptual Physics (12th ed.). Pearson.

Dangur, V., Avargil, S., Peskinb, U. and Judy Dori, Y. J. (2014) Learning quantum chemistry via a visual-conceptual approach: students' bidirectional textual and visual understanding, *Chemistry Education Research and Practice 15,* 3, 297-310.

Lasry, N. and. Aulls, M. W. (2007) The effect of multiple internal representations on context-rich instruction. *American Journal of Physics 75*, 11, 1030-1037.

Magana, A. J., Serrano, M. I. and Rebello, N. S. (2019) A sequenced multimodal learning approach to support students' development of conceptual learning. *Journal of Computer Assisted Learning 35*, 4, 516-528.

Mayer, R. E. (2002) Multimedia Learning, *Psychology of Learning and Motivation 41,* 85-139.

Moreno, R. and Mayer, R. (2007) Interactive multimodal learning environments. *Educational Psychology Review 19*, 3, 309-326.

Internet Sources:

https://kdenlive.org/en/, accesed 2019

https://krita.org/en/, accesed 2019

https://launchpad.net/kazam, accesed 2019

https://www.audacityteam.org/, accesed 2019

https://www.bensound.com/royalty-free-music, accesed 2019

https://www.doodly.com/, accesed 2019

https://www.toonly.com/, accesed 2019

Building and monitoring the aquaponics experimental lab for students

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Abstract

The combination between aquaculture and hydroponics is a unique an interesting cultivation method called Aquaponics. In comparison with conventional greenhouse agriculture and aquaculture, aquaponics system makes long-term environmental sustainability better. In aquaponics system, water and nutrients are put to use more than in aquaculture. When put together with low-impact energy sources and fish food, the ecosystem allows a food production strategy similar with a natural ecosystem. The structure of the experimental system containes a fish tank as the bottom layer, a plant basin as the second layer and a greenhouse on top of the first two layers. The system has a microprocesor ARDUINO for monitoring, attached with temperature and humidity sensors.We analysed diferent plants as cabbage, cucumber and salad and the fish tank contained goldfish. Using this lab, the students can learn about basic principels of biology, phyisics, chemistry and also use modern technologies to monitoring the physical conditions for grow up fishes and plants. Students can observe that the system is herbicide or insecticide free, soil is not necessary, it can be used in urban areas without concern because the aquaponics system does not require much space, release less pollution thanks to recirculation of water and use less energy and water therefore the sustainability of plants and fish gets higher.

Keywords: interdisciplinarity, aquaponics, educational physics, ARDUINO, sustainability

1 Introduction

The combination between aquaculture and hydroponics is a unique and interesting cultivation method called Aquaponics. Hydroponics is a way of cultivation without soil. Only water and liquid fertilizers are used. In the absence of soil, the roots of the plants are dipped in water with fertilizer and grow. The world is facing challenges now, in the 21st century, including the increasing number of people all over the world. Thus, more energy, food and water are required for keeping the population healthy. Some of the consequences of these circumstances are: changes in the climate, fossil fuel scarcities, not enough food or water, degradation of the soil. In order to overcome these problems, it is important to find a food production method which requires less water and consumes less energy (Suhl et al, 2016). In comparison with conventional greenhouse agriculture and aquaculture, aquaponics system makes long-term environmental sustainability better. Water and nutrient from aquaponics food production method are used in a more productive way in comparison with aquaculture. When put together with low-impact energy sources and fish food, the ecosystem allows a food production strategy similar with a natural ecosystem (Cohen et al, 2018). According to FAO (Food and Agriculture Organization of the United Nations, 2014) aquaculture is the quickest food production method. More so, 50% of all existing fish and fish products are provided as human's food. Negative impact upon the environment all over the world is caused by traditional aquaculture taking place in natural ponds. Some examples of negative impact are: big quantities of fresh water and a high amount of nutrients in the waste water. One way to make these problems disappear is recirculating aquaculture system (RAS). The RAS uses far less fresh water (up to 90-99% less fresh water) than conventional existing systems. The number of nutrients released into the environment is strongly reduced (Verdegem, 2013). In other words, the concept behind this farming system is: water from the fish is useful for plant growth, vegetables and bacteria living in their roots clean the waste water then, the water is used again for farming fish. This system is called a single recirculating aquaponics system (SRAPS) (Suhl et al, 2016). Aquaponics is a production method better in the long term than conventional greenhouse agriculture especially when refering to farming lettuce and tilapia (Cohen et al, 2018) Aquaponics systems use less energy and water therefore the sustainability of plants and fish increases (Forchino et al, 2018).

This paper's aim is to develop an aquaponics system for the student lab, to study together biology, physics, chemistry, and also to monitor it with an Arduino microprocessor. It represents an innovative method for students to understand the basic principles of physics, biology, chemistry, computers and to understand the necessity of natural and healthy food, grown in places easy to access in their home such as: windows, verandas. Similar with a lot of physical education works that projected proper teaching plans, virtual experiments, automatic monitoring systems, the present paper presents a means to motivate students to study interdisciplinary sciences. (Ion and Voinea, 2018; Dinu et al 2019; Pantazi et al, 2019; Grigore et al, 2017; Mihalache, Berlic 2018; Marciuc and Miron 2018).

2 Aquaponics system design

Components of an Aquaponics system are fish, plants and microorganisms. The most suitable fish to be used in aquaponics system is freshwater fish because it is resistant to changes in water quality and grows quickly. Normally, the accepted fish are: tilapia, American catfish and carp, goldfish, tetra etc. If we choose tropical fish, we need to take into account the high-water temperature these fish need. If water is heated using a heater, it will affect the plants. We also need to keep in mind the number of fish we want to use for a specific aquaponics system. If we use too much fish, the balance of circulation will become easily broken. We should use a small number of fish (4 goldfish in our experiment.) An oxygen aeration pump was placed into the aquarium.

Not every plant can be hydroponically grown because nutrition is needed for plants which eat fruits and roots and balancing their circulation becomes difficult. The best way to deal with this problem is by choosing leafy vegetables and herbs to grow. Plants which like moisture are the most suitable for the aquaponics system. Here are some plants that can be used in this experiment: basil, mint, lettuce, cabbage, watercress, arugula, tomatoes, melons, strawberries, corn, eggplant etc. Also, the water coming from the fish tank (which is rich in nutrients) helps the plant's growth

Figure 1. Experimental aquaponics system

We build an aquaponics system, in which vegetables are placed with their roots directly into the water, representing an upgrade of the experimental model realised by Pantazi et al (2019). A glass aquarium was used for fish. In order to encourage proper growth and development of the plants,holes are cut into a special stand which was placed directly on the water from aquarium. The roots of the plants are introduced in these holes. On top of the first 2 layers of the system's components,the greenhouse is situated (Fig. 1).

An Arduino board with a Mega 2560 microprocessor is used for monitoring the greenhouse. Maximum output voltage generated by the Arduino board is 5 V. It is recommended that the input voltage is situated between 7 and 12 V. The value of the intensity corresponding to the input voltage is 20 mA. Intensity value for an output voltage of 3.3 V is 50 mA. Senzors are needed for the monitoring of the greenhouse system. Two DHT-11 were used for monitoring of the temperature and air humidity. Input voltage necessary for these senzors is between 3.3 and 5 V and the corresponding intensity is 0.3 mA. Every 2 seconds, these senzors provide data regarding temperature and humidity (Fig. 2).

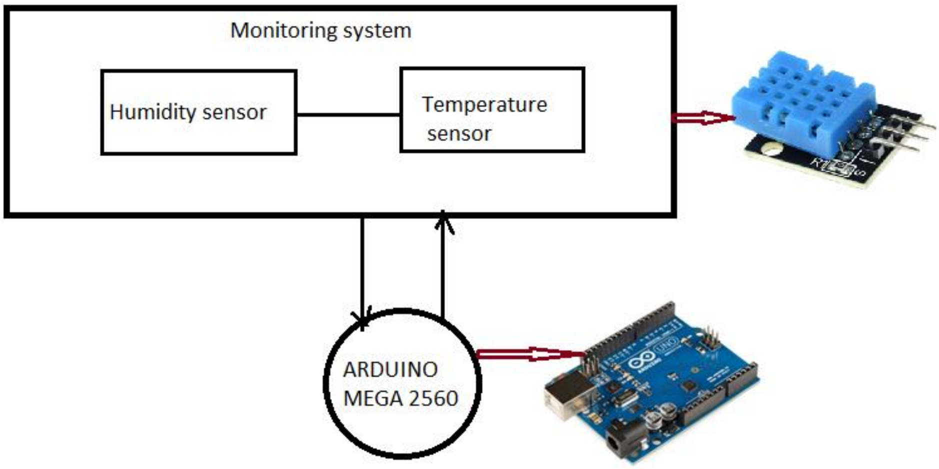

*Figure.*2 Monitoring system with Arduino microprocessor and sensors

3 Testing and experimenting with the system

In order to test the aquaponics system we used different plants (5 cabbages, 2 cucumbers and 3 lettuce) and 4 goldfish for this experiment. For each plant, we analysed a leaf and marked it with a red marker. We measured those leaves every 7 days, summing up 49 days of monitoring. Everything was put in place according to the wiring diagram and general knowledge about the components of the aquaponics system cycle. We checked the conditions regularly and fed the fish every 2 days. We also had to check the sensors and the air oxygen aeration pump because we didn't want to let any broken component of the system affect the well on-going of the project. The experimental aquaponics system had every component of it excelently taken care of. Fish food was required because we didn't have enough plants to supply the food every fish needed in order to remain healthy. This food came from a regular pet shop. One other observation we have to make is that, by experimenting, we found out that cabbage is excellent for the aquaponics system. It grows and develops quickly. All fish lived throughout the period of the experiment.

As we can observe from the table,1 every plant increased in height from the first week. We planted cucumber 1 and cucumber 2 in the fifth week. During the first six weeks cabbage 4 increased with 3 cm. Cabbage 4 showed the biggest increase of the leaf height about 43%. Cabbage 1 started to rot during the forth week, this is why during the fifth week, the height of the leaf decreased and was not measured anymore. Still, cabbage 1 grew 9.4% from the moment it was planted and became part of the system. Lettuce had a very fast growth rate with 21 percentages in one week, but is less rezistant than cabbage. Cucumber was available for planting only at the end of the experimental period, but it had an important development in a short time, about 13%.

Table 1 Measurements of vegetables during the monitoring period

Plant/Length of the leaf (L)	Initial L1(cm)	Week 1 L2(cm)	Week2 L3(cm)	Week 3 L4(cm)	Week 4 L5(cm)	Week 5 L6(cm)	Week 6 L7(cm)	(L7-L1)/L1(%)
Cabbage1	8.5	10	10.4	10.4	10	9.3	-	9.4
Cabbage 2	12	13.2	13.2	13.4	13.4	-	-	11.6
Cabbage 3	11	11.5	11.5	-	-	-	-	4.5
Cabbage 4	7.5	8.9	9.8	10.1	10.1	10.7	-	42.6
Cabbage 5	9	10.5	10.6	-	-	-	-	17.7
Lettuce 1	8.5	10.3	-	-	-	-	-	21.1
Lettuce 2	12	12.5	-	-	-	-	-	4.1
Lettuce 3	9.5	10.2	10.9	-	-	-	-	14.7
Cucumber 1	-	-	-	-	-	6.8	7	2.9
Cucumber 2	-	-	-	-	-	7.5	8.5	13.3

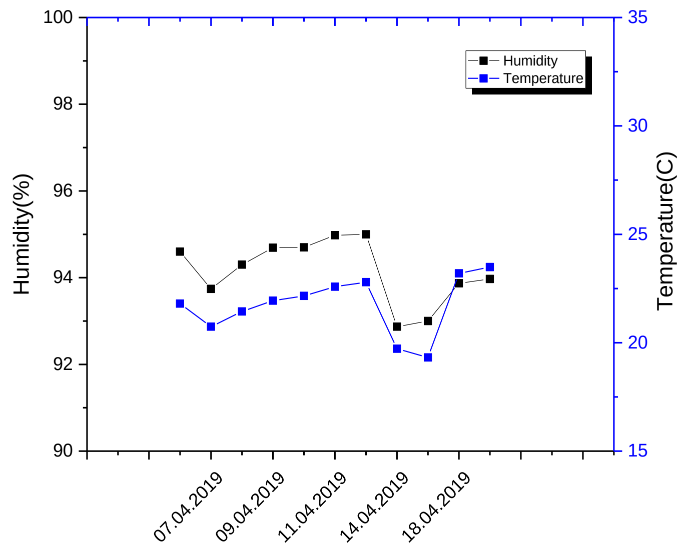

Figure.3. Daily average values of temperature and humidity in greenhouse during 05.04-20.04 2019

From Fig. 3 we can observe that for the entire period of the project, mean humidity showed values from 93 to 95% which gives us a better environment for growing cabbage. Mean temperature took values from 20 to 24 C degrees, which lead to a benefic development of the plants involved in the aquaponics system.

4 Conclusions

Building an experimental aquaponics system represents a complex activity for students, that involves knowledge of biology, physics, chemistry, software. The students understand the principle of sustainability, as the aquaponics system is herbicide and insecticide free and produced less pollution due to recirculation of water. Testing the system with goldfishes and different plants we obtained good results for developing of plants. The best result was obtained for cabbage that was very resistant and growth with 42.6 % in 6 weeks. The lettuce and cucumber are available for aquaponics system, also. The experimental lab may be upgraded with solar panels and batteries in order to power the monitoring system and the oxygen aeration pump.

References

Dinu S., Dobrica B., Voinea S. (2019) Educational laboratory system based on electrochemical devices, *Romanian Reports in Physics 71,* 4, in press, http://www.rrp.infim.ro/inpress.html

Grigore, I., Miron, C. and Barna, E. S. (2017) Exploring Excel spreadsheets to simulate the projectile motion in the gravitational field, *Romanian Reports in Physics 69*, 1, 901.

Marciuc, D. and Miron, C. (2018) Understanding multiple reflections in two plane mirrors by building computer simulations. *Romanian Reports in Physics 70*, 3, 902.

Mihalache, B. and Berlic, C. (2018) Using Excel spreadsheets to study the vibrating string behavior. *Romanian Reports in Physics 70*, 2, 901.

Pantazi D, Dinu S, Voinea S. (2019): The smart aquaponics greenhouse – an interdisciplinary educational laboratory, *Romanian Reports in Physics* 71, 902.

Suhl J., Dannehl D., Kloas W, Baganz D, Jobs S., Scheibe G., Schmidt U (2016): Advanced aquaponics: Evaluation of intensive tomato production in aquaponics vs. conventional hydroponics, *Agricultural Water Management 178,* 335-344.

Verdegem M. C. J. (2013): Nutrient discharge from aquaculture operations in function of system design and production environment, *Reviews in aquaculture 5,* 3, 158-171.

Conference Proceedings:

Cohen A., Malone S., Morris Z., Weissburg M., Bras B. (2018): Combined Fish and Lettuce Cultivation: An Aquaponics Life Cycle Assessment"-25th CIRP Life Cycle Engineering (LCE) Conference, 30 April – 2 May 2018, Copenhagen, Denmark

Forchino A., Gennotte V., Maiolo S., Brigolin D., Mélard C., Pastres R:(2018): Eco-designing Aquaponics: a case study of an experimental production system in Belgium- 25th CIRP Life Cycle Engineering (LCE) Conference, 30 April - 2 May 2018, Copenhagen, Denmark

Ion R.E., Voinea S. (2018): Experimental Design of Passive House, *Proceedings of the 13th International Conference on Virtual Learning, ICVL, 447-451.*

FAO. 2014. The State of World Fisheries and Aquaculture 2014. Rome. 223 pp, E-ISBN 978-92-5-108276-8 (PDF)

Smartphone used in physics experiments

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Abstract

Nowadays the smart phone is a flexible and accessible mean of communication and a way to obtain useful information. Being portable and having multiple integrated functions, it has become an irreplaceable accessory for the younger generation. Beyond the classic aspects, the mobile phone has an enormous potential, but insufficiently exploited in the field of education. The smartphone can become an excellent teaching tool, with special applications in the field of Physics. With a very large data storage capacity, it can also be used as a portable database. There are many applications, for example Sense-it, that allow the user to access all the motion, environment and position sensors available on a device. The study aims to carry out three real experiments in mechanics, namely inelastic collision, centripetal acceleration and spring, using some of the sensors of the mobile phone. The experimental data will be retrieved and processed through the software Phyphox, available free from Google Play or App Store for Android and iOS respectively. If a Wi-Fi connection is available, students will be able to follow the graphics obtained in real time by accessing an URL. This can be used by directly typing the following URL: http://192.168.1.3:8080 in the address bar of a browser. The experiments will have applications in table tennis, cycling and determining the elastic constant of the springs.

Keywords: Smartphone, Phyphox, Experiment, Physics education

1. Introduction

In the modern paradigm of teaching-learning process, marked by the fluidity of the roles of the actors involved in it and by the student-centered teaching, one main question is whether and how eLearning, as we understand it nowadays, can provide a viable alternative to the traditional education.

Students' concerns, ideals, attitudes and necessary skills for integrating in nowadays society have changed, so, in order to fulfill their present needs, certain changes in education are also mandatory.

As educational tools, smartphones bring about a new approach in designing a lesson plan. Every use of the mobile phone during a lesson is of particular importance for the students attending it. The use of mobile phones stirs to the fullest their interest and motivates them. By using mobile phones during a lesson, students can use applications that facilitate an education open to all areas of knowledge, as well as the use of modern technologies.

2. Theoretical framework

2.1 M-learning

Young learners are keen to use mobile technology, therefore learning and teaching should be, nowadays, hand in hand with this new technology, performing what is called m-learning. There is a deep need for new approaches both in the structure of the physics syllabus and also in modernizing the teaching methods.

Smart mobile devices allow collecting, organizing, storing and presenting the information. They are equipped with advanced multimedia players, provide access to recently updated information, store contacts and allow real time communication, using a wide range of internet environments. They also provide the possibility to synchronize information regularly and access it anywhere, any time (Seifert, 2014).

The use of mobile phone in learning and teaching physics brings about, with its physics apps, the link between real life and theory, the connection between informal and formal knowledge. Being equipped with sensors, a mobile phone is a device that allows the student to measure all the physics quantities that describe the environmental conditions, and, therefore, in a world threatened by climat changes, it might shape the knowledge and the civic attitude regarding the environment monitoring and protection, by running inquiry-based experiments (Sharples et al, 2017).

By m-learning, the student will experience the excitement of doing science by employing her/his own device and the teacher will face the the challenge of well-planning classroom lessons in which they should integrate the data collected by the students into a coherent final lesson and draw conclusions.

2.2 Blended education

Using m-learning in classrooms along with the classical methods of teaching is called blended education. Blended education represents a style of education in which students learn via electronic and online media as well as via traditional face-to-face teaching. Blended education is considered a form of hybrid education, because it overimposes the supervised education done away from one's home and the education delivered online helps the student to save time, place, pace and path self-control. Blended learning is the most logical and natural evolution of our learning agenda. It suggests an elegant solution to the challenges of tailoring learning and development to the needs of individuals (Thorne, 2003).

Thereby, introducing at high school level the smartphone into physics lessons by the experimental study of some mechanical phenomena develops technological skills and facilitates knowledge (Bromley, 2012).

Because almost every student has a smartphone with an Internet connection, the school no longer needs to have devices and educational software (Norris et al, 2011). The physics lab is not indispensable, the experiments could be performed right in the classroom. The classic experiment made by the teacher is seen by all students.They have access simultaneously to all experimental data and to all graphs obtained during the experiment using their own mobile phones, tablets or laptops by accessing an URL.

The real importance and significance in blended learning lies in its potential. If we forget the title and focus on the process, blended learning represents a real opportunity to create learning experiences that can provide the right learning at the right time and in the right place for each and every individual (Thorne, 2003).

3. Method

Educators need to consider adapting teaching methods to the changing world, whereby IT activities are currently integrated in teaching (Seifert, 2014).

This article aims to show a modern method of approaching a hight school physics lesson by using a smartphone application, Phyphox, in three experiments that took place during the physics class: inelastic collision, centripetal acceleration and mass-spring oscillator.

Mechanics is a chapter of great importance, that underpins the understanding of physics at any level. Innovative mechanical experiments can be performed thanks to the sensors embedded in the smartphone. By the method of teaching physics through experiment using smartphones, students can watch, via URL access, on their own devices the experiment carried out either by their teacher or by a classmate.

Students can access URL addresses by typing them directly into the address bar of a browser or by clicking a hyperlink found in their own emails.

3.1 Inelastic collision

This experiment aimed to determine the energy lost during an inelastic collision of a free falling ball with the surface of a desk. The experiment worked like an acoustic stopwatch experiment, by using the microphone of the smaptphone in order to detect the sounds produced by the collisions of the ball with the surface of a desk.

Figure 1 The ball and the ruler used in inelastic collision experiment

By analyzing the time intervals between the sounds produced by impact and by considering that, after each collision, the ball would retain the same percentage from the kinetic energy that the ball had before the bounce, Phyphox software determined the heights from which the ball fell and the kinetic energy of the ball after each collision as a percentage from the initial kinetic energy of the ball.

Students let the ball to fall on the desk surface from a certain height so they could get at least five ball's collisions with the desk surface. The smart phone's microphone detected the sounds produced by balls collisions with the desk and registered the time taken between two successive collisions.

Experimental data are laid out in *Table 1*.

Collision	Height (cm)	Energy (%)	Retained collision	Time interval between two collisions (s)
1	146	100.000	-	0.109
2	121.39	83.286	83.28	0.995
3	18.88	12.952	15.60	0.392
4	3.02	20.75	16.00	0.157
5	1.75	11.99	5.78	0.119

Table 1 Experimental data in inelastic collision

[1] $E_n = E_{n-1} \cdot \frac{h_n}{h_{n-1}},\ n \in (1 \div 5)$

[2] $h_0 = h_1 \cdot \frac{E_0}{E_1} \approx h_1 \cdot \frac{E_1}{E_2}$

Experimental data proved the correctness of the equations [1] and [2].

Students were challenged to find a practical use of the experiment and they came up with the idea to attach the smartphone to a table tennis paddle and to use balls and paddles made out of different materials in order to get the optimum choice for the least energy loss.

3.2 Centripetal acceleration

The experiment was run as an individual project, by a group of four students.

Figure 2 Measuring centripetal acceleration via Phyphox

The mobile phone was fixed on a rotating disk in a children's playspace. A tablet was also used in order to record the data. A wi-fi hotspot was created with the mobile phone so the tablet got internet connection. The tablet got remote access to the Phyphox application on the mobile phone using the URL generated by the Phyphox application.

The application "Centripetal acceleration" was chosen from Phyphox.The timed run was set.The application generated four graphs: centripetal acceleration versus angular velocity, centripetal acceleration versus squared angular velocity, centripetal acceleration versus time, angular velocity versus time.

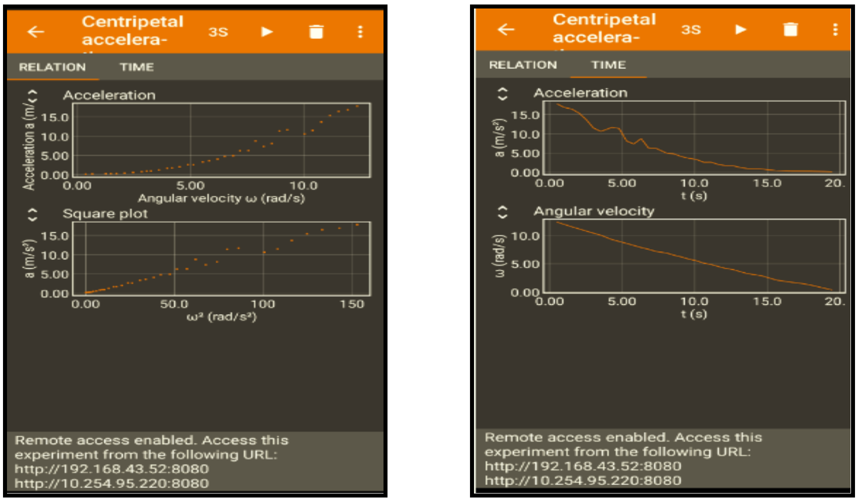

Figure 3 Graphs plotted using "Centripetal acceleration"of the smartphone, measured via Phyphox in the rotating disk

The experiment was run twice: first time the disk rotated freely until it stopped and second time it was pushed again in the middle of the rotation.

The equation between the centripetal acceleration and the angular velocity is:

[3] $a_{cp} = R \cdot \omega^2$

According to the equation of the centripetal acceleration, the graph of centripetal acceleration versus angular velocity should be a parabola. Students could notice that the line of best fit drawn in the graph of centripetal acceleration versus angular velocity, Figure 3, had the shape of a parabola.

According to the equation of the centripetal acceleration, the graph of centripetal acceleration versus the angular velocity squared should be a straight line. Students could notice that the line of best fit drawn in the graph of centripetal acceleration versus the angular velocity squared, Figure 3, had the shape of a straight line. The gradient of this graph is the radius of the circular path of the mobile phone. Students compared the value of the radius determined from the graph with the value measured directly, with a meter rule. There were two challenges to meet at this point of the experiment: to determine the center of the rotating disk and the position of the centre of mass of the smartphone.

After debating, for determining the diameter of the rotating disk, students decided to stick one end of an inelastic thread on one point on the edge of the disk and to rotate the thread over the disk around its margin. The longest length of the thread means the length of the disk's diameter.

For determining the position of centre of mass of the smartphone, students measured the distance from the centre of the disk to the nearest margin of the phone and the distance from the centre of the disk to the farthest margin of the phone and took the average value.

The lines of best fit, drawn for the graphs of acceleration versus time and angular velocity versus time, Figure 3, showed that the centripetal acceleration and the angular velocity are dampening in time, due to friction and transforming of mechanical energy into thermal energy.

As it was mentioned before, the second experiment was almost identical to the first one, but students could observe, in the angular velocity versus time graph, that, in this case, the support disk of the mobile phone had been twice given an impuls. The graph of acceleration versus angular velocity and the graph of acceleration versus angular velocity squared have had the same shape as in the first case, due to the equation of the centripetal acceleration.

Students could observe that, no matter which is the motion of the mobile phone, the radius of the circular motion being the same, the gradient of the graph of acceleration versus angular velocity squared in Figure 3 and Figure 4 was the same.

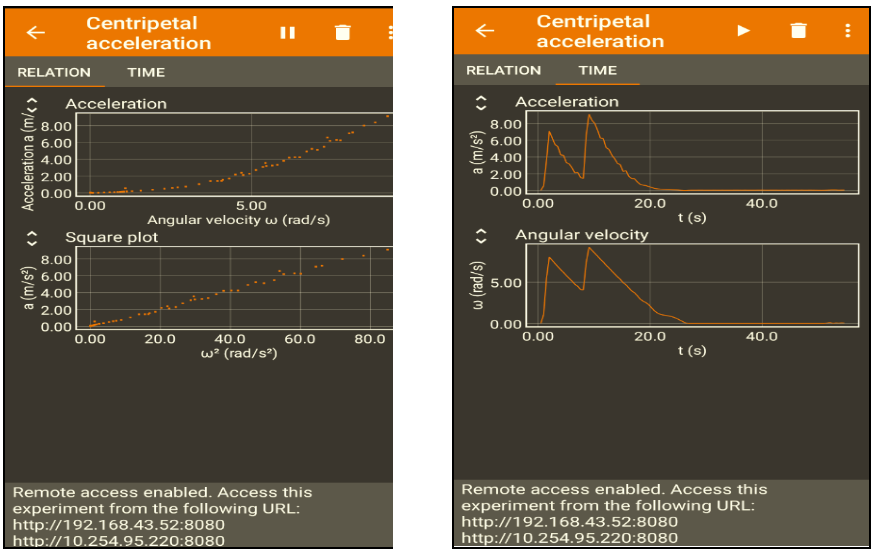

Figure 4 Graphs plotted using "Centripetal acceleration" via Phyphox

3.3 Spring constant

For this experiment, run by a group of four students, was used the Phyphox application called accelerometer. The students weighed the mass of a smartphone. Then they hung the smartphone along with a variable mass by a spring and made the system oscillate as it is shown in Figure 5.

Figure 5 Mass-spring oscillator and connection between a smartphone and a laptop

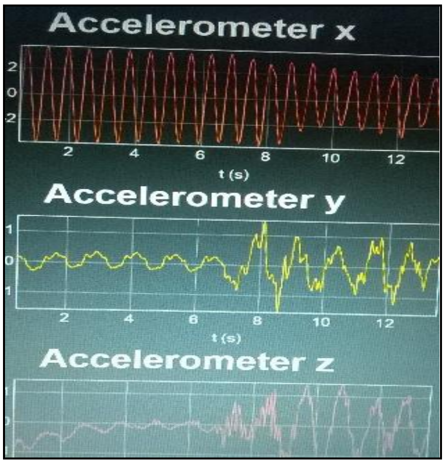

Figure 6 Graphs of acceleration versus time, plotted for the three Cartesian axes

For a total mass of 0.128 kg the application determined the period of the mass-spring oscillator as an autocorrelation of the sum of all the three components of the acceleration:

$T \cong 1.68\, s$.

Using the value of the period indicated by the smartphone or another device connected to the smartphone by URL.and the value of the total mass hung by the spring, the group of studentes determined the spring constant using the formula:

[4] $K = \frac{4\pi^2 m}{T^2}$

The determined value of the spring constant was:

$K = 1.81\, \frac{N}{m}$.

4. Conclusions

Smartphones, with their special applications in the field of physics, can be excellent teaching tools. The increase of students' interest in studying physics should be argued starting from their perspective of using modern technology. By promoting interactive learning, Phyphox application offers educational solutions through a device that students use the most, namely the smartphone.

References

Thorne, K., (2003): Blended Learning How to Integrate Online and Traditional Learning, ISBN 0 7494 3901 7, Kogan Page Limited.

Kali, Y. and Linn, M., (2008): Designing Coherent Science Education: Implications for Curriculum, Instruction, and Policy, ISBN-10: 0807749133, Teachers College Press.

Journal Articles:

Bromley, K. (2012): Using Smartphones to Supplement Classroom Reading, *International Literacy Association*.

Lalima and Kiran, L. D., (2017): Blended Learning: An Innovative Approach, *Universal Journal of Educational Research* 5, 1, 129-136.

Norris, C., Hossain, A., Soloway, H., (2011): Using Smartphones as Essential Tools for Learning: A Call to Place Schools on the Right Side of the 21st Century, *Educational Technology*, 51, 3, 18-25.

Sharples, M., Keynes, M., Aristeidou M., Keynes, M., Villasclaras-Fernández, E., Herodotou, C., (2017): The Sense-it App: A Smartphone Sensor Toolkit for Citizen Inquiry Learning, *International Journal of Mobile and Blended Learning*, 9(2),16-38.

Conference Proceedings:

Perez-Losada, J. and Fort, J., (2012): *Using Smart Phones To Enhance Undergraduate Learning In Laboratory Classes*, The University: An Institution Of Society, CIDUI Barcelona.

Seifert, T., (2014): Pedagogical Applications of Smartphone Integration In Teaching - Lecturers', Students' & Pupils' Perspectives, *Proceedings of the 10th International Conference Mobile Learning*, Madrid.

Internet Sources:

https://phyphox.org/ accessed on January 2019

https://www.youtube.com/watch?v=ikvtPDwV1FE, accessed 2019

https://www.youtube.com/watch?v=fs-7i_fgtgI, accessed 2019

https://www.youtube.com/watch?v=lLCf05Hc83Y, accessed 2019.

Using the Einstein Tablet in an interdisciplinary context

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Abstract

The spectacular development of computer science in the last years has led to a rapid useof the e-learning concept in the field of education. The traditional activities in the classroomcan be replaced gradually with a more flexible type of education by using the latest generation equipment, such as digital technology based on data logger and sensors, Einstein Tablet being specially designed for teaching-learning through experimentation. Using the Einstein tablet of the Fourier Education Company (USA) and the light sensor incorporated into it, the paper will investigate the relationship between the light intensity and the distance from the source. It can be also determined the frequency of the radiation emitted by a fluorescent lamp and the rotation frequency of the pallets of the fan.By conducting such experiments, the students were put in the situation to analyze the information acquired and to connect with other areas of activity, developing competences in an interdisciplinary context. The acquired knowledge will be related to mathematics, physics and computer science.

Keywords: Experiment, Einstein Tablet, MiLAB software, Physics education.

1. Introduction

Physics, as a high school subject,isregarded by many students, as an abstract subject, too little related to their interests. According to the Romanian curriculum, Physics, like Biology and Chemistry are viewed by many students as difficult disciplines. Physics subjects aretreateds eparately from other disciplines without connection with other areas of activity. In order to raisethe students' interest in the study of Physics, teachers should relate the content of their lessons to the everyday life(Volná et al, 2014).If the physics teacher could link his lesson to the extracurricular activity of her or his students and make the connectionbetween theory and practice, then Physics would become a more accessible and more interesting subject (Chalupkováand Demkanin, 2011).

Nowadays students are the first generations to have access to mobile phones, tablets, computers, and other digital era tools(Prensky,2001).Mobile devices, tablets and Smartphones, provide users a continuous access to Internet, which is a normal part of everyday life (Ramma and al, 2018).

By introducing digital instrumentation based on data logger and sensors, the study of physics could turn into a research-based learning(Mottmann, 1999).The use of digital instrumentation allows students to collect and analyse data, focusing more on interpreting them and on conducting observations over long periods of time (Bryan, 2006).

We are witnessing a spectacular evolution of technology that has revolutionated almost all the domains of interest of modern civilization:medicine, environment, industry, social services, transportation. Obviously,this exponential development of technology brings aboutchanges in the field of education too: new strategies, based on the use of stateof theart technology in designing lesson plans, interdisciplinarity.The final purpose of an interdisciplinary approach in education is to reach the understanding and the objective knowledge of the reality(Stoenescu, 2009).

2.The theoretical framework - Interdisciplinary Teaching:

To respond to the requirements of the real world, in a continuous change, high school graduates should be prepared not only to reproduce the contents of a subject, but also to make the connection between these contents and the surrounding world.Because knowledge is not acquired in isolation, the interdisciplinary teaching and learning is an important tool in producing newpatterns, in favoring critical thinking, creativity, collaboration and communication skills.Interdisciplinary teaching and learning increases students' ability to make decisions, to synthesize knowledge,to identify, evaluate,and transfer the information needed to solve practical problems. The interdisciplinary approach of various topics can be accomplished using advanced technology and interactive methods.

One of these tools is the Einstein tablet of Fourier Education (USA). Depending on users' interests, sixty types of external sensors can be added to the tablet, sensors with which students can perform more than fifty experiments in the category of sciences: physics, chemistry, biology, environment, allowing an interdisciplinary way in the study of allnatural phenomena.

MiLAB™ is the Fourier Education app for Android devices and is based on the MultiLab™ analysis software.

3. Method

Physics laboratories of"I.L. Caragiale" National College in Ploiesti have modern teaching equipmentsas well as equipments for computer assisted experiments, data loggers and sensors.

In this paper we proposed to realize three experiments using the light intensity sensor of the Einstein Tablet. In the first experiment we studied the photometric law of distance, in the secondobtaining radiation frequency emitted by a source of flashing light and in the third experimentcalculating the rotation frequency ofthe pallets of different fans.

3.1 Verifying of a photometric law of distance

A punctual light source has a luminous intensity. It emits a light flux throughout the spatial angle. Luminous intensity within a spatial angle element is:

[1] $I = \frac{d\varphi}{d\omega}$

For extended light sources the following relation is valid if illuminance is called B:

[2] $B = \frac{dI}{dA}$

If a surface dA' is illuminated by a light beam with flux $d\varphi$, illuminance is:

[3] $E = \frac{d\varphi}{dA'}$

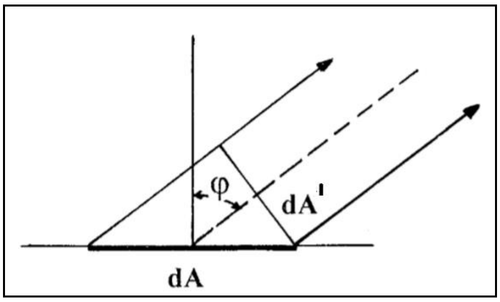

Figure 1 Dependence between illuminance and direction of observation

The illuminance of a surface which reflects uniformly and diffusely in all directions (Lambert-Reflector) in the direction of an angle φ against the normal to the surface is given by the following relation:

[4]$B = \frac{dI_\varphi}{dA'} = \frac{dI_\varphi}{dA\,cos\varphi} = \frac{dI_0}{dA}$

Thus:

[5] $dI_\varphi = dI_0 cos\varphi$

If the light falls perpendicular to the surface, then:

[6] $E = \frac{I}{r^2}$

According to the law of photometry, the illuminance of a surface by light source is inversely proportional to the square of the distance between the source and the surface.

For this experimental set up, the students used an optical bench on which they placed the light sensor of an Einstein Tablet at different distances from the light source. The experimental set up is shown in Figure 2.

The screen of the Einstein tablet displayed, in real time, the illuminance-time graph shown in Figure 3.

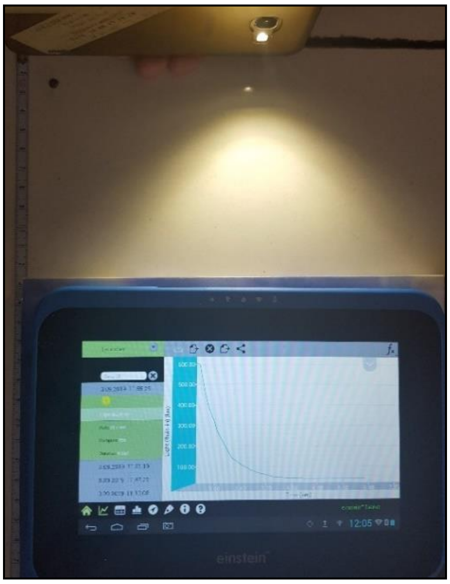

Figure 2 Experimental set up used in the study of photometric law of distance

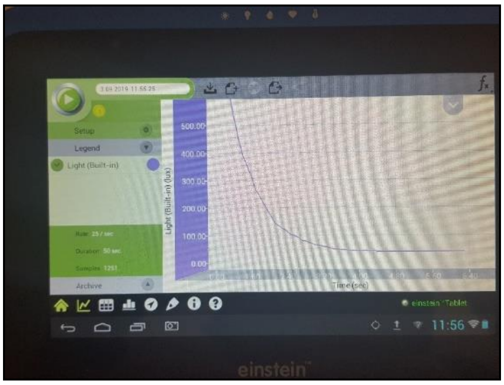

Figure 3 Illuminance – time graph

The students could observe on the graph that the illuminance is inversely proportional to the distance squared, which is in accordance with equation [6].

When increasing the distances between the light source and the Eistein Tablet sensor, the students recorded in a table of data the distances and the corresponding illuminances.The curve obtained is exhibited in Figure 4 and shows that the illumination decreases with the square of the distance, according to equation [6].They processedthe data using SciDAVis software.

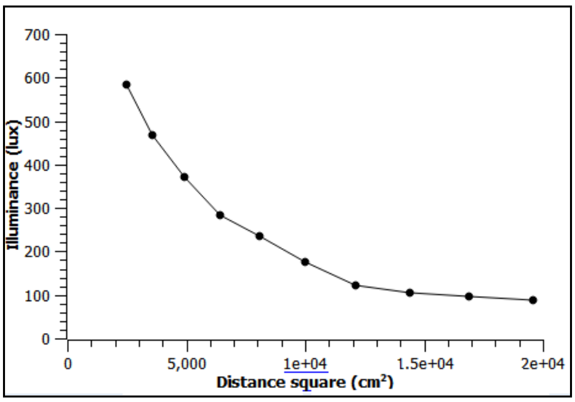

Figure 4 Illuminance inversely proportional to the square of the distance
Data processed by SciDAVis

3.2 Obtaining the frequency of emitting by a flashing light source

The students used a flashing light source.They placed the light sensorof an Einstein Tablet of the Fourier Education Company (USA) in front of the flashing light source.

The screen of the Einstein Tablet displayed, in real-time, the illuminance-time graph shown in Figure 5.

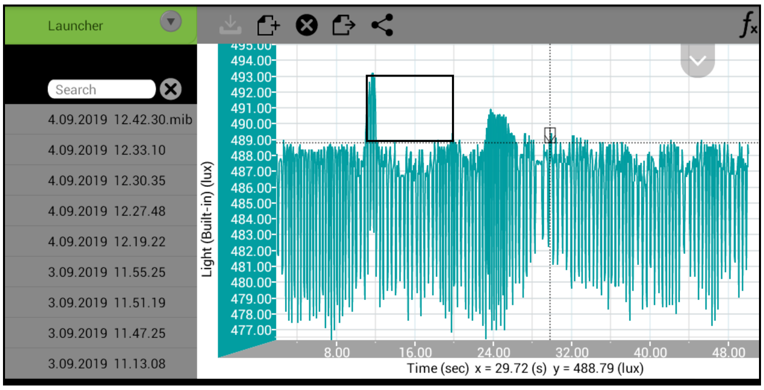

Figure 5 The graphic that shows the modulation of light intensity

In order to determined the frequency with which the flashing light emitted, the students chose a part of the graph, zoomed in and marked two successive peaks in order to determine the period dt of light emission.The equation used for calculating frequency is:

[7] $f = \frac{1}{dt}$

In this case the period time of light emission was dt=0,4s and the determined frequency was f=2.5 Hz.

3.3Determining the rotation frequency of a four-blade fan

During this activity the students aimed to find out, using the light sensor of an Einstein Tablet, how many rotations per second do the blades of a fan.

For this experimental set up, the students used a four-blade fan, a flashlight and a light sensor of an Einstein Tablet. The light sensor of the Einstein Tablet is, in fact, aphotodiode of high precision.During the experiment, in the lab it should be as dark as possible, and the flashlight should shine perpendicularly to the rotating blades of the fan.The experimental set up is shown in Figure 6.

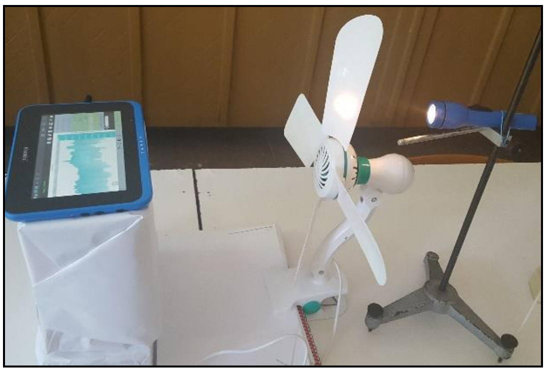

Figure 6 Einstein Tablet, the fan with four blades and the light source

After centering the three elements, namelythe flashlight, the fan and the light sensor of the Einstein Tablet, the students turned the fan on. The screen of the Einstein Tablet displayed, in real time, the illuminance – time graph shown in Figure 7.

In this activity we intended to find out how many rotations one blade makes per second by using the light sensor of the Einstein Tablet.

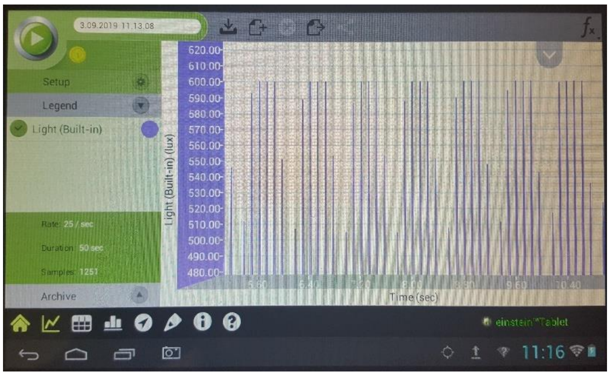

Figure 7 Illuminance – time graph for the four-blade fan

From the graph that represents the periodic variation of the illumination on the sensor, results in the time interval at which the beam obturations are twisted.

In figure 7there is the graph that shows the modulation of light intensity over a few seconds. We zoomed in and marked two peaks. An arbitrary peak with the left arrow and the then 4rd peak to its right because the fan has four blades.

The value of thetime period that the students determined from the graph in Figure 7 isdt=0.09s. In order to determine the frequency of the rotation of the blade, the students used the equation[7].

The value of the frequencycalculating with the equation[7] is f =11.11 Hz.

3.4 Calculating the rotation frequency of a two-blade fan

For this experimental set up, the students used a two-blade fan, a flashlight and a light sensor of the Einstein Tablet, as shown in Figure 8.

The portable mini fan was powered by a solar panel.As in the previous experiment, the students chose the time interval between an arbitrary peak with the left arrow and the then 2ndpeak. The value of the time period that the students determined from the graph in Figure 9 was dt=0.07s and that of the frequency was f=14.28 Hz.

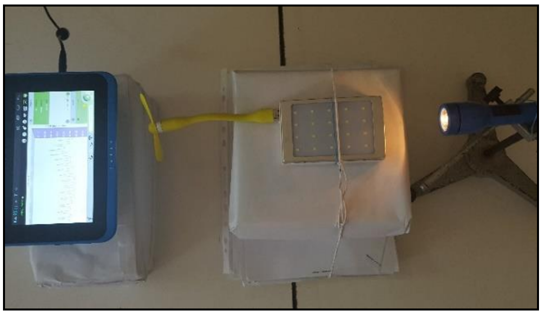
Figure 8 Einstein Tablet, the two blades-fan and the light source

Figure 9 Illuminance graph-time for the two-blade fan

4. Conclusions:

The three experiments shown in this paper were fast and easy to be done. They used anupdated system of data recording and graphics plotting.The use of the Einstein Tablet was equivalent toa complete scientific laboratory.The Einstein Tablet, with its internal software, displayed, in real time, the measurements got by running the experiments.

Performingsuch experiments raised the students' interest in studying physics by finding out that it is not an abstract science, but that it is closely linked to real life and high technology.

The Einstein Tablet allowed an interdisciplinary approach, connecting physics with other subjects such as mathematics and computer science, which is a requirement of a modern education.

References

Chalupková, S. and Demkanin, P. (2011): Students' hobbies as a context for physics teaching, *Scientia in educatione* 2(1), p.15–22.

Mottmann, J. (1999): Innovations in physics teaching. *The Physics Teacher*, 37, 74- 77.

Prensky, M. (2001): Digital Natives, Digital Immigrants, *On the Horizon,* MCB University Press, Vol. 9 No. 5.

Stoenescu, G., Florian, G., *Didacticafizicii*, EdituraSitech, Craiova, 2009.

Journal Articles:

Bryan, J. (2006): Technology for physics instruction. Contemporary Issues in Technology and Teacher Education, *Technology for Physics Instruction,*6(2), 230-245.

Ramma, Y., Bholoa, A., Watts, M. and Nadal, P. S, (2018) Teaching and learning physics using technology: Making a case for the affective domain,*Education Inquiry*, 9:2, 210-236, DOI: 10.1080/20004508.2017.1343606.

Volná, M., Látal, F., Kubínek, R., and Richterek,L. (2014): The human heart and the circulatory system as an interesting interdisciplinary topic in lessons of physics and biology, *European Journal of Physics*,doi:10.1088/0143-0807/35/1/015026,35 015026 (14pp).

Internet Sources:

http://einsteinworld.com/home/, accessed 2019

https://einsteinworld.com/product/einstein-milab-x/, accessed 2019

https://www.studica.com/einstein-tablet-science-education, accessed 2019

www.phywe-es.com,accessed 2019.

https://sourceforge.net/projects/scidavis/

Teaching strategies of learning

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Abstract

In nowadays society focused on knowledge, the ability to learn is associated to professional and personal success. Accustoming the students with some elementary techniques of work specific to intellectual activity contribute to the achievement of the fundamental objective of contemporary education, that is teaching the individual how to learn. This objective requires a new vision of the didactic activity by means of which the individuals are guided to choose or elaborate their own techniques of intellectual work which eventually will allow them to come gradually apart from external guidance and to engage themselves into the process of autonomous learning. As teachers, we can identify and define the problem our students deal with: they need to give up mechanic learning and instead they must be taught how to learn intelligently and creatively. Students must be accustomed with the main requests regarding the hygienic norms, the organisation and the increase of work efficiency. Our study focuses on lower secondary school teachers' perspective on the most efficient learning strategies since teachers are the first that contribute to a systematic work performed by clear rules developed within the didactic activity. The selection submitted to research was done according to specific literature and focus-group discussions: efficient reading, taking notes, use of auxiliary instruments, acquiring skills of work hygiene, revision of the learned concepts, reward for an achieved learning objective etc. The research could be continued with students' perspective upon the efficiency of the learning strategies previously mentioned. This perspective might be somehow different since the students are the ones who experience the process of learning and are its direct beneficiaries.

Keywords: Learning, Strategies of teaching learning techniques, Lower secondary school students, Intellectual work

1 Introduction

Learning how to learn is one of the key competences for lifelong learning presented in the documents of European Reference Framework in 2004. It is the starting point for the development of the other key competences and, at the same time, their result. Learning how to learn means persevering in learning, organising one's own study through the efficient management of time and information, both at individual and group levels. Strictly speaking, it involves gathering, processing, acquiring new knowledge, abilities and skills. In a broad sense, this competence includes an awareness of the learning process and needs, the correct identification of opportunities, the ability to overcome obstacles in order to learn successfully.

Specialists highlight the major contribution teachers have in teaching students how to learn in accordance to their needs, interests, personal qualities, aspirations, personal learning style. The role of school in supporting students to acquire this competence consists in exemplification through practice of an adequate learning environment based on techniques of intellectual work which integrate and exploit students' individual learning experiences (Bercu et al, 2010).

2 Literature review

Efficient reading makes reference, among other things, to techniques of selective and active reading that have a special role in the adequate management of the time allotted to homework. Decoding the meaning of any text is essential for the correct achievement of an academic learning task. Efficient reading involves skimming the text for the main idea, scanning the text for specific information, fast silent reading, global reading, identifying and insisting on passages with key information, focus on the meaning of new words. Whatever the strategy or technique used, the teacher aims to help students become flexible readers, able to choose the reading technique that suits best to the purpose of their reading. In addition, they also become reflective readers able to personalize the subject of the text and learn from it (Vizental, 2014).

Taking notes is good practice for developing the competence of learning how to learn. Taking notes means grasping the essential by processing, filtering registered information. It is considered a strategy of elaboration which facilitates the understanding of new information, encoding and storing it in long term memory. As strategy of learning, it is used in different contexts, in the classroom and outside the classroom, and is associated to individual learning. Teachers must guide students to take notes. They need to build presentations starting from the main ideas, using adequate vocabulary. They need to use various ways of organising the information, such as sketches, plans etc. Students must be monitored and encouraged to retrieve the whole information starting from their own or others' notes. This will help the student glue the new ideas into the brain. It is important to make a habit of this for each new content.

The concept map is one of the most relevant graphic organizers used for producing and enhancing learning. It is a relatively simple method of ordering and organizing students' thoughts. Structurally, concept maps are rendered in different ways, with the information organized hierarchically from general concepts to particular ones. As students create concept maps, they reiterate ideas, they identify and grasp new concepts, they revisit old concepts and information etc. In order to benefit from this learning tool, it is important that students should learn to create their own concept maps. This involves specific guidance from the teacher. As a first stage, teacher should explain and demonstrate the technique to all students. In the stage of guided practice, the students, individually or in groups, get as work task to create a concept map with teacher's model in mind. In the final stage, students create their own concept maps with different structures, with new concepts and links as they see fit.

Auxiliary instruments (dictionaries, encyclopaedias, anthologies, new media etc.) are meant to clarify, complete and grasp knowledge. Children must be taught that in order to understand better new knowledge they need additional information which they may find in such auxiliaries. Teachers must initiate students in the technique of using auxiliary instruments. Their objective is to help students become independent, to take advantage of the numerous available resources. If they are encouraged to develop interest for culture and education since a young age, they will become adults with an open vision of the world.

Work hygiene activities make reference to the efficient organisation of time and space which may provide a better perspective on daily priorities, thus creating the possibility to confront, reduce and avoid stress and, at the same time, offering the chance to reach one's purposes (Cucoş, 2002). In order to get good results, students must be taught to organize and perform their activities according to a strict daily programme. Once they get home from school, children must have their meal and rest for at least an hour. When they start their assignments they must avoid the noises coming from TV, radio or cell phone, they must be seated, they have to get enough light etc. (Răduț-Taciu et al, 2015). The TV, the video games, the social media often interfere with students' correct regime of rest and activity. It is up to teachers and parents to guide students into finding the balance between entertainment and individual study at home.

Putting the theoretical notions into practice helps students understand their practical value. The end-of-chapter tasks check, in fact, the level of understanding of the notional systems recently acquired. They become thus a form of consolidating the information. Doing them opens the perspective of reinforcing through individual effort the theoretical knowledge learned in school.

Reward oneself for an achieved goal is necessary as it increases students' motivation. Children must be taught that after an intense sequence of intellectual activity they should have a break in which they should do whatever they like: listen to their favourite song, dance on their favourite music, watch a video, eat something they like. But this should not last more than 5-10 minutes because, otherwise, the flux of the activity is disrupted. The idea is known as the pomodoro technique which works like this: shut off all distractions, set the timer for 25 minutes, focus on the task, reward yourself (Oakley et al, 2018).

The concept of learning style makes reference to the favourite way of getting, processing and storing information. Learner personalities and styles have been described and classified in different ways. The most general classification refers to visual, auditory, kinaesthetic styles of learning. Research have shown that 65 % of the population are visual, 30 % are auditory and only 5 % are physical (Mills, 2002, apud Călineci and Păcurari, 2009). Every person has a dominant style of learning. Once it is correctly identified, it is important that teachers help students select the learning strategies fitted to their style and personality.

3 Methodology of Research

Objectives

The research objectives are a) to identify the most efficient strategies of teaching lower secondary school students how to learn, b) to realise a descriptive analysis of the selected elements to determine a hierarchy in the school level under the lens. Mention must be made that lower secondary school includes four grades (grades 5-8 of gymnasium), with students aged 11 to 15.

Participants

The sample involved in the research consisted of 100 teachers working in lower secondary schools, from Vrancea County, Romania. Their experience in the field of education varied from 5 to 35 years.

Research instrument

The research method was the questionnaire-based investigation. The research instrument was built based on specific literature and focus-group discussions with teachers from lower secondary schools. As a result there were identified a series of strategies of teaching learning transposed into the following items: efficient reading, taking notes, concept mapping, use of auxiliary instruments, acquisition of work hygiene skills, revision of the learned concepts through the end-of-chapter tasks, self-reward for an achieved learning objective, identifying the correct learning style. The respondents chose one variant of a five-step scale: (1) to a very low extent, (2) to a low extent, (3) to an average extent, (4) to a large extent, (5) to a very large extent. The answers showed the relevance for each item as strategy of teaching students how to learn.

Results and Discussion

For the descriptive analyses, we used SPSS software.

Table 1. Means and standard deviation of strategies of teaching lower secondary school students how to learn

Items of strategies of teaching lower secondary school students how to learn	Teachers' opinions Mean (std. dev.)
Efficient reading	4.86 (0.969)
Taking notes	4.80 (0.904)
Concept mapping	3.32 (1.220)
Use of auxiliary instruments	4.08 (1.175)
Acquisition of work hygiene skills	4.98 (0.909)
Revision of the learned concepts through the end-of-chapter tasks	3.72 (0.919)
Self-reward for an achieved learning objective	3.76 (0.625)
Identifying the correct learning style	4.76 (0.886)

With the means included in Table 1 we realised a hierarchy of the strategies used to teach students how to learn as presented in Table 2. As such, the indicator that ranked the 1st was considered highly efficient as a strategy of learning, whereas the item in the 8th rank was perceived as less efficient for the same purpose.

Table 2. Descriptive of hierarchy of the strategies of teaching lower secondary school students how to learn

Strategies used in teaching lower secondary school students how to learn
1. Acquisition of work hygiene skills
2. Efficient reading
3. Taking notes
4. Identifying the correct learning style
5. Use of auxiliary instruments
6. Self-reward for an achieved learning objective
7. Revision of the learned concepts through the end-of - chapter tasks
8. Concept mapping

4 Discussions

The means obtained in lower secondary school vary between 4.98 and 3.32. The top three ranks are for the following items: acquisition of work hygiene skills (m = 4.98), efficient reading (m = 4.86), taking notes (m = 4.80).

The highest means (m = 4.98) in the hierarchy were for acquisition of work hygiene skills. The development of work hygiene skills is essential at the ages of 11 to 15 as in the prior school level, children have been monitored by parents for most of their tasks fulfilled at home (rest schedule, homework, breaks between the tasks, organization of the learning space etc.). Once they acceded to a superior school level, students manifest their need for independence and assertion. Moreover, most of the times, students go to school in the afternoon so they do their homework in the morning when parents are at work. On the other hand, during primary school students were monitored by one teacher only, whereas in lower secondary school each subject is taught by a different teacher with a proper teaching style, with proper requirements regarding individual training of students. At the same time, at this school level the quantity of homework is bigger as teachers do not agree on the volume of homework assigned to students every day.

That is why, it becomes necessary for the teachers to teach students how they can organize efficiently their work, time and space. Students should be taught to dose their effort according to homework difficulty, to organise the work space so that they should avoid repeated interruptions that disrupt the flux of work and the ability to focus. Breaks for rest must be established rhythmically and obeyed according to the schedule. At this level of age, children are tented to postpone the learning activity in favour of watching cartoons, playing video games, chatting with friends or simply playing. These leisure activities can be changed into rewards which students can grant themselves at the end of the programme of individual study. Children must be persuaded that putting these work habits into practice eases their learning process, increases the efficiency of personal work and ensures independence from parents and teachers.

Efficient reading (m = 4.86) ranked the second in teachers' opinions on the relevance of the strategies of teaching learning Efficient reading means understanding the information in the text. Selective and active reading are rather time consuming with students from 5th and 6th grades (ages 11-13). In general, children read a text several times before they grasp its essence. At first they focus on the reading process, then they select and explain the new words and during the next reading they understand the gist of the text. From these reasons teachers have to teach children techniques of efficient reading: scanning, skimming, identifying the paragraphs with the main information for the theme under the lens, techniques of looking up the unknown words, going back to the passages with the main ideas etc.

The 3rd position ranked for taking notes (m = 4.80). Students must be taught to write down only what is essential from what they read. The sources of information are diverse and sometimes complex (encyclopaedias, dictionaries, scientific books, sites on the internet). Children must be taught to select the main ideas from the vast information. In this way, the learning content is smaller, which motivates them in the learning process.

Identifying the correct learning style (m = 4.76) ranked the 4th in the hierarchy in Table 2. The learning style can affect students' results in school. Teachers involved in the research stated that students with poor results succeed in improving school performances, their attitude to school if they get to know their learning style. So it is teachers' job to help students correctly identify their learning styles using various strategies, with or without school counsellor' help.

Teachers state that self-reward for an achieved goal is beneficial for the efficiency of the learning process. Self-reward makes the learning less frustrating knowing that at the end there is something pleasant to do or get. Self-reward boosts well-being, motivates and imprints a certain rhythmicity to the learning process.

In the age of fast multiplication of information children must be taught to look efficiently for the additional information needed for the various assignments. Teachers should guide students to look for the relevant information according to some clear rules, stated repeatedly during school time. They also should be taught how to use auxiliaries such as dictionaries, encyclopaedias, anthologies, relevant web sites etc.

Teachers state that in the 5th and, sometimes, in the 6th grades, children find it difficult to realize the concept map by themselves, without guidance. However, the concept map, as instrument of organising the information, is successfully used individually with students in the 7th and 8th grades.

Students must be persuaded that an efficient technique of checking the comprehension of the information acquired is to do the end-of-chapter exercises. This should be part of individual study and should not take more than few minutes so that students should not feel too burdened.

5 Conclusions

Our study presented the most efficient techniques of intellectual work which help develop in children the competence of learning how to learn. Skills of autonomous intellectual work formed in school are the basis of lifelong learning so necessary in a society with a continuous evolution of the educational system and professional formation. Developing skills of intellectual work in children involves presenting methods and techniques of study and creating situations to practice them. Thus, students will acquire the ability to analyse their own learning process and will adjust the methods and techniques according to their idiosyncrasies, eventually developing their own style of intellectual work. They will become responsible, autonomous, with skills which will help them succeed in school and life.

The research could be continued with students' perspective upon the efficiency of the learning strategies mentioned above. This perspective might be somehow different since the students are the ones who experience the process of learning and are its direct beneficiaries.

References

Bercu, N., Căpiţă, L.E. and Nasta, D.I. (2010): *Domeniul de competențe cheie A învăța să înveți. Ghid metodologic*. ISE, Bucureşti.

Călineci, M.C. and Păcurari, O.Ș. (2009): *Cunoaşterea elevului. Ed. a 2-a*. Educaţia 2000+, Bucureşti.

Cucoş, C. (2002): *Timp şi temporalitate în educaţie*. Polirom, Iaşi.

Oakley, B., Sejnowski, T. and McConville, A. (2018): *Learning How to Learn: How to Succeed in School Without Spending All Your Time Studying*. Penguin Random House, New York.

Răduț-Taciu, R., Bocoș, M.D. and Chiș, O. (2015): *Tratat de management educațional pentru învățământul primar și preșcolar*. Paralela 45, Pitești.

Vizental, A. (2014*): Metodica predării limbii engleze. Strategies of Teaching and Testing English as a Foreign Language*. Polirom, Iași.

Values of the organisational culture in schools

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Abstract

Knowing the culture of an organisation is necessary as it probably constitutes an useful anticipatory element of its evolution on a long term. The organisational culture gives value to an organization, sets certain behavioural patterns which express its unique identity. The organisational culture contains visible and invisible elements tightly connected with each other. Most of the times, the invisible part constitutes the deep organisational culture. At the basis of the organisational culture there are the values, which set tone for the behaviours and attitudes of the individuals in any institution. The organisational values are factors of uniqueness and personality: they define the work process, the decisions and the actions of an institution. Studies have emphasized that, although investigating the "personality" of the organisation is not an easy task, it is important to acknowledge the climate of the organisational culture in order to maximize the efficiency of employees' work. Our research aims to identify the values considered essential for the efficient functioning of several school organisations. As such, a sample of 50 teachers from four different institutions in the urban and rural areas was used. Based on specific literature and focus-group discussions we proposed a set of indicators which underwent a hierarchy based on teachers' opinions. The indicators submitted to the discussion include team work, efficient communication, delegating tasks, discipline, ability to adapt to changes etc. The data collected were processed with the SPSS analysis. The results are useful as they can offer insights on what is considered to be of essence in the school organizations.

Keywords: Values, Organisational culture, Axiological principles

1 Introduction

The concept of organisational culture makes reference to collective standards of thinking, attitudes, values, convictions, norms and habits that exist in an organisation, all determining the ways in which members behave inside and outside the respective organisation (Macri, et al, 2011; Iosifescu, 2001). Values, as fundamental components of any organisational culture, represent moral, ethical, axiological principles which define and direct the decisions and the activities in the organisation. Values define what is desirable and undesirable, good or bad for the members of the organisation, being tightly connected to the ideals of work and living promoted in the group.

In schools, like in any other organisations, values constitute the support of ideals for the elaboration of a complex set of norms, representations and understandings shared by its members. Acknowledging them, their relevance and place in the organisational culture is, in fact, a way to maximize the efficiency of the teaching staff activity.

2 Literature review

Team work means that the members of the school organisation act together for the common benefit. Team work generates harmony, cooperation, affinity, acceptance. It also contributes to the intensification of positive attitude towards work. When working as a team, teachers consider school objectives above personal ones (Călineci et al, 2009). With the common goal in mind, members must cooperate and support each other. Note has been made that the success of any project depends more on the unity of the team than on the top professionals taken individually (Nedelcu et al, 2009).

The members of any organisation must understand the importance of the communicational act and assign the necessary time for it. They should also keep in mind that communication is usually imperfect and efforts must be made to improve it. Thus, they must know and obey the elementary rules of efficient communication such as concision, objectivity, active listening, correct and complete information, acceptance of a different point of view, negotiation of divergent aspects (Nedelcu et al, 2009; Macri et al, 2011).

Delegating tasks is a modern form of management in which managers, in schools or any other institutions, hand over the responsibility of solving tasks to employees with the necessary competences or to employees who actively get involved in making decision, in promoting ideas and concepts in the activity of the organisation (Stanciu, 2001). Thus, delegating tasks is one of the most efficient methods of time management as tasks require less time to be fulfilled if entrusted to the right person. It is also an efficient tool of motivating employees as it is usually associated with the trust granted to the employee by the manager of the institution. It is also a means of professional development as it provides opportunities to improve experience, to make learning more complex and to obey a set of work rules (deadlines, choices of efficient strategies of communication, means of control etc.).

Delegating tasks is important for the success of the organisation, but equally important is that each member to get involved seriously in their work. Responsibility is correlated with the assembly of internal determinations of the individual to freely assume his actions and their results in the organisation (Răduț-Taciu et al, 2015). In a group each member is responsible for all aspects of the collective problem and for the individual work.

Respect is a value that stands at the basis of each social construction. It is a form of consideration granted to another person. It is a means of recognising the merits of the individual in the society. Respect means polite and friendly attitude towards the others and is demonstrated through communication, understanding, punctuality, appreciation and care for the others' behaviours and feelings. So, respect as fundamental value of any school organisation is the engine that makes people live in harmony, build things together, feel dignified and do valuable things at their work place (Sandner, 2015).

Discipline represents the necessary order for implementing the social report of work within any organisation. It comes from obeying, irrespective of the hierarchy, of all behaviour norms that ensure the proper development of work (Crețu, 2008). Discipline, as value in school organisational culture, involves the existence of well-structured collectives that obey explicit and implicit norms of work behaviour.

Enterprising and creative attitude of members of the school organisation is one of the values that supports progress and high standards of work. Enterprising and creative attitude means initiative, courage to try new techniques of action. Creative people propose new solutions, ask uncomfortable questions or provide unexpected answers, think of ways of changing things for the better. For all these reasons, such an attitude is important for quality increase in any school (Tîrcă, 2011).

Any team is made of a variety of behaviours and human relationships, which is good as it allows a faster adjustment to the changes of its environment. Because of the diversity of personalities, building a positive climate is not easy, but it is necessary as it reflects positively on the employees' work. A positive school climate means development of the institution, establishing and assuming the same educational vision. Moreover, it brings joy, relaxation and fun in the routine of teaching activities.

Lifelong learning is a mandatory component for the professional development of any organisation. It is an essential element for work efficiency in schools. At individual level, lifelong learning refers to developing competences on a regular basis through knowledge increase and ability development. At organisational level, lifelong learning involves the analysis of personal experiences, questioning one's methods, work policies and interaction practices.

Changes from the exterior of the educational system are the result of reform or innovation and targets curricular, organisational, methodological, evaluative aspects. As a rule, the changes in the educational institutions are generated by social, political, economic and cultural alternations. They affect management, teachers and students altogether. The dynamic of changes introduced through the reform of education sometimes allows little time for clarifications and changes of mentalities. As such, this process of changing draws pros and cons from the teachers. Irrespective of the changes, teachers do their job professionally leaving no room to indifference and ignorance.

Trust as value for the organisational culture means that one can rely on his/her colleagues for support and honesty in dealing with different issues in the daily activity. Colleagues' trust makes any member feel valuable in the organisation. It emphasizes that professionalism is a key principle in the organisation (Nedelcu et al, 2009). Trust makes people feel part of the collective, laying the foundations of good relationships. As school is concerned, it is important to create situations in which teachers get to know each other, to communicate, to listen to each other, to show respect and trust.

3 Methodology of Research

Objectives

The research objectives are a) to identify the values considered essential for the efficient functioning of four school organisations, b) to realize descriptive analyses of the selected elements in order to determine a hierarchy for the schools involved in the project.

Participants

The sample used for research was made of 50 teachers from four different institutions in the urban and rural areas from Vrancea County, Romania.

Research instrument

The main method used for the research was the questionnaire-based investigation. The questionnaire was built based on specific literature and focus-group discussions with teachers from four institutions in the urban and rural areas. This led to the identification of a series of values of organisational culture in schools transposed into the following items: team work, efficient communication, delegating tasks, assuming responsibility, mutual respect, discipline, enterprising and creative attitude, positive school climate, lifelong learning, open attitude towards changes from the exterior, trust.

The respondents chose variants of a five-step scale: (1) to a very low extent, (2) to a low extent, (3) to an average extent, (4) to a large extent, (5) to a very large extent. Teachers' choices showed each item's relevance for the efficient functioning of the school organisations involved.

4 Results and Discussion

For the descriptive analyses, we used SPSS software.

Table 1. Means and standard deviation of values of the organisational culture in schools

Items of values of the organisational culture in schools	Teachers' opinions Mean (std. dev.)
Team work	4.92 (0.853)
Efficient communication	4.96 (0.968)
Delegating tasks	3.72 (1.084)
Assuming responsibility	4.50 (1.092)
Mutual respect	4.88 (0.756)
Discipline	4.08 (1.047)
Enterprising and creative attitude	4.24 (0.906)
Positive school climate	4.16 (0.661)
Lifelong learning	4.40 (1.309)
Open attitude towards changes from the exterior	3.64 (0.942)
Trust	4.46 (1.230)

Using the means in Table 1 we realized a hierarchy of the values identified as essential for the good functioning of school organisations. Thus, the indicator ranked one was considered the most influential, whereas the indicator ranked eleven was less appreciated as an essential value for the organisations.

Table 2. Descriptive of hierarchy of the values of the organisational culture in schools

Values of the organisational culture in schools
1. Efficient communication
2. Team work
3. Mutual respect
4. Assuming responsibility
5. Trust
6. Lifelong learning
7. Enterprising and creative attitude
8. Positive school climate
9. Discipline
10. Delegating tasks
11. Open attitude towards changes from the exterior

According to the hierarchy in Table 2, efficient communication (m = 4.96) registered the highest means. Communication is considered the most important value in the organisational culture of any institution. Teachers stated that communication is an important factor of cohesion in the group as it is involved in all work aspects in the organisation. They are aware that special attention must be paid to all elements of efficient communication both vertically and horizontally.

Team work was appreciated as one of the essential values of the organisation (m= 4.92) since cooperation is a condition of efficient work. Tasks are performed with little waste of time, the effort is split, solutions come easier when more people think of them. All in all, teachers are aware that team work is important for the improvement of school performances.

Respect ranked the third in the hierarchy (m = 4.88). Respect makes people feel valuable and visible for the collective. It is at the basis of positive relationships in school organisations. It also creates a sense of security for the group.

Assuming responsibility ranked the forth in teachers' hierarchy (m = 4.50). All employees must get involved with all their resources to fulfil their tasks. Everyone must respond for the quality of their work without blaming their peers or management because putting the blame on somebody else destroys the cohesion of the group.

Teachers granted trust a superior rank in the hierarchy (m = 4.46). Trust means that the objectives, set individually or in group, are to be fulfilled. Teachers also consider that manager's trust in the collective is also an important factor for the organisation.

Lifelong learning was appreciated as the fifth in the hierarchy of values of the organisational culture in schools (m = 4.40). Teachers are aware that lifelong learning is necessary to deal with the changes met in the learning process and in the educational system. Lifelong learning allows teachers to make the activity in the organization efficient. They highlight the necessity of workshops organised at the level of the institution in which they can debate the new teaching and management strategies or exemplify different new issues through good practice examples.

Enterprising and creative attitude was appreciated as the sixth in the hierarchy from Table 2 (m = 4.24). Teachers involved in the research associate it with personal effort, with taking initiative, implementing elements of novelty, finding creative solutions for the problems they come across in the organisation.

Positive school climate ranked the seventh in the hierarchy of values of the organisational culture in schools (m = 4.16). Positive atmosphere is important in any school organisation and must be supported through sessions of team building, activities dedicated only to teachers in schools or in community. The emphasis was laid on informal situations that can ensure the development of positive relationships which, as a rule, maintain a warm, pleasant climate in the institution.

Teachers in our focus group agree that discipline is an important value for the school organization (m = 4.08), but there are situations in which deviations from discipline determined by particular contexts are accepted as such: schedule commute for teachers in the rural areas, conflicts with the management when decisions are not transparent etc. However, teachers are reluctant to repeated negligence in performing their job in the classroom, delay in carrying out administrative tasks, disobedience of internal regulations.

Some of the teachers have a skeptical attitude (m = 3.72) towards delegating tasks because it means multiplying the number of work tasks without getting paid accordingly. On the other hand, they are aware that work is more efficiently done when tasks are delegated according to each person's skills. Delegating tasks is an open issue since there are persons who are eager to do extra work and people who systematically avoid having their work tasks multiplied.

Open attitude towards changes from the exterior ranked the eleventh in the hierarchy (m = 3.64). The repeated changes outside the organisation, most of the times resulted from incoherent political alterations, affect teachers negatively. In this case we can not speak of open attitude but of simple acceptance of the changes imposed.

5 Conclusions

These values are considered to be specific for the school organisations willing to progress. Acknowledging and obeying them represents the basic condition for shaping a strong organisational culture. Once accepted and internalized, the values constitute axiological support for elaborating a complex set of norms, representations and understandings shared by the members of the organisation. They become morale principles that guide relationships and work within organization.

Our research identified the values considered essential for the efficient functioning of four school organisations. The results are useful as they can offer insights on what is considered to be of essence in school organizations. The means emphasized that some items, although viewed as basic in focus groups discussions, were ranked last in the hierarchy: discipline, delegating tasks, open attitude towards changes from the exterior. The explanations provided revealed particular contexts which determined the teachers' choices. In order to increase the relevance of the results obtained, the research can be continued on a larger sample of teachers from different schools. There can also be performed a comparative analysis between rural and urban environment.

References

Călineci, M.C., Păcurari, O.Ș. and Stoicescu, D. (2009): *Valori comportamentale şi reducerea violenţei în şcoală*. Educația 2000+, București.

Crețu, I. (2008). *Managementul calității. Note de curs*. UTM, Chișinău.

Iosifescu, Ș. (2001): *Management educațional pentru instituțiile de învățământ*. MEC, București.

Macri, C., Nicolae, I. and Nicoară, V. (2011): *Management instituțional și de proiect*. MECTS, București.

Nedelcu, A., Palade, E. and Iosifescu, C.Ș. (2009): *Management instituţional şi management de proiect*. Educaţia 2000+, București.

Răduț-Taciu, R., Bocoș, M.D. and Chiș, O. (2015): *Tratat de management educațional pentru învățământul primar și preșcolar*. Paralela 45, Pitești.

Sandner, U. (2015): *Puterea ta interioară*. Gordian, Timișoara.

Stanciu, Șt. (2001): *Managementul resurselor umane*. Comunicare.ro, București.

Tîrcă, A. (2011). *Management educațional*. MECT, București.

Applications of e-Learning in textile and leather engineering education

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Abstract

The article proposes a comparative review of a set of applications that can be used in e-learning for faculty of textiles and leather students, in order to identify the advantages and disadvantages. Performing this analysis on how to integrate these applications into the online environment and applying them to higher education will be able to generate a series of results that will be discussed and could made recommendations and suggestions on the implementation of such applications in the training of future engineers in the textile and leather industry. The difficulty of approaching is because e-learning in engineering is not extensively used in current educational practice, being just a few attempts based on applications such as: applications available for online study, e-books and tutorials Moodle (http://moodle.org), WebCT/Blackboard (http://www.blacboard.com); applications which allow learning objects such as simulations, structured lessons, animations as MERLOT (http://www.merlot.org) and JORUM (https:www.jorum.ac.uk/) or WireFusion (https:// wirefusion.soft112.com); and multi-user, dynamic and interactive learning environments allowing constructive learning, Finesse (Michaelson, 2003) and WiFi Virtual Laboratory (Allison et al., 2008). Integration on these platforms of software specific to the textile and leather education such as: Assyst, OptiTex, FlexSim, Gerber, Nei Nastran, TexGen, OptiTex 3D, Clo 3D presents to students a number of advantages of the educational process. Identify how these applications can be used using cloud architecture e-learning technologies through XenServer an enterprise-ready, cloud-proven virtualization platform that contains all the capabilities required to create and manage a virtual infrastructure and provides an efficient management (Williams 2007) is another objective of this paper.

Keywords: Education, E-learning, Games

1 Introduction

The 21th century is characterized by the transition to “society 4.0”, a term that is defined by hybrid multi-agent teams which are completely interconnected among themselves and their environment. To educate and train for those “4.0. scenarios” the digitalization of education and hence the call towards more interactive and collaborative components within higher educational e-learning can be noticed. [6].

Engineering education is changing because it is under a huge pressure from society and industries to increase its effectiveness to prepare a new generation of engineers who can face global issues such as population, transportation, global climate change, sustainable energy, global poverty, and affordable quality health care [2]. Implementation of an e-learning system in technical education involves a change of option in what should be presented, discussed and interpreted with and by students. Learning method by working directly with offline / online or simulated type applications: Assyst, OptiTex, FlexSim, Gerber, Nei Nastran, TexGen, OptiTex 3D, Clo 3D „can be used in networked computing laboratory to demonstrate and carryout experiments which otherwise could have not been carried out in hardware laboratories due to non-availability of relevant or sufficient instruments or component(s) or due to time constraints." [2]. In applied electronics, telecommunications and information technology, textile and leather the learning environment also provides with hands-on experimentation work, simulation software packages and semester/diploma projects [5]. and for this learning cloud environment built around Citrix XenServer. XenServer is an enterprise-ready, cloud - proven virtualization platform that contains all the capabilities required to create and manage a virtual infrastructure and provides an efficient management of Windows and Linux virtual servers and delivers cost effective server consolidation [7].

Computer aided design techniques offer more efficient and time saving solutions to yarn and fabric design, print design, pattern making and garment design. Two dimensional software such as Illustrator, Photoshop and Corel Draw have been using by the fashion designers. Customized programmes for the textile and fashion industry such as fabric design software Kaledo, Ned Graphics, Tex Design, Arahne etc and pattern software such as Assyst, Modaris, Accumark are being used around the world [3].

2. Integration Software in E-Learning Platform

In view of the strong development of Fast Textile Industry, the educational system needs to transform its courses and implement more technical applications, and as many of them as possible to function through e-learning platforms. Some of them may be of the type:

CVP – Collaborative Virtual Prototyping

This web platform enables online collaboration between all actors involved in the design/prototyping phase of a new collection (product managers, designers, pattern makers, marketing personnel).It enables integration of remotely located 3D CAD systems, virtual fabric libraries, 2D CAD/CAM systems for the exchange of multimedia content (2D patterns, fabric data, etc). It further includes facilities such as virtual meetings and online showrooms. E-collaboration combined with virtual prototyping can lead to 60% reduction of design and prototyping time, as well as up to 75% reduction of the number of physical samples. It enhances team creativity and performance and shortens significantly time-to-market. (Leapfrog final results brochure 2018, www.leapfrog-eu.org)

Virtual TryOn

The Virtual TryOn is a real-time platform enabling consumers to evaluate physically simulated 3D garments on a 3D digital representation of their own body.

The consumers are able to customize a 3D template body to fit their specific morphology. This avatar can then be dressed with a 3D garment which is accurately simulated based on physical parameters.

The system allows for the interactive resizing of virtual bodies, adapting the animation to the new morphology. Garments are simulated in real-time and are interactively resizable. It further provides video functionality to record high quality simulation results. (Leapfrog final results brochure 2018, www.leapfrog-eu.org)

3D Garment design and 2D flattening software

The 3D Design Module, to be integrated into commercial design software, is an advanced 3D design application that streamlines the entire product life-cycle. It enables a 3D simulation of garments on a 3D parametric human figure. The 3D Design Module will provide 3D Simulation of garment fit on deformable human bodies, 3D design tools and flattening process to 2D patterns through data collaboration with the Collaborative Virtual Platform (CVP).

Major innovative elements are an accelerated design and product development cycle; true-to-life garment modeling, 3D Design tools for product design & development and innovative communication channels (through the CVP) for reduced time-to-market, improved product quality, reduced product development cost and enhanced product marketing. (Leapfrog final results brochure 2018, www.leapfrog-eu.org).

According with Papahristou E, Bilalis N [4] the main advantages and disadvantages of utilisation 3D in fashion industry are:

Table 1 Advantages and disadvantages of used 3D Virtual Prototype

Advantages / benefits	**Disadvantages**
• Speed of conception/Reduces time to develop • Increases time to experiment/Allow more designs • Eases communication • Better visualization-helps in presentation • Reduces Errors when integrated with 2D and PLM • 3D Digital much faster than physical • Reducing time for the design development and prototyping process • Quick integrated controls over the garment • Maintains the linearity between 3D changes and the 2D pattern	• Being the lack of experienced users with technical knowledge • The time it takes to learn this new technology, and how insufficient the tool can become when comparing a skillful simple technician with an amateur 3D user • Needed skills were ignored by many fashion courses in higher education run by non-technologists, and ineffectively developed by those inexperienced practitioners who focus on design only and are generally fearful of change

Clo vs Marvelous Designer

The primary difference between the Marvelous Designer and CLO3D is that the import/export of DXF-AAMA or DXF-ASTM files is only available in CLO, changing Avatar sizes is only available in CLO 3d and Clo3d allows for seems and a few other features for real life clothes.

Table2 Difference betweem CLO3D and Marvelous Designer

CLO3D	**Marvelous Designer**
• simply a very smart way to cut time and save money when making production-line clothes for real humans • very easily and quickly alter patterns and clothing designs and to simulate clothes they make on a virtual 3D model, to see how it hangs and looks, before actually cutting the fabric material in the real world and being wasteful for no good reason • Clo3d is used in fashion industry • is a cutting-edge 3D garment visualization technology with a true-to-life 3D garment simulation solution • Clo3D can be used as a design tool, specifically for design development, to visualize garments based on their 2D CAD patterns	• makers realized that aside from the fashion industry there was a market for film, animations, computer games and online fashion catalogs with a simplified version of Clo3D and with added featured 3D artist need for their workflow, using other 3D software tools like ZBrush, Maya, render engines and even Poser, DAZ3D etc. • Marvelous Designer is used in film and gaming industries as well as for making clothes for digital 3D markets for users of DAZ3D, Poser, iClone, SecondLife and more

Source: https://cgelves.com/marvelous-designer-vs-clo3d/ Accesed in 22 february 2019

Arena vs Flexsim vs Anylogic vs Simul 8 vs In-house

Table 3 Advantages of Textile Simulation programs

Simulation programs	Advantages
Arena	• Most well-documented simulation softwarein the market • ODBC data compatibility • Import AutoCad drawings • VB scripting, automation and macro recorder • Easy to automate and easyto collect statistics
FLEXSIM	• Perform database queries to import data into FlexSimusing SQL • Send messages (with parameters) between objects • Support DDE (Dynamic Data Exchange) • 3D Simulation and very clean GUI • Support any connectivity that C++ offers (including DLLs) • Use sockets to send and receive data (useful for Scada)
ANYLOGIC	• Allows threetypes of modelling: Agent Based, Discrete Event and System Dynamics • Because of that, allows all types of simulations(Discrete/Continuous, Micro/Macro Level, …) • Simulatorwith the most well-known clients • Extend default models with Java
SIMUL8	• Has anexcelent customer support, which is always good (including web demos of the tool) • Most cheap commercial tool • Creation of a class of models (template models) that can be easily tailored to different systems
IN-HOUSE	• Allows WCF communication • Probably the cheapestsolution • Can be adapted to meetall Critical needs and requirements • Solution adapted to the Critical coding guidelines • Can be adapted to each new product developed by Critical

Source: Simulator comparison https://paginas.fe.up.pt/.../SimulatorsComparison_V1.pdf Accesed 22 february 2019

Table 4 Disadvantages of Textile Simulation programs

Simulation programs	Disadvantages
Arena	• Doesn't allow WCF communication • Unintuitive and has a poor GUI • Simulation consumes too many computer resources • Debugging is a pain • Most expensive tool of the chosen ones
FLEXSIM	• Doesn't allow WCF communication • Second most expensive tool of the choosen ones • Has too many resources and tools that will not be needed • Lack of objects to use in the simulation (maybe it is possible to create some)
ANYLOGIC	• Doesn't allow WCF communication • Difficult to use, requires a large study of documentation and tutorials
SIMUL8	• Doesn't allow WCF communication • Few modeling components • Poor documentation/web-tutorials

IN-HOUSE	• Solution that doesn'thavemarket proofs • Can become obsolete if not upgraded regularly • High risk of developingsoftware from scratch • Only works with Critical's software • Will not have the level of functionality compared to a commercial-off-the-shelf product

Source: Simulator comparison https://paginas.fe.up.pt/.../SimulatorsComparison_V1.pdf Accesed 22 february 2019

FlexSim Simulation vs TexGen

FlexSim's ease of use and extensive pre-built logic selections mean that students are ready to handle significantly more complex applications without having to write software code. The advanced functionality of FlexSim allows the course to cover topics not included in other books. Additionally, since all work is carried out in a 3D environment, students show more interest in expanding their work and experimenting with simulation. They add realism to their models by using FlexSim's 3D objects or by importing existing objects from drawing packages, including AutoCAD, ProE, Solid Works, Catia, 3D Studio, AC3D, Rivit, and Google Sketch-Up to name a few. Also, students can import thousands of 3D objects into their FlexSim models from Google's 3D Warehouse. PDS can be used to create and amend the full range of flat patterns. The working environment and tools available have been designed to make pattern cutting straightforward and fast. Drawing on the experience of many pattern cutters the software has been developed to make the most complex tasks straightforward. Adding darts, amending seams, creating fullness, working on multiple pattern simultaneously are all approached logically and quickly. PDS can also have 3D design (hyperlink to 3D) integrated within the software. **Grading** Clothing requires grading, whatever the size range S,M,L..10,12,14,16..44short, 44 regular etc. This software is characterized by simple and intuitive handling. The different sizes are colour-coded for better clarity. Grading rules can be applied for single points or whole patterns. Pattern alterations are applied across the full size range automatically. Measurements can be exported in MS Excel to create and compare with size charts. **Marker making** Mark gives optimized support for marker making. Choosing between manual and automatic nesting is possible at any time, so the utilisation of the material is optimised. Additional functions like optimizing of the cutting path and much more, are integrated.	**TexGen** generates the geometry of any textile fabric in a generic way by specifying yarn path and yarn cross sections independently. In this approach, TexGen allows models to be generated easily for any 2D and 3D textile fabric structures, for example, woven, knitted, knotted or non-crimp

References

[1] Banday M. Tariq, Musavir Ahmed, Tariq R. Jan, (2014), Applications of e-Learning in engineering education: A case study Procedia - Social and Behavioral Sciences 123, p 406 – 413, p413
[2] Grasso & Burkins, 2010; Grasso, D., & Burkins, M. B. (2010). Holistic engineering education: Beyond technology: Springer
[3] Ögülmüs Esra, Üreyen Mustafa E., Arslan Cafer (2015), Comparison of real garment design and 3d virtual prototyping, 15th AUTEX World Textile Conference, June10-12, 2015, Bucharest, Romania
[4] Papahristou E, Bilalis N (2017) 3D Virtual Prototyping Traces New Avenues for Fashion Design and Product Development: A Qualitative Study. J Textile Sci Eng 6: 297. doi: 10.4172/2165-8064.1000297
[5] Porumb Sanda, Orza Bogdan, Vlaicu Aurel, Porumb Cosmin, Hoza Ioan, (2011), Cloud Computing and its Application to Blended Learning in Engineering, The Second International Conference on Cloud Computing, GRIDs, and Virtualization, p 173-180, p 176, ISBN: 978-1-61208-153-3
[6] Richert Anja, Plumanns Lana, Gross Kerstin, Schuster Katharina, Jeschke Sabina, (2016) Learning 4.0: Virtual Immersive Engineering Education, Digital Universities, International Best Practices and Applications, V.2 - N.2-3, p 52
[7] Williams D. E., "Virtualization with Xen(tm): Including XenEnterprise, XenServer, and XenExpress", (2010, 2007) Syngress Publishing House, ISBN: 1597491675
[8] www.leapfrog-eu.org
[9] https://cgelves.com/marvelous-designer-vs-clo3d
[10] https://paginas.fe.up.pt/.../SimulatorsComparison_V1.pdf

Cyberbulling As a Form of Youth's Destructive Behavior in Russia

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Abstract

One of the threats of the Internet space is the problem of cyberbullying. According to the study "Children of Russia on-line", 23 % of Russian children and adolescents aged 9-16 were objects of cyber-crimes. The results of the study, conducted by the World Health Organization in 2013-2014, prove the connection between cyberbullying and suicide among adolescents aged 11-15. The main goal of cyberbullying is the infliction of psychological harm to the individual, the destruction of his/her social relations through harassment of messages, containing insults, intimidation, critical statements, publications of negative information in Internet. Cyberbullying has a number of special characteristic features. Some of them are the following: the public nature of aggressive actions; the deliberate placement of negative information in Internet; the anonymity; the regular violent actions; the lack of complete control over the situation of harassment. The article contains the results of the survey of school children aged 12-17, conducted in 2017 in Saratov region (Russia). The empirical data indicates the increasing number of children and youth who were the target of cyberbulling for the last year and the need of implementation of prevention programs and the increase the awareness of parents, teachers and other children about the problem that is a cause of the aggression and violent behavior, emotional and neurotic disorders, depression, poor academic performance and low self-esteem of children and youth.

***K*eywords**: Cyberbullying, Children and youth, Internet, Threat, Russia

1 Introduction

Currently, cyberbullying as a form of destructive behavior is one of the most common issues in children and youth groups, which significantly increases the risk of suicide, leads to an escalation of aggression and violence, emotional and neurotic disorders, depression, lack of academic activity. One of the first scientist who has given a definition of cyberbullying was the Norwegian psychologist D. Olveus in 1993, who believed that cyberbullying is a deliberate, systematically repeated aggressive behavior involving the inequality of power (Olweus, 1993).

Nowadays, by cyberbullying we mean a deliberate, repeated, aggressive impact on a child carried out by an individual or a group through electronic or Internet technologies, including the use of web pages, e-mail, MMS or SMS-messages, instant messages in social networks, blogs, chat rooms, forums, and online computer games (Bochaver, 2014).

The problem of cyberbullying among peers appeared in the early 2000s in Japan, the United States, Canada and Western Europe, in countries where the level of Internet access is very high. The All-Russian Center for the Study of Public Opinion states, that 80 % of Russian population use Internet access in 2018 (Number of Internet users in Russia, 2018). According to the words of Vladimir Putin, President of the Russian Federation, who spoke at International Cybersecurity Congress, which took place on July 5-6, 2018 in Moscow, Russia ranks first in Europe in terms of Internet users, the number of which reached 90 million (International Cybersecurity Congress, 2018).

2 Main Part

2.1 The overview of the issue

The main goal of cyberbullying is the infliction of psychological harm to the individual, the destruction of his/her social relations through offensive messages, containing insults, intimidation, humiliation or critical statements, publications of negative information in the Internet. The problem of cyberbullying is the most relevant for children of adolescence, which is characterized by a high level of sensitivity to self-assessment by peers, rumors and social setbacks.

The survey, conducted in European countries (n=23 420) showed, that 5 % of children and youth were being cyberbulled more than once a week; 4 % once or twice a month and 10 % less often (Cowie, 2013).

According to research, conducted by Microsoft in 2012, Russia ranks fifth among 25 states in terms of the level of cyberbullying among Russian schoolchildren: almost half of them aged 8-17 stated that they were targets of harassment (Online bullying among youth 8-17 years old – Russia, 2012). According to World Health Organization's study "Growing up in unequal conditions: gender and socioeconomic differences in the health and well-being of young people. Behavior of school-aged children in health", commissioned in Russia in 2013-2014 among children aged 11-15, the correlation was found between cyberbullying and suicide. The report contained the information that 23% of 11 years old girls and 27% of boys of the same age confessed that they were the target of cuberbulling two or three times a month (World Health Organization, 2016). The results of the study "Children of Russia online" among children aged 9-16 showed that 23% of children and youth were victims of cyberbullying. It was found that every tenth girl experiences the consequences of cyberbullying for several months, which can lead to suicide (Children of Russia online, 2012). In addition, the peculiarity of the manifestation of cyberbullying in Russia is the fact that it is often carried out for social or national reasons and can be perceived as a kind of extremism (Parfentiev, 2009).

According to the Research Center for CyberBulling in 2017 on average in Russia: 42% of children were a subject of Internet harassment; every fourth person was in this situation more than once; 58 % of children received angry and offensive comments; four out of ten respondents faced this many times; 35 % of children received online threats; every fifth teenager was aggressively cyberbulled several times; 53% of children insulted others online themselves; one out of three did it several times; 21% of children received letters with threats or messages with insults; 58% of children have not informed their parents or teachers that they have been the victim of Internet harassment (Cyberbullying or Internet-hunting, 2018).

All participants of cyberbullying process can be conditionally divided into three groups: aggressors, victims and observers. In a virtual space, the position of the "cyberaggressor" gives an imaginary sense of superiority; the persecutor does not necessarily have the authority of peers, and he/she is not limited to moral, ethical and legal norms, unlike the real world. "Victims" of cyber-bullying, as a rule, are children who have been previously harassed in real life, in most cases because of low-self-esteem, vulnerability, difference in appearance, behavior, nationality, race, etc. (Kowalski *et al.*, 2011). "Observers" often choose one of the three main positions: an active aggressor because of the fear of becoming an object of attack; a passive observer or protector of the victim (Zincova, 2013).

2.2 Characteristics, Causes, Forms and Consequences of Cyberbulling

Bullying has a negative impact on different areas of children and youth's lives. A person under the influence of Internet technologies can be subjected to internal social and psychological changes. Anonymity, accessibility, invisibility, security, all of these makes it possible to get away from reality.

The main reasons of cyberbullying are the wish for excellence; inferiority complex; undeveloped empathy; revenge; conformism; problems in the relationship with peers, parents, teachers; lack of constructive conflict resolution skills; individual and personal characteristics such as isolation, character accentuation, aggressiveness, increased anxiety, etc.

Cyberbullying has a number of special characteristic features. First of all, it is the open, public nature of aggressive actions; the deliberate placement of negative, defamatory information about the victim on the Internet. Secondly, anonymity, because the person subjected to violence in a virtual environment can not identify a perpetrator. A quarter of teenagers on the Internet pretend that they are of a different gender, age, ethnicity, political views, sexual orientation than they really are; more than half have more than one email address or nickname (Lenhart et al., 2005). Third, continuity, so bully can reach the target at any time. Fourthly, it is the lack of complete control over the harassment by the aggressor because unlawful actions against the victim can be supported by others (Baranov et al., 2015).

There are several forms of cyberbullying depend on ways of interaction between users and the severity of the consequences it has produced: flaming is the most emotionally violent form of cyberbullying which is accompanied by insults or rude messages; harassment includes repeatedly sending insulting or humiliated messages; griefers usually take place in the multiple-users games in order to block the parts of the game or to destruct the pleasure of the game from other participants; sexting means sharing photo or video materials of the victim in a sexual content; cyberstalking is direct aggressive actions, threats; denigration includes sending false information about a person, his/her distorted images in a way of damaging to his/her reputation. One of the forms of the denigration is “online slam-book”, which creates for entertainment sites, where classmates publish rough and unpleasant ratings and comments (Bochaver *et al.*, 2014).

Cyberbullying is a type of psychological violence which has a devastating effect on the individual. Victim of cyberbulling suffers of a whole range of consequences: psychological (depression; low self-esteem; fear; attempts of suicide); physiological or medical (fatigue; memory and attention impairment; frequent headaches; sleeplessness; loss of appetite); pedagogical (poor school performance; drops of school; unstable estimates, misbehavior); social (reluctance to contact with peers, parents, teachers; disintegration; loss of communication skills) (Zincova, 2013). According to Schenk & Fremouw’ studies, university students from Kuwait (n=1 400) who were victims of cuberbulling demonstrated higher level of anxiety, depression and paranoia, as well as psychosomatic symptoms such as sleeplessness, headache, alcohol abuse than students of control group. Also it was found the strong interaction effect between age and cyber-victimization: the older person, the higher level of depression he/she suffered (Schenk *et al.,* 2012).

2.3 Procedure, Methods and Results

The research was conducted in 2017 at the secondary school in Saratov (Russia) in order to identify students who became victims of cyberbullying. The analysis sample consisted of 78 students of 6-11th grades, 64 % of whom were female. The questionnaires were processed using the IBM SPSS Statistics.22 software package. The results of the research made it possible to establish that all respondents were active Internet users, who were registered in such popular social networks as VKontakte, Odnoklassniki, Facebook, Instagtram, etc. The time which students spent on communication on the Internet was 5-9 hours a day in average. The main place of access to the Internet was their own house/flat (89,7 % of respondents), less often school or public places (cafe, entertainment facilities, equipped with Wi-Fi).

For the access to the Internet, 91,0% of respondents used personal gadgets (computer, laptop, and/or mobile phone); 85,9 % of respondents stated that they freely visited any sites, without any control from parents or other adults. The results of the survey showed, that 60 % schoolchildren (47 adolescents out of 78), at least once became victims of cyberbullying; 19,2 % young people confessed that they played the role of cyberbullers themselves, the rest claimed that they did not have such experience.

The frequency of cyberbullying is different: 2,5 % (2 teenagers) have faced cyberbullying 2-3 times a week, 17,9 % – 3-4 times a month, 19,2 % adolescences – 4-5 times in six months, 20,5 % respondents – 4-5 times a year.

In the case of emergency related to cyberbullying, the minors demonstrated different behavior strategies. About a third of them (32,1 %) are not going to ask for help and prefer to solve their problems themselves; the rest demonstrate the readiness to ask for help their parents or other adults. During the processing of the results, an inverse correlation of age and willingness to seek help was revealed: the younger the child, the more often he/she is ready to seek help from his parents. The results of our research are supported by Juvonen & Gross's studies who found that 90 % of victims did not tell their parents about their experiences and 50 % of them tried to deal with it themselves (Juvonen *et al.*,2008). One of the reasons is the fear of loss the Internet access at home computer or mobile telephone. In this connection, it is necessary to inform minors about the ways of safe use of the Internet and about the positive ways to get out of the problem situations.

2.4 Technological solutions

Based on the analysis of domestic and foreign experience, we have developed the following recommendations for children, educators and parents in order to improving their competence and the level of safety in the Internet space:

– to develop a special portal for children, where they can find useful information about the safe and efficient use of the Internet;

– to create a special website, whose employees analyze cyber-violence cases and take the necessary measures, conduct refresher courses for teachers; collect and analyze information, publish regular reports on the cybersecurity' issues (for example, the project Helpline.org.pl, implemented in Poland);

– to organize a group of volunteers who advise, help to communicate with network of moderators and law enforcers, provide psychological support to victims of cyberbullying in real time (for example, the group "Anti-CyberMobbing" in Vkontakte);

– to pay more attention to issues of personal Internet security, which will prevent unwanted intrusion into private space: set up access to your page only for friends; lay out a minimum of personal information, do not write defiant or inadequate messages about yourself and your life;

– to act within the framework of normatively acceptable rules of behavior in the Internet space based on a respectful relationship between users; to show a tolerant attitude to the feelings and thoughts of other people, different from your own; if possible, stop spreading negative, unsafe, degrading statements and images;

– to keep the evidence of committing a crime such as electronic copies and printouts; do not delete any messages or comments in case of occurrence or continuation of baiting;

– parents have to periodically monitor the sites viewed by the child; pay attention to the status of the child in social networks, especially to instant messengers (WhatsApp, Viber, Telegram), hashtags, the content of photo, video materials and text messages in order to prevent his/her involvement in "death groups", extremist communities, religious sects and other destructive communities.

3 Conclusions

Thus, it can be concluded that cyberbullying as a form of destructive behavior has a negative impact on children and young people; leads to the destruction of the individual, deviations, social dysfunction. In this regard, it is necessary to prevent cyberbullying by informing children, teachers, parents about its causes and consequences, developing a regulatory and legislative framework to protect children from information that destroys their physical and mental health, and enhancing information security in the Internet.

References

Baranov, A.A. and Rozhina, S.V. (2015): Cyberbullying is a new form of threat to the security of a teenager's personality. *Bulletin of the Baltic Federal University named by I. Kant* 11, 62-66.

Bochaver, A.A. and Khlomov, K.D. (2014): Cyberbullying: persecution in the space of modern technologies. *Journal of the Higher School of Economics* 3, 177-191.

Children of Russia online. The results of the EU Kids Online II international project in Russia (2012) / G. Soldatova, E. Rasskazova, E. Zotova, M. Lebesheva, P. Roggendorf.: http://psypublic.com/assets/files/EU-Kids -Online-II-in-Russia.pdf, accesed 10.07.2019.

Cowie, H.A. (2013): *Cyberbullying and its impact on young people's emotional health and well-being. The Psychiatrist* 37, 167-170.

Cyberbullying or Internet-hunting. https://vlada-rykova.com/kiberbulling/, accesed 12.07.2019.

International Cybersecurity Congress, 2018. https://rvision.pro/event-posts/mezhdunarodnyj-kongress-po-kiberbezopasnosti/, accesed 11.07.2018.

Juvonen, J. and Gross, E.F. (2008): Extending the school grounds?—bullying experiences in cyberspace. *Journal of School Health* 78 (9), 496-505.

Kowalski, R.M., Limber, S.P., and Agatston, P.W. (2011): *Cyberbullying: Bullying in the digital age* (2nd ed.). Chichester: Wiley-Blackwell.

Lenhart, A. (2010): *Cyberbullying: What the research is telling us.* http://www.pewinternet.org/Presentations/2009/18-Cyberbullying-What-the-research-is-telling-us.aspx/, accesed 15.07.2019.

Number of Internet users in Russia.: http://www.bizhit.ru/index/users_count/0-151, accesed 14.07.2019.

Olweus, D. (1993): *Bullying at school: What we know what we can do*. New York: Blackwell.

Online Bullying Among Youth 8-17 Years Old – Russia. The report is prepared by Cross-Tab Marketing Services & Telecommunications Research Group for Microsoft Corporation. file:///C:/Users/%D0%AE%D0%B7%D0%B5%D1%80/Downloads/WW%20Online%20Bullying%20Survey%20-%20Executive%20Summary%20-%20Russia_Final.pdf, accesed 06.07.2019.

Parfentiev, U. (2009): *Cyberaggressors. Children in the Information Society* 2, 66-67. http://detionline.com/assets/files/journal/2/threat2_2.pdf,accesed 12.07.2019.

Schenk, A. and Fremouw, W. (2012): Prevalence, Psychological Impact, and Coping of Cyberbully Victims among College Students. *Journal of School Violence* 11, 21-37.

World Health Organization: Russia leads in Europe on complaints of schoolchildren on cyberbulling (2016). https://www.newsru.com/russia/15mar2016/growingup.htm,accesed 16.07.2019.

Zincova, A. (2013) The influence of cyberbullying on the personality of a teenager. *Scientific works of SWorld* 21 (2), pp. 12-14.

Use of remote technologies in educational work on prevention of occupational diseases of employees in field of education

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Abstract

Teacher's job is associated with high density of interpersonal contacts and possibility of conflicts with need to fulfil scheduled scope of work within strictly regulated period of time. Key factors of risk of teacher's job are: increased psycho-emotional stress associated with need of continuous self control and emotional excitation with significant number of interpersonal contacts; significant vocal stress; static stress with insignificant general muscle movement stress; large volume of extensive visual performance; high density of epidemic contacts etc. Each of above listed risk factors of teachers' labor may become cause for occupational or profession conditioned disease.Topic discusses results of study aimed at – determining possibilities of remote technologies in implementation of social-educational project for prevention of occupational diseases of employees in field of education. Study involved participation of employees of educational institutions of Ryazan Region of the Russian Federation as well as medicine employees responsible for scheduled health assessments and professional examinations of teaching employees. Period of study – 2017 – 2019. Total number of participants of study: teaching employees – 480 people, medicine employees – 51 people. On basis of expert interviews and focus there were determined most efficient forms of remote representation of information (video-lectures, webinars, check-lists, cases, and etc.), frequency of training lessons, forms of control. By results of study there was developed concept for continuous remote educational lecture center within which the problem of informational support of prevention and preventive treatment of occupational diseases of employees of educational system is being solved.

Keywords: Professional diseases, teachers, prevention, remote education.

1 Introduction

Information technology is an integral part of modern human life. Digital devices and means of communication are used in almost all spheres of human activity, including management, science, education, culture, business, social sphere and health.

Telecommunications have always been used to solve medical problems, but with the development of the Internet, remote technologies have received a new round of development and a"new breath". Distance medicine at the present stage of development is a tool for the implementation of diagnostic, preventive, organizational and management processes in health care through computer and telecommunications technologies.

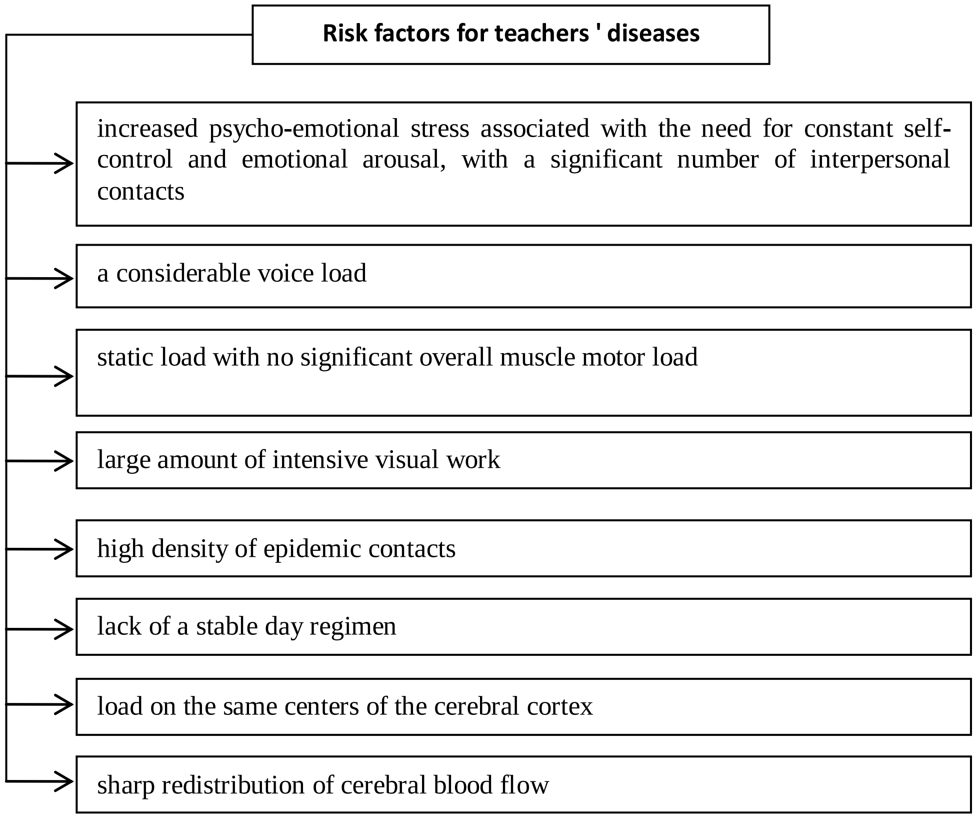
In our opinion, the use of remote technologies in educational work is a promising direction in the development of remote medicine in the prevention of occupational diseases and healthy lifestyles of employees of the educational sphere.

2 Risk factors for diseases associated with the professional activities of teachers

In the XXI century the requirements of society to the activities of the teacher is much higher than in the previous century. But these requirements cannot be fulfilled if favorable conditions for educational work are not created. The personality of the teacher is of great importance for solving educational problems in educational organizations. The quality of training depends not only on the professionalism of the teacher, but also his internal state – from physical and mental health. As you know, the health of the child is directly dependent on the health of the teacher [Karpov O., 2016].

In recent years, programs aimed at preserving and maintaining the health of schoolchildren have been actively developed. However, very rarely it comes to the health of the teacher, who every day is in the same conditions as the students, but because of the specifics of their work is more prone to increasing factors of social tension of society.

Statistics show that the number of diseases of the nervous system, vocal organs, musculoskeletal system, vascular system has recently increased among teachers of different educational institutions. The work of the teacher is associated with a high density of interpersonal contacts and the possibility of conflicts when it is necessary to perform the planned amount of work in a strictly regulated period of time. The main risk factors for teacher work are (Fig. 1):



Picture.1 Risk factors for diseases associated with the professional activities of teachers

In our opinion, it is necessary to introduce distance learning technologies in education on the prevention of occupational diseases of workers of the educational sphere in the system of teacher training programme, introducing the possible pathologies of organs and organ systems of the human body, due to teaching activities with the aim of defining the main directions of prevention of occupational diseases and also for healthy life.

A healthy lifestyle (HLS) is a rational lifestyle, an integral feature of which is active activity aimed at maintaining and improving health. Lifestyle, which contributes to public and individual health, is the basis of disease prevention, and its formation – the most important task of the social policy of the state in the protection and promotion of public health.

3 Remote technologies in the prevention of occupational diseases of education workers

Family education, all stages from pre-school to University education, the culture of behavior in society, religious views and the media have a great influence on the formation of a healthy lifestyle. With the development of the Internet, more and more citizens use it to obtain information on specialized websites, news aggregators and social networks. 84 % of Internet users use more than one device per month to access the network – for example, a work and home computer or a computer and a mobile device. More than half of the audience uses mobile devices along with computers, and the fifth part goes to the Internet only with their help. If a person uses both a computer and a phone, then in a week he goes online on average 19 times, where he spends more than seven hours (data for 2016 from the reports of the Public opinion Foundation and the TNS research group).

In this regard, remote technologies can play an important role in the formation of a healthy lifestyle of education workers, first of all, providing teachers with information on maintaining a healthy lifestyle, motivating them to do so and providing interactive tools for assessing risk factors leading to diseases and social distress. This requires the creation of specialized resources on healthy lifestyles. An example can be the portal "So cool" –official resource of the Ministry of health of the Russian Federation. The interactive portal is and how-to articles, and interesting news and editorials, expert commentary and tutorials, and posted on the website of the information, confirmed by studies and provide accurate information [Adilova N., 2015].

The creation of specialized resources for preventive health monitoring and information on the prevention of diseases of education workers will reduce the risk of sudden onset of chronic diseases and their consequences, to Orient teachers to respect for their health. Information in the health care system of the Russian Federation assumes reliable provision of the population with valid information on obtaining medical care, maintaining a healthy lifestyle, disease prevention, communication with medical organizations and organizations providing services in the field of health care (insurance companies, pharmacies, etc.).

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4 Opportunities of remote technologies in implementation of the social and educational project on prevention of occupational diseases of workers of the sphere of education

The authors conducted a study of the opinion of education workers, the purpose of which is to determine the possibilities of remote technologies in the implementation of social and educational project for the prevention of occupational diseases of education workers.

The study involved employees of educational institutions of the Ryazan region of the Russian Federation, as well as medical professionals engaged in routine medical examination and professional examinations of teachers. The duration of the study – 2017-2019. The total number of participants in the study: teachers-480 people, health workers - 51 people.

The majority of respondents (46.7%) rated their health as good. 38.6% of respondents are not satisfied with their health, rating it as mediocre. 12.5% of respondents rated their health as poor. 2.2% of respondents rated their health as excellent.

62.5% of respondents have a positive attitude to a healthy lifestyle. 33.2% believe that it is not necessary to always follow a healthy lifestyle. 2.2% noted that it is possible to do without it.

According to the survey, only about one in six of the respondents (17%) in the last year passed medical examination in the state polyclinic. 37% know about this possibility, but did not gather to the doctor. About a third (30%) were not aware that the diagnosis can be done at public expense, and 16% even if they knew about it, in the usual free clinic for medical examination still would not have gone.

The majority of respondents (85.3%) believe that a healthy lifestyle contributes to success in other areas of human activity. 5.4% of respondents do not agree with this statement. 9.2% found it difficult to answer.

Also, the majority of respondents (94.6%) believe that a balanced diet is an integral part of a healthy lifestyle. 2.7% of respondents do not agree with this. Found it difficult to answer 2.7%.

Video lectures (48%), webinars (26%), checklists (14%), cases (8%) and other forms (chats, newsletters, etc.) (4%) are considered to be the most effective forms of remote presentation of information in the prevention of occupational diseases.

According to respondents, the frequency of training sessions should be: annual-64%, 1 every six months-22%, 1 once a month-9% and constant access to materials-5%.

As forms of control the greatest popularity was received testing (62%), self (24%) and practical classes (14%).

Thus, the results of the survey revealed that in General, citizens are satisfied with their health and to maintain a healthy lifestyle are positive. Residents of the region understand that good health contributes to success in various spheres of human life. The most effective forms of remote presentation of information in the prevention of occupational diseases are video lectures, webinars, checklists, cases.

According to the results of the study, it is proposed to develop the concept of a permanent distance educational lecture hall, within which the problem of information support for the prevention and prophylaxis of occupational diseases of employees of the education system is solved. For the implementation of this direction we see it necessary:

1. Development of monitoring methodology, including health data structure, data exchange and storage formats, data collection procedures, data processing and decision-making algorithms.
2. Formation of a register of mobile devices that allow for effective health monitoring.
3. Development of training programs for the prevention of occupational diseases of education workers.
4. Development of software for mobile and remote devices for the implementation of the social and educational project for the prevention of occupational diseases of education workers.
5. Formation of a medical monitoring group, pilot operation.
6. Development of recommendations on the choice of organizational and legal basis for preventive monitoring of teachers ' health.
7. Analysis of information risks and development of proposals to minimize them (protection of personal data, identification and authentication of medical personnel and patients, etc.).

5 Conclusion

Thus, the use of remote technologies in educational work on the prevention of occupational diseases of employees of the educational sphere will allow to carry out medical prevention of noncommunicable diseases, will contribute to an attentive attitude to their health and the desire to observe a healthy lifestyle, giving up bad habits. Thanks to the introduction of remote technologies, it is possible to form a clear understanding that it is very important to lead a healthy lifestyle in these conditions and this directly affects other spheres of life.

References

1. Adilova, N.M., Azimov R.I. (2015) Osobennosti formirovania zdorovogo obraza zisni sredi naselenia // Molodoy ucheniy, 11, 618-622.
2. Karpov, O.E., Klimenko G.S., Lebedev G.S. (2016) Primenenie intellektualnih system v zdravoohranenii // sovremennie naukoemkie tehnologii, 7(1), 38-43.

Internet Sources:

3. https://edu.rosminzdrav.ru/specialistam/obshchaja-informacija/, accesed 2018.
4. http://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx, accesed 2019.
5. http://www.takzdorovo.ru/, accesed 2019.
6. http://www.takzdorovo.ru/, accesed 2019.

Practice of implementation of remote education projects by insurance within mandatory and voluntary medical insurance (case-study)

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Abstract

It becomes harder to hire trained specialists in field of insurance at labor market. Many insurance companies launch corporate educational projects aimed not only on increase insurance awareness of population but also on advancement of qualification of specialists willing to work in field of insurance. Such educations projects help to expand staff of companies and train loyal specialists helping them to make first steps toward successful career. On the other hand they promote increase in general knowledge about insurance, culture of which remains at low level in Russia among both, population and business. The topic discusses practices for implementation of remote educational project "Mandatory and Voluntary Medical Insurance: for doctors and patients". This is a pilot project that is implemented in certain regions of the Russian Federation in cooperation with several insurance companies. Provided are key stages of remote training, methodology materials developed for study, control-measurement materials. and etc. Also provided are results of survey about degree of satisfaction of trainees with process of training. Implementation of project allowed for sending proposal to the federal authorities about development of federal educational system on increase of awareness about insurance in field of mandatory and voluntary medical insurance.

Keywords: distance learning, Mandatory and Voluntary Medical Insurance, pilot project, corporate educational

1 Introduction

The active development of the Russian insurance market, accompanied by the growth of insurance companies, as well as the improvement of the quality of insurance services, has caused a great need for well-trained personnel of insurers. However, such needs are currently far from being fully met.

It is becoming increasingly difficult to find competent specialists in the field of insurance in the domestic labor market. That is why many insurance companies create corporate educational projects aimed not only at eliminating the insurance literacy of the population, but also at improving the skills of specialists who want to work in the insurance industry. Such educational projects help to expand the staff of companies and educate loyal professionals, helping them to take the first steps to a successful career. On the other hand, they contribute to raising the General level of knowledge about insurance, the culture of which in Russia, both among the population and in business is still not high.

2 Training for the health insurance market in modern conditions

The accelerated development of the insurance market, ahead of the training opportunities of insurers, necessitated the search for new ways of training. Prior to Russia's transition to a market economy, the system of training insurance specialists on the basis of higher education was not organized enough. The system of modern insurance education began to take shape in Russia in the early 1990s, having inherited many features of the system of training specialists in the field of Finance and management that existed in the former USSR. From the same time the market of educational services in the field of insurance begins to appear.

The effectiveness of the training system for the insurance market in General, and the health insurance market in particular, depends: first, on determining the current and future staffing needs of insurers-both quantitative and qualitative. Secondly, it is necessary to create a system of training specialists in the field of health insurance. Such a system, in our opinion, should be diversified and multilevel, taking into account the level of training of students, combining long-term basic education and short-term, implemented with the use of various forms of education.

One of the elements of the system – ongoing seminars, webinars, courses, etc. the Challenge is how to coordinate the subjects, their duration, and increase the quality of the lessons. Seminars, webinars and courses are designed to provide future insurers with practical training on specific problems of insurance activity. Live dialogue allows you to understand and learn a lot. At the same time, it should be noted that the process of organizing and conducting seminars is somewhat unmanageable. Their subject does not affect many issues that insurers should know, such as: organization of company management, organization of document flow and information flows, legal basis and requirements for the conclusion of contracts, methods of assessing the insurance value of the object of insurance, marketing in insurance, insurance Economics, etc.

The next element of the insurance education system is schools, courses for training in specific insurance specialties with a period of training from 3 months to one year. It is advisable to use, along with full-time and correspondence forms of education, distance learning technologies. Educational projects should be differentiated depending on the level of training of the student: with higher education, secondary education, economic, technical, etc. Such educational projects should be created both under the auspices of the all-Russian Union of insurers, and in the form of corporate training.

Also, the practice of using unified information portals created in various industries gives positive results. Thus, in connection with the adoption of the new rules of compulsory medical insurance, which came into force on may 28, 2019, which clearly spelled out the step-by-step regulation of support of insured persons at all stages of medical care, a single information resource of interaction of participants in the system of compulsory medical insurance is defined. Territorial funds are the operators of this resource, and medical and insurance organizations are its full participants. Medical organizations are obliged to make daily on this resource information on all changes related to the insured. On the same resource is the individual history of the insured cancer patient at all stages of medical care. And on the basis of this information, insurance companies quickly see all the changes and provide support to the insured.

3 Practice of implementation of distance educational project " Compulsory and voluntary medical insurance: for doctors and patients»

The distance learning project "Compulsory and voluntary medical insurance: for doctors and patients" is a pilot project and is being implemented in some regions of the Russian Federation with the cooperation of several insurance companies. The portal brings together specialists in the field of health care and health insurance, as well as patients who want to improve their knowledge on issues related to health care in Russia.

The project presents educational programs for specialists with higher professional education, secondary vocational education and for citizens acting as patients.

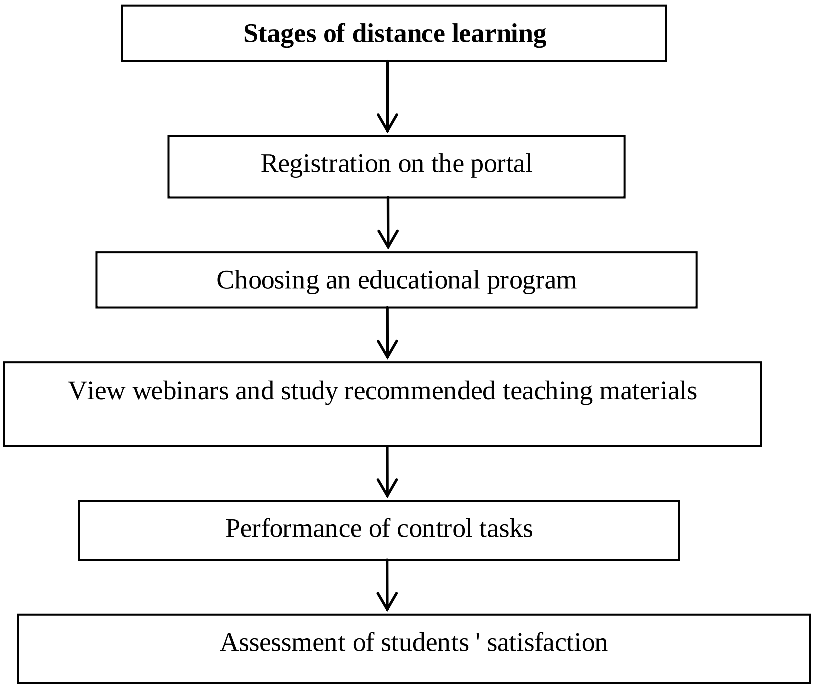
The website presents: an instructional video on working in a private office, brochures, reference materials on training opportunities in the framework of continuous medical education with the use of the portal and regulatory framework.

The main stages of distance learning implemented by the project are as follows (Fig. 1).

The results of the survey on the degree of satisfaction of students with the process of cognition are also presented.

It should be noted that due to the high growth rates of the health insurance market and a very large prospect of this market, most insurance holdings (insurance groups) open subsidiaries and are in need of a new formation of insurance agents – financial advisers. Therefore, insurance companies are actively involved in the creation of training programs and organization of practical classes.

Implementation of the project allowed to make a proposal to the Federal government on the development of a Federal educational system to improve insurance literacy in the field of compulsory and voluntary health insurance.

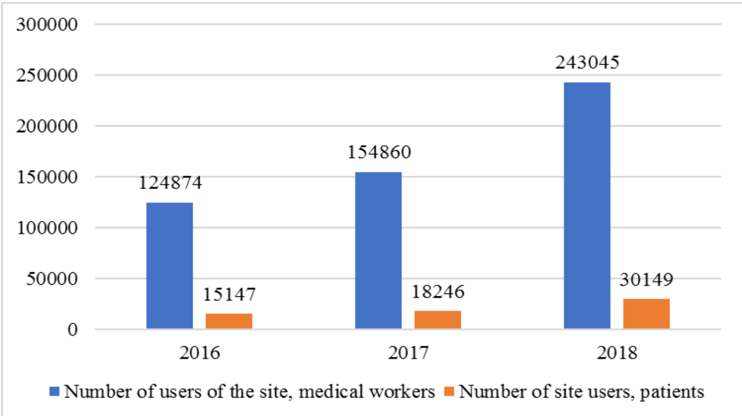


Picture 1. Stages of distance learning

4 Assessment of students' satisfaction with the work of the remote educational portal

The modern education system differs significantly from the education system of previous generations. And this is not surprising, the development of information technology has led to a radical change in the system of education and training. Today, distance learning technologies are actively developing. The implementation of the distance education project "Compulsory and voluntary health insurance: for doctors and patients" is supported by both doctors and patients. The number of registered users on the distance learning portal for the period 2016-2018 is shown in Fig. 2.

As can be seen from the chart, for the period 2016-2018 the number of users of the distance education project "Compulsory and voluntary health insurance: for doctors and patients" tends to increase, both among health professionals and among patients. However, the number of patients using the information resources of the portal is several times less than the number of medical professionals using the portal. This is due to the fact that medical workers are required to periodically (every 5 years) to improve their skills and confirm the certificate of a specialist, which increases the popularity of distance learning programs in the medical environment.



Picture.2 Dynamics of the number of users of the distance education portal

The number of visitors is one of the main indicators of the success of the project. The more of them, the higher the probability of achieving the conversion goal. We will analyze the sources of traffic to the site of the distance educational project. The channels through which visitors come to the web resource are shown in Fig. 3.

A survey of users of the distance education project "Compulsory and voluntary health insurance: for doctors and patients" revealed the advantages of training offered by the educational project with the help of distance education technologies:

1) obtaining the necessary knowledge in a convenient place (at home or at work);
2) cost savings on moving to the place of learning;
3) continuity of the educational process;
4) combining the educational process with another kind of activity;
5) training according to the established program or according to the individual plan;
6) obtaining quality knowledge that is not inferior to the usual educational process;
7) constant contact with the teaching staff;
8) virtual academic mobility of students, including international.

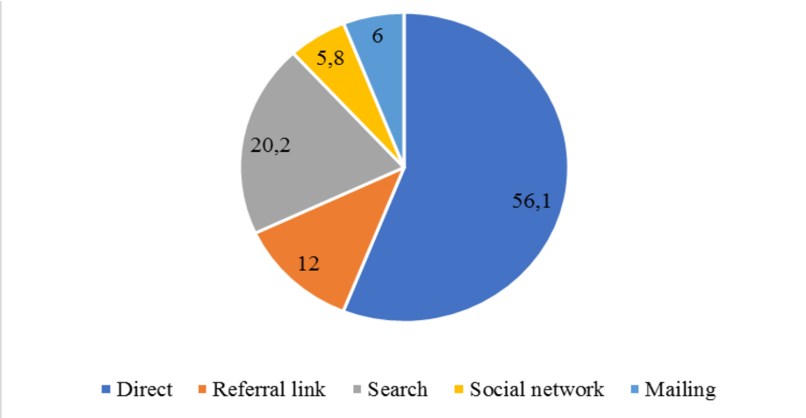
Nevertheless, despite the undeniable advantages of distance education, there are drawbacks that require adjustment in the course of practical application:

- disadvantages related to psychological factors:

1) lack of personal contact between teachers and students;
2) lack of interest in the educational process;
3) lack of self-organization and self-discipline in following a curriculum or plan.

- the disadvantages associated with the imperfection of the technology:

1) possible failures in the operation of technical means;
2) lack of transparency in exams and testing;
3) limited areas of study and specialty programs.



Picture.3 Sources of traffic to the remote educational portal

5 Conclusion

The creation of a system of higher insurance education requires serious joint efforts of state bodies, higher education institutions, insurers themselves and their unions. These, in our opinion, are the key problems of personnel training in the health insurance system in modern conditions. Their decision will contribute to the development of the national insurance market and thus turn Russia into a civilized economic power.

Thus, distance learning technologies are rapidly entering our modern life. This process will undoubtedly be enhanced by the development of technology or innovation in learning. Ensuring the realism of the virtual space is the main goal at the moment. But there is a problem-psychological, which is associated with a high degree of self-organization and self-development, motivation and lack of live communication.

References

http://www.consultant.ru/document/cons_doc_ LAW_107289/, accesed 2019.
http://www.consultant.ru/document/cons_doc_LAW_1307/, accesed 2019.
http://www.consultant.ru/document/cons_doc_LAW_324740/, accesed 2019.

Problems of development of remote training as a tool for advancement of professional qualification of healthcare professionals

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Abstract

In accordance with Article 41 of the Constitution of the Russian Federation everybody has a right for health care and medical assistance. Implementation of this right is provided by healthcare professionals acting in their activities on behalf of healthcare institutions, or, rarely, independently. Life and health of citizens directly depends on their qualification, professional work, professional and human qualities. During long period in Russia exists a system of post-graduation training of doctors within which certified specialists attend courses of advancement of qualification including the ones implement in remote form.

Each doctor during 5 years with purpose to continue professional activity shall undergo such training once and pass exams upon completion. Moreover, professional level of doctor is annually assessed within procedure of professional attestation. We analyzed data related to organization of process of doctors' qualification advancement under conditions of continuous medical education (CME) on basis of educational institutions implementing programs of remote training of healthcare professionals. Study was conducted using methods of content-analysis, surveys of healthcare professionals, attendees of programs for remote advancement of qualification, and a range of expert interviews. Study allowed us to obtain some results, including the following: format of remote education stimulates responsibility and discipline in process of mustering the course; most popular among doctors are remote programs focused on specific professional issue; conditions of need for annual confirmation of qualification and professional attestation for healthcare professional increases necessity of self training and self mustering of subject courses available in public domain.

Keywords: health care workers; remote training; specialist's certificate; level of qualification.

1 Introduction

In accordance with Article 41 of the Constitution of the Russian Federation everybody has a right for health care and medical assistance. Implementation of this right is provided by healthcare professionals acting in their activities on behalf of healthcare institutions, or, rarely, independently. Life and health of citizens directly depends on their qualification, professional work, professional and human qualities. Qualification of worker pursuant to Article 195.1 of the Labor Code of the Russian Federation means level of knowledge, skills, professional skills and work experience of worker.

Level of qualification of health care workers is also confirmed by specialist's certificate evidencing his/her holder level of theoretical knowledge, practical skills and techniques sufficient to conduct individual professional health care activities. Certificate of health care worker is valid for five years at the territory of the Russian Federation. Persons having received secondary or higher professional health care training at the Russian Federation such certificate is issued by state educational or scientific institutions in accordance with license for conduct of educational activities.

2 Standard regulation of professional qualification of health care workers

In accordance with Article 100 of the Federal Law dated 21.11.2011 No. 323-FL "On basics of health care of citizens at the Russian Federation" (hereinafter referred to as the Law No. 323-FL), prior to 1st January 2026 right to conduct health care activities at the Russian Federation is granted to persons having received medical training and holding specialist's certificate.

However, since 1st January 2016 Article 69 of said Federal Law has taken effect under which the specialist's certificate is replaced by certificate of accreditation of health care worker. Whereby, right to conduct health care activities will be granted to persons having received both, medical training and other. At this, the legislator has provided for transition period, i.e. in accordance with Part 1.1 of the Law No. 323-FL, transition to procedure of accreditation of specialists shall be carried out in stages in a period from 1st January 2016 till 31st December 2025, inclusive. It should be noted that earlier such transition period was not provided for. Changes were introduced by the Federal Law dated 29.12.2015 No. 389-FL "On making changes to certain legislation acts of the Russian Federation". In addition, Part 2 of the Article 100 of the Law No. 323-FL under which specialist's certificates issued to health care and pharmaceutical workers before 1st January 2021 remain valid until expiry date stated therein (before this regulation applied only to specialist's certificates issued before 1st January 2016).

Accreditation of health care workers is a procedure aimed at determining compliance of person having received medical, pharmaceutical or other education with requirements for conduct of health care activity on certain medical specialty or pharmaceutical activity. The specialist should be accredited by accreditation commission upon completion of mustering professional educational programs of medical training or pharmaceutical education not less than once in five years. Accreditation commission is formed by authorized federal executive authority with participation of professional non-profit organizations named in Article 76 of the Law No. 323-FL.

In order to implement the said standard, the Health Care Ministry has approved:

- Policy on accreditation of specialists (approved by the Order of the Health Care Ministry of Russia as of 02.06.2016 No. 334n);
- Procedure for issuance of certificate of specialist's accreditation, forms of specialist's accreditation certificate and technical requirements therefor (approved by the Order of the Health Care Ministry of Russia as of 06.06.2016 No. 352n);

It should be noted that the Order of the Health Care Ministry of Russia dated 25.02.2016 No. 127n establishes terms and stages of specialists' accreditation as well as categories of persons having medical, pharmaceutical or other education and subject to accreditation of specialists. Since 02.02.2018 named Order is void. In lieu, the Health Care Ministry of Russia has approved new terms and stages for accreditation of specialists on basis of Order dated 22.12.2017 No. 1043n.

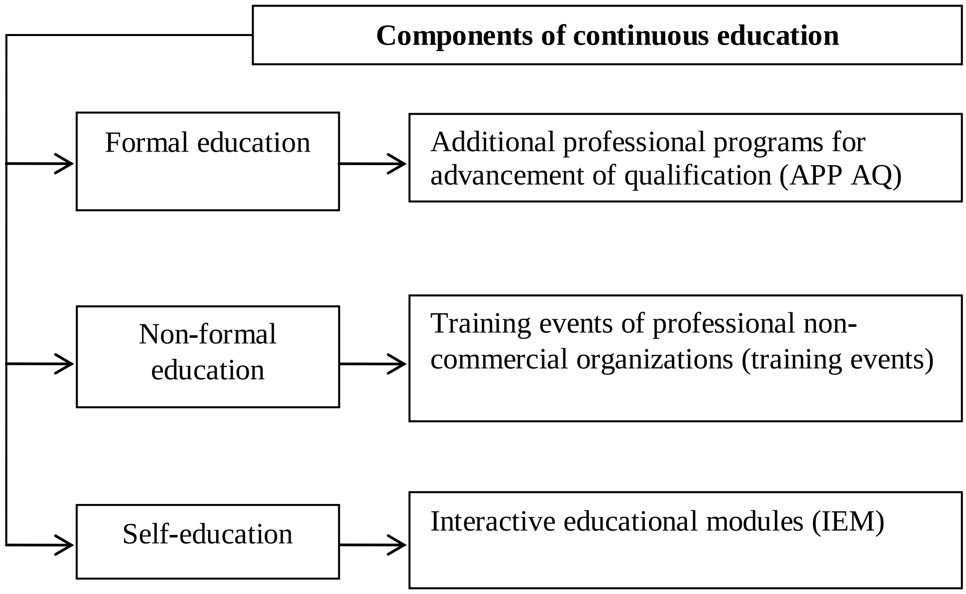
Analysis of regulatory-legal basis allows to conclude that during long period in Russia exists a system of post-graduation training of doctors within which certified specialists attend courses of advancement of qualification including the ones implement in remote form.

Each doctor during 5 years with purpose to continue professional activity shall undergo such training once and pass exams upon completion. Moreover, professional level of doctor is annually assessed within procedure of professional attestation.

3 Remote training of health care workers as a tool for advancement of professional qualification

We analyzed data related to organization of process of doctors' qualification advancement under conditions of continuous medical education (CME) on basis of educational institutions implementing programs of remote training of healthcare professionals.

Since 2016 the tool for management of educational activity and accounting for its outcome is the Portal for continuous medical and pharmaceutical education of the Health Care Ministry of Russia, which provides educational elements corresponding to all components of continuous education (p.).



Picture.1 Components of continuous education of health care workers

Study was conducted using methods of content-analysis, surveys of healthcare professionals, attendees of programs for remote advancement of qualification, and a range of expert interviews. There were different opinions about need for such scheme and whether said concept is implemented correctly.

Survey was carried out in 2018 with participation of 3036 health care workers. Answering the question: “Are you satisfied by existing system for advancement of qualification?”, which assumes educational cycle once in five years lasting 144 hours, the predominant number - 66% - of respondents answered “no”. At this, answering the question: “Do you participate in system of continuous medical education (CME)?”, 51% of same respondents answered that they participate, 45% stated that they do not participate, and 4% responded that this is the first time they hear about CME.

The survey has shown that the majority of health care workers registered with the CME system are against from implementation of system of continuous medical education assuming in person cycles of qualification advancement as well as participation in events conducted by professional society and mustering additional educational modules.

So, 42% or 1239 of respondents already participating in CME believe that it should not be implemented. 30% vote for its implementation and almost the same number – 28% – have not decided yet.

At the same time, it should be noted that need for changing traditional system of additional professional education has been noted by 39% of respondents, and almost the same number, 38% of respondents stated that in principle they were happy with previous system. 23% or 897 did not decide yet. Mostly young specialists opposed to it.

Analysis of survey result has shown that current system satisfies far from majority of respondents; it has been found that relation to the need for continuous professional training (CPT) depends on years of work. The lesser is number of years of work in health care industry the lesser enthusiasm in respect of new system.

So among health care workers having experience of work on specialty of 5 years and more, 41% supports its implementation. And among young specialists having experience of work not exceeding 5 years only 19% agree to work in system, and the vast majority thereof – 56,1% – oppose to it.

Thus, specialists having experience of less than 5 years say about need to maintain old system because they have no deep knowledge thereabout. After receipt of first certificate and first receipt of certificate five years did not pass yet, so they cannot fully assess old, customary system.

4 Reasons and solving of problems of development of remote training of health care workers

Majority of health care workers participating in CME state at the need for ensuring set off between programs and modules for several specialties according to 41% of the total number of respondents. 35% of respondents wish to have a possibility of choice of direction of training depending on initial level of qualification. 46% of respondent wish to increase number of remote programs and modules. 15% of respondents wish to improve control over quality of program modules presented on portal.

Whereby, some of respondents proposed answers of their own. Some wish to be able to chose between traditional and new systems. Others believe it is necessary to provide for state funding of short programs of advancement of qualification. Some spoke about motivating employer for training of employee using new system.

In our opinion, these are the new challenges the system of continuous medical education faces and requiring thorough attention. To respond such challenges, it is necessary to elaborate and update informational resources with purpose to provide for adaptive training allowing for to prepare individual training plan based on analysis of answers.

Actually, structured and formalized content supported by authoritative sources, authors and applicable regulatory documents having passed expert evaluation by not only professional educational community but also by professional health care and pharmaceutical communities is need.

More convenient form of materials, transparent mechanism for assessment of knowledges are required. It is necessary to provide for possibility for user to choose timeframes when he/she wishes to change level of his/her qualification in principle or to prepare for attestation. Also, it is necessary to take into account desires of doctors in respect of form of control over studied material.

5 Conclusion

Results of survey of continuous medical education program participants were found to be rather unexpected. Majority of health care workers are not satisfied with current system for advancement of qualification as it is.

During recent several years the professional health care community discusses issue of implementing system of continuous medical and pharmaceutical education as well as accreditation of health care workers giving right to engage in professional activity.

However, survey of respondents supporting implementation of continuous medical education allowed us to obtain a number of results among which:

- format of remote education stimulates responsibility and discipline in process of mustering the course;
- most popular among doctors are remote programs focused on specific professional issue;

- conditions of need for annual confirmation of qualification and professional attestation for healthcare professional increases necessity of self-education and self-mustering of subject courses available in public domain;

- and some others.

Most important in system of Continuous Medical Education is content, i.e. the actual information that will allow each practicing doctor at the territory of Russia to receive information of good quality when necessary, to check own capabilities and ensure professional growth for provision of affordable and of good quality medical aid".

References

The Constitution of the Russian Federation (Rev. dd 21.07.2014). [Electronic resource] URL: http://www.consultant.ru/document/ cons_doc_LAW_28399/.

The Labor Code of the Russian Federation dd 30.12.2001 No. 197-FL (Rev. dd 02.08.2019). [Electronic resource] URL: http://www.consultant.ru/document/cons_doc_LAW_34683/.

The Federal Law dated 21.11.2011 No. 323-FL (Rev. dd 29.05.2019) "*On basis of health care of citizens in the Russian Federation"*. [Electronic resource] URL: http://www.consultant.ru/ document/cons_doc_LAW_121895/.

Portal for continuous medical and pharmaceutical education of the Health Care Ministry of Russia. [Electronic resource] URL: edu.rosminzdrav.ru. (date of request 09.09.2019).

Learner's Outcome Enhancement through Scaffolding in Collaborative Game Based Learning

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Abstract

Game Based Learning (GBL) has proven to be an effective tool in education. The purpose of this study was to investigate the effect of scaffolding on learner's outcome. Hard and soft scaffoldings are appropriate substitutions for tutors, comparing GBL environments with traditional educational systems. Scaffolding is a process that provides learners with desired knowledge in the course of learning the task to enhance their outcome and also demonstrate their abilities. To this end, this study engaged 40 students to investigate the effectiveness of a game developed by the researcher supplied with scaffolding tools. The participants were assigned to two experimental and comparison groups. The experimental group received scaffolding, while learners in the comparison group were not presented with scaffolding. The results of the study indicated that those learners who received scaffolding in collaborative GBL (CGBL) outperformed those who were not exposed to scaffolding. Our findings lead us to believe that scaffolding may provide better results if it can be adapted to the player's personality types. If we want scaffolding tools to be able to compensate for the absence of an instructor, then they should be personalized.

Keywords: Game Based Learning, Scaffolding, Learner's Outcome

1. Introduction

According to previous research, game is defined as a comprehensive, voluntary and enjoyable activity in which a challenging goal is pursued (Bereiter and Scardamalia, 2003). A number of studies have shown that using game in education leads to an increase in the learners' interaction and cooperation. Moreover, the role of environments in which knowledge is cooperatively constructed in enhancing the depth of learning has been confirmed in previous researches (Scardamalia and Bereiter, 1994). In recent years, video games including games which are merely developed as an entertainment and games based on education have received a great deal of attention. The learners' high engagement in video games environments has caused them to spend much time playing games and choose these environments for education. On the other hand, many of the students tend to avoid traditional educational environments and this is not just due to the difficulty of learning in these environments, but it is because of the lack of amusing and attractive sources in these environments. In video games, a creative and pleasant environment is provided and that there is an amusing game mechanics which is one of the main reasons behind the learners' engagement in these environments.

Now that games, in recent era, have become so important and vital, it is necessary to take some drastic actions to improve their effectiveness. One of the most important challenges in the games, especially the games based on learning, is the absence of an instructor in the education environment (Chen and Law, 2015). In the games including games which are merely developed as an entertainment and games based on learning, when the instructor is not present, a kind of scaffolding can be used. Scaffolding is a process in which the learner is provided with some knowledge by which it is easier to perform a task and performing the task independently and without scaffolding is quite difficult (Kao et al. 2017). Scaffolding is of two types: hard and soft. Hard-scaffolding is defined as an equal assistance given to all of participants in the game. The hard scaffolding is fixed and is not changed by the learners' needs (Chen and Law, 2015). Soft-scaffolding is defined as a kind of spontaneous and periodical assistance which can facilitate the learning process and overcome the scaffolding problems (Chen and Law, 2015).

Sung and Hwang (2013) conducted a study with the purpose of determining the effect of scaffolding and a cooperative game on the motivation and efficiency of the learners. In a study, Kao et al. (2017) found that when scaffolding is personalized on a game based on learning in physics, the knowledge and creativity of designing game is increased significantly. Barzilia and Blau (2014) found that the presence of scaffolding in a game based on learning has a significant effect on the learners' game achievements. However, such studies have not examined the effect of a game based on a cooperative learning equipped with scaffolding on the efficiency of learners.

2. Literature Review

Digital game-based learning is the by-product of a balance between learning and gaming elements. To put it in other words, the entertaining essence of games has the potentiality to be integrated with the learning process and promote it. Hence, two significant elements of educational games are entertainment and educational component segregating educational games from entertaining games and e-learning applications (Bellotti et al. 2013).

The design of educational games could pursue three goals; they may be designed to enhance learning or to develop cognitive skills, or be simulated in order to pave the way for learners to demonstrate their abilities in a virtual environment (Erhel & Jamet, 2013). Games that are developed with the primary purpose of accomplishing knowledge transfer are typically utilized in education so as to teach math (Castellar et al. 2015) or language (Palomo-Duarte et al. 2017), for instance.

In recent years, researchers have embarked on exploring diverse approaches for bridging the gap between informal and formal knowledge representations in game-based learning. As mentioned previously, one effective approach to the problem is to incorporate formal knowledge representations within the game (Clark et al. 2010, 2011; Clark & Martinez Garza, 2012). A second approach to the problem is providing external scaffolds that assist learners in making the links between the knowledge gained in the game and disciplinary knowledge (Garris et al., 2002; Neulight et al., 2007; Charsky & Mims, 2008; Charsky & Ressler, 2011). Scaffolding takes place when a more competent or knowledgeable peer or teacher supports learners in performing a task which they cannot yet capable of doing independently (Brown et al.1989; Wood et al. 1976). In the area of computer-based learning, the concept of scaffolding has been expanded to cover software-based instruments that aid learners in engaging in complicated and challenging tasks (Collins, 2006). Reiser (2004) proposes that software tools may support learners through two supplementary mechanisms; Scaffolds may structure the task and decrease its complexity or they may make the subject matter problematic and cause learners to pay more heed to critical ideas and links that might otherwise be ignored.

3. Methodology

A game based on learning has been designed for instructing the English language in a cooperative fashion. In this game, two individuals play together or the opposite player is selected randomly. The game environment is in the form of multiple-choice questions and the choices of the questions have been extracted from the 504 book. There are four choices for any question which is asked and the learners need to select the correct choice in order to gain the desired score. The number of questions in each round of game is 15. At the end, each learner who has answered most of the questions correctly is chosen to as the winner of the game.

3.1 Soft and Hard Scaffolding

As it was mentioned above, scaffolding is a tool in the game which, during the periods of the game, helps the learner perform his/her task better and more effectively. Scaffolding is of two soft and hard types. Soft scaffolding is personal and is based on the learner’s needs. The soft scaffolding which is provided in the game includes the following: It deletes two incorrect choices among the existing choices for the learner. More explanation about a choice: The existing choices are one-word and a kind of soft scaffolding which can be considered for the learners is to provide explanations such as dictionary ones for word being in the choice. Selecting more than one choice: so that the learner can select more than one choice. In all these cases regarding the soft scaffolding, if the learner uses each one of these soft scaffoldings and answers the question correctly, some of the scores of the question are detracted for his using the soft scaffolding. The hard scaffolding is an equal and fixed assistance which is given to all the participants in the game. Such a scaffolding is fixed does not change by the learner’s need. One of the hard scaffoldings which is provided in the game is related to the explanations provided about each one of these soft scaffoldings presented in the game.

In figure 1, an image of a game in which different kinds of soft and hard scaffoldings have been presented is shown.

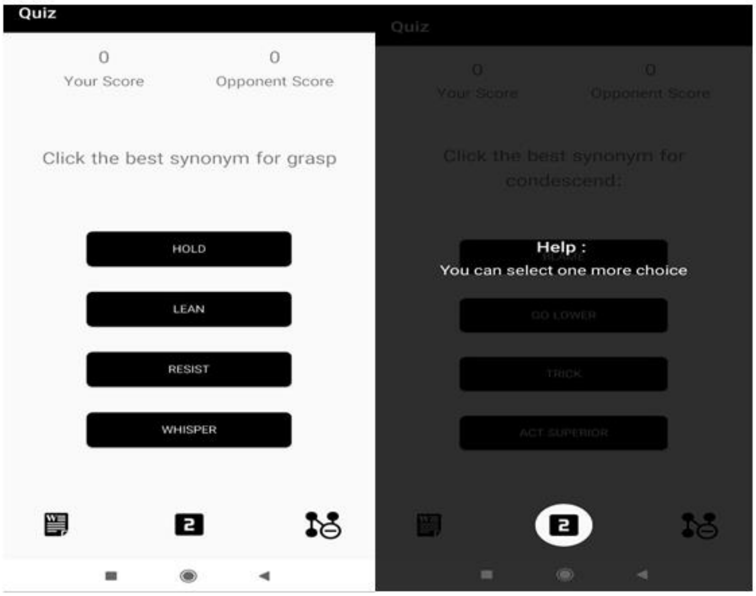

Figure 39: Soft and Hard scaffoldings

3.2 User Groups and Data Gathering

The game under investigation was assessed in an English language institute. Forty students (18 female, 22 male) who were all at the same level of proficiency were divided into two 20-people groups. Twenty of the learners played the game devoid of scaffolding and the other 20 learners played the game equipped with scaffolding. The students played the game for a period of time and at the end of the period a test was administered to them in order to assess their achievement. The test was consistent with the content of the game questions.

4. Result

In order to examine the effectiveness of scaffolding on improving learners' language achievement two Independent samples t-test was calculated. Firstly, an Independent samples t-test was run to compare two groups' performance on pre-administration of test to ensure the homogeneity of participant prior to treatment. Then in order to assess the effectiveness of scaffolding, another Independent samples t-test was computed to compare two groups' performance on the post administration of test.

Table 1 summarizes the results of descriptive statistics for both groups' performance on pre and post-test.

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Pretest	scaffolding	20	65.2000	3.20526	.71672
	comparison	20	66.6000	3.60409	.80590
Post-test	scaffolding	20	89.8500	4.28308	.95772
	comparison	20	71.2500	4.15331	.92871

Table 5: Descriptive statistics

	T	df	Sig. (2-tailed)
Pre-test	-1.29	38	.20
Post-test	13.94	38	.00

Table 6: Independent-Samples t-test

The results showed that the score of scaffolding group (M= 65.2, SD= 3.2) did not significantly differ from comparison group (M= 66.6, SD= 3.6, t(38)= -1.29, p= .2, p> .05) on pre-administration of test. Moreover, the results show that there was statistically significant difference in scores for scaffolding (M= 89.85, SD= 4.28) and comparison group (M= 71.25, SD= 4.15; t(38)= 13.94, p=00, p<.05) on post-test.

5. Conclution

As it was said previously, scaffolding is considered to be an efficient tool in games. In fact, the challenge posed to the learner due to the absence of the learner, can be met by providing the scaffolding tool. In this study, a cooperative game was equipped with soft and hard-scaffolding tools and it was found that when the game is equipped with this tool, the learner's outcome in significantly increased compared to the time when there is no such scaffolding. Moreover, the results of this study indicate that if games are equipped with the scaffolding tool, the game efficiency is increased significantly. In this study, due to time limitation, one group of students in a specific educational grade was assessed. Further research can extend the study sample to assess groups of students from different educational grades and in a longer period of time.

References

Barzilai, S. & Blau, I. (2014). Scaffolding game-based learning: Impact on learning achievements, perceived learning, and game experiences. Computers & Education, 70, 1, 65–79.

Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P. and Berta, R., (2013). Assessment in and of serious games: an overview. Advances in Human-Computer Interaction, 2013, p.1.

Bereiter, C., & Scardamalia, M. (2003). Learning to work creatively with knowledge. In E. De Corte, L. Verschaffel, N. Entwistle, & J. van Merrienboer (Eds.), €Unravelling basic components and dimensions of powerful learning environments. EARLI Advances in Learning and Instruction Series.

Brown, J. S., Collins, A., & Newman, S. E. (1989). Cognitive apprenticeship: teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), Knowing, learning, and instruction: Essays in honor of robert glaser (pp. 453–494). Hillsdale, NJ: Lawrence Erlbaum Associates.

Castellar, E.N., All, A., De Marez, L. and Van Looy, J., 2015. Cognitive abilities, digital games and arithmetic performance enhancement: A study comparing the effects of a math game and paper exercises. Computers & Education, 85, pp.123-133.

Charsky, D., & Mims, C. (2008). Integrating commercial off-the-shelf video games into school curriculums. TechTrends, 52(5), 38–44.

Charsky, D., & Ressler, W. (2011). "Games are made for fun": lessons on the effects of concept maps in the classroom use of computer games. Computers and Education, 56(3), 604–615.

Chen, C., & Law, V. (2015). Scaffolding individual and collaborative game-based learning in learning performance and intrinsic motivation. Computers in Human Behavior (in press).

Clark, D. B., & Martinez-Garza, M. (2012). Prediction and explanation as design mechanics in conceptually-integrated digital games to help players articulate the tacit understandings they build through gameplay. In C. Steinkuhler, K. Squire, & S. Barab (Eds.), Games, learning, and society: Learning and meaning in the digital age. Cambridge: Cambridge University Press.

Clark, D. B., Nelson, B. C., D'Angelo, C. M., Slack, K., & Martinez-Garza, M. (2010). Surge: integrating Vygotsky's spontaneous and instructed concepts in a digital game. In Proceedings of the ninth international conference of the learning sciences, Chicago, IL.

Clark, D. B., Nelson, B. C., Chang, H.-Y., Martinez-Garza, M., Slack, K., & D'Angelo, C. M. (2011). Exploring newtonian mechanics in a conceptually-integrated digital game: comparison of learning and affective outcomes for students in taiwan and the united states. Computers and Education, 57(3), 2178–2195.

Collins, A. (2006). Cognitive apprenticeship. In K. R. Sawyer (Ed.), The cambridge handbook of the learning sciences (pp. 47–60). Cambridge, UK: Cambridge University Press

Erhel, S. and Jamet, E., 2013. Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. Computers & Education, 67, pp.156-167.

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: a research and practice model. Simulation & Gaming, 33(4), 441–467.

Kao, G. Y. M., Chiang, C. H., & Sun, C. T. (2017). Customizing scaffolds for game based learning in physics: Impacts on knowledge acquisition and game design creativity. Computers & Education, 113, 294-312.

Neulight, N., Kafai, Y., Kao, L., Foley, B., & Galas, C. (2007). Children's participation in a virtual epidemic in the science classroom: making connections to natural infectious diseases. Journal of Science Education and Technology, 16(1), 47–58.

Palomo-Duarte, M., Berns, A., Cejas, A., Dodero, J.M., Caballero, J.A. and Ruiz-Rube, I., 2017. Assessing foreign language learning through mobile game-based learning environments. In Blended Learning: Concepts, Methodologies, Tools, and Applications (pp. 964-981). IGI Global.

Reiser, B. J. (2004). Scaffolding complex learning: the mechanisms of structuring and problematizing student work. Journal of the Learning Sciences, 13(3), 273–304.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. The Journal of the Learning Sciences, 3, 265-283.

Sung, H. Y., & Hwang, G. J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. Computers & Education, 63, 43-51.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. Journal of Child Psychology and Psychiatry, 17(2), 89–100.

PETA: Persuasion Techniques Awareness through Game-Based Learning

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Abstract

In recent years the educational games were known as a useful tool to enhance the learning process, and it has been used in several fields. This paper investigates the effect of game-elements and features for enhancing persuasion techniques self-awareness. We have developed a single-player, example-based game that uses scaffolding to help the learning process. Results show that our learning game elements affect media literacy learning skills. This study can present the ability of educational games in media literacy and to be used for further research with more details to find and show the specific game features that enhance speed and power of training media literacy.

Keywords Game-based-learning, Media literacy, Educational games, Scaffolding

1 Introduction

Nowadays, Game-based learning (GBL) is recognized as a significant methodology for enhancing the learning process (Maria José Sousaa, Álvaro Rocha, 2019). Several studies use this method in different domains such as business, math, statistic, computer science, biology, psychology (Meihua Qian, Karen R. Clark, 2016) and medical (Iouri Gorbanev *et al.*, 2018). However, there are a few titles that investigate the effect of GBL environments in media literacy training.

1.1 Media Literacy

In Media Literacy (ML) education, two methods exist: production-centered and audience-driven. In production centered method, learning process performs through media creation by learners (Tessa Jolls, Carolyn Wilson, 1993). In some studies like (Conceição Costa *et al.*, 2017) games have been used as a tool for this method to build ML learning models, but the audience-driven method has not been noticed.

ML is one of the 21st-century essential skills (Rizqa Ayu Ega Winahyu *et al*., 2018) that global organizations support their educational plans (Tessa Jolls, Carolyn Wilson, 1993). This domain has two features that must be considered in its learning environment design: 1- ML, intrinsically is a process or set of skills (Monica Bulger and Patrick Davison, 2018). 2- Since the ML is literacy, it is a public domain. These two features show that games are appropriate environments for ML learning.

Persuasion techniques are one of the useful sections of the ML that have been selected in for the learning environment.

1.2 Scaffolding

Scaffolding has been defined as an assistant in the learning process that gives some information to the learners that they could not obtain them without assistance. Hard and soft are two types of scaffolding. Hard scaffolds are fixed for all of the learners (Ching-Huei Chen, Victor Law, 2016), but soft scaffolds appear in the right situations (John W. Saye, Thomas Brush, 2002). This study uses both types of scaffolding.

2 Method

2.1 Game Environment

To achieve the goal of the research, we designed an example based 2D game that uses training elements of the games. This educational game named PETA that aim to enhance the persuasion techniques self-awareness. PETA has been designed for all of the age ranges, especially high school students. This game provided an environment to learn 10 of persuasion techniques. These techniques are selected from the Iranian media literacy high schools book. These techniques are Stars Certificate, Beauty, Comic, Fear, Lure, Claim, Comparison, Repeat, Intensity, and Symbol.

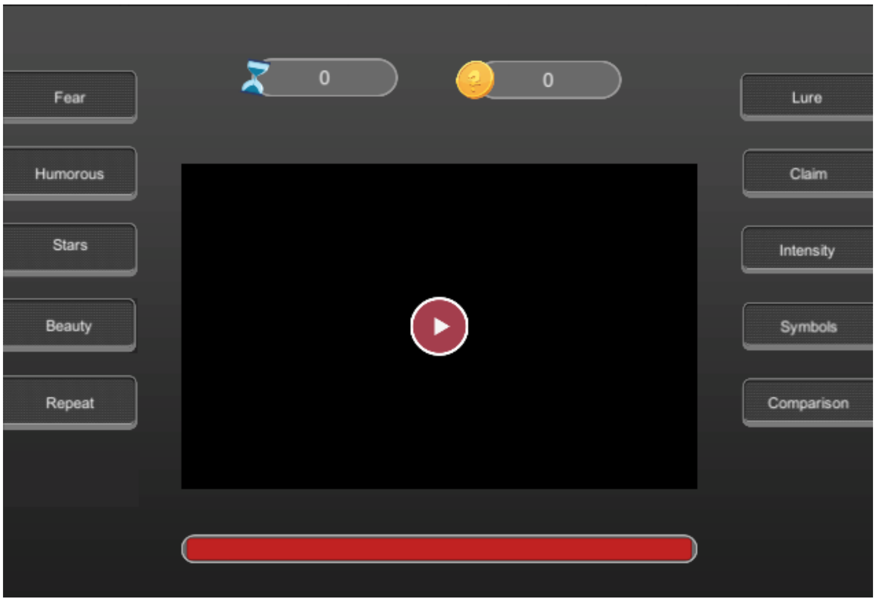

Figure 1. Game user interface

PETA has 25 steps at four levels. In each section, the player watches a film or an image and then guess which of the persuasion techniques have been embedded in that media and after correct answer can watch next media. The educational materials do not be displayed to the user altogether and be embedded insight the steps. In each level, the player is acquainted with 3 or 4 techniques and then try to answer the questions. Figure 1 shows the game user interface.

To support the learning process, we use three scaffolding elements: tutorial, tip, and hint that tutorial and tip are hard scaffold and have been displayed for all the players and hint is soft scaffold and have been displayed in some situations. Tutorials are displayed in 10 of the game steps when a new technique appears. In this situation, the player sees the technique definition. Tips are displayed when the player choose the correct answer. Tips are additional useful contents about technique or step media. Hints are embedded in the game for the players that have wrong answers.

After each right answer, 10 coins and time score that is equal to remain time are awarded to the player. After the wrong answer, the player is punished with some of the coins and time scores. So the player must pass each step.

Steps are sorted from easy to complicated, and techniques are sorted in this order too.

2.2 Analyze system

Since the using questionnaire seems not to be reliable, we use an automatically analyze system insight into the game. In this system, the most critical action of the player **is**sent to the server.

2.3 Participants
More than 50 participants took part in this study. The data preprocessing, which include omitting the invalid data, reduced the statistical society members to 27 participants.

2.3 Evaluation method
In the previous sections, we mentioned that the game has two types of steps. In 10 steps the player learn via tutorials and 15 steps are the test. In these steps, the player must answer the questions based on his/her information that learn in tutorials step. We investigate these 15 steps with analyze system that is mentioned above. For more accurate study steps are divided into two sections: (a) simple steps, (b) complicated steps. As we discussed in previous sections, simple steps are primary and difficult steps are in the last of the game.

To examine the impact of the training process, the correct answer time of the player is recorded. Furthermore, we calculate the repeat rate of steps answers in previous steps. Beside this number of steps, the answer is considered which display step hardship.

Finally, using these three parameters, we analyze the learning process.

3 Results and discussions
This study was performed in order to discover the effects of game training features on media literacy skill learning process. As we discussed, results are presented in two sections. First section outcomes show the learners improvement in techniques awareness. Table 1 displays this progression. The number of the steps are shown in Step column; Mean is players correct answer time average in each step; Techniques is about number steps answer and Repetition rate shows the number of times that each step technique was displayed. For example, Stars techniques were displayed in 1 step before step 4.

We can investigate each technique awareness with these parameters. For example, about Stars and Comic, in steps 4 and 5, most of the players could guess the correct answer after 1 example that they had seen. Regarding Fear and Comic, we see that this case repeats. In the second layer, we can see the effect of the game environment in harder questions. For example, in Steps 6,10 and 13, the average is still close to 1.

Table 1. Player outcomes in simple steps

Step	Mean	Standard deviation	Median	Techniques	Repetition rate
4	1.296	0.216	1	Stars	1
5	1.074	0.07	1	Comic	1
6	1.148	0.208	1	Comic, Beauty	2,1
10	1.5	0.60	1	Comic, Lure	3,1
11	1.632	1.57	1	Claim	1
12	1	0	1	Fear	1
13	1.25	0.2	1	Fear, Claim	2,2
14	1	0	1	Fear	3

The second section is about difficult steps. In these steps, we have two steps that their median is 1 and 4 steps with median 2 and only 1 step with median 3. Also, the difficulty level of techniques is shown in these steps. Table 2 display these results.

Analyzing these two sections and our game elements, we recognized that our environment could help persuasion techniques self-awareness until difficulty of techniques definitions and tutorials and hints quality be considered in level and training process design.

Table 2. Player outcomes in difficult steps

Step	Mean	Standard deviation	Median	Techniques	Repetition rate
19	1.33	0.5	1	Repeat, Comic	1,4
20	2.33	2.75	2	Comparison, Fear	1,4
21	1.88	0.86	2	Intensity, Claim	1 , 3
22	1.22	0.44	1	Stars, Lure	2, 2
23	2.88	3.36	3	Intensity, Comparison, Comic	2, 2,5
24	3	9.14	2	Comic, Fear, Claim	6, 5 , 4
25	2.28	4.57	2	Comic, Comparison, Fear, Claim	7,3, 6, 5

4 Conclusions

In this study, due to the Media literacy potential to use educational games, we investigated the effect of game-based environments on media literacy learning process. According to the automatically analyze system results, we identified our game could improve persuasion techniques self-awareness in simple media with 1 or 2 techniques and in difficult media with additional conditions. Our environment can be used in media literacy schools courses and analyze system can help educators to categorize training materials due to difficulty levels.

Since data collection time was in the summertime and student groups were inaccessible, data had some imperfections, so with data collection from schools, research results can be improved. Furthermore, scaffolding elements can be investigated in future works.

References

Ching-Huei C, Victor L. (2016): Scaffolding individual and collaborative game-based learning in learning performance and intrinsic motivation. *Computers in Human Behavior,* Volume 55, pp. 1201-1212.

Conceição C, Kathleen T, Sara H, Carla S. (2017): Games for media and information literacy – developing media and information litercay skills in children through digital games creation. Barcelona, EDULEARN 17.

Iouri G, Sandra A, Rafael A, Ariel C, Alexandra P, Vivian D, Francisco J. Yepes & Óscar M. (2018): A systematic review of serious games in medical education: quality of evidence and pedagogical strategy. *Medical Education Online,* 23(1).

John W, Thomas B. (2002): Scaffolding critical reasoning about history and social issues in multimedia-supported learning environments. *Educational Technology Research and Development,* 50(3), pp. 77-96.

Maria J, Álvaro R. (2019). Leadership styles and skills developed through game-based learning. *Journal of Business Research,* Volume 94, pp. 360-366.

Meihua Q, Karen R. (2016): Game-based Learning and 21st century skills: A review of recent research. *Computers in Human Behavior,* Volume 63, pp. 50-58.

Monica B and Patrick D. (2018): The Promises, Challenges and Futures of Media Literacy. *Journal of Media Literacy Education* , 10(1), pp. 1-21.

Qian, M. (2016). Game-based Learning and 21st century skills: A review of recent research. *Computers in Human Behavior,* Volume 63, pp. 50-58.

Rizqa Ay, Leo A. (2018): The Media Literacy in 21st Century: Role of Teacher in Historical Learning. *International Journal of Multicultural and Multireligious Understanding,* 5(4), pp. 363-369.

Tessa J, Carolyn W. (2014): The Core Concepts: Fundamental to Media Literacy Yesterday, Today and Tomorrow. *Yesterday, Today and Tomorrow,* 6(2), pp. 68-78.

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