The 12th 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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MODELS & METHODOLOGIES, TECHNOLOGIES, SOFTWARE SOLUTIONS
Phase II - Period 2010-2020: e-Skills for the 21st Century

ICVL 2017
INTERNATIONAL CONFERENCE ON VIRTUAL LEARNING

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ICVL and CNIV Partners: Grigore Albeanu, Mircea Popovici, Radu Jugureanu,
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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."

Gr. 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

"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 2017

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"

© Project Coordinator: Ph.D. Marin Vlada, University of Bucharest, Romania
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, SIVECO Romania

October 28, 2017 – SIBIU, EUROPE-ROMANIA

Location: "L. Blaga" University of Sibiu, Faculty of Engineering - Department of Computer Science and Electrical, SIBIU, ROMANIA

Organizers: University of Bucharest, "L. Blaga" University of Sibiu, Faculty of Engineering, SIVECO Romania

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.

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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

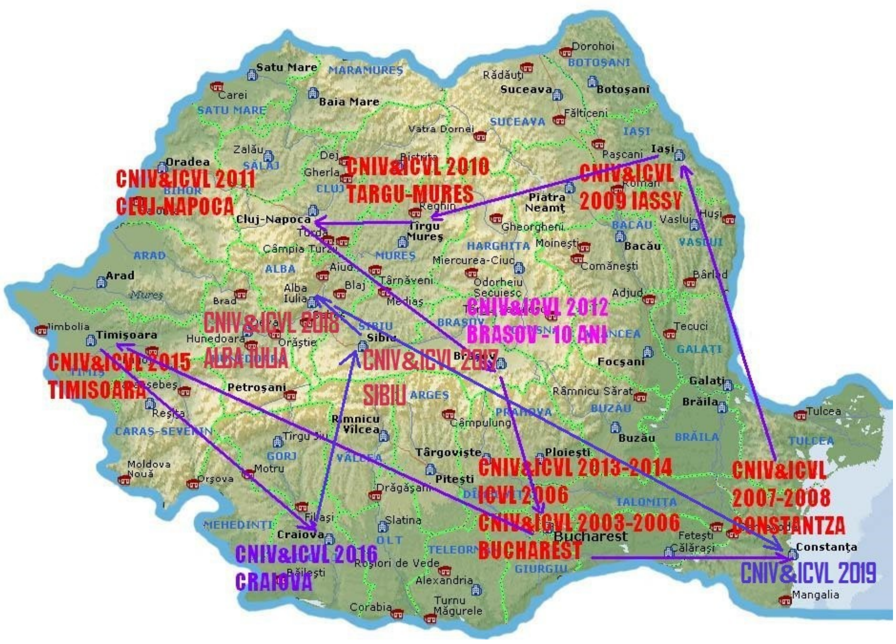
Virtual Reality (VR):

- 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

History of Informatics. From recursivity to the Turing universal machine and Horn clauses

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Abstract

The article describes the contribution of Romanian scientists in several fields of scientific research, on the fundamentals of calculus theory, the fundamentals of cybernetics, the algebra theory of automatic mechanisms, the mathematical logic applied to the construction and use of the first electronic computers, etc. In the 1960s, Romania was considered among the first countries in the world (after the USA, England, USSR, Germany, France, Japan, Austria, the Netherlands, Italy, Denmark) on research and efforts to build an electronic computer. The Romanian School of Mathematics developed under the influence of the Romanian mathematicians who supported their doctorates with prestigious mathematicians from France, Germany, and Italy. Mathematician Gabriel Sudan (1899-1977) published in 1927 (before W. Ackermann, 1928) the first recursive function that is not primitive recursive. Dr. Ştefan Odobleja (1902-1978) - a professional military doctor, is one of the forerunners of generalized theoretical cybernetics and Artificial Intelligence, the author of "Consonant Psychology," published in Paris for the first time in 1938. In the 1950s, Grigore Moisil (1906-1973) developed a new theory of finite automata and proposed what is known today as "Łukasiewicz–Moisil algebras" and which Gr. Moisil applied to the logic of commutation circuits, which is an important contribution to the development of computer science.

Keywords: Computation, Recursive function, Turing machine, Computer System

1 Contribution of Romanian scientists to the appearance of electronic computers

> Motto:*“Sciences and theories have an evolution and development, but also a dynamic of concepts and terms that can change through new meanings and new valences. Man is the result of his own efforts for knowledge and learning, and of the influences of society (phenomena, processes, decisions, etc.) which works on him. The destiny of the people, but also the destiny of the institutions (structures for organizing the activities of a human society) are influenced and guided by a multitude of factors, events and moments resulting from processes, phenomena (controlled or not by people), deliberate decisions at the individually, collectively, regionally or globally levels.”* M. Vlada (ICVL & CNIV Projects, 2011)

Today, *Informatics* is part of the exact science class, together with Mathematics, Physics and Chemistry. Mathematics is the oldest in the class of exact sciences, and Informatics is the science with the most vertiginous development, with a revolutionary impact for all other sciences, as well as for all fields of activity of human society. *Computer Science* has emerged and developed as a science in the second half of the 20th century, after 1960, when the modern computer (computing machine), designed by mathematician *John von Neumann* (1903-1957) and based on computability of *Alan Mathison Turing's* ideas (1912-11954). *Informatics* has developed theories, methods and techniques of data / information / knowledge processing using computer performance that is designed after the architecture of *John von Neumann* [29], the architecture based on A. Turing's works (1936) describing the so-called Turing machine [30]. In 1943, Turing built Colossus, the first electronic digital computer to decrypt German codes, and in the period 1945-1946 he contributed to the prototype of the Automatic Computing Engine, physically made later in 1950. In 1946, Turing presented a paper what is the first detailed project of a stored program calculator. At present, this architecture is recognized and valid.

In Romania, one can speak about a high level of development and use of Information and IT & C (*Information and Communication Technology*) as a result of the scientific progress generated by mathematicians who, in collaboration with physicists, engineers, etc. made possible the emergence of computers and, above all, the methods and technologies of computer use in solving various problems in the scientific, technical, economic, social, medical, military, etc. areas. Worldwide, in the 1940s, with the development of newer and more powerful computing machines, the term Computer (calculating man) referred to machines rather than to their human predecessors. It became clear that these computers could be used for complex mathematical computations, and computer science / computer science expanded to study computing in general. Informatics began to be established as a distinct academic discipline in the 1950s and early 1960s. The first IT specialization in the world, the Cambridge Diploma in Computer Science, began at the University of Cambridge at the Computer Laboratory in 1953. The First Computer Specialization science / computer studies in the United States was at Purdue University in 1962 ("Computer Science Pioneer Samuel D. Conte dies at 85", Purdue Computer Science, July 1, 2002. Retrieved December 12, 2014.). In Romania, in 1960, at the initiative of Professor *Grigore C. Moisil*, the Department of Computing was founded within the Faculty of Mathematics, which he graduated for many generations, and in February 1962, through the efforts of Professor *Grigore C. Moisil* supported by the professors at the Faculty of Mathematics and Physics, was established the "*Computer Center of the University of Bucharest*" (CCUB) [37].

Initially, although many people believed that it was impossible for the field of computers to be a scientific field of study at the end of the 1950s, it gradually became accepted among the academic community. The IBM (International Business Machines) brand that was part of this IT revolution. IBM 704 (1954) and then IBM 709 computers were launched, which were widely used, although the cost of these computers was very high. Over time, significant improvements have been made in the use and efficiency of computing (computers). Modern society has seen significant change in IT users, from users only by experts and professionals to users in all areas of activity. Initially, computers were quite expensive and some human help needed for efficient use - partly from computer operators. As computer adoption became more widespread and more accessible, less human assistance was needed for common use [21]. We mention that in the 1960s Romania was considered among the first countries in the world (after *USA, England, USSR, Germany, France, Japan, Austria, Holland, Italy, Denmark*) on research and efforts to build electronic computer. The Romanian School of Mathematics developed under the influence of the Romanian mathematicians [32, 37] who took their doctorates in the following countries (in 1860 the University of Iasi was founded, and in 1864, the University of Bucharest):

• *France* - the first doctors in mathematics in Paris: Spiru Haret (1878), David Emmanuel (1879), Constantin Gogu (1882) and Nicolae Coculescu (1895), followed by Gheorghe Titeica (1899), Dimitrie Pompeiu (1905), Traian Lalescu (1908), Constantin Popovici (1908), Simion Stoilow (1916), Miron Nicolescu (1928), Alexandru Ghika (1929), Alexandru Froda (1929), Nicolae Teodorescu *(1931), Tiberiu Popoviciu 1935), Caius Iacob (1935);*

• *Germany* - Alexander Myller (1906), Victor Valcovici (1913), Gabriel Sudan (1925), Dan Barbilian (1929);

• *Italy* - Octav Onicescu (1920), Gheorghe Vranceanu (1924), Gheorghe Mihoc (1930), Ion Creanga (1930), Mendel Haimovici (1932).

After 1940, a leading role was played by the mathematician *acad. Grigore C. Moisil* (in 1942 he transferred from Iasi to Bucharest) - today he was considered the founder of the Romanian computer science, who with great vision and enthusiasm fought and acted to concentrate the efforts of researchers and scientists for the appearance of the computer electronics and use to solve complex problems in all areas of people's activity. Moreover, he considers a mathematician's duty to get involved in creating a community of scientists and scientists to collaborate on using computers to solve problems in society. It forecasted a new era in world science and technology through the appearance and use of the computer. "In the 1950s, Moisil developed a new theory of finite automata and proposed what is known today as" Łukasiewicz–Moisil algebras (LMn algebras)"and which Grigore Moisil (1906-1973) applied to the logic of commutation circuits, an important contribution to the development of computer science." Andrei Neculai [18]. In [11] is presented the definition of *Łukasiewicz–Moisil* algebras (LMn algebras):

Definition. Let $J = \{1,2,...,n-1\}$. An *n-valued Łukasiewicz-Moisil algebra* ($n \geq 2$) or an *LMn* bf algebra for short is a algebra A $= (A, \cup, \cap, {}^{-}, (r_j)_{j \in J}, 0, 1)$ of type $(2,2,1,(1)_{j \in J},0,0)$ such that:

(i) (A, ∨, ∧, ¯, 0, 1) is a *De Morgan algebra*,

(ii) the unary operations $r_1, r_2, \dots, r_{n-1}$ fulfil the following axioms: $for\ every\ x, y \in A\ and\ every\ i, j \in J,$

(L1) $r_j(x \vee y) = r_j x \vee r_j y$

(L2) $r_j x \vee (r_j y)^{-} = 1$

(L3) $r_j \circ r_i = r_i$

(L4) $r_j(x^{-}) = (r_{n-j} x)^{-}$

(L5) $r_1 x \leq r_2 x \leq \dots \leq r_{n-1} x$

(L6) if $r_j x \leq r_j y$ for every $j \in J$, then $x=y$; this is the determination principle.

If A fulfils (i) and only (L1)-(L5) we shall say that A is an *LMn* pre-algebra.

In this effort Gr. C. Moisil encountered obstacles, some of them even from some colleagues in the university, or from the governing bodies of the country, obstacles generated by the political context of that period, but also by the mentalities of some reserved people in terms of change and evolution. For example, after 1970, he became divergent with his former friend and colleague Nicolae Teodorescu, dean of the Faculty of Mathematics, having to transfer his teaching to the Faculty of Philosophy and the Faculty of Law. Professor *Constantin P. Popovici's* testimony is proof of this: *Gr. C. Moisil* proposes to the Dean and the Teaching Council that a number of specialists outside the faculty should be invited to hold some lessons on the current research of mathematics and the use of computers in solving problems from the fields; The Teaching Council did not approve this proposal, killing Moisil. Instead, he was helped by *Mircea Malita*, colleague of the faculty, minister of education from 1970 to 1972. From his memories of Moisil, Mircea Malita tells that when he was a minister, he often came to the ministry because it insists greatly that it is time to start the computerization of Romania: the establishment of computer schools (High schools and vocational schools), departments of computer science transformed into faculties of computer science, computer centers etc. However, Moisil managed to impose that in 1971, the specialization of Informatics appeared at the major universities in Romania. On January 27, 1973, Gr. C. Moisil wrote a memo to the Dean of the Faculty of Mathematics, *I. Bucur*, regarding some proposals for the training of IT teachers and specialists, where he concluded: "*That's why I think, for the mathematical progress in our country, it is dangerous to teach computer science somewhere outside the mathematics faculty*"[14], reproduction after [15]. The evolution of history gave Moisil justice. He succeeded, for a relatively briefly period, to see the evolution of this specialization, because on May 21, 1973, he died in Ottawa, Canada ,after having had several conferences at several US universities.

Internationally, *Acad. Gr. C. Moisil*, was recognized as the first Romanian having contributions to the emergence and development of computers in Romania, being awarded (post-mortem) with the *Computer Pioneer Award* by IEEE Computer Society [8, 34]: "*For the development of the polyvalent logic switching circuits, the Romanian School of Computing, and the support of the first Romanian computers.*" The award was handed over to Moisil's wife, *Viorica Moisil*, in a ceremony held at the Government of Romania in 1996 (fig. 1).

Fig. 1. Gr. C. Moisil, Computer Pioneer Award of IEEE Computer Society, 1996 [16, 34]

In Bucharest, at the Institute of Atomic Physics Bucharest- Magurele, between 1954 and 1959, the first Romanian computers (first generation CIFA-1 (1957) and CIFA-2 (1959) were realized, by the team led by eng. *Victor Toma* and under the scientific leadership of *Tudor Tanasescu*. It followed in 1964, the computer built with transistors (generation II), CET500. In 1969, the "Computer Center of the University of Bucharest" (CCUB) was equipped with an American computer system IBM 360/30 (originally the IBM 360 computer was in the Bucharest exhibition, after which it was bought from the IBM subsidiary Vienna), which has been used to train many generations of computer scientists, contributing to the IT program in Romania. In October 1965, *Grigore C. Moisil* became Head of the Computer Engineering Department at the Faculty of Mathematics and Mechanics where he taught Special Chapters of Calculus Machines and Programming Theory. In 1966 an important event was the International Colloquium "Computer Techniques and Computers", organized by the Computer Center of Bucharest University (CCUB), ASE and “Politehnica” University in Bucharest, on the basis of financial support from the Romanian Government. The CCUB's young researchers have contributed substantially to the organization of this Colloquium [42]. The colloquium has brought new experiences in the field of computers [37, 42]. In 2003, recognizing them as pioneers of Romanian informatics, the Romanian presidency awarded *Victor Toma, Armand Segal, Vasile Baltac, Gheorghe Farkas, Mircea Bocu* and *Emil Muntean*, with the National Order of Knight's Grave Service.

In Cluj-Napoca, at the Computer Institute, computers MARIKA (1959), DACICC-1 (1959-1963) and DACICC-200 (1968) were built. In 1962, the Department of Computer Engineering was established, where the first computer courses were taught, one in the fourth year, Computing Machines, held by confessor *Kiss Ernest*, and another Programming in the FORTRAN language, taught by Prof. *D. D. Stancu*. It is worth mentioning that during the period 1950-1961, the MECIPT-1 computer was built at the Polytechnic Institute of Timisoara, using the original design of *Iosif Kaufmann* and eng. *William Löwenfeld*. The dome of the central pavilion of the “Romexpo” building, located in the „Piata Presei Libere” Square, was designed with the MECIPT-1 computer. Also, using the MECIPT-1 computer, the calculation tables for concrete casting in the Vidraru dam were listed.

In 1958-1960, Professor *Adolf Haimovici* initiated a series of conferences on "Applied Mathematics and Computer Science" in University “Al. I. Cuza” of Iaşi, and in 1960 he held his first "Elements of Informatics" course, while in 1961, Professor Costică Cazacu introduces in the course "Complementary Mathematics" which includes Programming Theory Elements and Game Theory. In the curriculum of the Faculty of Mathematics in Iasi, the first course of "Calculable Machines" appeared. In 1968 the first Romanian book in this field is published "Universal Computers and Programming Theory" authored by Professor *Costica Cazacu*. In 1965, the Department of Computational Machines was established, which became the Department of Computer Science in 1971. In 1992, the Faculty of Informatics was founded based on the Department of Computer Science from the Faculty of Mathematics, the first Faculty of Informatics in Romania. Professor *Călin Petru Ignat* was the director of the University's Computer Center where, in 1979, was initiated the first National Computer Science Symposium, “INFO-IASI”.

2 Calculation Theory and Cybernetics

> "*Development of Western science is based on two great achievements: the invention of the formal logical system (in Euclidean geometry) by the Greek philosophers, and the discovery of the possibility to find out causal relationships by systematic experiment (during Renaissance).*" **Albert Einstein (1953)**

Today, it can be appreciated that there is an important period in the emergence and evolution of Informatics, and in the construction of computers: The period 1920-1940 (Fundamentals and Concepts), where the ideas and concepts of calculus theory, the study of recursive functions, as well as defining formal systems and calculus limits, completing the concept of algorithm as a support for a computing machine (*Turing machine* or *Post machine*); in this period came the ideas and studies on *Cybernetics*, which laid the foundation for the concept of system (for man and

machine), system science (control and communication between the components of a system) and which led to the construction of computer systems [41].
Analyzing the development of ideas, theories, concepts, and building of computing systems, one can assert that there are two important directions in computer evolution:

- *Hardware Component* - represented by systems (computing units - microprocessor, storage units - memory, communication units-bus), electronic circuits (equipments), Input / Output devices;
- *Software Component* – represented by algorithms, languages and programs (operating systems, programming languages, computer systems and applications).

Cybernetics has helped define a schematic scheme for a cybernetic system that applies to all hardware and software components: INPUT → PROCESSING → OUTPUT. Time has shown that this scheme of a cybernetic system shapes the structure and functioning of the most important concepts in Informatics:

- *Computer system (computer)*;
- *Algorithm*;
- *Program*;
- *Information System* (Problem Solving).

These aspects were not realized if calculability problems (calculus theory) and problems related to the development of computer systems (cybernetic systems) of the electronic computer were not elucidated [12].
In this context, the invention and construction of the modern / digital computer was possible through the emergence of new sciences and new products:

- *Computer Science and Cybernetics*[1];
- *Languages and Algorithms*;
- *Input/Output Devices*;
- *Memory and storage environments*.

In the field of Cybernetics, Romania is represented by the scientist *Ştefan Odobleja* (1902-1978) - a military medical professional, being one of the precursors of the Generalized Theoretical Cybernetics and Artificial Intelligence, the author of the 2 volume "*Consonant Psychology*" published in Paris for the first time date in 1938 (volume I) and then in 1939 (volume II). The paper has set out many of the major themes on cybernetics and thinking systems (introduced the concept of feedback, with the meaning of reversible links or reverse links, provided the telecommunication model, as well as the ideas on automation of thinking - which underlies Artificial Intelligence). From this point of view, *Stefan Odobleja* was a real visionary for a new thinking - algorithmic thinking, which led to the emergence of computers. An important role in the two volumes is that, for the world premiere, the concepts of System and Model are introduced.
As a discipline, Cybernetics (the name comes from the Greek "cybernetos" meaning "stormy") was established by *Norbert Wiener*, *Warren McCulloch* and *Walter Pitts* (“A Logical Calculus of the Ideas Immanent in Nervous Activity”, 1943), *Arturo Rosenblueth* and others such as *W. Ross Ashby* (“Design of Brain, 1952), mathematician *Alan Turing* and *W. Gray Walter* (one of the first to build autonomous robots from animal behavior study).

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[1] The roots of the cybernetic theory: "*Ştefan Odobleja (1902–1978) was a Romanian scientist, one of the precursors of cybernetics. His major work, Psychologie consonantiste, first published in 1938 and 1939, in Paris, established many of the major themes of cybernetics regarding cybernetics and thinking systems ten years before the work of Norbert Wiener(1894-1964) was published, in 1948.*" [12]

"*Cybernetics is a homogenous and coherent scientific complex, a science resulting from the blending of at least two sciences - psychology and technology; it is a general and integrative science, a crossroads of sciences, involving both animal and car psychology. It is not just a discipline, circumscribed in a narrow and strictly defined field, but a complex of disciplines born of psychology and centered on it, branched out as branches of a tree in its stem. It is a stepwise synthesis, a suite of multiple, often reciprocal, modeling; syntheses and modeling in which, as a priority, and as a great importance, the modeling of psychology on the technique and then the modeling of the technique on psychology. Cybernetics is an intellectual symphony, a symphony of ideas and sciences*." Stefan Odobleja, 1978 [5].

Cybernetics and Mathematics are the sciences that have provided the foundation for the development of various theories for electronic computer building: Data Systems and Structures, Electronic Circuits and Devices, Computational Algorithms and Programming Languages. In some of these aspects, it took many years, even hundreds of years, for finalization and use. E.g.:

- *Algorithm concept* - description of some computational processes to be executed by man or a machine; *Abu Abdullah Muhammad bin Musa al-Khwarizmi* (ca. 780 - ca. 850) Baghdad (now in Iraq) used for the first time precise and clear rules to describe computational processes (fundamental arithmetic operations) in his work " The Compendious Book on Calculation by Completion and Balancing "[9]. Later, this description appears under the name of the "Euclid Elements" algorithm. Euclid's algorithm for calculating the largest common divisor of two natural numbers is apparently the first known algorithm in mathematics. Initially, the notion of algorithm was considered primary. In modern mathematics the notion of algorithm has received several definitions (A. A. Markov's normal algorithm, A. A. Leapunov's operational algorithm, Turing machine / stack machine, recursive functions, POST systems). The first description of the mathematical definition of the notion of algorithm was given by Russian mathematician A. A. Markov. It has been demonstrated that from a mathematical point of view these definitions are equivalent. At present, in the field of probabilities and statistics, so-called Markov processes are known. In fact, today, the process concept is encountered very often under different circumstances: in the representation and execution of algorithms, in the operation of computer systems, in the execution of operating systems, in the execution of programs, in the operation of computer networks, etc. [41].
- *The theory of mathematical logic* - many decades, the theory of mathematical logic has not found applicability. The foundations were made by *G. Boole* and *A. De Morgan*, followed by *Dedekind*, *B. Russell*, *L. Lowenhein*, *T. Skolem*, *K. Gödel*, *J. Łukasiewicz* in *S. Kleene*, etc., who created various research directions: crowd theory, model theory, formal language theory, recursivity theory, prophecy logic, predicate logic, demonstration theory (in particular first-order logic theory). The first system of multiple-valued logic was introduced by *J. Łukasiewicz* in 1920. Independently, *E. Post* introduced in 1921 a different multiple-valued logic. The first applications were conducted by the Russian *Victor Ivanovich Shestakov* (1907 - 1987) and American *Claude Shannon* (1916-2001) (IEEE Medal of Honor - 1966). Claude E. Shannon introduced the use of Boolean algebra in the analysis and design of switching circuits, 1937) and in Romania, *Gr. C. Moisil* founded the "Algebraic Theory of Automated Mechanics" School (1959). At the instigation of *Grigore C. Moisil*, eng. *Leon Livovschi* (1921-2012) uses for the first time Mathematical Logic (Boole Algebras) for analysis and synthesis of discrete automata (automatic circuits with contacts and relays) (1959) [36]. For the first time, the first order logic theory is used to develop the logic programming language PROLOG ("Programmation et

Logique"), the University of Marseilles (Colmerauer, the '70s), France. Thus, besides procedural programming (imperative), a new type of programming emerged, namely declarative programming (logic programming), based on the Horn clauses describing facts and rules in expressing a problem, all of which constitute a knowledge base in the universe of the problem. The solutions to a problem are obtained by querying this knowledge base based on a logical reasoning implemented by searching for solutions using the Backtracking method (SLD resolution, Selective Linear Defined Resolution, *Robert Kowalski*, 1970). The compiler was written in FORTRAN code, and the representation of the terms Prolog is made by defining functions (predicates) and list structures, these being syntactically represented by a functional or semantic form through a tree form [13, 37].

Historically, Informatics / Computer Science preceded the emergence of an electronic / digital computer. Before 1920, the term "computer" referred to a person making calculations (the official person). Among the first researchers to substantiate and use theories that have influenced the name of Computer Science were mathematicians:

- *the German David Hilbert* (1862-1943) (mathematician with major contributions in the axiomatization of geometry, in the fundamentals of functional analysis, in numerical theory, as well as in mathematical logic and demonstration theory, opened the path of formalism in mathematics and computer science),
- *the American Emil Leon Post* (1897-1954) (mathematician and logician with major contributions to mathematical logic and computational theory, independent of A. Turing in 1936 he developed a mathematical model for calculating functions equivalent to the Turing machine)
- *the American Alonzo Church* (1903-1995) (mathematician and logician with major contributions to mathematical logic and theoretical background),
- the Austrian Kurt Gödel (1906-1978) (mathematician, logician and philosopher, friend with Einstein, John von Neumann and Morgenstern) researcher in calculus theory,
- *the British Alan Turing* (1912-1954) (mathematician, logician, cryptanalyst, and theoretical computer scientist) who studied with Alonzo Church holding his doctorate at Princeton in 1938.

In 1936, Turing[2] [30] (founder of Artificial Intelligence and Turing test author), who had announced that he wanted to "build a brain / machine that thinks," published an article describing the "Universal Turing Machine". Thus, *Turing* is the first person to provide data / information to a "computing machine" to enable him to perform multiple tasks at the same time, as computers perform in our time. Turing reformulated *Kurt Gödel's* results of 1931 on the limits of demonstrability and computability, replacing the universal formal language based on Gödel's arithmetic with what is today called the Turing machine, a simple formal device. Turing has demonstrated that such a machine would be able to solve any mathematical problem that can be represented in the form of an algorithm, although no real Turing machine could have real applications, being much slower than achievable alternatives. "A. M. Turing (1912-1954) introduced a new model for calculus, replacing Gödel's arithmetic numerical language with what are today called Turing machines. It has been shown that the stop problem for Turing machines is undecidable: there is no algorithm (general) which, for a program P and for input X as data,

[2] Turing, A.M. (1936). „*On Computable Numbers, with an Application to the Entscheidungsproblem*”. Proceedings of the London Mathematical Society. 2 42: 230–65. 1937. Turing, A.M. (1937). „*On Computable Numbers, with an Application to the Entscheidungsproblem: A correction*”. Proceedings of the London Mathematical Society.

determines whether the P program with the X data ends, after a finite number of steps, tells us if the Turing machine will stop (1936). "D. Vaida, [31].

Also in 1936, *A. Church* showed that there is no computable function to decide for two expressions from the introduced λ−calculus[3], (recursive functions can be represented by λ−calculus, Lambda-calculus) if these expressions are equivalent, or not. *A. Church* introduced the following sentence that bears its name: "The class of computable intuitive functions is equal to the class of recursive functions." The problem of decidability is related to the 10th problem of D. Hilbert, which required an algorithm to decide if an Diofantic equation has a solution, the coefficients and solutions being integers. Subsequently, in 1970, *Y. Matiiasevici* showed that the answer was negative [26].

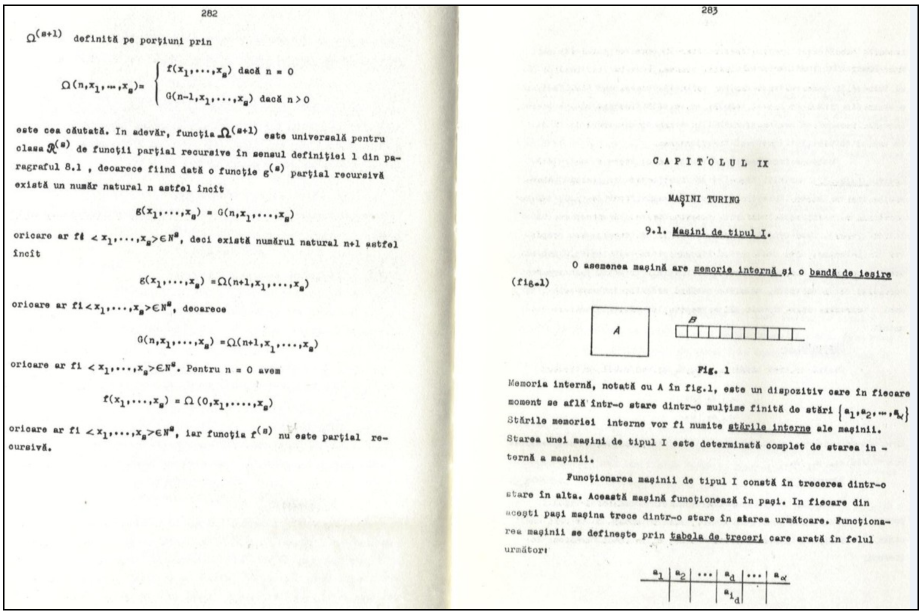
In Romania, the scientists were connected to global research on calculability theories, through the participation of some in doctoral studies in France, Germany and Italy, and then by the work of those who retired in the country and continued their research in the direction doctoral studies. E.g.:

- *Acad. Tiberiu Popoviciu*, Ph.D. in Paris (coordinator Professor Paul Montel), who contributed to Numerical Analysis and Approximation Theory, and to the construction of electronic computers in Cluj-Napoca (MARICA-1959, DACIC-1-1963, today Computer Institute of the Romanian Academy is named "Tiberiu Popoviciu")
- *Professor Gabriel Sudan*, with his doctorate in Germany (coordinator Professor David Hilbert), with remarkable contributions to the theory of recurrent functions, as well as to the theory of transfinite ordinal numbers. Gabriel Sudan is the author of the first recursive function, nowadays called Sudan function (1927), which is not primitively recursive, in parallel with W. Ackermann's (1928) and Ph.D. professor David Hilbert [1, 10].

All these studies and research, on the aspects of calculus and appearance of the fundamentals made by the Turing machine, and on the other hand, on the construction of the first electronic computers, made possible the emergence of the specialization "Informatics" in the universities of Romania in 1971 [37].

Thus, courses and seminars for the field of informatics took place. We will give as an example a "*Theory of Algorithms Theory. Recursive Functions and Turing Machines*", by Prof. *Constantin C. Popovici*, from the Faculty of Mathematics, University of Bucharest, printed in 1976 [24]. From the preface we find that this course contains the lessons for students of the 4th year, the Informatics section, from the academic year 1974/1975, a compulsory course, becoming an optional course, in the academic year 1975/1976. This course also includes the "*Recursive Functions and Turing Machine*" lessons cycle, held in the winter of 1969, for V-year students, the "Computing Machines" section [24].

[3] Introduced in the 1930s by Alonzo Church as a way to formalize the concept of efficient computability. λ-calcul is a universal language in the sense that any computable function can be expressed and evaluated using this formalism and is thus equivalent to Turing machines. This λ-calculation method emphasizes the use of transformation rules and does not depend on the current machine. It is a more software-related approach than hardware [26]



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$\Omega^{(s+1)}$ definită pe porţiuni prin

$$\Omega(n,x_1,\dots,x_s)=\begin{cases} f(x_1,\dots,x_s) & \text{dacă } n=0 \\ G(n-1,x_1,\dots,x_s) & \text{dacă } n>0 \end{cases}$$

este cea căutată. In adevăr, funcţia $\Omega^{(s+1)}$ este universală pentru clasa $\mathcal{R}^{(s)}$ de funcţii parţial recursive în sensul definiţiei 1 din paragraful 8.1 , deoarece fiind dată o funcţie $g^{(s)}$ parţial recursivă există un număr natural n astfel încît

$$g(x_1,\dots,x_s) = G(n,x_1,\dots,x_s)$$

oricare ar fi $<x_1,\dots,x_s>\in N^s$, deci există numărul natural n+1 astfel încît

$$g(x_1,\dots,x_s) = \Omega(n+1,x_1,\dots,x_s)$$

oricare ar fi $<x_1,\dots,x_s>\in N^s$, deoarece

$$G(n,x_1,\dots,x_s) = \Omega(n+1,x_1,\dots,x_s)$$

oricare ar fi $<x_1,\dots,x_s>\in N^s$. Pentru n = 0 avem

$$f(x_1,\dots,x_s) = \Omega(0,x_1,\dots,x_s)$$

oricare ar fi $<x_1,\dots,x_s>\in N^s$, iar funcţia $f^{(s)}$ nu este parţial recursivă.

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CAPITOLUL IX

MAŞINI TURING

9.1. Maşini de tipul I.

O asemenea maşină are memorie internă şi o bandă de ieşire (fig.1)

A B

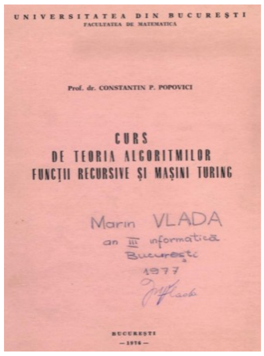
Fig. 1

Memoria internă, notată cu A în fig.1, este un dispozitiv care în fiecare moment se află într-o stare dintr-o mulţime finită de stări $\{a_1,a_2,\dots,a_\alpha\}$ Stările memoriei interne vor fi numite stările interne ale maşinii. Starea unei maşini de tipul I este determinată complet de starea internă a maşinii.

Funcţionarea maşinii de tipul I constă în trecerea dintr-o stare în alta. Această maşină funcţionează în paşi. In fiecare din aceşti paşi maşina trece dintr-o stare în starea următoare. Funcţionarea maşinii se defineşte prin tabela de treceri care arată în felul următor:

a_1	a_2	...	a_d	...	a_α
			a_{i_d}		

Fig. 2. Pages 282-283 from textbook of *C. Popovici* [24]



The author also states that during 1972-1974, he has coordinated the scientific seminar "*Recursive Functions and Turing Machines*" for PhD students at the Institute of Mathematics (fig. 2).

The contents include the following chapters: 1. (Algorithm, Calculable Function, Primary Recurrence, Substitution); 2. (Elements of Mathematical Logic); 3. (Recursive primitive functions); 4. (Recursive primitive enumerations of N^s and N^∞); 5. (Numerical recursive predicates); 6. (Partially recursive functions); 7. (General recursive functions and general predicates); 8. (Universal Function); 9. (Turing Machine) [24].

3 The first examples of a recursive function which is not primitive recursive: W. Ackermann and G. Sudan

> "*Computers are incredibly fast, precise and unintelligible." Human beings are incredibly slow, inaccurate and intelligent. "Together, their power goes beyond any imaginable limit.*" Albert Einstein
> "*Mathematics is both abstract and concrete, revealing much of the mental experiment, working with unobserved abstractions and objects, and the current scientific progress depended on the ability to operate precisely with abstractions and force of reasoning; let us think of today's nanometrics technologies, whose management requires a new type of heuristics not studied.*" O. Stanasila, Metabolism of Mathematics and Computer Science, Curtea de Arges, no. 8/2015, pp. 17-18

The German *Wilhelm Ackermann* and the Romanian *Gabriel Sudan* supported their doctoral theses with Professor David Hilbert (Göttingen University), (the first on August 4, 1924, Thesis “*Begründung des "tertium non datur" mittels der Hilbertschen Theorie der Widerspruchsfreiheit*, and the second on 20 July 1925., Thesis “*Über die geordneten Mengen”*). In mathematics, at that time, there were important researches on the computational theory of D. Hilbert and the mathematicians Alonzo Church and Kurt Gödel [10].

In 1928, *Ackermann* helped *David Hilbert* turn his 1917-22 lectures on introductory mathematical logic into a text, Principles of Mathematical Logic (first ed., 1928). This text contained the first exposition of the first-order logic, and posed the problem of its completeness and decidability (Entscheidungsproblem). Ackermann went on to construct consistency proofs for set theory (1937), full arithmetic (1940), type-free logic (1952), and a new axiomatization of set theory (1956).

In the late 1920s, the mathematicians *Gabriel Sudan* and *Wilhelm Ackermann*, students of *David Hilbert*, were studying the foundations of computation. Both Sudan and Ackermann are credited with discovering total computable functions (termed simply "recursive" in some references) that are not primitive recursive. Sudan published the lesser-known Sudan function, then shortly afterwards and independently, in 1928, Ackermann published his function φ. Ackermann's three-argument function, $\varphi(m, n, p)$, is defined such that for $p = 0, 1, 2$, it reproduces the basic operations of addition, multiplication, and exponentiation [1]:

$$\varphi(m, n, 0)= m+n,$$
$$\varphi(m, n, 1)=mn,$$
$$\varphi(m, n, 2)=m^n,$$

and for $p>2$ it extends these basic operations in a way that can be compared to the *hyperoperations* (*Goodstein's notation* or *Knuth's up-arrow notation*). In 1947 R. L. Goodstein introduced the specific sequence of operations that are now called *hyperoperations*, for the extended operations beyond exponentiation: $a\uparrow^{(n-2)}b$, for n>2. In mathematics, *Knuth's up-arrow notation* is a method of notation for very large integers, introduced by *Donald Knuth* in 1976: $a\uparrow^{n}b$.
The emergence and construction of the modern computer would not have been possible without research, studies and results from 1920-1940, when mathematicians around the world focused on the Theory of Calculability, Theory of Algorithms and Theory of Formal Languages.

The Theory of computability and Algorithm theory were constructed simultaneously by the inter-dependence:

- A *computable function* is any mathematical function for which an algorithm can be generated that generates the values of the function, having as input the values of the function definition, and generating constructive values / objects; according to the normality principle (A.A. Markov's normal algorithm), any algorithm can be expressed with an algorithm from a class of mathematically defined algorithms;
- Independent of the notion of algorithm, a computable function is any mathematical function for which a class of partial recursive functions can be constructed; recursive functions were presented and studied mainly from a structural-constructivist perspective, following the construction mode and their computational properties; a function is primitive recursive if it can be obtained by a finite number of steps of applying direct transformation operations, substitution / composing and primitive recursivity, starting from the zero basic functions (constant function λx.0) and successor (successor function λx.x + 1). Similarly, a function is partially recursive if, in addition to the above mentioned operations, the minimizing operator is used in the construction process. The operations used to construct a recursive function are in turn functions that accept as functions parameters and calculate functions, being - as built functions - effectively calculable.

In 1928, Wilhelm Ackermann (fig. 3) observed that A(x,y,z), the z-fold iterated exponentiation of x with y, is a recursive function that is not primitive recursive. A(x,y,z) was simplified to a function of 2 variables by Rózsa Péter in 1935. Raphael M. Robinson simplified the initial condition in 1948. In 1948, *Rózsa Péter* and *Raphael Robinson* later developed a two-variable version of the Ackermann function that became preferred by many authors [1, 22, 23, 25, 26].

1.

Wir wollen die erwähnte Funktion zunächst angeben. Bei dem Aufbau der Funktionen vermittels Rekursion muß die Funktion $a+1$ als bekannt vorausgesetzt werden und kann nicht wieder durch Rekursion definiert werden. Die Funktion $a+b$ wird dann durch die Rekursion

$$a + 0 = a,$$
$$a + (b+1) = (a+b) + 1$$

definiert. Der Einfachheit halber wollen wir noch zwei weitere Funktionen als bekannte Ausgangsfunktionen nehmen, nämlich $\lambda(a,b)$ und $\iota(a,b)$. $\lambda(a,b)$ ist gleich 1, falls $a=b$, und gleich 0, falls $a \neq b$. Bei $\iota(a,b)$ ist es umgekehrt. Man kann aber auch λ und ι durch Rekursion definieren.

[a]) Eine Arbeit, die mit der vorliegenden manche Berührungspunkte hat, wird von Herrn G. Sudan publiziert weıden. Es handelt sich bei ihr um die Definition von Zahlen der zweiten Zahlklasse, die man in ähnlicher Weise klassifizieren kann wie die Definitionen der reellen Zahlen.

Fig. 3. From original paper authored by *Wilhelm Ackermann,* 1928 [1]

The Ackermann function $A: N^2 \rightarrow N$:

$n \geq 0$, $A(0, n) = n+1$

$m \geq 1$, $A(m, 0) = A(m-1,1)$

$m \geq 1$, $n \geq 1$, $A(m,n) = A(m-1, A(m,n-1))$

n	A(0,n)	A(1,n)	A(2,n)	A(3,n)
0	1	2	3	5
1	2	3	5	13
2	3	4	7	29
3	4	5	9	61
4	5	6	11	125
5	6	7	13	253
6	7	8	15	509
7	8	9	17	1021
8	9	10	19	2045
9	10	11	21	4093
10	11	12	23	8189
11	12	13	25	16381
12	13	14	27	32765
13	14	15	29	65533
14	15	16	31	131069
15	16	17	33	262141
16	17	18	35	524285
17	18	19	37	1048573
18	19	20	39	2097149
19	20	21	41	4194301
20	21	22	43	8388605
21	22	23	45	16777213
22	23	24	47	33554429
23	24	25	49	67108861
24	25	26	51	134217725
25	26	27	53	268435453
26	27	28	55	536870909
27	28	29	57	1073741821
28	29	30	59	2147483645
29	30	31	61	4294967293
30	31	32	63	8589934589

Table 1. The *Ackermann* function for n=1...30, m=0,1,2 and 3

For m> 3 the values are very large and cannot be stored in the computer's memory.
For m = 4, only a few volumes can be calculated: A (4,0) = 13, A (4,1) = 65533, $A(4,2)=2^{(A(3,2)-3)}-3=4294967293$, but for A (4,3) the value is very high. Animated arithmetic, The Ackermann function at address: http://www.gfredericks.com/sandb ox/arith/ackermann (table 1).

<html><head><body><SCRIPT LANGUAGE=JavaScript>	<html> <head> <body><SCRIPT LANGUAGE=JavaScript>
function achermann()	function sudan(){
{var m=3; var n=3;	var m=3;var n=3;
m=eval(prompt("A(m,n), input m : ",m)) n=eval(prompt("A(m,n), input n : ",n)) alert("A("+m+" , "+n+") = "+A(m,n))}	m=eval(prompt("S(m,n,k), input m : ",m)) n=eval(prompt("S("+m+",n,k), input n : ",n))

function A(m,n)
{if (m!=0 && n!=0)
{return A(m-1,A(m,n-1))}
else{if (m==0) {return n+1}
if (n==0) {return A(m-1,1)
}}
}
	k=1;k=eval(prompt("S("+m+","+n+",k), input k : ",k))
	alert("S("+m+","+n+","+k+") = "+S(m,n,k))}

// main program
alert("Achermann Function A(m,n)=?");
achermann();
	function S(m,n,k){if (k!=0 && n!=0) {return S(S(m,n-1,k), S(m,n-1,k) + n, k-1)} else{if (k==0) {return m+n}if (n==0) {return m}}}

</SCRIPT></body></head></html>	// main program
	alert("Sudan Function S(m,n,k)=?"); sudan();
	</SCRIPT></body></head></html>

Table 2. Programs in JavaScript for functions of Ackerman and Sudan

The *Sudan* function $A: N^3 \rightarrow N$:

$$S(m, n,0) = m+n$$
$$S(m, 0,k) = m$$
$$n \geq 1,\ k \geq 1,\ S(m,n,k) = S(S(m,n-1,k), S(m,n-1,k)+n,k-1).$$

In the theory of computation, the Sudan function is an example of a function that is recursive, but not primitive recursive. This is also true of the better-known Ackermann function. The Sudan function was the first function having this property to be published (1927). [27,28,29]. For several years, the scientific community did not know the merits of the Roman mathematician *G. Sudan* in defining the first recursive function that is not primitively recursive. Sudan's contribution was presented at a conference from the Faculty of Mathematics, University of Bucharest, by *C. Calude*, *S. Marcus* and *I. Tevy*, "*The first example of a recursive function which is not primitive recursive*", 1979. The article was published in Historia Mathematica (fig. 4): "The first example of a recursive function which is not primitive recursive is usually attributed to W. Ackermann. The authors of the present paper show that such an example can also be found in a paper by *G. Sudan*, published concomitantly with Ackermann's paper." [7].

Germany, from 1922 until 1925, after which Sudan returned to Romania.

The reason that Hilbert cited only Ackermann's example of a recursive function which is not primitive recursive and failed to mention Sudan's result, seems to be the following: In his argument, Hilbert used a number-theoretic function (similar to the one discussed by Ackermann), not an ordinal function (like Sudan's), because he believed, at that time, that any definition by transfinite recursion could be replaced by a definition using ordinary recursion. Later this conjecture was proved to be false [van Heijenoort 1967, 368]. We also observe that Sudan's equations expressing the nested recursion are mentioned in Hilbert [1926; see van Heijenoort 1967, 388] without explicitly relating it to the preceding construction of Ackermann's function. This reinforces the hypothesis that these equations were borrowed from Sudan. The same equations, $\rho_c(f(c), a, o) = a$, $\rho_c(f(c), a, n+1) = f(\rho_c(f(c), a, n))$, are considered by van Heijenoort [1967, 493].

Like Sudan's function, Ackermann's function is obtained as the superposition of two functions: The first function, which Sudan denotes by t_c, appears in Ackermann's paper in a different notation and with a permutation of the first two arguments. More precisely, Ackermann's function is given by

$$\phi(a, b, o) = a+b$$

$$\phi(a, b, n+1) = g_c(\phi(a, c, n), \alpha(a, n), b),$$

where

$$g_c(f(c), a, o) = a,$$

$$g_c(f(c), a, n+1) = f(g_c(f(c), a, n)),$$

and

$$\begin{aligned} \alpha(a,n) &= 0, \ n=0 \\ &= 1, \ n=1 \\ &= a, \ n=2. \end{aligned}$$

[Ackermann 1928, 119].

Some other points in Ackermann's paper are also related to Sudan's paper [Marcus 1975, 19], [2].

Ackermann's function is an example of a function of type 2 which is not of type 1. Later, Péter [1956] proved that it is not a primitive recursive function. The recursiveness of a slight modification of Ackermann's function was proved by Eilenberg and Elgot [1970]. Sudan's result is stronger than Ackermann's because he also gave a characterization of variables of type 2

Fig. 4. Page 382 from the paper [7]

(1928) eliminated reference to functionals in favor of a simultaneous recursion.

It is worth noting here that at about the same time that Ackermann submitted his paper for publication, Gabriel Sudan independently gave an example of an effectively computable function that is not primitive recursive (cf. Sudan, 1927). It was an ordinal-valued function defined by nested recursion indexed by a transfinite ordinal. Ackermann's paper was cited by Sudan

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and *vice versa.* Unfortunately Sudan's result remained unknown. The reason for that can be the fact that his paper appeared in an obscure Romanian journal (cf. Calude *et al.*, 1979).

Ackermann's construction gave a stimulus to researches on the classification of recursion schemas (cf. Péter, 1951). It seems also to have guided Jacques Herbrand (1908–1931) in his studies towards a definition of the notion of effectively computable function (cf. Herbrand, 1931).

An explicit definition of recursiveness appeared for the first time[3] in a paper by Kurt Gödel (1906–1978) (1931). Studying incompleteness of a system of arithmetic of natural numbers

Fig. 5. Page 91-92 from the book authored by *Roman Murawski*, 1999 [18]

Conclusions

Year 1938: "*Thanks to the psycho-physical reversibility, we can materialize the act of creation. Undoubtedly, the inventive machine has not yet been created, but we can see its creation soon*." Stefan Odobleja, "Consonant Psychology", Paris [5].

Year 1973: "*Informatics restores not only the union of pure and applied mathematics, of concrete technique and abstract mathematics, but also the union of natural sciences with man and society. It re-establishes abstract and formal concepts, and brings peace between art and science, not only in the scientist's spirit, where they always are at peace, but also in their philosophy*." Gr. C. Moisil.

Year 1917: Molecular computer - "*Define a molecular computer as one molecule which transforms, by random chemical reactions mediated by a collection of enzymes, into a predictable other molecule, such that the output molecule can be conceived as the result of a computation encoded in the initial molecule.*" M. Buliga [6].

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Ştefan Odobleja: A Scientific Visionary, precursor of Cybernetics and Artificial Intelligence

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Abstract

The article describes the contribution of the Romanian scientist Dr. Ştefan Odobleja (1902-1978) to the emergence, development and development of Cybernetics, whose ideas and concepts meant the emergence and development of computer science. The scientific activity of Stefan Odobleja, a military physician, makes his ideas, results and visions a precursor to Cybernetics and Artificial Intelligence. His major work "Psychologie consonantiste", first published in 1938 and 1939, in Paris, established many of the major themes of cybernetics regarding cybernetics and thinking systems ten years before the work of Norbert Wiener (1894-1964)-mathematician, published, in 1948. Odebleja's contributions are all the more important if he is considered to be a physician, because they have created ideas and concepts complementary to some ideas introduced by N. Wiener. It can be appreciated that during 1920-1940 the ideas and studies on Cybernetics appeared, the science that laid the system concept (for man and the car), the structure of the systems (control and communication between the components of a system) and which led to the construction of the systems computing (computer system). Dr. Stefan Odobleja was recognized as a precursor of Cybernetics at the 4th International Cybernetics Congress, held in Amsterdam in August 1978. His Communication "Diversity and Unity in Cybernetics" was presented at the Congress by Dr. Stelian Bajureanu. After the presentation of Odobleja's work, the participants chanted "40 Years of Cybernetics," although they were celebrating "30 Years of Cybernetics" and mathematician Norbert Wiener.

Keywords: Cybernetics, System, Feedback, Model, Structure, Artificial Intelligence

1 Cybernetics, Science of systems, Structures and Models

> Motto: *"The Art of Creation is a Global Art: The Art of Thinking"* Ștefan Odobleja (1902-1978).
> "*Thanks to the psycho-physical reversibility, we can materialize the act of creation. Undoubtedly, the inventive machine has not yet been created, but we can see its creation soon*." Stefan Odobleja, "Consonant Psychology", Paris [8]
> "*By trying to build machines that simulate and reproduce human brain activity, and because the most important computational models were made by simulating the activity of the nervous system, it can be said that Informatics was born as a chapter of the medical sciences*" Solomon Marcus (1925-2016) [17].

Human thinking has invented the sciences. Science is a model and philosophy of thought. In 2014, *Solomon Marcus* describes "The 10 Human Needs" where the number 2 need is expressed as: "*The need for refreshment. As we daily need to refresh our body through rest and movement and the use of water and soap, we need a refreshment of our mind, our senses and our psyches*."[17]
Man's adaptation to nature and his survival in nature, depending on the area and time, forced man to organize not only survival, but rather to organize his experiences, learn from the obstacles with which he confronted, and especially to plan their future activities. All this is done through thought, as a manifestation and normal functioning of the brain. For these reasons, there are no two

"identical" people with the same thoughts, primarily because there is no single criterion to compare two "thoughts".
"*The automated models of the 1940s, the Turing machine of the 1930s and the electronic computer produced by John von Neumann and his team in 1948, looked at the nervous system. "In my book (Grammars and Finite Automats from 1964) there is a great chapter about the neural system, as it is modeled by S. C. Kleene's finite automata and grammar. ... Things continued through everything that followed in the disciplines cognitive and Artificial Intelligence, so we published the article "The Human Brain, Many Hypotheses - Few Clarifications," in the "Academica" journal of the Romanian Academy*" S. Marcus [18].
Today, it can be appreciated that there are three significant periods in the emergence and evolution of Informatics, and in the construction of computers:

1. *Period 1920-1940* (Fundamentals and Concepts), in which: the ideas and concepts of calculus theory were grounded; recursive functions were studied; formal systems have been defined and the limits of calculability have been established; the concept of algorithm has been finalized as a support for a computing machine (Turing machine or Post machine). During this period, the ideas and studies on Cybernetics[1], the science that laid the concept of the system (for Man and the Machinery), and the system science (control and communication between the components of a system), science that led to the construction of computing systems;
2. *Period 1940-1960* (Design and Implementation), in which: ideas and concepts of calculus theory were implemented; computer systems and peripheral equipments (based on research and results in several areas: systems, data structures, electronic circuits, memories and storage devices, algorithms and programming languages) were built;
3. *Period 1960-1980* (Hardware and Software Performance, Interactivity). During this period: an explosive development of the computing equipment occurred - due to the appearance of the microprocessor; high performance operating systems[2] (UNIX, DOS, RSX-11M, etc.) have been obtained; programming languages[3] have been developed (Algol, Fortran, Cobol, Simula, Pascal, C, etc.); intelligent / expert systems, generated by the Artificial Intelligence languages (List, Prolog, etc.) appeared.

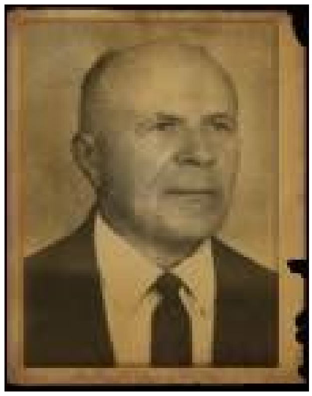
Analyzing the development of ideas, theories, concepts, and building of computing systems, one can assert that there are two important directions in computer evolution:

- *Hardware Component* - represented by systems (computing units - microprocessor, storage units - memory, communication units-bus), electronic circuits (equipments), Input / Output devices;
- *Software Component* – represented by algorithms, languages and programs (operating systems, programming languages, computer systems and applications).

Cybernetics has helped define a schematic scheme for a cybernetic system that applies to all hardware and software components: INPUT → PROCESSING → OUTPUT (fig. 1).

[1] "Cybernetics is a transdisciplinary approach for exploring regulatory systems—their structures, constraints, and possibilities.", https://en.wikipedia.org/wiki/Cybernetics
[2] On August 4, 2017, there were 611 operating systems (including versions) and 656 Linux distributions, http://www.operating-system.org/betriebssystem/_english/os-liste.htm
[3] On August 4, 2017, updated list https://en.wikipedia.org/wiki/Timeline_of_programming_languages

Fig. 1. The unified / general scheme of a cybernetic system



Time has shown that this scheme of a cybernetic system shapes the structure and functioning of the most important concepts in Informatics:

- *Computer system (computer)* - where INPUT = input devices and input data, OUTPUT = output devices and output data, and PROCESS = execution of programs using operating system, microprocessor and memory;
- *Algorithm* - where INPUT = input data, OUTPUT = output data, and PROCESS = computation process represented by pseudo-code;
- *Program* - where INPUT = input data, OUTPUT = output data, and PROCESS = computational instructions represented in a programming language;
- *Information System* (Problem Solving) - where INPUT = input data, OUTPUT = output data, and PROCESS = procedures and instructions represented in a programming language.

These aspects were not realized if calculability problems (calculus theory) and problems related to the development of computer systems (cybernetic systems) of the electronic computer were not elucidated [12].
In this context, the invention and construction of the modern / digital computer was possible through the emergence of new sciences and new products:

- *Computer Science and Cybernetics*[4];
- *Languages and Algorithms*;
- *Input/Output Devices*;
- *Memory and storage environments*.

In the field of Cybernetics, Romania is represented by the scientist Ştefan Odobleja (1902-1978) - a military medical professional, being one of the precursors of the Generalized Theoretical Cybernetics and Artificial Intelligence, the author of the 2 volume "Consonant Psychology" published in Paris for the first time date in 1938 (volume I) and then in 1939 (volume II). The paper has set out many of the major themes on cybernetics and thinking systems (introduced the concept of feedback, with the meaning of reversible links or reverse links, provided the telecommunication model, as well as the

[4] The roots of the cybernetic theory: "*Ştefan Odobleja (1902–1978) was a Romanian scientist, one of the precursors of cybernetics. His major work, Psychologie consonantiste, first published in 1938 and 1939, in Paris, established many of the major themes of cybernetics regarding cybernetics and thinking systems ten years before the work of Norbert Wiener(1894-1964) was published, in 1948.*" [12]

ideas on automation of thinking - which underlies Artificial Intelligence). From this point of view, Stefan Odobleja was a real visionary for a new thinking - algorithmic thinking, which led to the emergence of computers. An important role in the two volumes is that, for the world premiere, the concepts of System and Model are introduced.

As a discipline, Cybernetics (the name comes from the Greek "cybernetos" meaning "stormy") was established by Norbert Wiener, Warren McCulloch and Walter Pitts ("A Logical Calculus of the Ideas Immanent in Nervous Activity", 1943), Arturo Rosenblueth and others such as W. Ross Ashby ("Design of Brain, 1952), mathematician Alan Turing and W. Gray Walter (one of the first to build autonomous robots from animal behavior study).

"Cybernetics is a homogenous and coherent scientific complex, a science resulting from the blending of at least two sciences - psychology and technology; it is a general and integrative science, a crossroads of sciences, involving both animal and car psychology. It is not just a discipline, circumscribed in a narrow and strictly defined field, but a complex of disciplines born of psychology and centered on it, branched out as branches of a tree in its stem. It is a stepwise synthesis, a suite of multiple, often reciprocal, modeling; syntheses and modeling in which, as a priority, and as a great importance, the modeling of psychology on the technique and then the modeling of the technique on psychology. Cybernetics is an intellectual symphony, a symphony of ideas and sciences." Stefan Odobleja[5], 1978 [11].

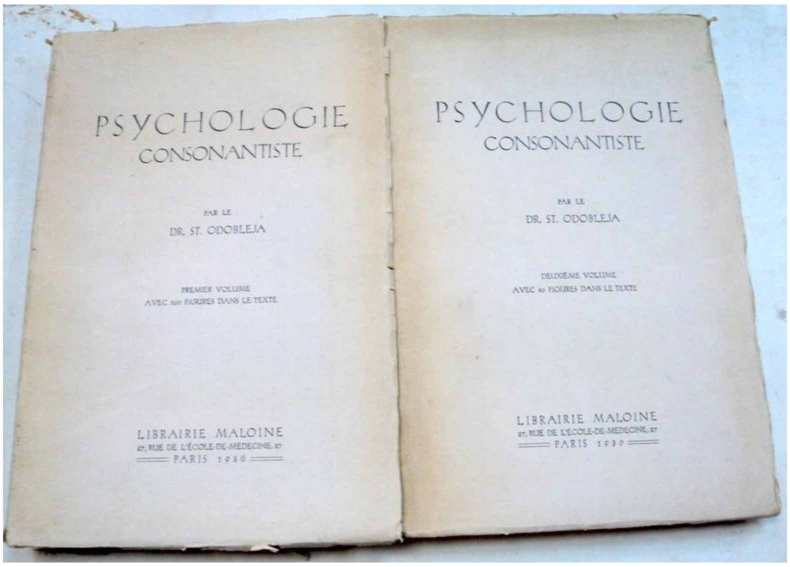


Fig. 2. The book's cover: Ștefan Odobleja "Psychologie consonantiste ", Paris, 1938 [8]

Below are some of Stefan Odobleja's ideas:

- The first thought that Thinking has, Thought is to meet.
- The law of reversibility is fundamental and defines life by reversibility: "life is a vicious circle of actions and reciprocal reactions. A complex reversibility of physicochemical phenomena, a reversible couple of actions and reactions. A complex phenomenon where each partial phenomenon is, successively, either a cause or an effect.
- The possibility of automating the human thinking process and developing mechanisms to transfer this process to a machine are precursor ideas of Artificial Intelligence.

[5] https://en.wikipedia.org/wiki/%C8%98tefan_Odobleja

- The logic of resonance would have, after Odobleja, four subordinate disciplines: geometry of logic, kinematics of logic, logic dynamics, and logic mechanics. Thus, the forms of thinking, conceived in the act, in the process of their exercise (logical-psychological), were to find a geometrical (spatialized) representation.

The ideas are extracted from "Psychology and Neurophysiology", the works being a world premiere. These thoughts were accomplished ten years before the publication of the work of mathematician Norbert Wiener (1894-1964) [2, 23].
With an admirable scientific belief, in the two volumes of 1938, Stefan Odobleja strongly supports the reality of the concrete facts, crystallized around and with the consonant theory: rigorous duality, symmetry, dichotomy, binarity, bivalence, bipolarity, correlation with the opposition, alternation , circularity or reversibility, selectivity, specificity, transformations and retreats, actions and reactions, attractions and repulsions, agreements and disagreements, unions and deductions, etc. Odobleja comes to establish the essential relationships between scientific concepts, expressed in the form of laws - known resonance laws or consonant laws. These were, in short, the logical premises of consonant psychology. The possibility of mechanizing the processes of thought, materialized in the scientific-consonant fields, was a natural consequence of their logical-psychological analysis [8,9].
Odobleja's "The Logic of Resonance" project, a project with an impressive grandeur: "By comparing it with traditional and mathematical logic, we find that Odobleja defines its object of study in the traditional sense (the classical forms of thought: notion, judgment, syllogism); but the method is conceived (geometric and physical modeling) in the sense of physical-mathematical sciences. The logic of resonance would have, after Odobleja, four subordinate disciplines: geometry of logic, kinematics of logic, logic dynamics, and logic mechanics. Thus, the forms of thinking, conceived in the act, in the process of their exercise (logical-psychological), were to find a geometrical (spatialized) representation. This creates the premise of the corporalization of thought, its embodiment in the patterns of geometrical sketches. If the geometry of logic or geometric logic, as Odobleja sometimes called it, was the external, pictorial-schematic moment of thought, the kinematic logic had to be the sculptural, rigid-bodied moment. The dynamics of logic would represent the animation of this inert golem[6], which would be nothing more than artificial thinking, modeled on the image and the likeness of the natural one, except that it could not be carried out by itself except in the last moment, that of automation . "Acad. Alexandru Surdu [19].

2 Odobleja's Contribution to the Fundamentals of Cybernetics and Artificial Intelligence

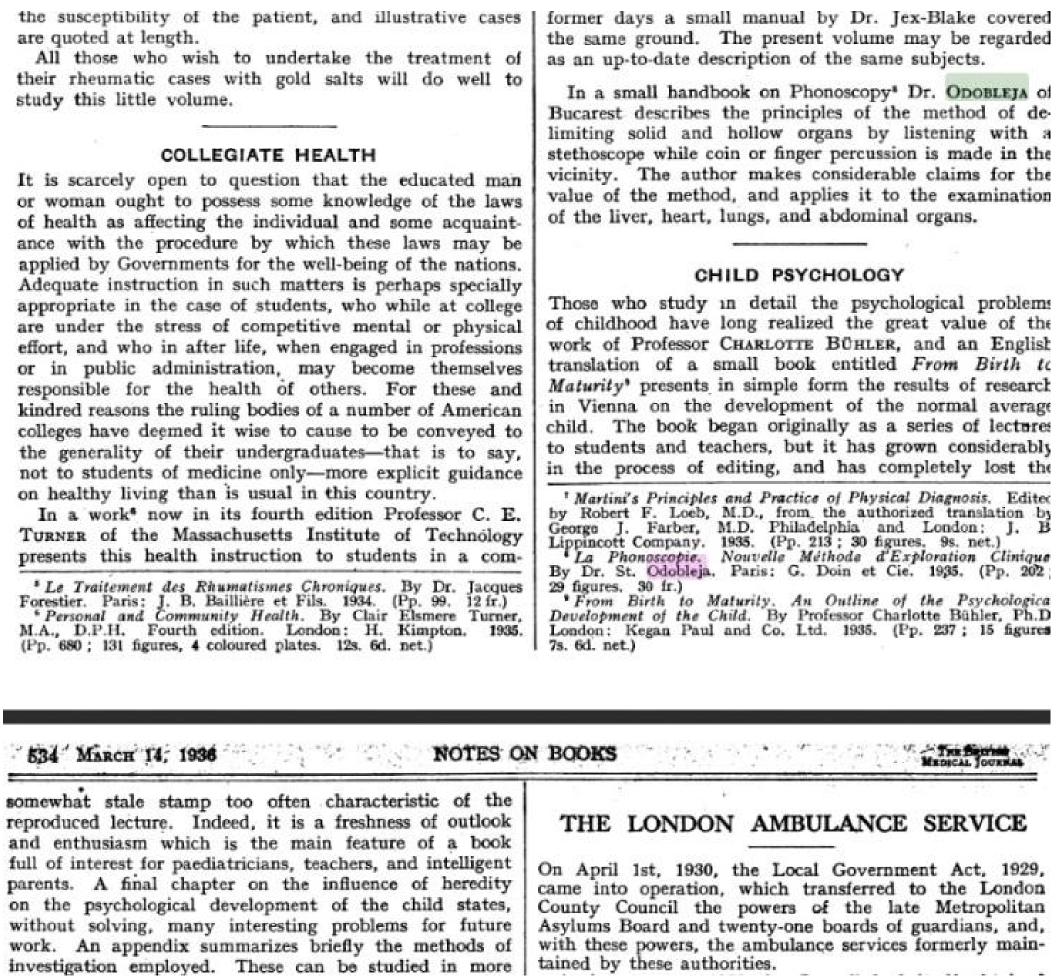
> "*The ideas of the "Great lonely person" who was the Romanian scientist Stefan Odobleja, could not impose themselves because - as we have previously shown - he was not lucky to enjoy any scientific community, a strong enough institution and a favorable social context, as well*." Nicolae Jurcău, 1998 [2]

At the time, Stefan Odobleja was aware that his ideas were advanced to contemporaries and expected the latest technology to confirm. Stefan Odobleja was aware of the originality of his ideas and therefore addressed the international scientific world. In 1937, the International Military Medicine Congress was held in Bucharest, where Dr. Stefan Odobleja received the "General Dr. Alexandru Papiu, physician " award, with the work "La phonoscopie" published by Gaston Doin & Cie Publishing House, Paris. He also launched a prospectus announcing that "Consonant Psychology" is in print in Paris. On that occasion, being present at the Congress, William Seaman Bainbridge, chief medical officer of the 7th American Mediterranean Fleet, announced this book

6 In Jewish folklore, a golem is an animated anthropomorphic being that is magically created entirely from inanimate matter (specifically clay or mud). The word was used to mean an amorphous, unformed material in Psalms and medieval writing.

appearance in the United States, and a summary was published in the American Psychological Abstract.
"It is known that it is harder for you to convince yourself of a truth than to find it, because truth has been found most often through intuition, if not through a hazard. While someone else's belief requires, in order to produce, the deductive way, with heavy and numerous syllogisms. Moreover, for the one who found it, the truth seems to it to be simple and manifest, while for others we have to erase their previous opinions, a process that is always disagreeable, and which opposes opposition through a very natural reaction, whose roots go beyond psychological and even biological, for physical phenomena are already dominated by the conflict of action and inertia. " Ştefan Odobleja from the preface of the work "La Phonoscopie" published by Ed Gaston Doin & Cie, Paris (1935) and translated into Romanian in 2011 [7].
After World War II, Romania was under the influence of the USSR and isolated from the free world, and Cybernetics was considered a reactionary science that "the imperialists used to destroy the revolutionary conquests of socialism." For Romania, only after 1968, began an international opening period. At the International Cybernetics and Systems Congress, held in Bucharest in 1975, Odobleja participated with the work "Consonancial Psychology", which he was able to present, with the approval of the Chief of the Cybernetics Department, Dr. Aldo Masturzo of Italy (Editor, Cybernetic Medicine, International Society of Cybernetic Medicine), although some Romanian specialists have been reserved under the influence of the politicians of the time – https://www2.gwu.edu/~asc/key_journals.html.
In an interview in 2013, the son of the scientist, Mr. *Stefan Odobleja Jr*., says that due to his illness, Stefan Odobleja did not attend the 4th International Cybernetics Congress, held in Amsterdam in August 1978. His communication "Diversity and Unity in Cybernetics" was presented at the Congress by Dr. eng. Stelian Bajureanu (in 1975, he gave his doctorate in Cybernetics, being among the first doctoral theses in the world in the field of Cybernetics). After the presentation of Odobleja's work, the participants chanted "40 Years of Cybernetics," although in reality they only commemorated "30 Years of Cybernetics"; in addition, the mathematician Norbert Wiener was celebrated. With this event of recognition of the Romanian priority on Cybernetics, who led the Congress, J. Rosse came to Romania and awarded "Norbert Wiener" medal to Nicolae Ceausescu, the political leader of Romania, for the special merits in Cybernetics of Romanian Researchers. [13]

In 1979, the Romanian Academy Publishing House published the collective work "Romanian Precursors of Cybernetics", a book in which the merits of Stefan Odobleja are acknowledged, and in 1981, the Romanian Academy consecrated the work "Odobleja between Ampere and Wiener" has been distributed around the world [13] [4,5,9].



the susceptibility of the patient, and illustrative cases are quoted at length.

All those who wish to undertake the treatment of their rheumatic cases with gold salts will do well to study this little volume.

COLLEGIATE HEALTH

It is scarcely open to question that the educated man or woman ought to possess some knowledge of the laws of health as affecting the individual and some acquaintance with the procedure by which these laws may be applied by Governments for the well-being of the nations. Adequate instruction in such matters is perhaps specially appropriate in the case of students, who while at college are under the stress of competitive mental or physical effort, and who in after life, when engaged in professions or in public administration, may become themselves responsible for the health of others. For these and kindred reasons the ruling bodies of a number of American colleges have deemed it wise to cause to be conveyed to the generality of their undergraduates—that is to say, not to students of medicine only—more explicit guidance on healthy living than is usual in this country.

In a work[6] now in its fourth edition Professor C. E. TURNER of the Massachusetts Institute of Technology presents this health instruction to students in a compact form ... former days a small manual by Dr. Jex-Blake covered the same ground. The present volume may be regarded as an up-to-date description of the same subjects.

In a small handbook on Phonoscopy[8] Dr. ODOBLEJA of Bucarest describes the principles of the method of delimiting solid and hollow organs by listening with a stethoscope while coin or finger percussion is made in the vicinity. The author makes considerable claims for the value of the method, and applies it to the examination of the liver, heart, lungs, and abdominal organs.

CHILD PSYCHOLOGY

Those who study in detail the psychological problems of childhood have long realized the great value of the work of Professor CHARLOTTE BÜHLER, and an English translation of a small book entitled *From Birth to Maturity*[9] presents in simple form the results of research in Vienna on the development of the normal average child. The book began originally as a series of lectures to students and teachers, but it has grown considerably in the process of editing, and has completely lost the somewhat stale stamp too often characteristic of the reproduced lecture. Indeed, it is a freshness of outlook and enthusiasm which is the main feature of a book full of interest for paediatricians, teachers, and intelligent parents. A final chapter on the influence of heredity on the psychological development of the child states, without solving, many interesting problems for future work. An appendix summarizes briefly the methods of investigation employed. These can be studied in more

[5] *Le Traitement des Rhumatismes Chroniques.* By Dr. Jacques Forestier. Paris: J. B. Baillière et Fils. 1934. (Pp. 99. 12 fr.)

[6] *Personal and Community Health.* By Clair Elsmere Turner, M.A., D.P.H. Fourth edition. London: H. Kimpton. 1935. (Pp. 680; 131 figures, 4 coloured plates. 12s. 6d. net.)

[7] *Martini's Principles and Practice of Physical Diagnosis.* Edited by Robert F. Loeb, M.D., from the authorized translation by George J. Farber, M.D. Philadelphia and London: J. B. Lippincott Company. 1935. (Pp. 213; 30 figures. 9s. net.)

[8] *La Phonoscopie. Nouvelle Méthode d'Exploration Clinique.* By Dr. St. Odobleja. Paris: G. Doin et Cie. 1935. (Pp. 202; 29 figures. 30 fr.)

[9] *From Birth to Maturity. An Outline of the Psychological Development of the Child.* By Professor Charlotte Bühler, Ph.D. London: Kegan Paul and Co. Ltd. 1935. (Pp. 237; 15 figures. 7s. 6d. net.)

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THE LONDON AMBULANCE SERVICE

On April 1st, 1930, the Local Government Act, 1929, came into operation, which transferred to the London County Council the powers of the late Metropolitan Asylums Board and twenty-one boards of guardians, and, with these powers, the ambulance services formerly maintained by these authorities.

Fig. 3. Reviews, Handbook of Phonoscopy, pag 534 din British Medical J. 1936 Mar 14 [14]

Stephen Odobleja died in September 1978. As a sign of recognition of his entire opera, in connection with Ştefan Odobleja, we recall:

- he was elected post-mortem member of the Romanian Academy;
- since 2005, the village of Valea Hoţului, from Izvorul Aneştilor, Mehedinţi county, where he was born, is called "Stefan Odobleja.
- In his memory there is the "Stefan Odobleja" Memorial House in his native village;
- The Foundation "Ştefan Odobleja" from Drobeta Turnu Severin was founded, led by his son, eng. Ştefan Odobleja Jr.
- The Romanian Post edited an envelope in 1988 (when it was 50 years since the publication of the book "Psychology Consonantiste", Paris) and a stamp in 2011.

Fig. 4. Envelope 1988 edited by Posta Romana (50 years since 1938) and stamp 2011

Stefan Odobleja's ideas and thinking are today sources of insight for many researchers in various fields of science.

For example, in an article published in the journal Laser Therapy (2014) by a team of physicians, it shows [16]: "*The Romanian scientist Odobleja Ştefan (1902–1978), the founder of cybernetics, defined for the first time in the world the psyche as a system. "The psyche is a system consisting of multiple elements: dynamic, reversible and associated". The reverse connection termed by Odobleja "vicious circle" or reversible link is then identified in different psychic processes. Affectivity is a vicious circle, directly subordinated to the great circle: the life. Knowledge is a small vicious circle, directly subordinated to the affectivity, and through it, to the life". Assoc. Prof. Dr. Dragos Cârneci states that emotion is not a function of the brain, but a label that refers to a set of its functions. The brain does not have a system that mediate emotion, but subsystems that mediate fear, anger, disgust or pleasure. In the 1980s Le Doux, studying the adverse conditioning to auditory stimuli, showed the existence of two neural pathways involved in the mechanism of this conditioning, regarded as one of the phobias mechanisms in psychiatric diseases. The two pathways are: a path that link the thalamus directly to the amygdala (1) and another path leaving the thalamus to the primary auditory cortex (2)*".

Ştefan Odobleja (1902 - 1978) is the author of a remarkable work - Psyhologie consonantiste , Librairie Maloine, vol.I, 1938; vol. II, 1939 -, considered to be one of the forerunners of the present - day cybernetics and the founder of a general cybernetics as a theory of the laws of consonance between the sciences. Essentially, this is an original work of the foundations of a science consist of establishing its logical concepts, their geometrical model, their definition and classification, establishing their common laws.
The consonantiste psyhology and the present-day cybernetics are different not only by generality. The latter is the outcome of a neopositivist foundation of sciences, which is algebrical, symbolical and logical - mathematical, while the consonantiste psychology is geometrical, figurative an logical - classical. On the basis of the letters Odobleja tried to develop a logic called "the logic of resonance", that is a logic of the common substratum, in resonance or consonance with the conceptual contest of sciences.
Unlike the formalist - symbolic orientation of the contemporary logicians, Odobleja considers thinking in development, as a psychological process belonging to human's activity in general and to the scientifically one in particular. His logic does not apply to the forms of thinking already set, but to their becoming. Thus in Odobleja's opinion, the mechanization of thinking does not imply a device for reproduction thought already conceived but a device for effective reasoning , for producing thought. According to Odobleja, there is a creative artificial thinking which implies,

similarly to the consonance laws of sciences, a geometrical positioning in space of the results of thinking, their physical (kinematical and dynamical) model, and finally a mechanization of these processes. Each of these phases has its own counterpart in the real of logic, i.e.: geometrical logic, kinematical logic, dynamical logic and mechanical logic.
This was a vast project, which Odobleja had no time to accomplish. But he left us a bulky manuscript, about 15.000 pages, with a lot of notes, drawings, sketches and a few pages to be published [13].

Conclusions
The ideas of the "Great lonely person" who was the Romanian scientist Stefan Odobleja could not impose themselves because - as we have previously shown - he was not lucky to enjoy any scientific community, a strong enough institution and a favorable social context, as well [2]:
The reversibility law (feedback) is present at the interpretation of all the domains that Stefan Odobleja approached.

Examples (The examples might continue):

- Psycho-physiology: "The intellectual exercise develops the brain and its development incites to the development of the intelligence";
- Psycho-pathology: "Between the cerebral structure and the cerebral function, between the cerebral pressure and mental disorder there is reversibility and reciprocity of determination, The lesion produces disorder and the mental disorder produces lesion";
- Language: "The image evokes the spoken word; in its turn, the spoken word evokes the image";
- Sociology: "The functioning of a society determines its structure but (the structure) influences, in its turn, upon the functioning"; philosophy: "Any philosophy is the crop of the past experience, in its turn any philosophy determines the experiments and behaviors in future";
- Aesthetics: "Art is the product and the expression of the individual and society which comprises him; in is turn, art influences the individual and the society".

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An Overview on the Contributions of the Academician Octav Onicescu to the Informational Statistics and Further Developments

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Abstract

Octav Onicescu is the greatest statistician that Romania ever had. He is the only Romanian statistician included in the Statisticians of the Centuries' volume published in 2001 by Springer Science at the initiative of the International Statistical Institute. The paper presents an overview on the academician Octav Onicescu's research activity in the field of informational statistics. Two major contributions brought to this domain are discussed: Onicescu's informational energy and correlation, highlighting some applications' areas and further developments.

Keywords: Probability theory, Information theory, Mathematical statistics, Informational statistics, Onicescu's Informational energy

1 Introduction

Octav Onicescu (1892-1983) is one of the greatest mathematicians of Romania with a remarkable international reputation, being the only Romanian statistician included in the Statisticians of the Centuries' volume published in 2001 by Springer Science at the initiative of the International Statistical Institute, the representative association for international statistics, his presentation in the book being made by Marius Iosifescu [11]. He considered himself ([18], page 18) as *a researcher of facts: human, social, economic, of natural phenomena, with mathematical means, preferable probabilistic or mechanical, researcher that determined along his whole life to assimilate much more mathematical science in order to use it in his research activity.* The academician Octav Onicescu promoted probability as the science of events measure and random processes, and mechanics as support or model of any science of natural movements. He is the founder of the probability theory and statistics in Romania and he developed a new mechanics, the *invariantive mechanics* [20]. Also, he investigated and applied methods from geometry, pure algebra, functional analysis, game theory, mathematical logic and topology. Details regarding the Octav Onicescu's education, academic and research activities are given in [3], [11], [17] and [18].

In 1930 (the year of the population census in Romania), Octav Onicescu founded together with other scientists (e.g. Gheorghe Mihoc, Alex Pantazi, Nicolae Teodorescu, Miron Nicolescu, Grigore Moisil, Alex Froda, Nicolae Ciorănescu, Max Sanielevici, Paul Sterian, Roman Moldovan, I. Argeşeanu, N. Georgescu-Roegen, S. Manoilă, Mircea Vulcănescu, Ciril Petrescu), the *School of Statistics, Actuarial Science and Computation* that became the *Institute of Statistics* till 1948, when it was dismantled, and it was later reactivated as a department of the Institute of

Mathematics of the Romanian Academy [3], [11]. This institute represents one of the greatest scientific achievements of his generation that was dedicated to the society service in an efficient and direct way.

Onicescu looked for new significances of the statistical information. His main contributions to the science are in the domains of probability theory, statistics, mechanics, some domains of analysis, philosophy etc. He had many collaborators and was the mentor of several remarkable mathematicians (*his first doctoral student* Gheorghe Mihoc, who was the closest and probable, the dearest disciple and collaborator, Silviu Guiașu, Cassius Ionescu Tulcea, Marius Iosifescu, Ion Văduva, Vasile Ștefănescu, Mihai Botez, Ion Săcuiu, Tiberiu Postelnicu, Luminița State, just naming a few of them).

At University of Trieste he taught several lessons about the *information theory*, trying to adopt as information measurement instrument, *the informational energy* instead of the Shannon's entropy. Still, in order to demonstrate the existence of codes (founded by the Shannon's theorem) he had to use the entropy, which although more complicated as expression, gave a simpler demonstration. He emphasized the quality of informational energy as a statistical instrument.

The results of the academician Octav Onicescu' research work were published in several research articles, studies, memoires, textbooks and books (more than 200). In this article we have included only 15 references, from which one refers to his memoirs [17], one to his life's pathways [18] and the rest to his scientific activity in the domains of probability theory, statistical information, invariantive mechanics etc.

The academician Octav Onicescu had a complex personality, that apart his academic, scientific and cultural activities (described in [3], [17], [18]), was an excellent organizer (being the president of some professional societies, scientific seminars and the manager of certain public institutions in Romania and abroad) that participated actively during the first World War to the Mărășești battle in 1917 (exactly one century ago), being the leader of a company within the Romanian air force. He was a great professor with remarkable pedagogical and methodical abilities that was admired by his students. Octav Onicescu is an excellent model as a scientist, as a professor and as a human being, for every mathematician, every professor, every researcher and even everyone, which contributed to the development of science at national and international level.

From the vast research activity of academician Onicescu, in this paper we focus on some achievements in the domain of informational statistics and their applications.

2 A brief overview on the Onicescu's informational statistics theory

Informational statistics is an area of mathematical statistics that study the structure of the statistical relations and their correlations. Shannon [34] proposed the entropy $(-\sum_{i=1}^{n} p_i \log p_i)$ as a measure of the uniformity degree or diversity degree of the corresponding distribution. The entropy has the additive property for independent structures. Onicescu demonstrated that from the statistical viewpoint, the more simple expression $\sum_{i=1}^{n} p_i^2$, which he named as *informational energy* characterizes as well as the Shannon's entropy, the uniformity or diversity of a distribution. Also, he proved the possible extensions to infinite distributions of this characteristic and revealed the statistical significances of the information correlation. The concept of *informational energy* was introduced by academician Onicescu in 1966 ([23], [24]) being the basis of the theory he built, namely *the Onicescu's theory* on informational statistics.

We present some elements of the Onicescu's theory of informational energy and correlation ([19], [23] and [35]).

Definition 1. (*informational energy*) Suppose x is a random variable with the distribution of probabilities: ($p_1, p_2, \ldots, p_n$). The *informational energy* of x, denoted as $IE(x)$, is defined according to [23] as follows:

(1) $$IE(x) = \sum_{i=1}^{n} p_i^2$$

This expression was introduced first by Corrado Gini and it was named by Octav Onicescu as the *informational energy*. Relation (1) is named the *Onicescu formula* for the measurement of uncertainty or information related to x. It can be written as relation (2).

(2) $$IE(p_1, p_2, \ldots, p_n) = \sum_{i=1}^{n} p_i^2 .$$

The *informational energy* is a measure of the uncertainty of an events system, S, with n events (considered as an *experiment*) having the corresponding frequencies $f_1, f_2, \ldots, f_n$, and is denoted as follows:

$$IE(S) = \sum_{i=1}^{n} f_i^2; \quad \sum_{i=1}^{n} f_i = 1.$$

Some properties of the informational energy are:

1) If the events are equiprobable then $IE(S) = \frac{1}{n}$.
2) If one event has the probability 1 and the others have the zero probability, then $IE(S) = 1$.
3) $IE(S) \in \left[\frac{1}{n}, 1\right]$.
4) If we add to S an event with zero probability, the informational energy is not modified.

Another important concept of the Onicescu's theory is *the conditioned informational energy*.

Definition 2. (*conditioned informational energy*) Suppose we have two experiments A and B, where B is conditioned by A. The probability distribution, g_{ij}, is defined by the following relation:

(3) $$g_{ij} = p(B_i / A_j),\ i = 1,2,\ldots,n; j = 1,2,\ldots,m$$

The definition of *the conditioned informational energy* of the B experiment when within the A experiment occurred the A_j event, is given by the following expression:

$$IE(B / A_j) = \sum_{i=1}^{n} g_{ij}^2$$

The core concept of the informational statistics is the *informational correlation*, which was introduced by Octav Onicescu, and is a coefficient that has a remarkable property, that *its equality to 1 represents the distributions identity*.

Definition 3. (*informational correlation*) Let's consider two experiments A and B, characterized by an n-system with n events $A_1, A_2, ..., A_n$ and $B_1, B_2, ..., B_n$, with the following probability distributions:

$$p(A_1) = p_1,\ p(A_2) = p_2, \dots,\ p(A_n) = p_n;$$
$$p(B_1) = q_1,\ p(B_2) = q_2, \dots,\ p(B_n) = q_n.$$

The correlation between A and B, denoted as $IC(A,B)$, is given by relation (4).

(4) $$IC(A,B) = \sum_{i=1}^{n} p_i q_i$$

Some properties of the informational correlation are given as follows.

1) $0 \le IC(A,B) \le 1$;
2) $IC(A,A) = \sum_{i=1}^{n} p_i^2 = IE(A)$, i.e. the informational correlation of an experiment with itself is the informational energy.
3) $IC(A,B) \le IE(A) \bullet IE(B)$

The *informational correlation* is a measure of the connection between two systems of events having n common characteristics.

Definition 4. (*indifferent experiments*) Two experiments A and B with the probability distribution ($p_1, p_2, ..., p_n$) and ($q_1, q_2, ..., q_n$) are *indifferent* if there informational correlation is zero, i.e. $IC(p_1, p_2, ..., p_n, q_1, q_2, ..., q_n) = 0$.

Let's consider the following four experiments A, B, C and D, where A is connected to C and B is connected to D. Then, $IC(A \times C, B \times D) = IC(A,B) \bullet IC(C,D)$, where $\times$ is the product operator of two experiments and is defined later.

The experiments A, B, C and D are given by the following corresponding probability distributions ($p_1, p_2, ..., p_n$), ($q_1, q_2, ..., q_n$), ($r_1, r_2, ..., r_m$) and ($s_1, s_2, ..., s_m$).

Definition 5. (*the product of two experiments*) $A \times C$ is the experiment A and C product that has the probability distribution given by relation (5):

(5) $$A \times C = \begin{pmatrix} A_1C_1 & \dots & A_1C_m & \dots & A_nC_1 & \dots & A_nC_m \\ p_1r_1 & \dots & p_1r_m & \dots & p_nr_1 & \dots & p_nr_m \end{pmatrix}$$

where, A_i ($i=1, ..., n$), C_j ($j=1, ..., m$) are the events of the experiments A and C, and p_i, r_j are the probabilities corresponding to these events.

Let's consider two experiments A and B characterized by the probabilities ($p_1, p_2, ..., p_n$) and ($q_1, q_2, ..., q_n$). Suppose that the C experiment is conditioned by the results of the A experiment and the D experiment is conditioned by the results of the B experiment.

If under the A experiment it was produced the A_i event then the events of the C experiment will obviously depend on the probability of A_i occurring under the A experiment and we'll have:

$$C / A_i = \begin{pmatrix} C_1 / A_i & C_2 / A_i & \dots & C_m / A_i \\ r_{i1} & r_{i2} & \dots & r_{im} \end{pmatrix}$$

where $P(C_1/A_i)=r_{i1}$, $P(C_2/A_i)=r_{i2}$, ..., $P(C_m/A_i)=r_{im}$. The same for B and D.

Definition 6. (*conditioned informational correlation*) The conditioned informational correlation of the experiments C and D when the events A_i and B_j occurred is given by relation (6).

$$IC(C/A_i, D/B_j) = IC(r_{i1},\dots,r_{im}; s_{j1},\dots,s_{jm}) = \sum_{k=1}^{m} r_{ik} s_{jk} \tag{6}$$

Definition 7. (*correlation coefficient*) The correlation coefficient of two experiments A and B, denoted as $R(A,B)$, is given by the following expression:

$$R(A,B) = \frac{\sum_{i=1}^{n} p_i q_i}{\sqrt{\left(\sum_{i=1}^{n} p_i^2\right)\left(\sum_{i=1}^{n} q_i^2\right)}} = \frac{IC(A,B)}{\sqrt{IE(A) \bullet IE(B)}} \tag{7}$$

Examples of properties of the correlation coefficient:
1) $R(A,B) = R(B,A)$,
2) $R(A,B) \in [0, 1]$.

Examples of other concepts that were introduced by the Onicescu's theory are: *multiple correlation* and *multiple correlation coefficient*. More details on Onicescu's theory are included in [22], [26], [29] and some of the references discussed in the next section.

The research work of academician Onicescu on informational statistics was continued by his collaborators and disciples. We have selected the contributions of three mathematicians, Gheorghe Mihoc, Ion Văduva and Luminița State, presented in [35].

1. Gheorghe Mihoc proposed some estimators of the informational energy and formulated some theorems (*Gheorghe Mihoc' theorems*).
2. The statistical hypotheses verification with information energy was studied by Ion Văduva who formulated his own theory (*Ion Văduva' theory*).
3. The behavior of the Onicescu' informational energy corresponding to a posteriori distribution and the study on the Onicescu' informational energy corresponding to the weighting processes were the main subjects of the research performed by Luminița State in the area of informational statistics who formulated some theorems (*Luminița State' theorems*).

In the next section we shall present some details regarding these contributions and more applications will be discussed.

3 Applications of the Onicescu's informational statistic theory

The new systematic theory on informational statistics developed by academician Octav Onicescu starting from the informational energy concept introduced by him in 1966 was applied to several domains during the last fifty years. We have selected for this review some further developments and applications.

Further developments (selection)

1. Professor Gheorghe Mihoc noticed the connection between *IE* and the dispersion index of the probability values distribution p_i ($i=1, \dots, n$) of an experiment. If in relation (1) the probabilities p_i are replaced with frequencies f_i ($i=1, \dots, n$) then it is obtained the *empirical information energy*. This new concept introduced by Gheorghe Mihoc opened new perspectives of the Onicescu's theory.

Definition 8. (*empirical information energy*) The empirical information energy of an experiment defined by the frequencies f_i is given by the expression:

(8) $$IE(f_1, f_2, ..., f_n) = \sum_{i=1}^{n} f_i^2$$

Two theorems that were given by Gheorghe Mihoc are included in [35].

The mathematician Gheorghe Mihoc brought several contributions to the informational statistics and probability theory (see. e.g. [15], [27], [28], [30]), some of them in collaboration with academician Octav Onicescu and other mathematicians (as e.g. C. Ionescu Tulcea).

2. Another important contribution to further developments of the Onicescu's theory on informational statistics was the introduction of the *weighted entropy* and *weighted energy* concepts by Silviu Guiașu.

Definition 9. (*weighted informational energy*) The weighted informational energy of an experiment A having the elementary events $A_1, A_2, ..., A_n$ ($p(A_i)=p_i$; $\Sigma p_i=1$) to whom correspond the weights $w_1, ..., w_n$ is given by the expression:

(9) $$IE(w_1, w_2, ..., w_n; p_1, p_2, ..., p_n) = \sum_{k=1}^{n} w_k \cdot p_k^2$$

$$IE(w_1, w_2, ..., w_n; p_1, p_2, ..., p_n) \geq = 0$$

One further development of this contribution was performed by Luminița State, who proposed two theorems (included in [35]).

Another contribution of Silviu Guiașu is the definition of the informational energy for continuous random variables. Also, together with the academician Octav Onicescu he built *the first theory on random automata* [8], [25] and published a book on statistical mechanics [21]. Also, Silviu Guiașu developed an information model of learning theory [10] and presented some applications of information theory in [9].

3. We have selected five other mathematicians that collaborated with academician Octav Onicescu in the area of informational statistics and further developed and applied their research work, Ion Văduva, Marius Iosifescu, Mihai Botez, Vasile Ștefănescu and Luminița State. Ion Văduva is the first researcher who used *IE* for *checking statistical hypotheses*. He formulated a theory on this subject. Also, he gave examples of industrial applications of this theory for technological processes. Some of his contributions are described in [36] (a book on dispersional analysis) and [37]. Marius Iosifescu extended some results previously obtained by Onicescu and Mihoc to the case of chains with complete connections whose variables can take a finite number of values, showing that the reduced sum of variables checks at limit the normal law. Also, he extended the concept of a Markov chain' entropy to chains with complete connections, his research on sampling entropy for random homogeneous systems with complete connections being published in [12]. Mihai Botez worked with the academician Octav Onicescu to the development of *information econometrics* and they published a book on this subject, for uncertainty and economic modelling [16]. Vasile Ștefănescu collaborated with the academician Onicescu in the area of informational statistics, focusing on applications, some results being published in [19], [35], and he continued the research work by introducing new concepts as *the measure of information loss* concept. Luminița State introduced the definition of a *σ-experiment* and used the *a posteriori distribution series* providing some theorems (as e.g. those given in [35]).

Applications (selection)

4. *Applications of the informational correlation to the study of the education efficiency* (see e.g. [35]). In such applications, the informational energy was used for the detection of the factors that can influence the educational processes (as e.g. the student's level of knowledge, the student's learning style, the professor's competences, the teaching style) in order to build some effective pedagogical and methodical strategies that improve the outcomes of the educational activity. Another application of the Onicescu's theory in the educational domain is the use of the informational energy of a questionnaire (as defined by Claude Picard) in order to evaluate students' knowledge and to improve the quality of the educational processes.

5. *Applications of the informational energy to qualitative factorial analysis, to the agriculture domain* (e.g. planning the territorial distribution of the agriculture production), *in linguistics* (e.g. the phonetic structure of a language, for automated translations between natural languages). Some examples are given in [19], [35].

6. *Applications in social sciences* (e.g. the distribution of the population by age in different countries) and *economy*. Examples of some recent published research work in these areas are the use of informational energy on measuring external complexity of complex adaptive systems [5], its use in financial time series [6], the approach proposed in [33] for financial econometrics, and the uniformity test based on informational energy described in [32].

7. *Applications in biology, physics, chemistry and engineering*. An analysis on the use of the Onicescu's informational energy in some fundamental physical models is presented in [1]. Other examples of using Onicescu's informational energy in recent research work performed in physics and physical chemistry are discussed in [2] and [38], while some applications in engineering are described in [6] (for sensor data analytics), in [14] (as a measure of energy consumption), in [4] (first use in an artificial neural network model for adaptive resonance theory, the new fuzzy ARTMAP architecture) and in [7] (tackling the inference of the informational energy from small datasets). The last two applications are based on the $o(X,Y)$ estimator (given by relation (10), introduced by the authors in some previous work).

$$o(X,Y) = IE(X/Y) - IE(X) \tag{10}$$

Finally, at the end of this brief overview, we mention that some *applications of informational statistics in medicine and petrochemical industry* are presented in the PhD theses elaborated by two mathematicians from Petroleum-Gas University of Ploiești, Miron Oprea and Cristian Marinoiu, under the supervision of two disciples of the academician Octav Onicescu, Tiberiu Postelnicu and Ion Văduva, respectively, at the Institute of Mathematics of Romanian Academy and the University of Bucharest. The PhD thesis of Miron Oprea [31] tackles some stochastic aspects in the diagnosis processes focusing on medical diagnosis. The PhD thesis of Cristian Marinoiu [13] presents models of linear regression and their applications, mainly to the catalytic cracking process.

Conclusion

The academician Octav Onicescu is the greatest Romanian statistician with a remarkable international recognition. One of his main achievement in the domain of informational statistics is *the Onicescu's theory of informational energy and correlation*. His research work was continued by its collaborators and disciples, followed by several PhD researchers that elaborated PhD theses with topics in this area, providing new applications in various fields such as engineering, education, medicine, sociology, economy, for different types of processes and systems. The Onicescu's theory can still inspire nowadays researchers in new current research directions as we have seen in this brief overview that included recent published work or by searching the ScienceDirect web site with his research work citations.

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On the Development of an Educational Ontology for Logic Programming

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Abstract

Educational ontologies are important resources for the support of didactical activities in a university (i.e. teaching, learning and examination). They conceptualize certain educational domains and can be used as standalone resources (i.e. strictly as a vocabulary of terms with their definition) or as "building blocks" for web-based education, e-learning platforms, and intelligent tutoring systems. The paper focuses on some details related to the development of an educational ontology for the course of Logic Programming taught at the Computer Science specialization at undergraduate level. A preliminary form of a prototype ontology implemented in Protégé is also described.

Keywords: Educational ontology engineering, Computer programming, Logic programming

1 Introduction

Ontologies are valuable resources for computer based education in universities. They can conceptualize the domain knowledge of the taught courses. Several applications of ontologies in various educational domains were reported in the literature (see e.g. (Boyce and Pahl, 2007; Ganapathi et al, 2011; Pierrakeas et al, 2012; Panagiotopoulos et al, 2012; Oprea, 2016)), showing their benefits when included in e-learning platforms or intelligent tutoring systems.

Educational ontologies engineering can follow different methodologies such as DILIGENT (Pinto et al, 2004), HCOME (Kotis and Vouros, 2006), NeOn (Suárez-Figueroa et al, 2012) and others (e.g. those described in (Mizoguchi, 2004; Panagiotopoulos et al, 2012)). Some of these methodologies are domain-specific and few of them use collaborative ontology engineering. We have proposed a general framework, *EduOntoFrame* (Oprea, 2013), for the development of educational ontologies in all phases of a university course didactical activity (i.e. course teaching, learning and examination). Starting from this framework, we have designed a collaborative version of it, *EduOntoFrame-2*, which is based on semantic ontology mapping (Oprea, 2016). This paper focuses on some details related to the development of an educational ontology for the course of *Logic Programming* taught to undergraduate students from the Computer Science specialization of a university by using the *EduOntoFrame* general framework, and highlights some issues that need to be covered when using its collaborative version, *EduOntoFrame-2*. A preliminary form of a prototype ontology for the *Logic Programming* course teaching was implemented in Protégé and is described herein.

2 The Methodology for Educational Ontology Development

The methodology that was applied for the *Logic programming* course educational ontology development is based on *EduOntoFrame*, a general framework described in (Oprea, 2013). The framework was designed for a full lifecycle of didactical activities associated to a university course: teaching, learning and examination. Eight ontologies are generated, some of them course dependent and some them course independent. For each course are generated the following core ontologies:

1) Course prerequisite subject ontology (CPS-Onto);
2) Course basic subject ontology (CBS-Onto);
3) Course advanced subject ontology (CAS-Onto);
4) Basic teaching ontology (BT-Onto);
5) Course practical activities ontology (CPA-Onto);
6) Basic learning ontology (BL-Onto);
7) Course examination ontology (CE-Onto);
8) Basic examination ontology (BE-Onto).

Three ontologies are course independent, BT-Onto, BL-Onto and BE-Onto, referring to basic concepts specific to the activities of course teaching, learning and examination. They include general university educational terms, methodological terms, pedagogical terms, psychological terms etc.

Basic teaching concepts

Examples of common terms from BT-Onto are as follows: knowledge resource, teaching model, pedagogical role, teacher competences, teaching style, teaching tools, teaching goals, teaching feedback, course description, course content, educational unit, course presentation, lecture notes, course tutorial, textbook, course references.

Basic learning concepts

Examples of common terms from BL-Onto are as follows: learning model, student model, student competences, learning goals, learning style, student learning feedback, learning object, resource, practical activity, applications, research work, laboratory work, experimental work, learned lessons, learning progress.

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Basic examination concepts

Examples of common terms from BE-Onto are as follows: examination method, computer-assisted examination, written examination, oral examination, written and oral examination, exam, test, assessment, problem, exercise, question, theoretical problem, practical problem, research experiment, student synthesis capacity, student analysis capacity, student research capacity, student problem solving capacity, student examination feedback, student examination result.

Five ontologies are course dependent, CPS-Onto, CBS-Onto, CAS-Onto, CPA-Onto, CE-Onto, referring to basic and advanced concepts of the course, as well as to prerequisite course concepts, used for all three didactical activities: university course teaching, learning and examination.

Therefore, under the *EduOntoFrame* general framework, the educational ontology of a university course, *UnivCourse-Onto*, is composed of three main educational ontologies: CourseTeach-Onto, CourseLearn-Onto and CourseExam-Onto.

UnivCourse-Onto = {CourseTeach-Onto, CourseLearn-Onto, CourseExam-Onto},

where,

CourseTeach-Onto = {CPS-Onto, CBS-Onto, CAS-Onto, BT-Onto},
CourseLearn-Onto = {CPA-Onto, BL-Onto},
CourseExam-Onto = {CE-Onto, BE-Onto}.

The main steps of the methodology that we have used for developing an educational ontology for the course of *Logic programming* are given below.

Methodology
Input: university course (including course specification and resources)
Output: **UnivCourse-Onto**, the educational ontology of the university course

1. Generate or reuse the course-independent ontologies, BT-Onto, BL-Onto, BE-Onto;
2. Select the course prerequisite subjects, generate or reuse the corresponding educational ontologies and generate CPS-Onto;
3. Select the basic and advanced subjects of the course and generate CBS-Onto, CAS-Onto, CPA-Onto and CE-Onto;
4. Generate *UnivCourse-Onto* by integrating all generated ontologies.

The *EduOntoFrame-2* methodology (introduced in (Oprea, 2016)) allows collaborative development of the educational ontologies by using some ontology mapping and merging techniques. The main collaborative sub-phases of the methodology are corresponding to:

- course independent ontologies generation (i.e. by mapping and merging existing ontologies),
- course prerequisite collaborative development (i.e. by mapping and merging ontologies of the prerequisite courses),
- course domain ontology collaborative development (i.e. by mapping and merging different existing educational ontologies of the course with basic and advanced concepts for teaching, learning and examination activities).

The application of the *EduOntoFrame-2* methodology for the development of the *Logic programming* course educational ontology supposes the existence of an educational ontologies set, corresponding to some or all of the eight ontologies generated under the *EduOntoFrame* general framework. The collaborative development of ontologies can improve the quality of the generated educational ontology if it uses some existing ontologies that are agreed by larger academic communities (as e.g. those based on well-known textbooks).

3 A Prototype Ontology for the Logic Programming Course

The course of *Logic programming* is mainly taught to students of the Computer Science and Informatics specializations, at undergraduate level and rarely to other specializations. It is included in the computer programming domain, which contains some basic programming courses: procedural programming, object-oriented programming, and some more specialized courses such as functional programming, event-oriented programming, service-oriented programming, agent-oriented programming etc.

We have designed a preliminary form of a prototype educational ontology for the *Logic programming* course taught at Petroleum-Gas University of Ploiesti by following the guidelines of the *EduOntoFrame* general framework that were synthesized in the methodology presented in the previous section, and we have implemented the resulted ontology in Protégé, a Java-based ontology development tool.

The course specification and main resources of the *Logic programming* course are:
Course specification:

- Course title: *Logic programming*;
- Course level: undergraduate;
- Year of study: third year, second semester;
- Prerequisite courses: *Computer programming*; *Mathematical logic* (basic notions; first-order logic, if not included in the course content); *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:

- (Russel and Norvig, 1995) for First-order logic and Inference in first-order logic;
- (Oprea, 1999) for the basic knowledge of the course taught at the Petroleum-Gas University of Ploiesti;
- (Metakides and Nerode, 1998) for Logic and Programming Logic principles;
- (Konigsberger and de Bruyn, 1990) for Prolog programming language;

Optional textbook and other course source:

- (Bramer, 2013) for Logic programming in Prolog - optional textbook;
- (Brna, 1994) for Logic programming in education - a state of the art;

Course lecture notes:

- PowerPoint slides for 2016-2017 academic year;

Optional course sources (if available):

- a set of educational ontologies for prerequisite courses and the current course;
- a set of course independent educational ontologies (i.e. BT-Onto, BL-Onto, BE-Onto);

Software tools:

- Prolog programming language (e.g. Turbo Prolog, SWI-Prolog, Visual Prolog, LPA Prolog).

The preliminary form of the prototype educational ontology that we have designed include concepts for the following ontologies: CPS-Onto, CBS-Onto and CAS-Onto.

Three courses were considered as prerequisite of the *Logic programming* course: *Computer programming*, *Mathematical logic* and *Data structures and algorithms*. Examples of fundamental concepts from the course prerequisite ontology, CPS-Onto, are:

- (concepts from the *Computer programming* course) - computer program, statement, compound statement, control statement, sequence, decision, selection, iteration, variable, variable domain, constant, data, data structure, input, output, data type, simple data type, compound data type, array, record, structure, file, pointer, list, tree, graph, procedure, function, +procedure parameter, function parameter, parameter transfer, recursion, programming language, procedural programming, declarative programming;
- (concepts from the *Mathematical logic* course) - logic, classical logic, non-classical logic, bivalent logic, sentence, complex sentence, relation, logical expression, propositional logic, first-order logic, clause, Horn clause, term, predicate, predicate expression, function, functional expression, logical operator, conjunction, disjunction, truth table, quantifiers, universal quantifier, existential quantifier, nested quantifier, equality, equivalence, logic syntax, logic semantics, inference, reasoning, implication, validity, inference rule, Modus Ponens rule, resolution;
- (concepts from the *Data structure and algorithms* course) - algorithm, backtracking, sort algorithm, quick sort, binary sort, search algorithm, binary search, data structure, static structure, dynamic structure, list, stack, queue, double linked list, tree, binary tree, graph.

The basic concepts of the *Programming logic* course are included in CBS-Onto ontology and they are based on the fundamental notions of *Mathematical Logic*, which are included in CPS-Onto. Some examples of basic subject concepts are: symbolic logic, logic programming, descriptive programming, logic program, Prolog program, Prolog program section, constants section, domains section, database section, predicates section, global predicates section, global domains section, global database section, clauses section, internal goal section, logic statement, predicate, standard predicate, user defined predicate, Prolog predicate, clause, rule, fact, query, goal, internal goal, external goal, Prolog operator, predicate evaluation, unification, recursion, backtracking, logic operator, inference procedure, programming language, input standard predicate, output standard predicate, Prolog data type, symbol, standard data type, complex data type, Prolog list.

The advanced concepts of the programming logic course are included in CAS-Onto and are referring mainly to notions from the Prolog programming language. Examples of such terms are: backtracking control operator, Prolog file, built-in Prolog predicate for Prolog files, Prolog database, internal data base (synonym: dynamic database), built-in Prolog predicates for Prolog internal database, external database, built-in Prolog predicates for Prolog external database, Prolog object, chain, data base selector, Prolog tree, binary tree, binary tree selector, place, Prolog graph, Prolog module.

The current form of the prototype ontology for the *Logic Programming* course teaching is defined as:

LogicProgramming-TeachingOnto = {CPS-Onto, CBS-Onto, CAS-Onto}

where, BT-Onto was not considered explicitly as part of the prototype ontology.

The ontology implementation was performed in Protégé 4.3 under the OWL format. Each identified concept of the *Logic Programming Teching-Onto* ontology was defined as a class in Protégé. Some screenshots with selection from the class hierarchy of the developed ontology are shown in Figure 1 (Prerequisite concepts, Basic concepts and Advanced concepts).

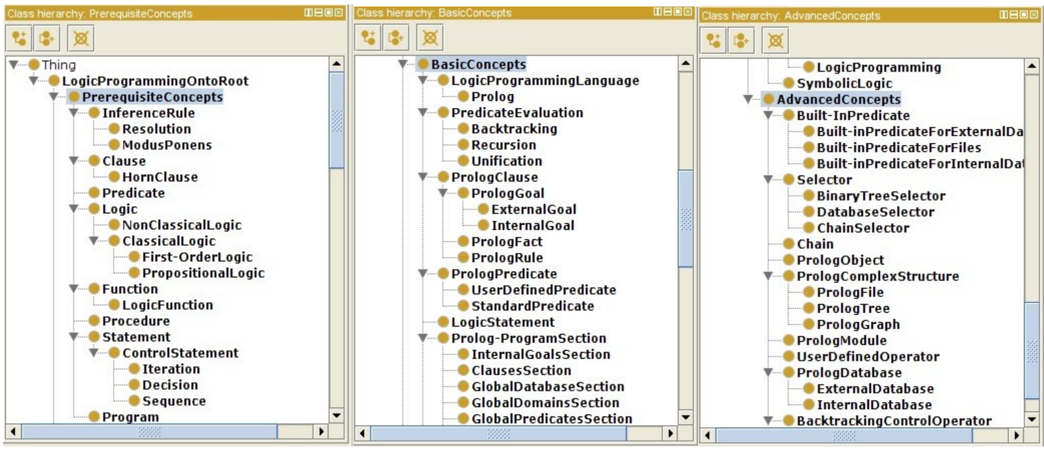

Figure 1. Screenshots with selection of the LogicProgrammingTeaching-Onto prototype ontology class hierarchy

We have defined also 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 *belongsTo*, *hasClause*, *hasInternalGoal*, *hasArity*, *hasName*. These relations allow a more complex interconnection between classes through the inferences performed by the Protégé 4.3 FaCT++ Reasoner. Examples of data properties that were defined are *predicateName* (of string type) and *predicateArity* (of int type).

Figure 2 and Figure 3 show some details related to the *PrologPredicate* class: the definition of the *Prolog predicate* concept which is associated to this class (Figure 2), and some usage of the class under its defined relationships, such as *hasArity*, *hasName*, *SubClassOf* (Figure 3).

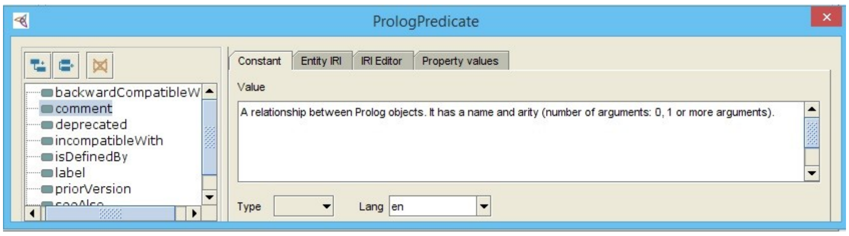

Figure 2. Example of concept definition (*PrologPredicate* class)

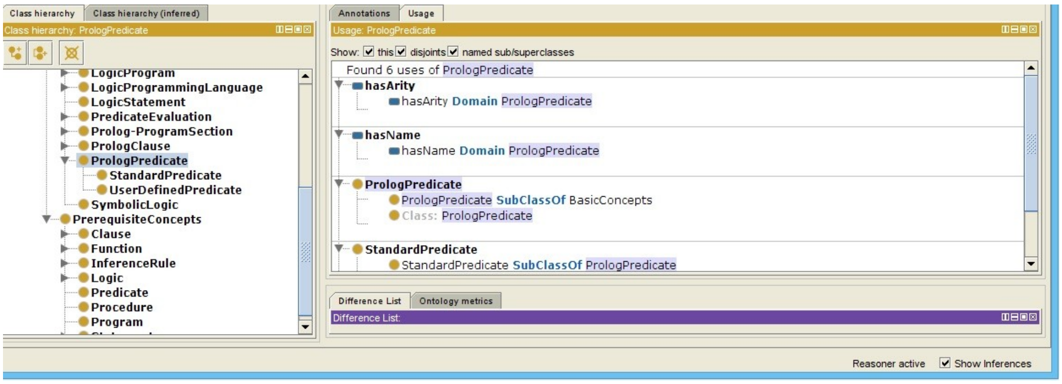

Figure 3. Example of concept usage (*PrologPredicate* class)

In its present form, the *Logic Programming Teaching-Onto* prototype ontology can be used for the course of *Logic programming* as a vocabulary of terms with their definition, and for sharing it with the ontology of the *Artificial intelligence* course, taught at the same specialization, Computer Science.

Conclusion and Future Work

The development of educational ontologies with current semantic technologies provides very useful didactical resources for web-based higher education, in particular. The paper presented some details related to the development of an educational ontology for the course of *Logic programming* taught to undergraduate students of the Computer Science specialization, by following the guidelines of the *EduOntoFrame* general framework. A preliminary form of a prototype ontology implemented in Protégé was also presented.

As a future work we intend to extend the developed ontology with new concepts and to apply a collaborative ontology design approach based on ontology mapping under the *EduOntoFrame-2* methodology.

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Testing applications online using ASP.NET framework

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Abstract

Nowadays, programming has a special role in technology development, so its teaching in our educational system is extremely important. Thus, the students need learning resources and platforms to develop their skills in algorithms' implementation. In this paper we want to present the use of ASP.NET framework and other technologies in creating some platforms for algorithms' implementation and testing, which can be successful used in the process of learning a programming language.

Keywords: programming, online development environment, ASP.NET

1 Introduction

The need for new programmers has become essential in our society, in order to increase our productivity and to ease our lives, but the process of learning computer programming is considered by many people complex and difficult because of the large number of skills they have to achieve.

Although having a teacher or a master is often the easiest way to learn computer programming, the internet brings a lot of resources very helpful in this process, starting from programming languages' documentation, explained algorithms, tutorials, or even interactive learning platforms, where the users can test the algorithms or instructions presented. Therefore, the programming learning becomes easier and interesting due to the benefit of immediate applying of the new learned notions.

ASP.NET is a very useful framework because it allows deploying complex web applications on Windows Server operating system, in which all Windows' abilities can be used naturally, as shown by [2] and [4]. It is a platform which provides powerful tools that can be used to create real-time, interactive applications.

Starting from this, a programming environment can be build using the fact that programs written in different programming languages can be compiled and run using command line, as can be seen in chapter 'Compiling and Linking' from [1]. Many such applications were created, in order to ease the programs' testing, like those from [3], [5] and [6], some of them using the abilities of the ASP.NET framework, such as [8].

This type of online platforms offers the possibility to build useful tools for self-learning, where the users can directly implement and test the described algorithms.

2 Web application structure

The web application has an interface which allows the user to choose the desired programming language, write the code and test it, viewing the syntax errors or the program's execution results in a terminal implemented in the web page.

The application saves the source code and the others files on the server, and then it compiles the program for detecting syntax errors. The compilers and the linkers for each language are located on the server. During the program's running, the terminal sends and receives data interactively from the server, so the user can insert input data this time. This feature makes the application more similar to the usual development environments (IDEs) for offline software building.

Each programming language is identified in the application by its compiler and interpreter, which have associated some commands for compiling and running. Because of this structure, a new language can be easily introduced in the web application.

3 Implementation

The application is organized using MVC (Model – View – Controller) architecture, figure 1, in order to divide the client, data and server code.

The client side, based on HTML and CSS uses JavaScript for instant webpage update and Ajax for sending data to the server without refreshing the page.

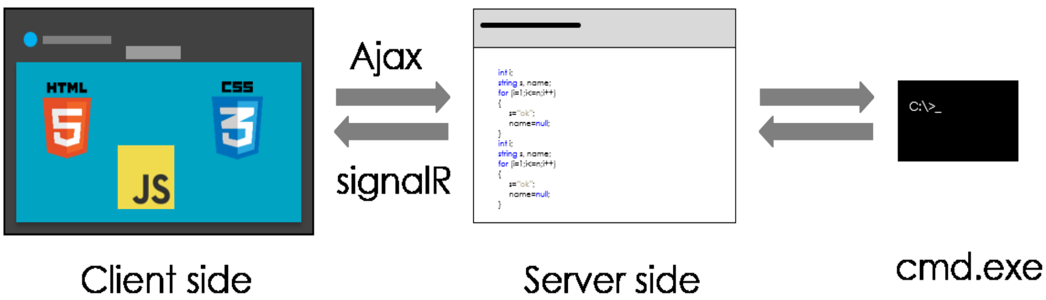

Fig. 1. Model for Application

The server side is implemented in C# using ASP.NET framework, which allows the running of compiling and testing commands through a Command Prompt process (cmd.exe). The commands and data are entered in this process using the StandardInput, and the output data and errors are retrieved from StandardOutput and StandardError. The commands for C and C++ languages can be found in [9]. The C# Controller includes the methods that will be called from the client side when the user starts the program's building and running.

The communication between the two sides of the application is made using a signalR hub, that initializes a real-time connection between the web page terminal and the command line (cmd.exe) which runs on the server. The hub allows the client side of the application to make remote calls to the methods from the server and then to receive the results from the command line. Thus, the user can interactively enter the input data, receiving instantly the output data.

Every user is identified by its connection ID, so the application can be used concurrently by multiple users (the source files are saved on the server with the name main_ID). When a user disconnects, any process assigned to him is interrupted, in order to release the system resources. This action ensures the web application's scalability.

begin

```
Process proc;
string compile, run; //commands for testing the program
string errors; //syntax errors
get_source(); // write the source code in file on the server
proc.Start();  // run cmd.exe
proc.StandardInput.WriteLine(compile);
//compile the code
errors=proc.StandardOutput.ReadToEnd();
if (errors == null)
        proc.StandardInput.WriteLine(run);
//run the program
else
        Write(errors);
proc.Close();
write_output_data();
```

end.

The server side of the application starts the cmd.exe process and associates it the streams for reading and writing. Then, the source file is compiled and the executable is created. The last step is represented by running the program and printing the results in console or in output files. Then, the build process can be repeated.

In figures 2, 3 and 4 are shown some application screenshots.

The picture shows the online development environment. The user can choose the programming language and write the code into the editor. The program can be run afterwards. It can use text files for input or output data, which are automatically refreshed after every program running.

The results written in the terminal during the execution can be seen above. The output files are also updated when the running ends.

The scripts for processing the text files are implemented in AngularJS, using an angular controller to ease getting data and updating the files after execution. Therefore, the user can create any number of files to work with.

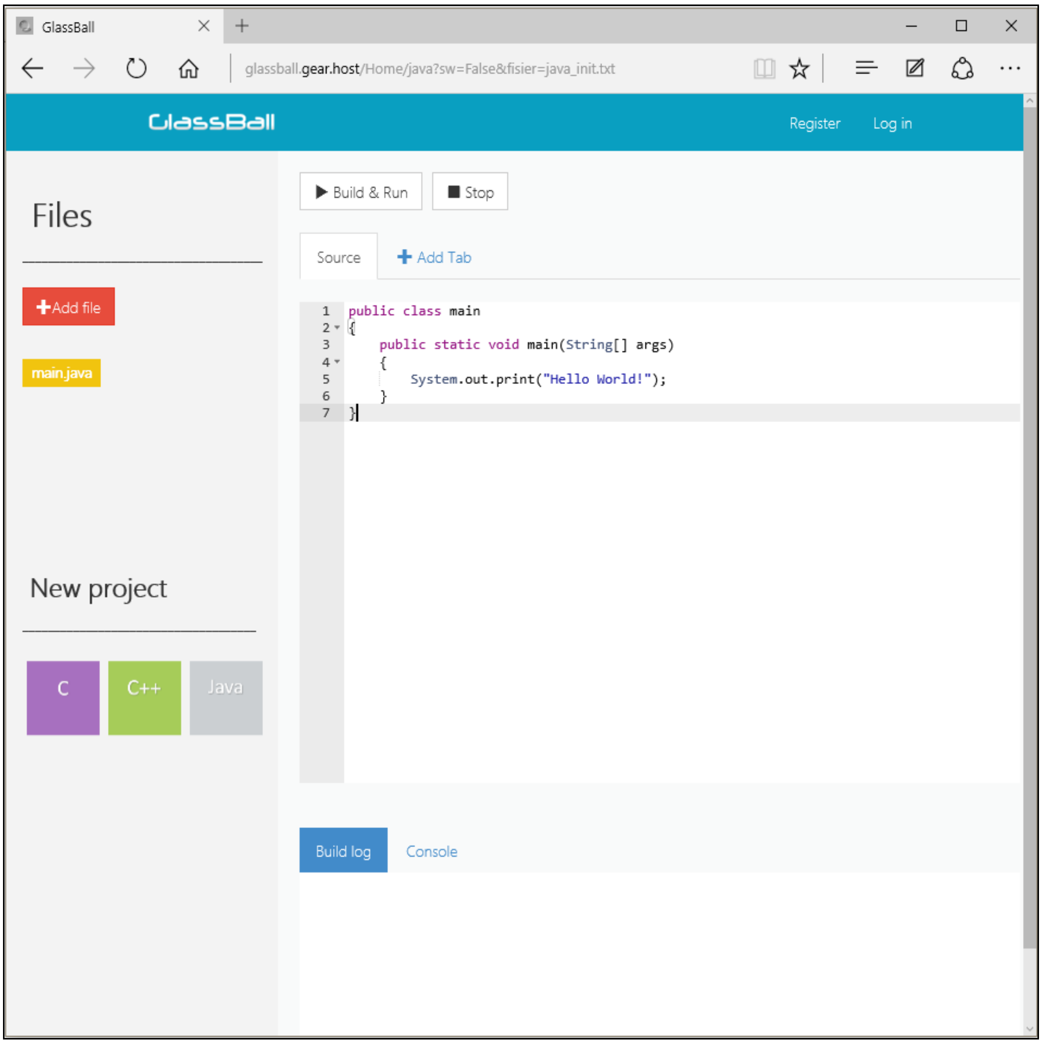

Fig. 2. Example of using Java programs

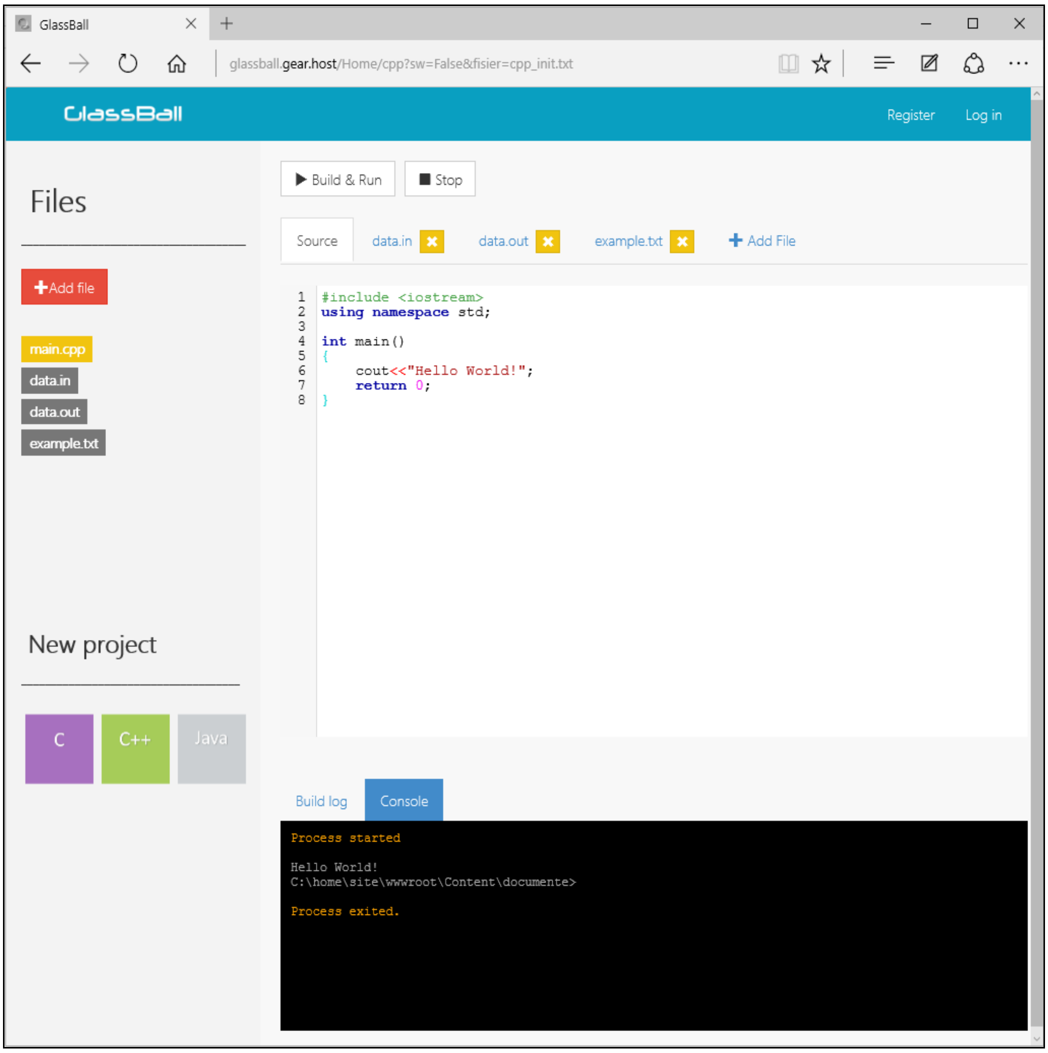

Fig. 3. Example of using C++ programs

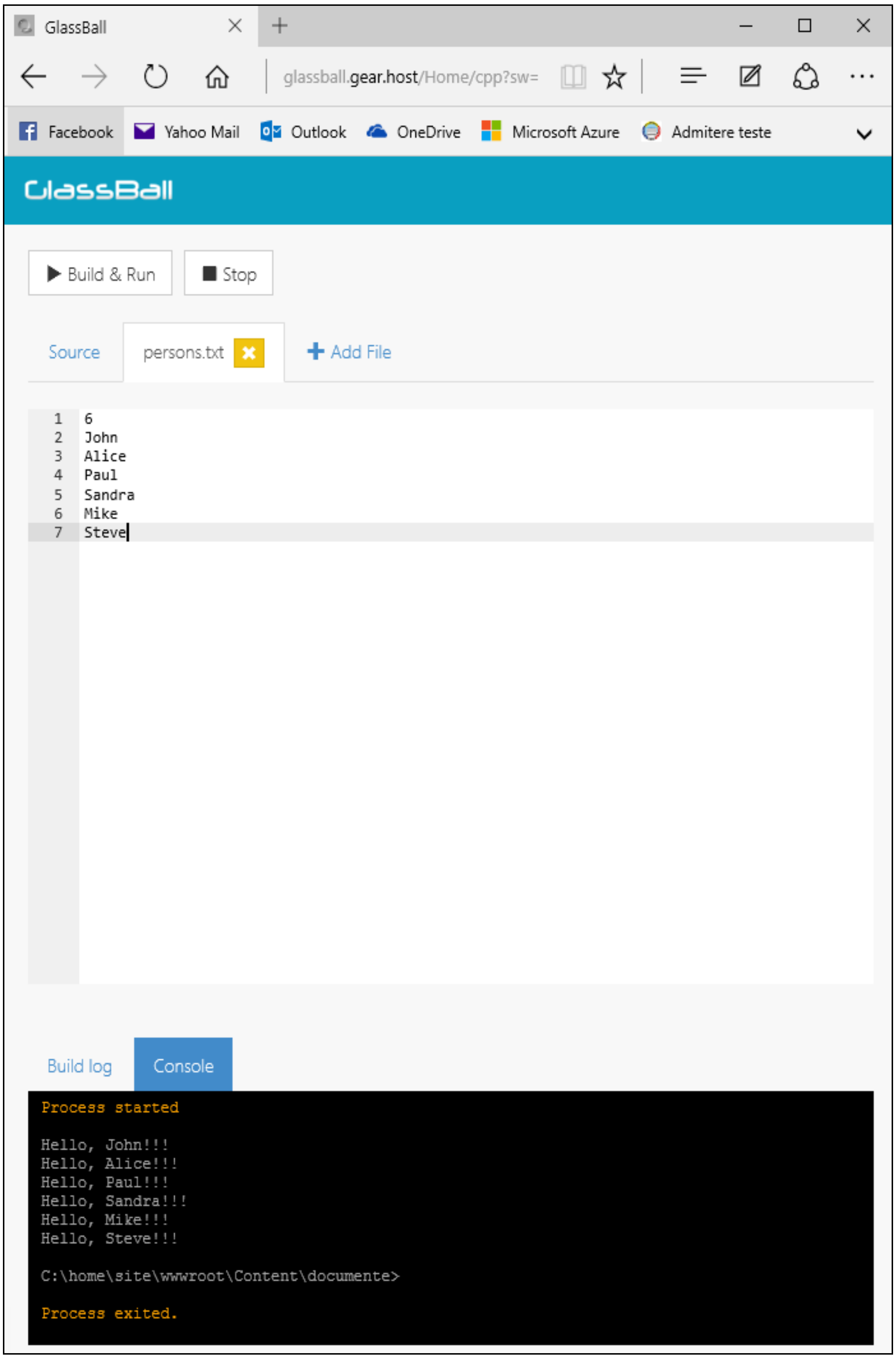

Fig. 4. Using data from text files

The picture above illustrates the use of text files for getting input data.

The time required to perform the tasks involved in the process of compiling and running depends on the system resources available on the hosting server. Therefore, the number of users that can access the platform concurrently is limited.

The execution of the program can be canceled by the user by pressing the Stop button, giving the possibility to kill a program which enters in infinite loop. The process is also killed if the user leaves the webpage.

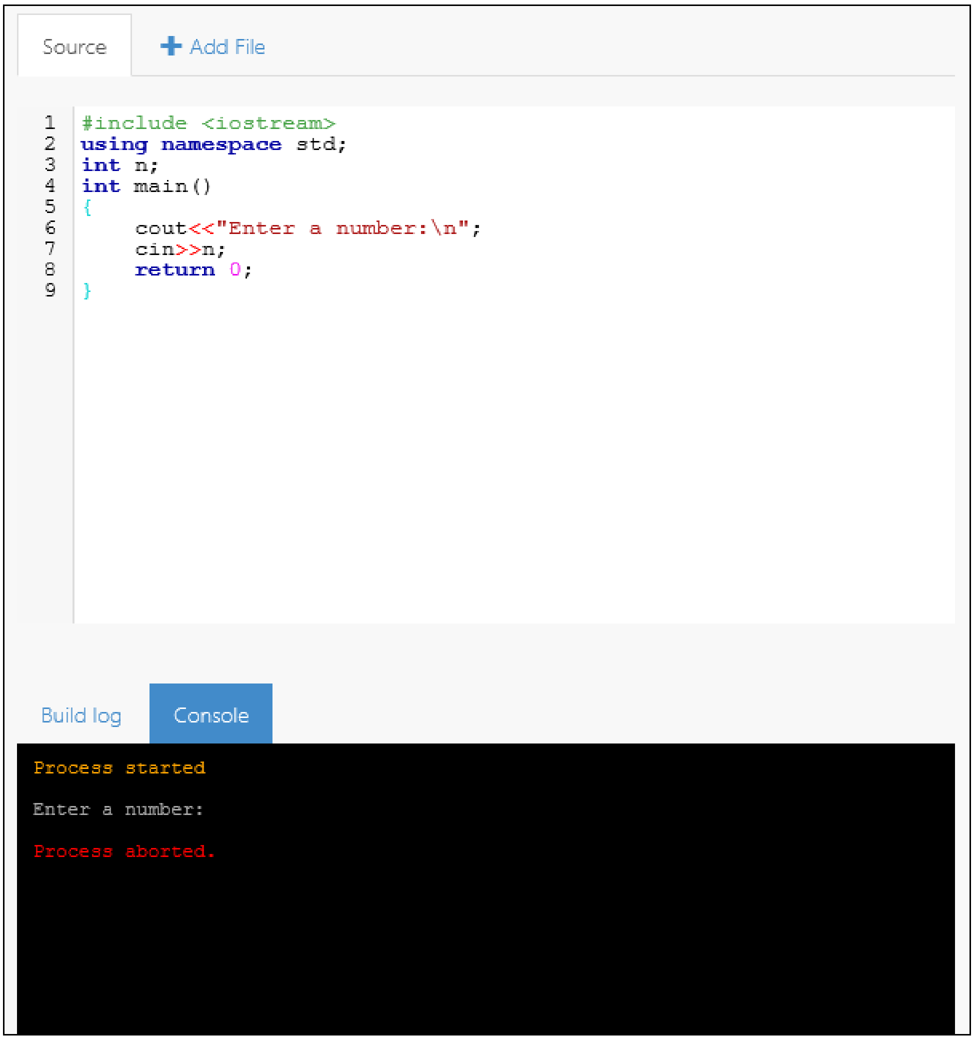

Fig. 5. Aborting a program during its execution

Conclusions

The application we have created based on this paper was built for Pascal, C, C++ and Java, but it can easily be extended to any other programming languages which allow command line compiling. This application represents a tool that can be used free by anyone, accessing the web application's site: http://glassball.gear.host/.

The advantages of this type of web platforms are multiple, starting from the improved accessibility and the reduced system resources needed to use the web application. The platform can be used anytime and anywhere, from any device.

For future work we intend to develop a debugger for the application, using a similar algorithm, as in [7].

Online compilers can be successfully used in educational system by building programming learning environments, but also coding contests, very helpful for improving coding knowledges. An example is represented by [10], a web application for learning some genetic algorithms with integrated testing.

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User Behavior Characteristics for Mobile and Web Applications

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Abstract

The current method of user authentication in the mobile and web applications is by using a username and a password. The same method used fifty years ago. In this paper, we propose a method for identifying the users by their behavior. For that it is necessary to identify the user's behavior characteristics for mobile and web applications, based on a predefined set of features.The analysis of individual behavior has been conducted in multiple areas including human-computer interaction. Researchers have been able to extract different interaction patterns that can be observed for various groups of users. To achieve the proposed objective we identified user types, user classification criteria and user behavior characteristics through analyzing the user response time together with types of controls used in applications. These user-specific properties can be further used to create specific profiles for each user and to identify the users by their behavior profile.

Keywords: characteristics, user behavior, online applications, web applications, mobile applications, interaction patterns

1 Introduction

At national and international level, there are preoccupations about user behavior research in online software applications (Yampolskiy, 2008), (Li, 2013).
For example, because typing the user-password credentials on mobile devices is difficult, we introduce a system that recognizes the user based on his behavior taking into account previous application hits (Shi, 2011). Thus, at each user authentication step, the application is registering certain behavior parameters and, when sufficient data has been collected and the model finalized, the application will compute a score based on both current and previous behavior, as described in Figure 1.
By comparing current behavior from the current session with previous behavior, determined based on previous sessions, we get as result a ranking or compatibility score between the current session behavior and the previous sessions behavior. Depending on the outcome of the algorithm (the compatibility score), we can determine whether or not the user is the right owner of the account.

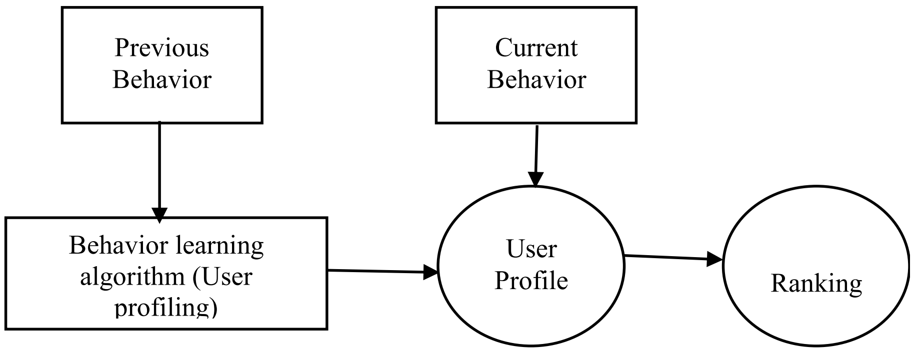

Figure 1. The algorithm structure proposed by Shi, 2011

At the same time, in order to achieve the proposed objectives, we will focus on describing data on user behavior, as data acquisition process is quite easy to implement and it covers all client-software interactions. The information is organized in very large databases, the main idea being to adequately use this information on the basis of static methods to obtain the user profile of mobile and / or web applications, by analyzing the user response times as well as the types of controls used in applications.

2 Types of users

For mobile and web applications we must take into consideration that users:

- are not homogeneous;
- they do exist in large number;
- they require efficiency and fast response from applications.

In Figure 2 we have listed the user types. Users typically do not like reading an application's documentation to learn how to use it. Only a small fraction of them tend to read the documentation. Another part are intuitive users, but the largest number of users are normal users and use online applications naturally.

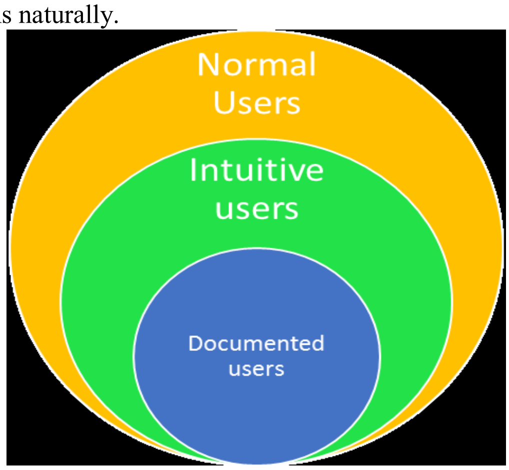

Figure 2. User types by the documented characteristic

For any platform, users are considered to have a single profile, treating non-homogeneous communities as a homogeneous community. This is a false assumption. An online application must correct this and set of users to be considered heterogeneous and consists of homogeneous subsets of users with similar interests, Figure 3.

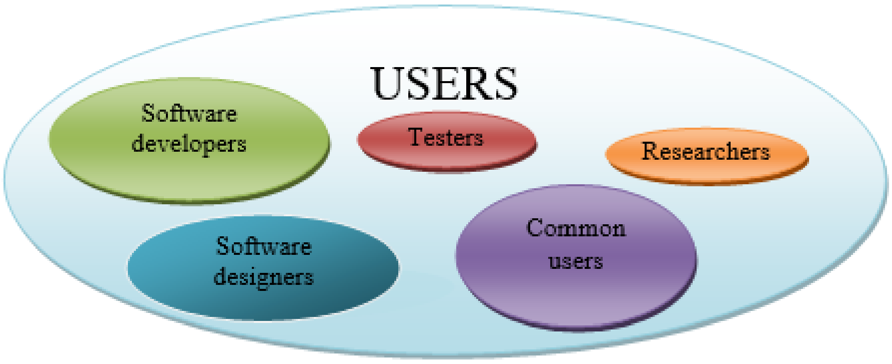

Figure 3. The multitude of users composed of homogeneous subsets

Thus the submultiples that make up the set of users are:

- Software developers, a sub-set of programmer users, who create code-based applications in different programming languages; The subset of software developers is:
  [1] $$ST^D = \{ST_1^D, ST_2^D, ..., ST_{nD}^D\}$$
- Software designers, the sub-set of users who design software applications that develop software implementation specifications; this subset is given by:
  [2] $$ST^P = \{ST_1^P, ST_2^P, ..., ST_{nP}^P\}$$
- Common users, the subset of users who use software, have no knowledge in software development, but have a thorough knowledge of the use of programs; It is defined subset by:
  [3] $$ST^U = \{ST_1^U, ST_2^U, ..., ST_{nU}^U\}$$
- Researchers, the crowd of users inclined to investigate the use of software applications, especially extreme cases or limitations; subset is given by:
  [4] $$ST^C = \{ST_1^C, ST_2^C, ..., ST_{nC}^C\}$$
- Testers, the subset of users who test software products from developers and from which they will go to users; They test software applications following the test specifications and test cases in its design plan; the subset is defined by:
  [5] $$ST^T = \{ST_1^T, ST_2^T, ..., ST_{nT}^T\}.$$

The five subparts are defined for the total set of web application users. Each category of users view the web application from a different perspective.
The web user browsing behavior can be described by three kinds of data: the web site structure, the web page content and the web user session.
In [4] it is presented how the interface and the context factors have also an influence of user characteristics of web navigation behavior.
For this reason, users have a well-established behavior that they use to interact with all the applications they come into contact with. Thus, if a user's behavior is analyzed, we can create a user profile which can be used widely by the applications.

3 Identified user's behavior characteristics

3.1 Behavior characteristics for web applications

The user profiles must be established based on a predefined set of features. For web applications, are considered a set of behavior characteristics, presented in Table 1:

Table 1. Behavior characteristics for web applications

Nr.	Shortcut	Characteristic
1	**NrLCE**	the number of left clicks executed
2	**NrLCnF**	the number of left clicks with no functionality
3	**NrRC**	the number of right clicks
4	**AoMP**	the area where the user holds/parks the mouse pointer
5	**SM**	the method of scrolling
6	**SS**	the speed of scrolling
7	**TS**	text typing speed
8	**KPT**	the time the user holds a pressed key on the keyboard
9	**RT**	time of reaction/reading
10	**DTM**	the method of deleting typed text
11	**STM**	the method of selecting the text
12	**CTM**	the method of copying or cutting the text
13	**CLM**	the method of capitalizing the letters
14	**CKU**	which control keys are used
15	**BM**	browsing method

The number of left clicks executed within the application for pressing control buttons or hyperlinks over a time frame; this feature is influenced by how the application is implemented; so if the application requires pressing many control buttons, then the values of this indicator will be very high;

The number of left clicks within the app, but with no fallback functionality (not pressing any control buttons or hyperlinks); many users, while reading, are habitually using the mouse and do left-clicking, selecting the text they read, or simply highlighting the cursor on the screen;

The number of right clicks in the app for using the contextual menu;

The area where the user holds/parks the mouse pointer when not using the mouse; to determine this feature, it is preferable to divide the entire application area into well-defined number of sectors and relate to these areas instead of pixels; this way, the memory used for retaining these data is minimal; segmentation across sectors varies from one application to another and is defined according to the requirements of each application;

The method of scrolling a web page with a lot of text; a user may have preference for one of these methods:

- by using the mouse scroll wheel; this is a specific method and more practical to users who use the mouse intensively;
- by using the VerticalScroll of the page (the right side scrolling bar);
- by using PageDown and PageUp control buttons; this is specific to users that make use of the keyboard and have a preference for scrolling the page by large segments; this method is used by users when reading large texts and they need to scroll more paragraphs at once;

- by using Up and Down controll buttons to scroll one paragraph after another, which is similar to PageDown and PageUp method, but less sensitive;

The speed of scrolling the web page; this feature is influenced by the reader's rapidity, so the user is characterized directly by a personal feature; this feature is influenced by the content of the page and the information presented on the page;

Text typing speed is a very important feature but is only applicable when the user has to enter text; it is important to note that the user has to type a lot of text in order to have an accurate profile based on this feature [5];

The time the user holds a pressed key on the keyboard (in milliseconds); this feature is directly influenced by the typing speed, so an user who has a very high typing speed will hold down the key for less time; also, this keystroke time analysis can be extended to tracking each key as long as it is pressed; that is, the keys are held down by the finger used to press that key, and each finger has an average pressing time; the application cannot determine with which finger the user has used, but by computing the average time of holding down each key, we can determine which finger is used for key groups; the keystroke time is also influenced by the distance between the key and the finger use to press the key; for examples, for the left hand index finger, keystroking J key will take longer than keystroking F key, since J key is further away from the left hand index finger position;

Time of reaction/reading is the time elapsed from the time a question is displayed until the question is answered; this feature is greatly influenced by the question the user needs to answer and the way it is presented; this feature only applies when there are user interaction questions in the application, but these questions might not exist within each session, so it will be very difficult to achieve an exact profile based on these measurements;

The method of deleting typed text; there are several ways to delete, and each user has a favorite mode:

- by using the DELETE key, some users prefer to position the cursor at the beginning of the word and by using the DELETE key to delete that word;
- by using the BackSpace key, some users prefer to position the cursor at the end of the word and use the BackSpace key to delete that word;
- by selecting the word to be deleted, right-clicking the mouse, then selecting the delete option from the context menu;
- by selecting the word to be deleted and using the DELETE key or the BackSpace key to delete the entire word.

The method of selecting the text; text selection can be done with the mouse or with the SHIFT + LEFT / RIGHT keys; this feature depends on user type: users who prefer the mouse or users who prefer the keyboard;

The method of copying or cutting the text from web pages which can be one of the following:

- select the text and use the shortcuts Ctrl + C, Ctrl + X to copy it;
- select the text and use the right-click contextual menu;

This feature is also influenced by the type of users using the keyboard or mouse to interact with online applications.

The method of capitalizing the letters which can be done:

- by pressing the CapsLock key before pressing the key for the letter to be capitalized, and reapplying the CapsLock key after pressing the desired key to return to the non-capitalized letters;
- by pressing the SHIFT key once you press the key for the letter to be capitalized;

- by writing normally (non-capitalized) and capitalizing the desired characters after entering the entire text;

Which control keys (SHIFT, ALT, CTRL) are used, the left or the right keys on the keyboard; each user uses these keys depending on whether they are right or left-handed; so if you use a left-hand key then the left-hand control keys will be used; If a right-hand key is used then the control key used is on the right side;

Browsing method within the application; for example, when using a web browser, some users prefer the BACK button of the browser, while others prefer using keyboard combination ALT + BackSpace to return to a previous visited web page;

3.2 Behavior characteristics for mobile web applications

For web-enabled mobile applications, you can consider the features of traditional web applications, but also other features specific to mobile devices [6]. When users use smartphones, the smartphones sense the users' finger movements and interpret the sensed data as different gestures [7].

Table 2. Behavior characteristics for mobile applications

Nr.	Shortcut	Characteristic
1	**TS**	Typing speed
2	**CAT**	The area covered when typing
3	**KT**	Keystroke time
4	**HVK**	The method of hiding the virtual keyboard
5	**ATS**	The area where the screen is tapped to scroll a page or text
6	**RZR**	The zoom factor required to read a text
7	**TM**	The method of typing
8	**MDR**	The way that the user holds the mobile device when he reads
9	**MDW**	The way that the user holds the mobile device when he writes

Typing speed which is significantly different typing speed from a computer keyboard;

The area covered when typing; each user has a way of tapping on the screen of the mobile device, depending on the size of the user's fingers;

Keystroke time on the virtual keyboard which is similar to a computer keyboard;

The method of hiding the virtual keyboard when it is no longer needed which can be done by the touching the screen outside the keyboard in the application or by using the virtual keyboard drop-down or minimize control button;

The area where the screen is tapped to scroll a page or text; similar to determining the area where the user holds the cursor, the mobile device screen is divided into several sectors by saving the sector used to scroll the page content within the application;

The zoom factor required to read a text; each user prefers a certain degree of text magnification so that he can efficiently read the text displayed by the application and as comfortable as possible;

The method of typing; the user can use a single finger, use two fingers from two hands, or use more fingers to execute keystrokes on the virtual keyboard; this method only applies to users using virtual keyboard devices; for other devices, like it is the case with physical keyboards, this method cannot be applied;

The way that the user holds the mobile device when he reads: landscape or portrait;

The way that the user holds the mobile device when he writes: landscape or portrait.

All these features must be measured for all users of the online application and based on them, each user profile should be created.

Conclusions

Within this article we have done an analysis of the current state in the domain of authentication within mobile and web application.

Research has been conducted on how users interact within applications and, based on these methods of interactions, users can be grouped in clusters. The analysis has determined how users interact with mobile and web applications.

In future research we will create models for determining the user profile based on the features identified in this material, as well as identifying user patterns based on behavior characteristics and the measurements made for the identified features.

Acknowledgment

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Computer use in speech pathology practice. Synthesis Report of TIMLOGORO project

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Abstract

The authors present the current status of a Romanian project, in the field of computer-assisted speech therapy, in order to disseminate some actions and results in a structured manner. The whole project follows a few successive stages: documentation, research, resource design/developing and a testing process. Project partners, Ascendia SA, Faculty of Psychology and Sciences of Education, University of Bucharest and „Vasile Alecsandri" University of Bacău, offer, through an interactive platform, a complex framework for learning to those categories of speech impaired users, both children and adults with cerebrovascular accident. The future receivers of the project benefits will be speech therapists, parents, educators and/or teachers, psychologists etc.

Keywords: computer-assisted speech therapy, interactive platform, speech pathology.

1.A conceptual phase. Literature review

In a first stage of the project, the specialists have gathered information about the subject, describing the current level of knowledge in CASLT (computer-assisted speech therapy), applied to the project "*Multiplatform Technologies with Interactive Applications in Romanian for Speech Therapy"*. The use of technology in speech therapy contributes to new educational resources design, which should bring new ways of action or changing the traditional relationship with the speech therapist. This can enrich the quality of the therapy, so technology become a tool for innovation (Tezci, 2009). The most popular terms illustrating this concept are: CBST (*Computer Based Speech Training*), CAMST (*Methods of computer assisted therapy*), CASLT (*Computer assisted therapy*) (Griessl, Stachowiak, 1994). All specialists have included in their activities: the internet, applications and digital programs, interactive platforms, through online therapy or mobile applications on the phones.

The benefits of multimedia learning environments are reflected in many educational studies (Toki & Pange, 2010). In a large number, empirical studies confirm the success of digital learning in language pathology (Simpson et al., 2004, Skau & Cascella, 2006, Thorp, 2007, Sansosti et al., 2008; Rayner et al. et al., 2010; Mayer, 2009). The speech therapy based on computer is not a known trend in Romania.

2.An empirical phase. Research actions

2.1. Technology use in speech therapy

In the beginning of the project, the experts from University of Bucharest analyzed the need for the technology in language therapy. They discovered that technology used in speech therapy in

Romania is really poor. A first research showed opinions related to the weak technology use in language therapies, but also the best qualities for an efficient platform etc. The needs' analysis was realized applying a questionnaire on 157 respondents connected to this field. Over 70% think that speech therapy can be accomplished effectively through *the blended learning style*.

This research registered the perceptions of a group of students and practitioners with different experience in the field of speech therapy about: the high-frequency forms of technology use, difficulties encountered, the level of digital skills of the users. The difficulty in using speech technology was one of the goals of the investigation: there are insufficient funds for the purchase of software-63%; there are no adequate resources market – 20 %; access to computers and the Internet is limited -11%; speech therapists and students have no digital skills – 3%.

The experience of subjects is relevant for these conclusions. According to respondents, some weaknesses of technology in speech therapy are revealed: computer addiction, absence of emotional support, fatigue, lack of spontaneous communication, incomplete feedback, algorithmizing. To produce beneficial effects, the platforms must have some characteristics. In this study, respondents classify a number of features in order of their relevance: exercises to address specific language disorder; applications to be attractive and stimulating the game; exercises have different levels of difficulty; to provide individualized support; provide prompt feedback. Creating multimedia material involves the combination of scientific content, speech methods and tools. The most commonly are: interactive games, audio for 62.2%. Simulations and animations are an option for 7.7%. These are known for their interactive feature, being motivational parts of the games. We requested respondents a few suggestions for improving speech therapy. First option, over 43% refers to the *gaining of resources in the centres and in schools*. Also, it is important the use of technology in the initial training of speech therapists (27%). Other recommendations are addressed to software firms for *creating the new resources* (11%) and *spreading positive practices* (9%). Another point is a request *for a national database* (10%).
According to all these data, the technology is an effective tool in speech therapy. Even with its popularity, there are not enough resources to show its usefulness in Romania. There are only a few top practices that can help to create a new methodology in speech disorders. TIMLOGORO is one of them.

2.2. Training with ICT support

A training built on ICT solutions represents also an extended aria of our research. The topics revealed the significant features of training in speech therapy, from the viewpoint of young specialists. Based on academics, this analysis was done to show the following: e-skills competences, the impact of technology in training; customs of use technology among users; the awareness with the technology; the best solution for an activity; the degree to which scholars could benefit from CAI. All practicioners know the value of techology in speech therapy and promote some resources.
A solution should be *a curricula based on tehnology use*. Various platforms, but not many, are addressed to different communication skills difficulties. Over 25% from respondents talk about 1 or 2 online platform, met at random in daily activity. A possible reason could be even the small number of such platforms on the market or limited access to computer and Internet. Such a statistic should be considered a critical signal for designers.

In speech therapy, the technology is popular especially in *diagnostics and testing of speech skills*. *Online testing* begins to grow the interest of practitioners. Survey participants confirm the usefulness of technology in training, especially for blended learning system. Blended learning is one of the most recent ideas of pedagogy, although it was less spread. Based on the study findings, we promoted some useful recommendations: various equipment and resources, the computer insertion in the academic curriculum, good examples of integrating digital resources in speech therapy, a national database with various e-learning platforms in the field, a continuous innovation in academic training.

2.4. Satisfaction of using technology

Another research was centred on the correlation between emotional intelligence and the satisfaction of using technology by specialists in speech therapy. It was interesting to find some differences between specialists and students in terms of satisfaction in using technology in speech therapy activities. The questionnaire *Emotional Intelligence* realized by Paul Mohapel, a professor at the University of San Diego, was built on four aspects: *emotional awareness, emotional management, socio-emotional awareness and relationship management*. Each dimension is constructed of 10-choice items on scale Lickert of 1 to 5. The participants in this study were 60 subjects, including 30 specialists in speech therapy from Centre Bucharest Resource and Educational Assistance and 30 students in the second year of study from studies master in speech therapy at the Faculty of Psychology and Education Sciences, University of Bucharest. Participants were selected randomly. As regards the level of emotional intelligence, experts *find a higher score for the students to master compared with specialists* for the four areas covered in the questionnaire. Was identified a high score for emotional awareness and relationship management, and the lowest score was recorded on the socio-emotional awareness.

2.5. Child's language development

Two focus-group sessions with preschool teachers were organized at university to show the value of current methods in the language development. Focus group objectives were: to list the most common difficulties that teachers encounter in language education; to identify the most frequent children's difficulties; to describe the family involvement for the children with speech difficulties; to list ways of intervention. Themes discussed were various: aspects of the verbal behaviour of children with speech difficulties, children's socialization methods, technology use in the classroom, intervention strategies. It was interesting to find the most useful approaches. The language is an instrument of children's development which offers prospects for communication. The game is highlighted as the most effective method of reducing vulnerable verbal behaviors in its social variant. The technology is a popular idea in the education. As it emerges from the discussion, teachers need more resources in addressing speech difficulties, including digital resources. Interactive platforms such as TIMLOGORO would be extremely useful tools for the teachers. During discussion, all teachers mentioned that this can cause significant changes in the acquisition of language. After only a few learning experiences, they see the impact that virtual games and speech exercises have on correct expression and vocabulary.

Speech exercises can be used in different activities. These are based on narrative data that have allowed children to adopt good communication strategies. Teachers selects interdisciplinary applications, for example: „Letters", "Spring", "Autumn" „Colours and forms", „Rex", „Piti-Clic" CD collection, „Animated alphabet".

In the teacher's opinion, educational software can have many benefits: individualized training, effective feedback on child progress and attractivity through pictures, animation and sound. There is also some feebleness. The children should not be „forgotten", using electronic devices, they must be assisted by their parents. Depending on age, the time spent causes tiredness or low concentration at school.

3.A pragmatic phase. Platform design and developing

The purpose of the project's experts was to design modules with the support of digital games, under the supervision of a specialized avatar. TIMLOGORO platform covers the following: *Modules* - module view/selection; Specialists - Therapist data, project partners; My Account -

subscriptions for distinct type of user: classical student, specialist, private cabinet /institution; About Us - useful information; Subscriptions - the place of the project website (http://timlogoro.ro/)

Figure 1. TIMLOGORO site

Platform design has an interactive sustenance through sound, image and gesture. The user, child or adult, will use a diversity of vocal, auditory, kinesthetic stimulus. The organization of the platform is defined by a map with a modular construction. The feedback is a vital division of language exercises. Sensitive actions encourage users, especially children through color and movement.

The avatar, so-called TIMLOGORO, is expressly settled for speech therapy: has a good graphic, his posts are comprehensive. The dynamics is sustained by mouth movements, synchronized with the sound, based on phonemes and fluent, natural movements of the body. The design implied a few actions related to the interactive platform, the virtual avatar, the scientific content of the program, digital games, and the project website. *The avatar* has emotional self-expression. In order to generate the avatar, 2D Canvas Technique was used. For the children, the avatar presents a story, the peoples and the aims. For the adults, the avatar shows the learning objectives. In both children the adult unit, the avatar offers to the user data about: navigation on the platform, feedback for the locked buttons, a guide when the user selects an advanced step; e-Content (input/story for each module, work tasks for each activity, final feedback of an activity, unit or the entire module). During navigation, the avatar is placed in the center, talking with the user giving him needed instructions. For the units or application selections, the avatar will move in the frame or in corner, providing continuous feedback. The avatar may leave and come back only when needed. In *General Exercise* section, the avatar shows how can be performed every type of exercise.

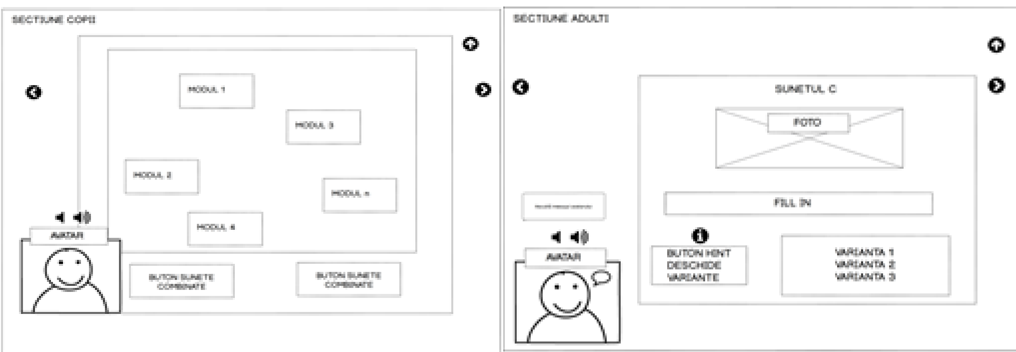

Figure 2. Module configuration

From My account, the learner can see the following components:
- *Account details* - the user can change personal details;
- *Subscription* - refers to the details of the purchased subscription;
- *Module status* - refers to the progress on the module;
- *Specialist* - is the specialist assigned to the learner. If the student has not assigned a specialist, a "Contact" button will be present instead of the name. By clicking on this button, the learner will be taken to the "Specialists'" section.
- *Extensive Specialist Notifications* - this section can also be accessed by clicking on the notification button on the main menu bar.
- *Specialist recommendations* - If the specialist has made a recommendation.

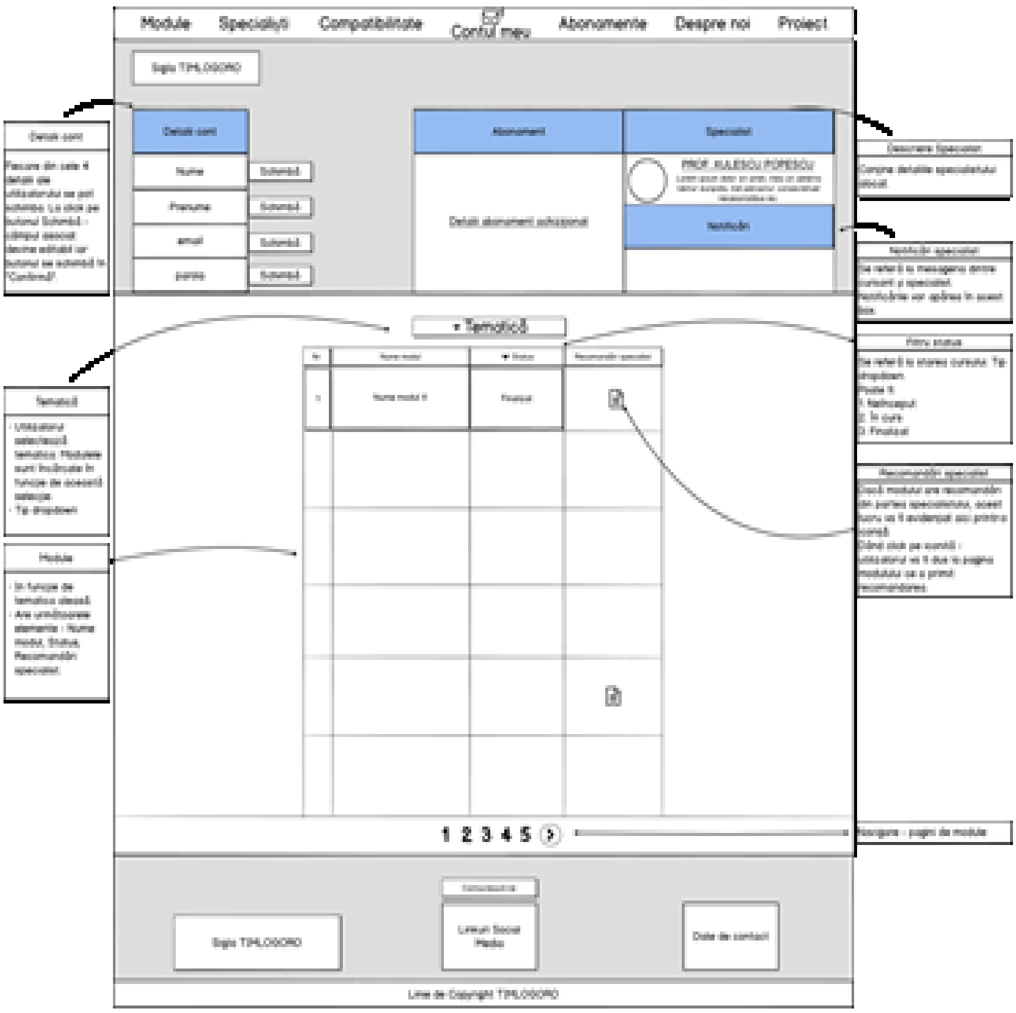

Figure 3. *My account* Section

3. Follow-Up

The follow-up is related to the future use of TIMLOGORO by different institutions: schools, kindergartens and recovery centers in Romania. A final action is testing and validating the avatar, the digital game and modules. This platform can be used both in therapy meetings and in the form of home exercises, so it can be opened from any device, computer, or mobile phone. TIMLOGORO could become a cohesive and practical system. The authors intend to fit in the TMLOGORO platform in the entire speech therapy system.

Acknowledgment
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A Flexible Method to Teach Astronomy using Virtual Lab Approach and Real Data

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Abstract

Astronomy holds a special place in the history of the sciences and is recognized as one of the oldest sciences, which has undergone considerable new developments due to space scientific research in astrometry and astrophysics nowadays. The present study focuses on describing the students' practical skills, scientific analysis and interpretation of real-world astrometry data using E-Learning concepts and specific teaching methods of a virtual classroom. The paper is based on the stages of didactic research methodology (preliminary analysis, realization, posteriori development and analysis) according to the didactic principles. This approach has been used to generate and improve modules that include virtual training lessons in astrometry, dedicated to students and future teachers.

Keywords: Astronomy, Astrometry, Virtual Lab

1 Introduction

Astronomy is undoubtedly the oldest of sciences, being considered the science of heaven which has always enchanted people. Synonymous with fascination and mystery, this science is, perhaps more than any other, a source of curiosity and fun for scholars and students.

However, the study of the stars is little taught in school. This paradox can be explained partly by the fact that astronomy is often perceived as too complex by teachers in schools.

In fact, scientific education has too few objectives in terms of \"know-how\" that are essential for the understanding of the phenomena studied (Giordan and De Vecchi 1994). The place of experimentation and practical application is often reduced in favor of learning encyclopedic knowledge.

In astronomy, phenomena should generally be observed over long periods (several days or even weeks depending on the subject of the study) and sometimes at night. These conditions can create difficulties that are not necessarily insurmountable. But the essential feature of astronomy lies in the impossibility to experiment on the real, which forbids any experimental reproduction in the laboratory of the phenomena studied and the objects studied.

Therefore, we are forced to put into practice other methods of approaching this scientific field, characteristic methods of virtual laboratories based on the modeling and simulation of the studied phenomenon. These two stages complement the observations and documentation.

The purpose of the study presented in this paper was to identify and to implement the most appropriates methods for teaching and learning astrometry (the part of the astronomy that refers to the identification and determination of the locations of various celestial bodies) in high school, using flexible teaching methods and the advantages of the modeling and simulation of a virtual laboratory.

The study was accomplished by experimenting with simple astronomy teaching modules for high school students on a group of students in the final year of the preparation of future teachers of science. The goal was to test and separate the various ways of introducing and fixation of the main notions of astrometry, from the constellation recognition to the use of the virtual planetarium, in order to identify and determine the correct positions of the asteroids captured in the real pictures taken by a big telescope.

2. Preliminary analysis: the identification of the main objectives of the astronomy formation at the high school level

The interest shown by students of all ages for astronomy derives from the fact that astronomy is a science that submits imagination to vast expanse of space in time and space, while offering spectacles of great beauty. The interest of both young people and adults is naturally related to recent discoveries about the Universe and is often accompanied by metaphysical questions. This interest is manifested through a questionnaire centered on several emblematic elements that are often difficult to popularize, such as black holes, supernovae or big-bang (Merle and Girault 2003).

The interdisciplinary character of teaching astronomy is often highlighted by the spectacular effects of recent discovery. The main objective of training in this area at the school level, but should focus on to the link between the various scientific domains indissoluble that contribute to the advancement of knowledge of the Universe, the first being the mathematics and physics.

Adoption of mathematical notions such as spherical coordinates, or scientific approach to physics through its traditional stages (observation, modeling, experimentation, analysis) are also easy targets to be attained in the context of the lessons of positional astronomy. Among the skills targeted by teaching high school in astronomy we have identified the categories

1. The skills for position recognition of astronomical objects (identification of North Pole position, the constellations, the ecliptic)
2. The use of sky modeling software tools (virtual planetariums)
3. The use of simulation to determine the probable position of a celestial object in the near future,
4. Correct identification and retrieval of heavenly objects, invisible with the naked eye, using real-world data and software utilities specific to astronomy.

3. The methodical experiment

The methodical experiment of introduction of astrometry was concerted by direct testing of a number of teaching-learning techniques on a group of students and was materialized in a number of graduated positional astronomy lessons, alternated with activities of individual study and testing of knowledge, controlled by the trainer via a virtual connection with the learners. The teaching modules used are described in the following sections.

3.1 First step: Identification of the constellations

The module aimed at studying of the night sky, the eye-observation techniques, the understanding and the use of a celestial map. The following direction of the module was defined by the common conceptual elaboration of the notions of *constellation* in the field of astronomy and the *'level of formulation'* in terms of didactics of science.

In astronomy, the concept of constellation is essential. It is used to locate a space object of the celestial vault without using a spherical coordinate system. Thus, the position of any heavenly object is given in relation to the celestial constellation in which it is located (visible Stars are named using the Greek letter and the name of the constellation in which it arises).

In the didactic field, a " level of formulation " is defined as a statement considered to be scientifically acceptable at some point in building a concept by a learner. A learning sequence always involves conceptual development. For a given concept, its wording varies according to the level of education so that it becomes accessible to students.

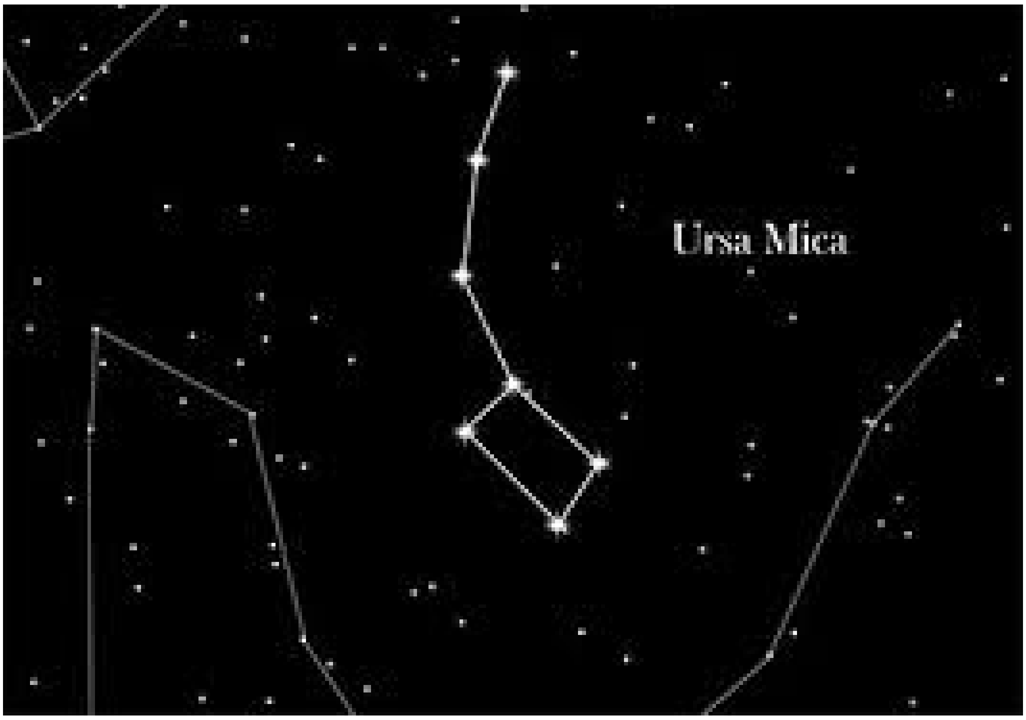

Figure 1.Ursa Minor and Polaris

For example, a constellation can be defined as "a group of stars that connected arbitrarily imaginary lines, forming the sky an easy to remember which is assigned a name". Students were asked to identify a number of imaginary reasons (pattern) in images of the sky (see Figure 1).

At the conceptually more elaborate scientific level, the definition of a constellation is ”An area of the celestial sphere, the precise limits of which were defined in 1930 by the International Astronomical Union, around the figures identified by ancient civilizations”. The heavenly sphere is divided into 88 constellations, whose official names are Latin (Ursa Major for Great Bear). Any region of the sky belongs to a constellation.

Students were presented at this stage the Stellarium software tool, which allows the users to virtually access any part of the sky and identify the positions of stars and constellations in real time or at any other time in the past or the future.

Figure 2. Capture from Stelalarium planetarium tool

Using Stellarium (Figure 2), some methods of fast identification of the positions of more well-known stars from the boreal sky (Altair, Vega, Polaris) and the identification of the visible planets at one time could be tested. Students were asked to recognize a particular configuration in the real sky after they searched for it on the virtual map and to suggest exercises to stimulate students' interest in using the presented utility.

3.2 Second Step: Introduction of the sferical coordinates

The more mathematized module of teaching the celestial coordinate systems (equatorial, ecliptic) has been implemented through classical teaching methods. The equatorial coordinates are the *right ascension* (the horizontal angle determined by the heavenly object and a fixed direction, convectionally determined by the position of the Sun at noon at the spring equinox) and the *declination* (the vertical angle under which the heavenly body is seen against the celestial equator).

The shift from the classical coordinates, which have as reference the Earth's rotation motion (equatorial coordinates) to those used in observational astronomy (ecliptic coordinates), which have as reference the Earth revolution's plan, around the Sun, is not a simple passage , producing difficulties of orientation for pupils, although mathematical formulas are accessible to high school students with minimal knowledge of trigonometry.

Again, Stellarium software, which allows visualization of both coordinate systems, has proven its practical utility..

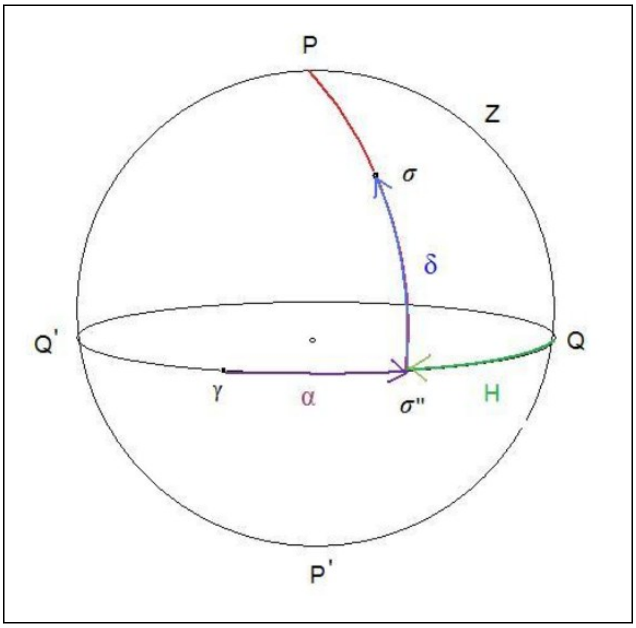

Figure 3. Equatorial coordinates (Right ascension α and Declination δ)

3.3 Third Step: Identification of stars from real astronomical pictures

The last step in our experimental approach was to identify visible objects in real-life photographs taken by a telescope. Popular photos packages have been put at our disposal by the Romanian astronomer Ovidiu Văduvescu from INT (Isaac Newton Group of Telescopes, La Palma, Spain) in the framework of a research-led approach under the aegis of the project *Euronear* (see the Web page of the project in the References).

The photos captured by a telescope's CCD camera are saved in a *Flexible Image Transport System* (*FITS*) format that allows the storage of some meta-data package, such as size of the image, origin, coordinates, binary data format, free-form comments and history of the data.

To process these images, students worked individually, each on different packages of photos, using the SAO Image DS9 utility (Figure 4). The stated purpose of the exercises was to correctly identify the more visible stars in the images and place them on the map of the sky, simulated with the Stellarium. The didactic approach was based on the use of the discovery as a didactic method, checking the results obtained at the end.

The method used at this stage was a flexible learning, unconditionated strictly in time, running over a week and aimed at testing the individual learners' capacities to adapt to this approach, more specific to the scientific research than the educational activities.

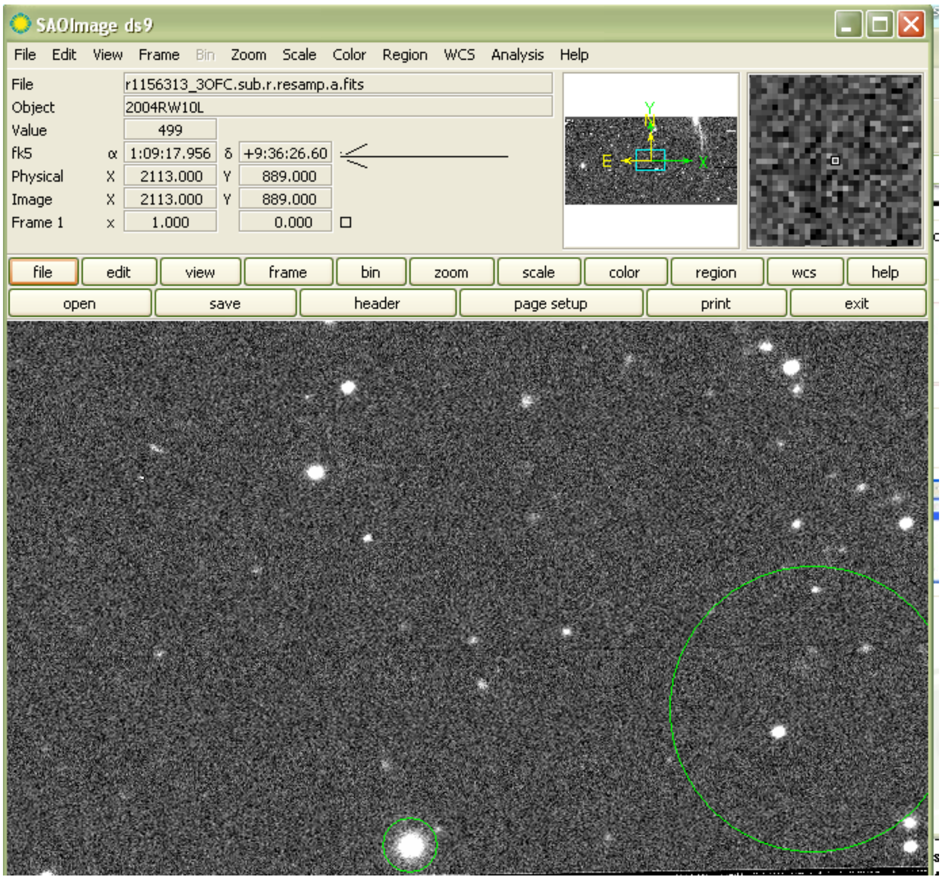

Figure 4. Using SAO Image DS9 for the identification of the coordinates of a star

4. The analyze with the students of this methodical approach

Transposition of these learning activities with students to the level of a class of high school has been the subject of a final analysis of the experimental teaching approach described above. Students were asked to develop, on the basis of the past learning process of Astrometry, some lessons planning for teaching this subject at high school classes. The topic has generated numerous discussions about the classroom reproducibility of the Astrometry modules described before, the motivation of pupils for sky observation, their ability to understand the mathematical component of second module and the choosing of the best teaching strategies in classroom.

Most students participating in this experiment have been adhering to the use of observation, documentary research and discovery as modern teaching teaching methods useful in teaching high school astronomy, arguing by significantly increasing the interest of children in science through combining these teaching methods.

Conclusions

The didactic experimental approach described in this paper has demonstrated that the teaching of astronomy can be approached in a form of investigation / discovery methods, provided that the specificity of this discipline is taken into account. Learning astronomy also seems capable of developing a certain number of specific skills and competences for high school students, generally associated with other scientific fields (mathematics, physics, geography).

This approach to the teaching process, using blended training methods, seems to produce very good results in the short and medium term.

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I wish to thanks Professor Ovidiu Vaduvescu for providing the packages of astronomical pictures used in the frame of this experimental approach.

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Cartography teaching website – online tool for supporting geography higher education

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Abstract

The large-scale use of virtual resources by students and staff, especially in the context of Web 2.0, prompted us to design a teaching website for various disciplines related to Cartography and Topography. The main purpose was to support students in their learning and to promote a better organization of the teaching activities, according to the requirements of student-centered education. The accomplishment of this teaching website (https://sites.google.com/a/geo.unibuc.ro/cartografie-topografie-site-didactic/) came as a response to the opinions of 330 undergraduate and master students from the Faculty of Geography within the University of Bucharest. These opinions were expressed in October 2016, by answering an online questionnaire. By analyzing the answers, we identified the dominant preferences, which were subsequently included in the structure and content of the teaching website. Although 99.4% of the respondents had never used a site like this, 98.8% appreciated that such a tool would be useful to them much and very much. For instance, most students demanded useful links (99%), course notes (71.5%), examples of good practical works (70.3%), tutorials (69.1%), etc. So far, the site has proved to be very useful, because the connection between teacher and students can be established from anywhere and at any moment.

Keywords: teaching website, cartography, e-learning, higher education

1. Introduction

Over the past decades, the European higher education was influenced by the reorganization processes that envisaged the policies regarding the university autonomy, the quality assessment of teaching and research, the introduction of competitive funding mechanisms (Capano and Regini, 2015), and the adjustment to the alterations caused by the internet. In the light of the last developments, the role of the online learning has increased (Glenn and D'Agostino, 2008), because documentation and learning are mediated by the virtual environment, which makes materials accessible to any student, anywhere, anytime (Volery and Lord, 2000). Consequently, the way in which knowledge and materials are disseminated has adapted to the online environment (Badia et al., 2006; Banini, 2017), which is why more and more virtual learning platforms are tested and used in all educational levels (MacBeath, 2008; Carman et al., 2017).

The distribution of various materials (course notes, basemaps, individualized work areas, worksheets, files with raster or vector data, statistical information, good practice examples, delivery deadlines, evaluation results, absence accounting, etc.) used to be done in digital format (sticks, external hard drives, uploadings in Google Drive, etc.) on paper or in face-to-face meetings. Likewise, the teachers used to disseminate information by sending e-mails to a representative of the working group, by posting various materials on their personal pages hosted by the University of Bucharest (www.unibuc.ro), by oral communication during the classes, etc. However, those students who for various reasons missed the classes were in the situation of not knowing what materials they needed, where to find them or what the delivery deadlines were. At the same time, there were situations when some of the students forgot the required materials for the practical activities at home.

Over the last years, the students have asked more frequently if they can find on the web the materials needed for their practical activities, the evaluation results, and the deadlines for delivering individual assignments, but they have not suggested the creation of a teaching website. However, because we were constantly confronted with such kind of problems, we thought of designing a teaching website for the students involved in campus-based education, creating them the conditions that besides face-to-face interactions to be able to access the online learning tools (E-learning, mobile learning).

2. Materials and Methods

In order to accomplish a teaching website, we decided to take into account the students' needs and options regarding the professional training, inasmuch as the Romanian higher education is a student-centered one. In order to fulfil this objective, we had to complete four stages: (1) designing an original questionnaire to assess the students' perception regarding the usefullness of such a website; (2) applying the questionnaire to a sample of as many students as possible; (3) collecting and analyzing the professional training preferences, options and needs of the students and comparing them with the objectives of the teachers who initiated the survey (i.e. the two authors of the present study); (4) creating the website by taking into account the students' needs, the teachers' objectives, the curriculum provisions and the organization of the teaching and learning activities.

Stage1. Based on their personal teaching experience, the authors of this research have developed eight questions (both open-ended and closed-ended), using Google Forms, as on prior occasions (Vlada, 2014; Osaci-Costache et al., 2015).

Stage 2. Because in the Faculty of Geography within the University of Bucharest a number of disciplines related to Cartography and Land Survey are taught starting with the first semester of the first year of study, all students were asked to fill in the online questionnaire. Many of them were sent this invitation by e-mail, but it was also posted on the official website of the Faculty of Geography (http://www.geo.unibuc.ro/), as well as on the institution's Facebook page, because the latter is very popular among students (Dulamă et al., 2016). The students responded willingly to the questions and agreed to let us use their answers provided we do not disclose their names. The questionnaire was filled in by 330 students, who although do not represent the entire student population, can be considered a representative sample.

Stage 3. We collected (by Google Forms) and analyzed the answers given by students in various years of study and from various study programs (both undergradudate and Master students).

Stage 4. We accomplished the website with Google Sites tool by taking into account the students' options and the organizational and scientific needs of the teaching and learning process.

3. Results and Discussion

3.1. Analyzing the students' preferences. Before applying the questionnaire, we already had in mind the structure of a teaching website, which could have largely responded to the students's requirements and the teachers' needs. However, we thought it was appropriate that the website contained especially the elements considered useful by the students. Some requests were surprising, as will be seen in the following analysis.

The student sample included undergraduate students (86.7%) and Master students (13.3%). The high percentage of the first-year undergraduates who participated in the survey (66.1%) can be explained by the fact that they were following two courses, which were about to have a teaching site (*Land survey*; *Methods and techniques for cartographic representation*). A number of second-year students (depending on the study program) were interested in the discipline *Fundamentals of* *thematic cartography*, while part of the master students were interested in *Thematic cartography*. Although the third-year undergraduates and the second-year Master students had no other discipline which was about to have online support, 9.7% of the answers came from the former and 1.2% from the last. The information they provided was very useful, due to their longer experience (Figure 1a).

Naturally, most of the questionnaires were filled in by the students enrolled in Cartography study program (39.4%), who during the first two years of study are required to attend the majority of the disciplines related to Cartography and Land survey. Although the students enrolled in Tourism Geography and Hydrology-Meteorology study programs, have to attend only Cartography and Land survey classes, the former provided 28.5% of the answers and the last 15.2% (Figure 1b).

We should note that 80% of the respondents declared they had never used a teaching website, while the rest of 20% gave examples of teaching sites they had already visited. By analyzing these examples, we observed that many respondents included in this category other types of pages (for instance, the official site of the Ministry of National Education, https://www.edu.ro/), but only two of them could be considered teaching sites (http://oceanclass.blogspot.ro/ and www.opengis.ro, the latter non-functional for about two years). Consequently, the real percentage of those who had never accessed a teaching site amounted to about 99.4%.

An overwhelming percentage of the total respondents (98.8%) thought that a teaching website for every subject related to Cartography and Land survey would be useful to them much (39.4%) and very much (59.4%). It is interesting to note that all four students (1.2% of the total) who appreciated that the teaching site would be of little use to them were first-year undergraduates, who had not used any teaching sites before, so that to be able to appreciate their usefulness. No interviewee ticked the options "not at all" and "very little", which means that the students' expectations regarding a teaching website were very high.

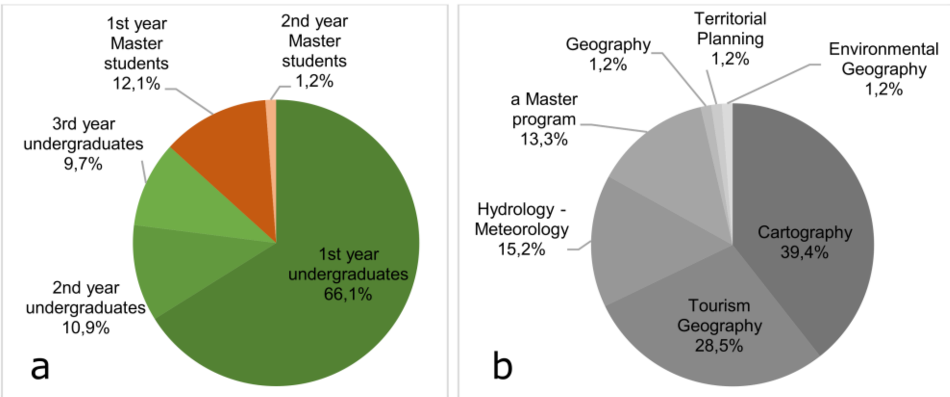

Figure 1. Structure of the student sample by year of study (a) and by study programs (b)

Before analyzing the answers given to the other items of the questionnaire it is worth mentioning that most students (328 of 330) had never used a teaching website (so they could not compare), but neverthelss they thought that such a portal would be useful to them, because they expected to find there support for their activities. Therefore, it is very interesting to see what elements they wished to be able to find on such a website.

The questionnaire included two items related to the content: one regarding the professional training and the other concerning the organization of the lectures and practical activities. Both questions had several closed-ended possible answers and a single open answer.

The percentage of those who expected the website to offer them useful links (for maps, atlases, statistical data, etc.) was surprisingly high (90.9%). Other studies (Dulamă et al., 2015) have proved that the present-day students, considered "digital natives" (Prensky, 2001), are familiar with looking up the necessary resources on the internet. About 70% of the options (Figure 2) refered to course notes (71.5%), completed works as good practice examples (69.1%), and tutorials (69.1%). Smaller percentages (between 55.8 and 59.4%) were recorded by the very elements that might have helped them to learn better and to develop and strengthen their competence: exercises, task-rating grids and evaluation sheets (applicable at home, as forms of self-evaluation, before delivering the tasks/projects) (Figure 2). This is explicable, because this type of learning requires individual effort, and that is why many students tend to avoid it. Most respondents ticked several options suggested in the questionnaire, except a third-year undergraduate, who would have prefered the site to provide only tutorials (not links), and four first-year undergraduates, who deemed it was enough to find there only course notes. The multiple-choice answers were suggested by the teachers, but the questionnaire was also meant to collect useful ideas concerning various resources. Unfortunately, only two students provided open answers. Thus, a first-year undergraduate in Cartography said "*a section like Tips and tricks would be great*", but without mentioning the subject, while another first-year student in Tourism geography asked for "*works that are not easy to find in libraries*". This last requirement suggests that not all the students are acquinted with intellectual property rights (copyright).

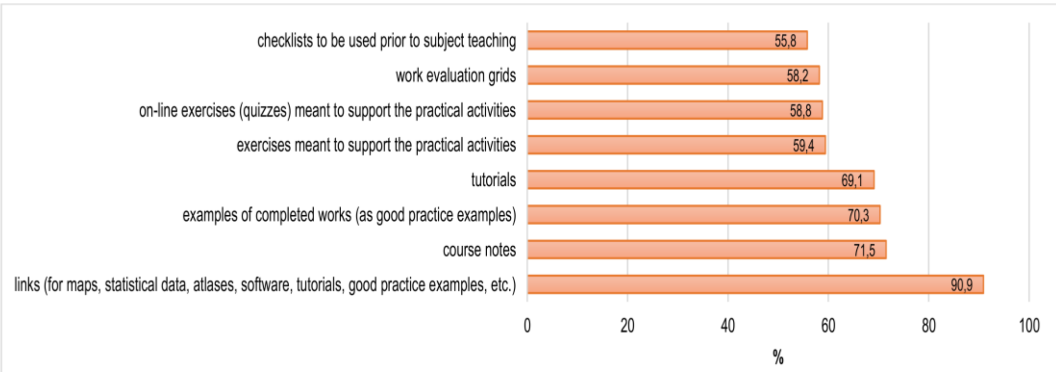

Figure 2. Student answers to the question: "In terms of professional training, what should the site contain to help you?" (Multiple-choice question plus a single open answer)

As far as the organization of lectures and practical activities is concerned, the answers are given in Figure 3. There was no supplementary suggestion from the students, because they only ticked the options offered by the questionnaire. Most of them (84.2%) wanted to be able to download materials for the practical activities carried out in the class, which was to be expected, because the previous procedure in this respect was rather difficult. Usually, the teacher either had to distribute the printed or digital materials a week in advance (with the risk that the following week some students would forgot them at home) or they had to e-mail the information to a representative of the working group, who subsequently disseminated the information to his collegues (on Facebook/work groups or by e-mail). But the website has the great advantage that all materials are accessible to the students anytime and anywhere, the more so as the Faculty of Geography has a permanent connection to the internet. In this way, the teaching activity can be better organized, because the students will be spared for loosing their time in order to get hold of the necessary materials (maps, statistical data, etc.).

More than 60% of the respondents (Figure 3) thought useful to find on the website their final marks and scores (for projects, practical activities and examinations). Although the students are promptly informed about evaluation results, the idea is pertinent in case of those who miss the classes or who forget the scores obtained previously (for some disciplines amounting even to seven points per student, through continous evaluation). Likewise, 64.2% of the interviewees thought that it would be helpful m to find on the website de delivery deadlines for their tasks and projects.

Although the students are informed from the first meeting on the conditions for taking the exam, and these rules are reminded on a periodical basis, 57.6% of them thought useful to find this information any time on the website. The fewest options (49.1%) were recorded by the number of absences accumulated by each student in each discipline (Figure 3).

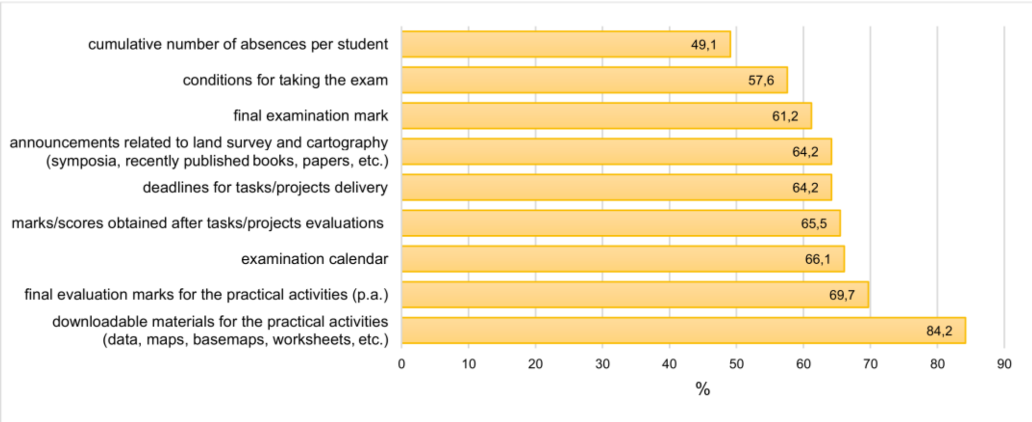

Figure 3. Student answers to the question: "In terms of organizing lectures and practical activities, what should the site include in order to help you?" (Multiple-choice question plus a single open answer)

The last open-answer question, "What dominant color would you prefer for this website?", was aimed at helping us come up with a nice looking site. There were various answers, but the most desired colors were green (27.3%), blue (22.4%), red (7.9%) and mauve (4.8%). Some of the answers were cute and they confirmed the psychological importance of color; for instance, somebody wrote, "*Any pastel color able to soothe you when you fail an examination or when the course content makes your hair stand on end*" (third-year undergraduate in Tourism Geography).

3.2. Making the teaching website. Discussion.

The website (https://sites.google.com/a/geo.unibuc.ro/cartografie-topografie-site-didactic/) was designed in Google Sites by using an institutional e-mail address created by the University of Bucharest in the Google domain (Gmail). The advantage was that the site received automatically the logo of the University of Bucharest, while the drawback was represented by the fact that this site was connected to a single e-mail address and therefore only the address holder was able to manage it. Consequently, for the academic year 2016-2017 we decided that only the first author of this study was responsible for its administration (and only for the disciplines she teaches).

As soon as the website was in place, we gave the link to the students either during the lectures, by e-mail, or by posting it on the internet page of the Faculty of Geography. Within the first five days from the launch, it had more than 1,750 new visits (indicated by the IP addresses recorded by Google Analytics). The access was free, so no one had to register in advance.

At this very moment, the website includes the following dsiciplines: Land survey (first-year undergraduate studies, first semester), Methods and techniques of cartographic representation (first-year undergraduate studies, second semester), Fundamentals of thematic cartography (second-year undergraduate studies, first semester), and Thematic cartography (first-year Master studies, first semester).

Most disciplines have four subsidiary pages, as follows: (1) Delivery deadlines (tasks's name; form of delivery: digital, printed, etc.; last delivery day; delivery status: on hold or completed); (2) evaluation sheets (for self-evaluation before delivering the tasks); (3) Dowloadable materials (for being used in class or for tasks/projects) in various formats: .pdf, .doc, .shp, links to Google Drive for the large files; here there are also the individual tasks/working areas for each student, in order to avoid the loss of the task); (4) Course notes (in .pdf format).

The website also has the following sections:

- Announcements (with a link in the Home page and with an option to subscribe to the new posts);
- Exams, with several subsidiary pages: (a) Conditions for taking the exam; (b) Examination calendar; (c) Results (marks). The Excel tables show the situation of each student: number of absences, scores obtained in each project, task or test, final evaluation mark for the practical activities, final examination mark, verdict of being accepted to take the exam or not, etc.
- Useful resources (links): (a) Tutorials; (b) Freeware and Open Source software; (c) Maps, atlases; (d) Other useful pages (a collection of links considered essential for Cartography and Land survey, which are permanently updated and modified).

The website is intended only for the students involved in campus-based education, who have practical activity classes every week. Such being the case, the teacher-student interactions are not available for the moment.

The site can be accessed in many browsers: Chrome, Mozilla Firefox, Internet Explorer, Edge, etc. Because other studies have revealed that the students access the internet mostly from their cell phones or tablets (Dulamă, 2015; Osaci-Costache et al., 2015), the website has also been optimized for the mobile phone. The prevailing colors (regarding the occurrence frequency) are consistent with the first two options.

From the teachers' point of view, the website has many advantages: the students are not any more in jeopardy of not having the required materials in class; they can be aware every moment of their situation (number of absences, scores, etc.), the tasks they have to accomplish, and the delivery deadlines; they can download the materials when it is most convenient for them, without having to turn to their collegues or teachers; before delivering the project, the students have the opportunity of making a self-evaluation based on the sheets uploaded on the site; all of them are able to acces the course notes and the links to scientific materials at their own pace, as well as the tutorial links and the good practice examples, if these match their learning and training needs.

The main drawback, at least for the moment, is that the website can be managed only by a single person. Besides, updating and uploading the materials takes a lot of time, but the benefits are great, both for the organization of teaching and learning activity and in terms of online accessibility of the materials needed by the students.

In future, we intend to archive on every academic year the marks, the tasks/projects, etc., in order to be available for the students who fail the exams or for those who are compelled to interrupt their studies for a while. At the same time, we also consider the opportunity of adding new susidiary pages in the next academic year (with graduation paperworks in Cartography, etc).

Conclusions

The results of the survey conducted on a sample of 330 students, who answered voluntarily and anonymously to a questionnaire, largely corresponded with the initial website design made by the teachers. At the same time, these answers helped us identify the students' expectations, so that to take them into account. We wished this site to be a real help for the students and to offer resources for several disciplines that are taught in the Faculty of Geography within the University of Bucharest during the first two years of undergraduate studies and during the first year of Master studies Cartography, Methods and techniques of cartographic representation, Thematic cartography, etc.).

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PERRYBOT rover – an example of Physics learning in a STEM PBL approach

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Abstract

This paper highlights a way of approaching Physics learning in the context of STEM (Science Technology Engineering Mathematics) and PBL (Project Based Learning) concepts. The main purpose of building this rover was to collect data about the environment it is in and where no man can go because of the narrow space or because of the harmful environment. The system's design of movement allows it to go on any kind of soil, and, with improvements, even on water. It collects atmospheric data like methane and hydrogen, vital elements for surviving but also carbon monoxide. Even so, the atmospheric and soil temperature and humidity of the environment it is in, haven't been forgotten. Our rover is also equipped with light and proximity sensors. To view the environment we use an IP wireless camera through WIFI technology. The camera is equipped with a night vision system and a special designed flashlight.

Keywords: rover, STEM, PBL, physics education.

1 Introduction

Modern instruction models show that for improving learning results, it is necessary to interconnect scientifical knowledge gathered by students and applying this knowledge practically. This approach is necesassary in the development of new skills for students: building knowledge and concept integration, knowledge modelling, constructive learning (Iofciu et al, 2010; Iofciu et al, 2011), operating different instruments, communication, innovation and involvement in scientifical processes (Bybee, 2010).

In order to develop critical thinking for students and actually making them use their abilities in order to solve problems (Korganci et al, 2016; Bejan, et al, 2015) we will use the STEM (Science Technology Engineering Mathematics) PBL (Project Based Learning) approach. Students are approaching problems exactly like researchers and enginners, problems that have incomplete tasks, but have a very specific goal. By using STEM PBL, profound learning is generated by integrating concepts and abilities in a systematic manner (Korganci et al, 2016; Bejan, et al, 2015).

1.1 Mechanical/ structural design

The rover we built was made with recyclable materials like restored metal sheets from old computers. These metal sheets were first cut at the right sizes and then bent and welded. Afterwards they were all painted in black. These photos show how our rover, PERRYBOT, started to take shape. The carcase's metal sheet has a thickness of 0.5 mm (Figure 1).

Figure 1. Structural design of rover

We also designed a well for the collection of two parameters. The rotation of the well is made by a servomechanism and its extension is driven by an 75:1 adapter engine for having a high torque for the penetration of any kind of soil. The measured parameters are shown in Figure 2.

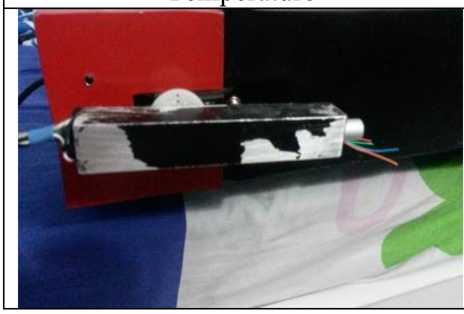
Temperature	Humidity
	

Figure 2. The measured parameters

The movement system is based on two twin screw of opposite direction which assures a safe transport on any kind of environment, soil, sand, swamp. Because of the engines used by us, it isn't capable of walking on water. The two twin screw are made of duralumin, an easy and strong material (Figure 3).

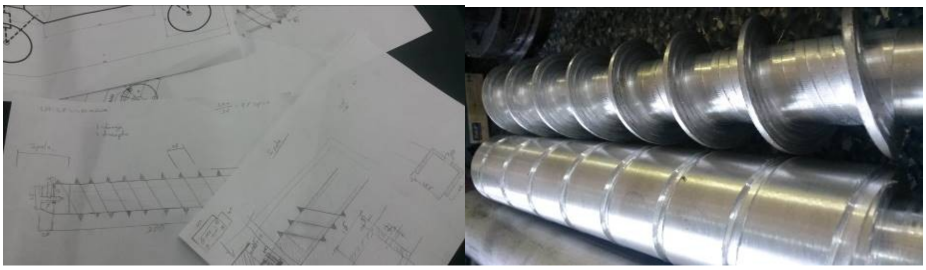


Figure 3. The movement system of rover

The engines contain brushes which represent an advantage and an disadvantage. The major disadvantage is that they're not waterproof, but, even so, they have a high speed. The materials we used are a 34:1 reductor and a 4.31 kg/cm torque with 285 rpm.

The sensors used and their characteristics are shown in Table 1.

Table 1. The sensors used and their characteristics

Sensor	*Characteristic*
MQ4	Methane, Gas
MQ7	Carbon Monoxide
MQ8	Hydrogen Gas
MPL3115A2	Altitude, Atmospheric pressure, Temperature
DHT22 or AM2302	Humidity, Temperature
LM35	Temperature (of soil)
HC-SR04	Ultrasonic
Homemade humidity sensor	For soil

1.2 Electrical design

Our robot is using a variety of sensors:

A. Biometric

- ✓ Methane (MQ4)
- ✓ Carbon Monoxide (MQ7)
- ✓ Hydrogen (MQ8)

The gas sensor used in this project is based on semiconductors. The gas sensor is built from a sensing element, sensor base and sensor cap. The sensing element contains sensing material and heater to heat up sensing element. Depending upon the gas to be detected, the sensing element will employ different chemicals such as Tin dioxide (SnO_2), Tungsten oxide (WO_3), and so on.

When a metal oxide crystal such as Tin dioxide and heated at a certain high temperature in air, oxygen is absorbed on the crystal surface with a negative charge. Then, donor electrons in the crystal surface are transferred to the adsorbed oxygen, resulting in leaving positive charges in a space charge layer. Thus, surface potential is formed to serve as a potential barrier against electron flow.

The relationship between sensor resistance and the concentration of deoxidizing gas can be expressed by the following equation over a certain range gas concentration:

$$R_s = A[C] - \alpha \quad [1]$$

A = constant

[C] = gas concentration

α = Slope of Rs curve

Due to the logarithmic relationship between sensor resistance and gas concentration, this type of gas sensors have an advantage of high sensitivity to gas, even at low gas concentration.

We didn't convert the value in standard PPM (parts per million) gas unit, because to do so, requires a known reading from a known amount of gas. Nevertheless, the integer reading (0-1023) was put into trial and error tests to find out a hazardous level for creating an alert.

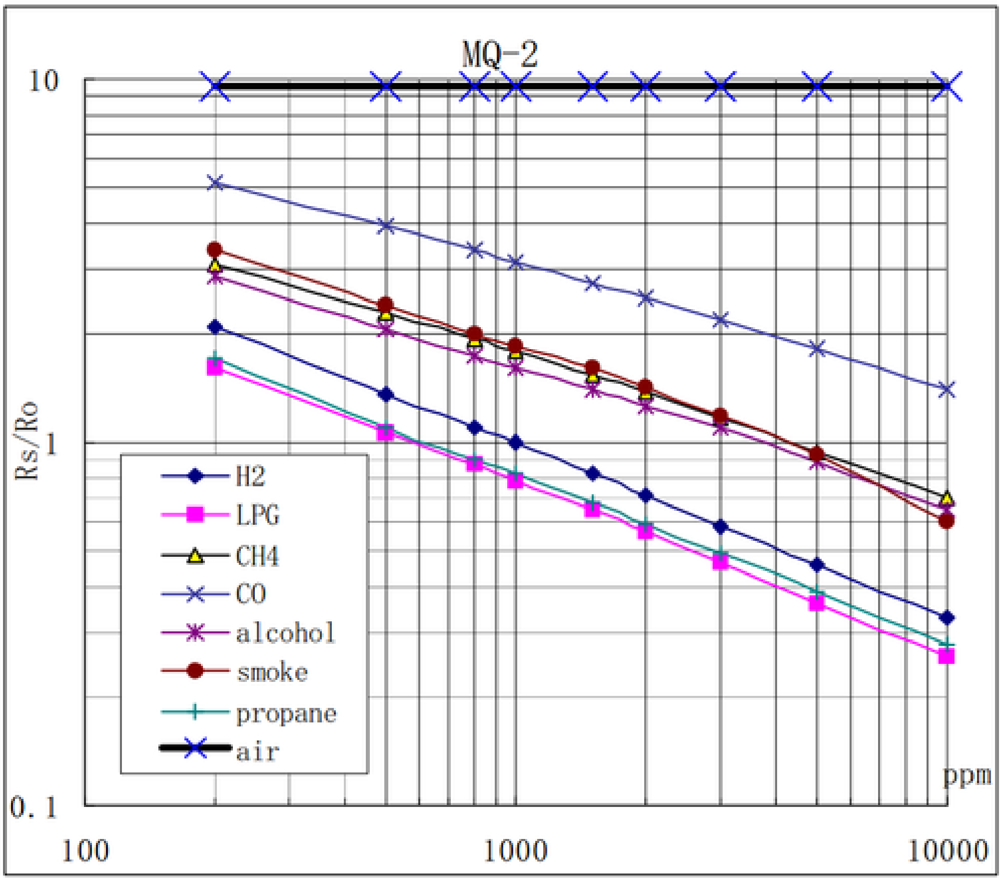


Figure 4. Sensitivity characteristic curve – biometric sensors (example for MQ2 sensor)

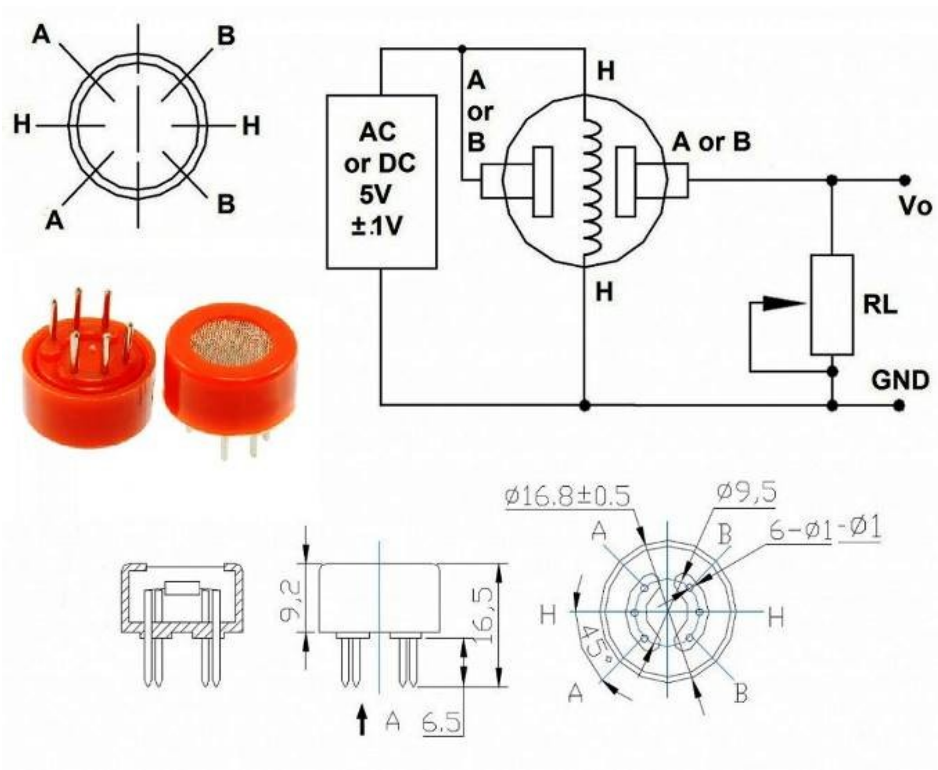


Figure 5. Electrical schemes sensors

B. Atmospheric

- ✓ Humidity (DHT22)
- ✓ Temperature (DHT22)
- ✓ Temperature (MPL3115A2)
- ✓ Temperature soil (LM35)
- ✓ Humidity soil
- ✓ Altitude/pressure (MPL3115A2)

Tables 2, 3 and 4 show the parameters of the DHT22 or AM2302, LM35 and MPL3115A2.

Table 2. Description of sensor parameters DHT22 or AM2302

Item	*Condition*	*Min*	*Typical*	*Max*	*Unit*
Power supply	DC	3.3	5	6	V
Current supply	Measuring	1		1.5	mA
Collecting period	Second		2		Second
Operating range			Humidity 0-100%RH; temperature -40~80Celsius		
Accuracy			Humidity +-2%RH(Max +-5%RH); temperature		

Table 3. Description of sensor parameters LM35

Range	-55 to 150°C
Power supply	4 V to 30 V
Current supply	60 μA

Table 4. Description of sensor parameters MPL3115A2

Parameter	***Min***	***Typ***	***Max***	***Unit***
Measurement Range PFS	50		110k	kPa
Current supply		2		mA
Supply Voltage	1.62	3.3	3.6	V
Pressure Absolute Accuracy PFS		±0.4		kPa
Measurement Range TFS	-40		+85	°C

C. Humidity soil

This sensor places the probe resistance into the base resistance, thereby changing the base current as the soil resistance changes. This base current is, obviously, translated into an emitter current and produces an output voltage indicating the soil resistance or moisture level (typical values for a probe separation of 30 mm are R2 = 10kΩ, and R1 = 100Ω).

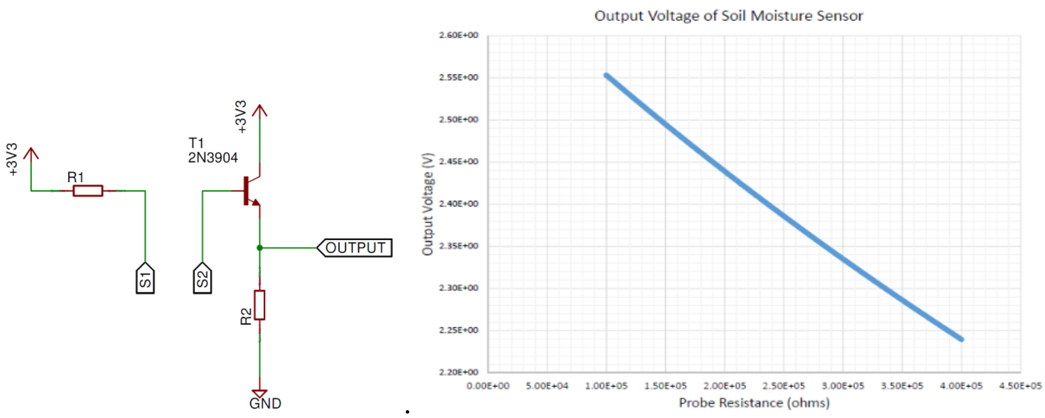


Figure 6. Electrical schemes humidity sensors and Output Voltage of Soil Moisture Sensor

D. Proximity sensor - HC-SR04

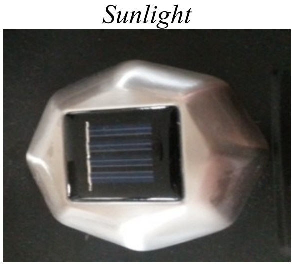
The rover (PERRYBOT) needs to have an "eye" to see its surroundings. There are many sensors that are accomplishing this, starting from LDR sensors to Laser and satellite guided navigation. For this rover it seemed fit to use an ultrasonic sensor, because it does the intended job. Ultrasonic sensors are a pretty neat solution because they work by propagating pulse of ultrasound and waiting for them to come back. Table 5 describes the parameters of the HC-SR04 sensor.

Table 5. Description of sensor parameters HC-SR04

Working Voltage	*DC 5V*
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL level signal and range in proportion
Dimension	45*20*15 (mm)

E. The optical sensors are shown in Figure 7.

Sunlight



For Sunlight level we use a photovoltaic panel

Simple Light

For simple light level we use a photo resistor

Figure 7. The optical sensors of rover

1.3 Printed Circuit Board (PCB)

A motor controller is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.

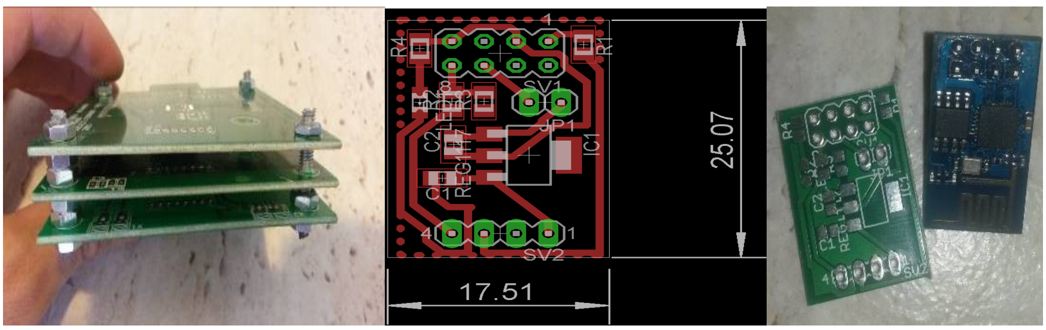


Figure 8. PCB of the computer

The rover control is made from an android operating system device which runs an application which communicates through the internet with the rover. This application is multitasking which means that this option helps at performing simultaneous tasks.

The equipment used for rover control is made of a laptop for livestreaming and an android operating system tablet to control the rover.

The transmission of data and robot control is made through the help of WIFI technology because of its transmission speed. Image transmission is made through a local network or with the help of an router, separate from the control one.

The rover's WIFI module is an ESP8266 one which works on a frequency of 24GHz.
Note that a 220V power source is required to power the equipment.

Conclusions

STEM PBL is challenging but also motivating for students. Activities like this, make students think analitically and critically, improving their abilities of higher level thinking. These activities also involve collaboration, communication with other students, solving problems on paths which are chosen by students. STEM PBL, by using engineering design as a foundation element, builds scientifical, mathematical and technological knowledge for students and also tries to make them understand and solve real-life problems. This kind of learning creates real circumstances for applying knowledge from different areas and also provides a better structure for dividing and analyzing complex problems. STEM PBL builds and develops the most important qualities of students: creativity, innovation and problem solving.

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Approaches of Educational Technologies of Open Systems

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Abstract

The article analyzes the principles and technologies of open systems to substantiate the scheme for managing the interactive learning process in the system of open education within the framework of the processes of block-module formation of educational and methodological content. In particular, the information and technological aspect of the pedagogical design of the educational process in an open environment is studied, which requires fundamentally new approaches to the formation of the optimal structure of the information basis of interactive learning technologies. The high complexity and practical importance of the task of forming optimal information basis structures for open interactive adaptive-learning management systems determines the urgency of scientific research of the article. The authors of the article suggest an algorithm for the formation of educational content of open systems on the basis of the block-modular approach and optimization of the structure of individual modules of the teaching and methodological material of the automated learning system based on the principles of modeling dynamic networks. The proposed approach to the formation of educational content in an automated training system will increase overall performance of the training system, as well as automate the configuration of the educational trajectory considering the individual characteristics and priorities of the learner. Also, issues of standardization of mutual exchange processes for open-type computer-based learning systems are studied and approaches to modeling and standardizing the content of educational systems based on standard methods of packaging the content of educational courses are substantiated. The article substantiates the priority directions for improving the electronic educational environment of an open type, in particular, the integration direction with global educational networks for the implementation of the "transfer of educational technologies" strategy and supporting the business environment of the information-learning system as an intellectual resource.

Keywords: Open system, Educational technology, Learning model, Optimization, Educational content

1 Industry and Practice of the Personality Development in the Open Education

Open education is considered in the modern context of the society development as a practical way of developing the potential of the individual for purposes related to the construction of possible images of the future, the development and planning of personal growth in it. The methodology, on its basis the structures and technologies of open education are formed, requires a transition from schemes of theoretical and engineering-design thinking that oppose the subject of thinking to its object, to schemes of practical thinking. Recognition of the idea value of the practical thinking leads to a conceptual shift in the organization of educational practices based on the principles of practical interpretation of knowledge, where the element of planning of the education content is not the concept, but the scope or form of knowledge (Mullen et al, 2017).

Open education as a practice of developing the potential of the individual requires a networked and open organization of the educational space, in contrast to education focused on the culture broadcasting. The organizational element of open education is an educational program, not an institution. In this case, the educational program in open educational system is not set in didactic logic, based on a sequential process presentation of the mastering an subject, but in integral logic, that is, with the simultaneous unfolding of all the completeness of practice that represents the mastering object.

At the present time, a new educational industry is being created, including the processes of re-scoping or re-forming knowledge in order to actualize the potential of the individual in education. Modern statistics point out the activation of the processes of formation and capitalization of new global educational brands which are not connected with traditional universities, and attract the audience attention of the open network space (Ivaniushin et al, 2016). The attendance statistics of open universities demonstrate the high relevance of these resources to students of different nationalities and state affiliation. Modern institutions of open education are developing either as networks of additional education, gradually integrating with the institutions of basic education, or as a system of professional education. The development of such networks requires methodological, logical-epistemological (classical), technological research of the content of educational tasks, possible schemes of transitions and pathes in the educational space, schemes of organization, leadership and management. However, the problem of reorganizing existing educational institutions as spaces for the development of human potential remains very urgent.

Along with the above-mentioned phenomena in the field of open education, a whole range of unique educational directions emerges, possible only within the framework of an open approach to the educational process and forming exclusive human qualities for orientation in extreme situations, creative thinking, record-breaking strategies, creative intuition, abilities to opening (such as institutes of intensive training, educational Game industry, a next generation of professional simulators and trainings, mass trainings, networks and network education, social and territorial educational programs of advanced development, the practice of human development, personnel training and so on). New forms of e-learning and technology are being developed and institutionalized to support the implementation of these models and standards for evaluating and recognizing educational achievements are emerging (Stuchlíková and Kósa , 2013; Berezytskyi and Oleksyuk, 2016) as a response to the emergence of new educational platforms which are oriented towards a global educational audience.

The noted trends demonstrate the increasing scale of the "exit" process of the training contingent (and other categories of educational services consumers) into global educational networks. The peculiarity of such networks is the educational concentration in the leading educational centers and an impressive increase in the number of students per teacher due to e-learning opportunities. This ensures knowledge from leading professors and experts, access to current and demanded courses for all consumers of educational services.

The purpose of the research carried out by the authors is to describe the application of the principles and technologies of open systems for setting the information infrastructure of science and education as one of the most important fragments of the national information infrastructure and justifying the need for further integration of this infrastructure with the global information infrastructure.

The operations analysis system, optimization theory, probability theory, open system principles, open systems technology, system profile construction are used to solve such problems.

One of the key problems in the field of the open educational space informatization is the effective use of network-wide information and computing resources, which is caused not only by increased hardware and technical system requirements, but also by increased requirements for the applicability, content and personalization of system content.

The research shows that interaction, integration and differentiation of natural-mathematical and technical-technological knowledge generate the problem of exponential growth of scientific knowledge offered for mastering. One of the ways to resolve this problem is to optimize the content of training, carried out through a number of activities, including optimization of the courses structure, in particular, by using a block-modular approach for organising the course content. The informational and technological aspect of pedagogical planning within the block-modular approach framework is connected, first of all, with the revision of the information content of education and significantly affects the formation of the information basis of interactive teaching technologies. Thus, the formalization of the teaching material and the optimization of the information basis structure refers to one of the most difficult and time-consuming problems in the field of e-learning (Korpacheva, 2006).

2 Optimization of Knowledge Management Processes

The analysis of methods for improving the mechanisms for managing the process of interactive learning in the education system allowed the authors to form a general scheme, for which the subject's active actions the in the learning environment is characteristic, including experimental and research activities. In this activity process there is an accumulation of data on the progress and management of the learning process, (the subject acts alternately as a managed and control system), as well as the determination of the parameters of information and computer systems, the determination of optimal forms of the information basis (IS), the development of the typology of information resources of educational material (EM), the basic requirements for them.

During the research it was also revealed that the formation of requirements for the IS block-modular structure in training systems corresponds the main directions for determining specifications and standards for training systems based on software and information technologies. At the same time, it is possible to single out the main directions of modeling and standardization of information-learning systems: architecture and general requirements to the system; models of the student, teacher, their interaction; the development of IS course (educational and methodological content); data and metadata (format of training materials); educational management system.

The authors of the work also suggest to use mathematical formalism to optimize the information structure of the content (knowledge) of automated learning systems as a mechanism for efficient management of the distribution of information flows of knowledge in open systems based on the Grid computing knowledge principles.

The main idea of optimizing the processes of knowledge redistribution in open learning systems is to represent distributed information flows of knowledge in the form of controlled processes and is based on the decomposition of these processes into separate modules of the mobile and flexible structure formed by the system itself depending on some optimality (efficiency) criterion (Korpacheva, 2006; 2013; Stupina et al, 2013).

To determine the optimal characteristics of the processes of controlled knowledge and to analyze the modular structure of these processes, some additional assumptions were made in the work, in particular:

- the elemental operational composition of the process is quite uniform, which allows to split it into modules of separate procedures (parts of knowledge) of an arbitrary volume;
- the probability of an effective implementation of the process is proportionally dependent on the operations volume in the process;
- as a criterion for the decomposition effectiveness of distributed knowledge flows, the total labor intensity of the process as the main characteristic of the educational process was chosen.

In the research, the hypothesis about the exponential nature of the dependence of the probability of effective realization of the process on the volume of operations in the composition of this process, often used in the practice of process management, was used [8].

In this case, the probability of an effective process execution can be represented in the form: $p(\Theta) = \exp(-\lambda\Theta)$, where Θ – the amount of time for operations execution for a certain process is (unit of time); λ (1/ unit of time) – is a constant representing the rate of decrease in the probability of an effective completion of the process, depending on the volume of operations in this process.

The value of λ depends on the type (content, structure, etc.) of operations in the process and can be evaluated expertly or experimentally based on experience with a particular process.

With a large number of experiments, the problem of estimating the parameter λ can be solved using the method of least squares and is:

$$\lambda = -\frac{\sum_{i=1}^{m} \ln p_i \Theta_i}{\sum_{i=1}^{m} {\Theta_i}^2},$$

where

- m – the number of experiments performed to modify the structure of the process;
- $\Theta_1,\ldots,\Theta_m$ – the volume of operations included in the process (unit of time);
- $p_1,\ldots,\ p_m$. – probability of successful completion of the process.

In the author's research, the use of standard methods of probability theory was proposed to evaluate the reliability of the obtained results. In particular, to describe the process of managing distributed knowledge flows in an open interactive education system, a Markov model of dynamical systems is proposed (Gorobets, 2013).

In the proposed model for managing distributed knowledge flows in an open system, a number of states and probabilities of system transitions from one state to another are identified:

- S_1 – implementation of the educational process;
- S_2 – interactive impact (treatment) during the implementation of the educational process (for example, inclusion of additional information materials in the process, use of consultations during the process; the "teacher-learner" feedback and response to this feedback, decision-making under alternative implementation scenarios process, etc.) and associated with this impact the need for dynamic adjustment of the educational process;
- S_3 – evaluation of the effectiveness of the educational process in an open system;
- S_4 – completion (implementation) of the educational process in an open system;
- r – probability of interactive impact (treatment);
- s – probability of transition to evaluation activities for the educational process in an open system;
- p – probability of effective performance of evaluation activities and completion of the educational process in an open system;
- q – probability of inefficient implementation of evaluation activities and re-implementation of the educational process in an open system to achieve the ultimate goal of training.

Using the apparatus of matrix algebra, taking into account the fulfillment of the obvious relations $r+s=1$, $p+q=1$, the authors obtained estimates of the average number of attempts to implement the educational process in an open system in the form of the average number of process stays, respectively, in the states $\{S_1, \ldots, S_4\}$ when starting from the state S_1:

$$[1]\quad n_1 = \frac{1}{s \cdot p}; \quad n_2 = \frac{r}{s \cdot p}; \quad n_3 = \frac{1}{p},$$

where

- n_1 – the average number of attempts to implement the educational process in an open system;
- n_2 – the average number of attempts of interactive influences during the implementation of the educational process in an open system;
- n_3 – the average number of attempts to perform evaluation activities for the educational process in an open system.

At the same time, the total complexity of the educational process in the open system, taking into account relations [1], can be determined by the following expression:

$$R = n_1 \cdot \Theta + n_2 \cdot \Theta_1 + n_3 \cdot \Theta_2 = \frac{1}{p}\left[\frac{1-q}{s}(\Theta - r\Theta_{1)} + \Theta_2\right],$$

where
Θ – the complexity of implementing the educational process in an open system;
Θ_1 – the complexity of interactive impacts when implementing an educational process in an open system (state S_2); Θ_2 – the complexity of the implementation of evaluation activities for the educational process in an open system (state S_3).

To evaluate the parameters of the overall complexity of implementing the educational process in an open system with the aim of optimally redistributing educational content, the authors suggest an approach based on the probabilistic characteristics of distributed dynamic online education systems. In particular, a simplified numerical evaluation of the total labor intensity of the educational process was justified:

$$R = e^{\lambda\,\Theta}(k\Theta + m),$$

where Θ (unit of time) – the total volume of operations (actions) in the educational process; λ (1/ unit of time) – the rate of decrease in the probability of an effective completion of the process; k (unit of time) – total costs for the implementation of the educational process; m (unit of time) – the work complexity of the implementation of evaluation training activities and not depending on the volume of the service (operation).

The structure optimization of the educational process in an open learning system is considered by the authors as a task of decomposition of a separate educational process with a total time of operations Θ units time for n procedural educational modules, each of which has a volume of Θ_i units time when the relation.

$$\Theta = \sum_{i=1}^{n} \Theta_i.$$

3 Knowledge Management in the Open Educational Space

Thus, the task of optimizing the block-modular structure of informational educational and methodological material in an automated educational system, the approach for solving it was considered by the authors of work in previous studies, with some additional limitations can be used to improve the management efficiency of the distribution of knowledge flows in open learning systems on the basis of the optimal re-arrangement of information “portions” of the total system content at each current time of learning and taking into account the state of the system and the requirements for learning outcomes.

As part of the solution of the issues of standardization of open education systems, the authors propose an architecture model for component-based computer-aided instruction systems, taking into account the needs of Intelligent Learning Environment software and Intelligent Tutoring Systems. In this case, open training courses models are considered as objects for unifying the requirements for their structure, the sequence of presentation of training materials, packaging courses in unique shells. In the framework of this direction, the authors propose a standard for the language of interchange for computer-aided learning systems (SIT), as a standard for describing the language of specifications and the environment for sessions managing in open-type information-learning systems, with mechanisms of incorporating educational resources and supporting individual education. Standardization on SIT base allows using unified methods of packaging the contents of training courses, creating collections of replicable training components, setting up flexible electronic communications environments, which improves the quality of interactive e-learning.

Within the framework of the researches carried out by the authors, the creation of an electronic educational environment (EEE) based on cloud technologies aimed at implementing world standards in the field of e-learning is also substantiated (Wang et al, 2013). At the same time, information is systematized in studies, and experience is analyzed in the field of e-learning of educational organizations, as well as organizations interested in the development of education and educational technologies, including start-ups that provide sites and technologies that ensure the introduction and distribution of e-learning technologies.

Based on the above mentioned, the authors justify the understanding of the term of the open education system not in the form of a single technical platform and a set of electronic resources placed on it, but as a set of standards / norms that ensure the use of educational content placed on different platforms (incl. international), in the network space of education system.

The analysis of the conditions for the EEE implementation in Russian universities shows that such an environment is realized through partnership and involvement of the main stakeholders: the state, universities, business (employers), students. In the EEE concept, the Ministry of Education and Science of the Russian Federation implements a number of functions: providing a communication platform for launching projects for the development and use of electronic content and the introduction of modern educational technologies; provides improvement of the legal framework for e-learning technologies; implements mechanisms to stimulate demand and the need of electronic content. In addition, the analysis of practical experience in the implementation of e-learning in Russian universities has shown that the electronic environment is created on the basis of mechanisms that promote students mobility, encourage them to choose quality courses and educational programs, support market competition mechanisms, and drop out “high-education providers” of low-quality content.

Taking into account the above conditions, the authors identified a number of priority areas of work that contribute to the development of an open electronic educational environment, in particular, the development of standards for educational platforms in the electronic environment that provide the possibility of a network form for the implementation of educational programs; the development of incentive mechanisms for electronic content developers; the development of mechanisms for motivating corporations to participate actively in educational development projects; the development of tools to stimulate the active position of students and listeners in the selection of quality electronic content and educational programs; the implementation of “transfer of educational technologies” strategy, namely, the use of opportunities for interaction with the world's educational content providers in order to adopt technologies and develop the competencies of Russian content providers; cooperation with the leading players of the educational market for a quick access to the global educational space; the development of Russian brands of content providers and opened educational platforms.

The large-scale application of educational technologies of open systems, researched by the authors, contributes to the development of an integrated information environment of science and education, and also improves the infrastructure of society as a whole and creates prerequisites for the all-round development of the individual.

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Video vs Audio Input for Developing Listening Skills in an Online EFL Course

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Abstract

The purpose of this paper is to continue our research of content design for Ural Federal University online EFL (English as a foreign language) course. In our previous study we surveyed the students to find out their preferences on the course content, including the ways of input for listening tasks. Choosing between audio file and video file as a form of instruction input, the majority (70%) of students preferred video. We designed an experiment to check if video input is easier to process for the students. We compared the results of two listening tasks of two groups at 4 CEFR levels (A1, A2, B1, B1+). At each level one group watched "task1" and listened to "task 2" and the other group listened to "task 1" and watched "task 2". This way we eliminated the probability of results depending on the level and background knowledge of a particular group. After each group had a chance to both listen and watch, students gave feedback on the ways of input and explained their preferences. The results show that there is no significant dependence of students' correct answers on the way of input. Analyzing students' feedback we found that the ratio of video/audio preference is 50/50. Taking into account the results of our experiment and the fact that creating video content is much more time- and resource-consuming we made a conclusion that there is no need in preparing mostly video content for developing listening skills.

Keywords: Audio-only input, video-mediated input, listening comprehension, online EFL course

1. Introduction and Literature Review

This paper is the continuation of our previous research. The purpose was to design an attractive useful and practical EFL online course for Ural Federal University students in Russia. To do this we surveyed students on their past experiences in online learning, advantages and drawbacks of these courses, their learning styles, their needs and preferences in content and time allocated, etc. The results were reported at a conference (Troshina and Sazonova, 2017).

One of the questions was: Choosing between an audio file and a video file, what would you prefer for listening tasks and developing listening comprehension skills? The majority (70%) of respondents preferred video which corresponds well with 75% of visual learners reported in English-language teaching methodology nationwide.

There are published research papers on the effect of visuals on listening and comprehension in different experiment settings, on participants with different national and cultural backgrounds, with different video clues (from still graphics through nonverbal gestures to video lectures and movies), etc

The studies attempting to prove, justify the difference have had a long history. As stated by Wagner (Wagner, 2010) and Batty (Batty, 2014) they rose in frequency in the 1980s. Then they gained momentum in the 1990s with the increase in the use of technological inventions as an educational facilitators. This fact shifted the focus of traditional audio-only listening comprehension to listening in multimedia settings and continued through the 2000s up to the present day, especially through the numerous writings of Wagner (Wagner, 2010; Wagner, 2013) and references therein.

Karbalaie and Hamidi (Karbalaie and Hamidi, 2012) hypothesized that providing Iranian advanced students majoring in English with videos in which learners are provided with the speakers' gestures and facial expressions as additional sources of clue will help them improve their listening comprehension proficiency. The result of this study strongly suggested that foreign language pedagogy, especially for adult English learners, would benefit from applying videos presenting speakers' gestures and facial clues.

Batty (Batty, 2014) compared the results of an audio-only test of foreign language listening comprehension to an identical test that also incorporates video. He concluded that "the distance between the audio and video formats is so small as to be of no practical significance". The observed average raw score for the items investigated delivered in these formats was similarly indistinct.

To refer to the latest studies, İnceçay and Koçoğlu (İnceçay and Koçoğlu, 2017) explored the effects of three input deliver modality on listening comprehension of upper-intermediate level foreign language learners enrolled in the English language teaching department preparatory program at a foundation University, in Istanbul, Turkey. Among other findings they concluded that "students have positive attitudes about the audio-only mode owing to the fact that they are most used to that type of input delivery and they felt less stressed during that input mode".

For the most part, the studies described above suggest that the use of video texts does influence L2 listening performance. However, despite a firm theoretical grounding for the importance of nonverbal information in listening comprehension, comparative studies of video-mediated and audio-only listening comprehension tests have produced contradictory or inconclusive results. To settle the debate about the extent of the video influence, and whether it is positive or negative the researchers continue experimenting with different experiment settings, types of video texts, instruction and task types, times of listening, national background, age groups, English language proficiency level.

Three reasons were important for us to consider when deciding whether video input is worth including in online EFL course:

1. Video-mediated listening comprehension tasks require more resources to develop and administer than audio-only listening tests. It places much burden on teachers and test designers;
2. Insufficient facilities can stop learners from enjoying the benefits of video-mediated input;
3. In practice video input is never used in testing and assessing listening ability at official exams perhaps in part "due to the belief that including the visual channel involves assessing something beyond listening ability" (Wagner, 2010).

With these factors in mind we conducted our own experiment to check whether video input is easier to process for students.

2. Method

The participants of the experiment were 114 Russian students majoring in different disciplines and studying English as a Foreign Language. They don't range in age a lot (17-19 year-olds), from the same national and cultural background. The students were in four language proficiency levels (A1, A2, B1, B1+), two groups of 15 students on average at each level. The students didn't undergo any pre-test. They were placed in these levels based on the results of a placement test that is composed of listening, use of English, and speaking sections and proved by semi-final University tests.

The listening section of the test in question is video-mediated. In order to conduct the experiment we used two video Episodes of each level from New English File (Oxford University Press). Every Episode consists of 4-5 clips showing in-the-street-interviews about speakers' hobbies, memories, past experiences, everyday life, etc. The instructions to the Episode state: Watch or Listen. We ensured that the students had not encountered the material previously.

The participants of both groups neither received warm-up on the theme of the interviews on which they were going to work that session, nor had pre-teaching or concept-checking of the vocabulary. Printed copies of 5 multiple-choice questions related to each interview were handed out to the students right before the test. They were designed in a way that no nonverbal behaviors (gestures and facial clues) are necessary to answer the questions. The questions were presented in the

Episode before every clip. The first group were exposed to video-mediated listening to Episode 1 (hereinafter Task 1) by projecting it onto the screen or on TV, and were presented audio-only input of Episode 2 (hereinafter Task 2) by minimizing the window of video clip. The second group were presented audio-only input of Episode 1 and watched Episode 2. While listening the participants were supposed to answer the question/s related to each clip. They listened to each Episode twice.

Each time the overall practice took 10 to 15 minutes. The only dividing point of presentation was that the audio-visual input provided the speaker’s nonverbal behaviors in addition to verbal behaviors, while the audio-only group had no additional clues on interviewees’ facial expressions and gestures.

After completing the tasks the students didn’t get any teacher’s feedback on the correct answers. We asked the participants to answer the question on which (audio-only or video-mediated) input was easier, more helpful for them. And then in the open form we collected students’ feedback about what made their choice.

3. Results and Discussion

The results of our experiment are going to be divided into three sections.

3.1 Comparison of Two Input Modes

In order to estimate which input method, audio or video, was more efficient, that is which method provided the students with most benefit, we calculated the average number of correct answers for each group, each level.

Table 1. *Comparison of Average Results for the Same Task with Varying Input Modes between the Groups*

	Average number of correct answers			
	group 1	group 2	group 2	group 1
CEFR level	Task 1 Audio	Task 1 Video	Task 2 Audio	Task 2 Video
A1	3,5	3,75	3,875	3,25
A2	2,54	3,25	2,875	2,07
B1	3,8	3,3	3,3	3,4
B1 +	4,28	3,4	1,9	2,28

As we can see in the Table 1 the results for each level are different. A1 students have insignificant difference in the results of Task 1. Video input results are better by 0,25. In Task 2 they performed better with the audio input. Average correct number of answers with audio input exceeds video input by approximately 0,6.

Similar situation occurs with A2 level students. In Task 1 they performed better with video input (by 0,7) and in Task 2 audio input results are better (by 0,8).

B1 students in Task 1 had better results with audio input (by 0,5) and in Task 2 with video input (by 0,1). In Task 2 the difference in very insignificant.

B1+ students in general performed much better in Task 1 than in Task 2 which suggests that the tasks themselves were not equal in difficulty for the students. In Task 1 results with audio input were higher by almost 0,9 and in Task 2 results with video input are higher by 0,4.

Looking at these results we couldn’t definitely conclude that one way of input is more beneficial for students than the other, i.e. we found no main effect for the presence or absence of visuals. It all depends on the task content. However, some significant interactions between the order of tasks were observed.

3.2 Comparison of Order of Tasks Input

We decided to reorganize the results and obtained a regularity. Even though we did not distinguish the most beneficial way of input, we found that students' results depend on the order of input methods. In group 1 the Audio was the first introduced way of input and in group 2 - video. No matter audio or video, the first input method was the one with more correct answers, with two exceptions - B1 level students in the second group had equal results and A1 level students performed better with audio input in both groups. The possible explanation for the fact that the mode that contained only oral stimuli resulted in better performance with A1 students can be attributed to the fact that they "were already used to this type of presentation and they did not feel nervous while listening" (İnceçay and Koçoğlu, 2017). During the first presentation of the video they had to decide whether they should physically orient their eye gaze to the video input (i.e. the video screen), orient to their test handouts, or switch back and forth between the two input sources. During the second presentation the test-takers were so busy looking at their papers and answering questions that they were not even watching the video monitor. To sum up, students at this proficiency level cannot decipher the speakers' articulation to benefit comprehension from it. These results are shown in Table 2.

Table 2. *Comparison of Average Results within Each Group Depending on the Order of Input Tasks*

	Average number of correct answers					
	group 1			group 2		
CEFR level	Task 1 Audio		Task 2 Video	Task 1 Video		Task 2 Audio
A1	3,5	>	3,25	3,75	<	3,875
A2	2,54	>	2,07	3,25	>	2,875
B1	3,8	>	3,4	3,3	=	3,3
B1 +	4,28	>	2,28	3,4	>	1,9

Even though the order of input did not dictate the results with 100% accuracy, we believe this pattern is consistent. There are two possible reasons for such regularity: 1) it might be difficult for students to switch from one type of perception to another. These tasks are quite short 2-3 minutes each, so it's hard for brain to switch activities: 2) the concentration might decline with the second task.

3.3 Analysis of students' feedback on the preferred input mode

After finishing both tasks, students were asked to give some feedback. They were to choose which way of input they preferred: audio or video. 114 students took part in the experiment. 57 preferred audio input and 52 - video, which leaves us with 5 students who stated that there was no difference.
Now let's look at these results according to the CEFR level of students in Table 3.

Table 3. *The Ratio of Audio/Video as Preferred by Students between Different CEFR Levels*

CEFR level	Audio	Video
A1	51,6%	48,4%
A2	48,3%	51,7%
B1	58,8%	41,2%
B1+	58,3%	41,7%

As we can see from the results in groups of B1 and B1+ levels more students preferred audio input, but with the difference being less than 10%. The figure of roughly 50% of those in favour of audio-only input mode is much smaller than 75% of those interviewed in the previous study.

It was mentioned earlier, students were not given any feedback on the tasks, they didn't know if their answers were correct or not. So when they chose the best way of input, it was totally subjective, because in fact they didn't know with which input method their results were better. This way we could see if students' subjective perception met the objective results. 80 students out of 114 chose the way of input in which they got more right answers, and 34 felt that either audio or video was easier to understand, but in reality they did better in the opposite input mode.

The second part of the students' feedback included an open question. They were to explain why they chose audio or video as a preferred way of input.

We can divide all the answers into some categories. Most students in favour of the audio firmly stated that "the video distracts my attention, it's hard to concentrate". It confirms the results of (Wagner, 2010) that "visual components of the video text could distract the learners' attention away from the aural input". The second argument in favour of the audio was "in the video there are street noises, which I don't hear in the audio". Complexity of input can overwhelm human mind with redundant information, reducing its ability to process. It's interesting to note that some students stated that the quality of the recording in video was worse and there were more street noises, although we were using exactly the same recording.

The reasons for video-mediated input mostly included the statements "emotions, gestures and face expressions help me understand better" and "in the video the speech is slower and clearer". The students did need to look at the visual cues such as speakers themselves and their articulation. The learners retrieved the necessary clues to accentuate the background knowledge to process information.

The least popular conclusion was that there was no difference at all.

Conclusion

The main purpose of this research was to decide which input mode, audio-only or video-mediated, the students of Ural Federal University can benefit from. The final decision is to affect the content of an online EFL course in terms of listening comprehension tasks. Previously, 70% of students had claimed that they wanted to have video rather than audio. Unfortunately, the experiment on the same students with different input modes produced confusing results with no strict prevalence for either of the modes. Meanwhile, the quantitative analysis of students' feedback produced evidence that the ratio of audio-to-video preferences was about 50/50% which is much smaller than 75%. It led us to conclusion that we need to design more audio-based tasks for teaching listening comprehension skills online. Supplementary results of the research were that students' performance depends very much on the order of tasks input and task types. These facts will become the subject for future research.

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Methodical aspects of remote trainings for unemployed people

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Abstract

Remote training is a prospective way to get high quality education for unemployed and unoccupied people living far away from territories concentrating academic and educational centers. However, organization of remote training within system of employment service requires appropriate methodical skills of teachers and their readiness to use innovative technologies for remote training in educational process.Among challenges teachers face in process of lessons based on results of authors' study the following have been noted: gathering materials that could be presented to audience remotely; methodical and didactical support; intermediary and final control. In part of process itself, main challenges named by teachers include the following: low level of audience discipline in process of video- and online conferences;untimely 'uploading' of individual works on respective portals;inability of audience to use relevant software and Internet resources; not readiness of certain citizens (mostly of elder age) to self-development and mustering computer software and other programs. However, absolutely all teachers having used remote technologies in process of teaching their disciplines have noted prospects and efficiency of said technologies and possibility for their active use in process of training unemployed citizens.

Keywords: unemployed people, unoccupied people, training, methodical skills of teachers

1 Introduction

The modern Russian labor market is seriously affected by general economic processes occurring not only on the territory of the Russian Federation, but also on a global, worldwide scale.

The globalization of trade and economic relations, export and import of production technologies make managers of enterprises, on the one hand, ensure competitiveness by reducing costs, using new technologies that is associated with reduction of number of employees and, as a consequence, increase in unemployment; and, on the other hand, raise requirements to staff, level of their professional competence that actualizes need for retraining of unemployed citizens according to programs most suitable for needs of employers.

The Law "On employment of people in the Russian Federation" (1991) declared status of unemployed person, rights of citizens to employment and professional education determined that professional training, advanced training and retraining of unemployed person should "be carried out in educational institutions of professional and additional education, training units of state employment agency or other educational institutions, educational units of organizations in accordance with contracts concluded with employment agency"(art. 23, cl. 2).

An active policy of citizens employment involving organization of professional training and retraining of unemployed citizens shall be aimed at creating an appropriate educational environment (Novikov, 1999). This, in turn, requires from educational organizations innovative approaches to organization of training, use of modern technologies increasing training process efficiency for unemployed citizens.

Definition of the word "unemployment" is given in Explanatory Economic and Financial Dictionary of Bernard and Collie, i.e. "suspension of employment beyond control of employee for a long period of time due to impossibility to work, usually as a result of termination of employment agreement between the person to be employed and employer" (Bernard, Colli , 1994).

According to definition of International Labor Organization, an unemployed person is a person who:

1) has no work at the moment;

2) takes specific and active measures to find a job;

3) is ready to start working at the moment .

Unemployed person is a special category of citizens with their own social and legal status which includes rights and obligations, responsibility for improper performance or non-performance of duties, as well as social guarantees and compensations provided for by the legislation to provide unemployed citizen with opportunity to exercise the rights granted.

Policy of Russia with respect to unemployed persons is characterized as an "active employment policy" with main element being a flexible and job-oriented system of professional training for unemployed citizens and unoccupied persons. The advanced form of organization of training for unemployed persons is a system of distance education called by experts in strategic education problems as educational system of the 21st century.

2 Research methodology and findings

To determine efficiency in use of distance technologies within professional training for unemployed citizens for their further development and use for training of unemployed persons, we consider a data of the author's research conducted in 2012-2015.

Within this period the author participated in organization of professional training of unemployed citizens of the Southwestern District of Moscow by professions demanded in capital labor market, by number of disciplines within the scope of professional retraining program "Human Resource Management", in particular. Training was conducted using distance learning technologies with specific list thereof being determined by teachers of disciplines independently in accordance with specifics of the courses taught.

And in 2012, and in 2015 the study was conducted by 2 stages: at the first stage graduates were asked to answer questionnaire. At the second stage teachers were interviewed in order to study their opinion on possibilities to use distance technologies in process of training of unemployed citizens.

To implement the program of professional retraining of unemployed citizens the following were made and approved:

- Basic curriculum including a list of disciplines for study, regulated forms of final control (graduate qualification exam and graduate qualification work);
- Calendar and disciplinary (academic) curriculum regulating time sheet by hours as per each discipline of basic curriculum indicating number of hours for all types of classroom work, self-guided work as well hours for study by using remote technologies;
- Methodological support for each discipline (teaching and methodological sets), training recommendations for graduate qualification exam and graduate qualification work.

Total amount of hours for training is 516 with 400 therefrom being in classrooms and on distance, 116 - self-guided ones.

In Curriculum (hereinafter CUR) developed in 2012 it is considered learning of educational program within 400 hours that are divided into 128 hours of classroom work and 102 hours using remote technologies and 170 hours of self-guided work, that is 32% and 25.5% and 42.5% respectively.

Following the results of implemented program the author conducted a survey among students in order to find out their attitude to distance technologies used in learning process. Survey data will be presented below.

Since feedback of students of program as a whole was positive further while implementing a similar program of professional retraining it was decided to increase number of hours allocated for training by using remote technologies.

In Curriculum represented in 2015 it is considered learning of educational program within 400 hours that are divided into 56 hours of classroom work and 174 hours using remote technologies and 170 hours of self-guided work, that is 14% and 43.5% and 42.5% respectively.

While amount of hours for learning of the discipline using remote technologies having being grown from 25.5% to 43.5%.

When training is completed graduates have been questioned about the program that made possible to assess possibilities to use distance technologies while training unemployed citizens. Selection scope is 339 persons: in 2012 - 115 persons, in 2013 - 124 persons.

Let's consider certain results of the research.

When answering the question "Why did you choose this program for retraining?" following answers have been given:

- "I worked in HR Department of small company and I liked it. Having studied the curriculum of "Human resource management", I realized that this will greatly enhance my knowledge in the field of HR management and, I hope, will allow me to find a suitable job".

-"I liked list of subjects of the program".

-"Suitable hours of training. Within year you can really learn HR technology and seek normal position in HR structure".

- HR management is always needed. In any company HR professionals are required".

Respondents were asked to estimate satisfaction with training program by 4-point scale, where:

4 points mean "I liked training, I am satisfied completely»

3 points mean "I liked training in general"

2 points mean "I do not like training in general"

1 point means - "I do not liked training, I was disappointed".

Results showed that in the year 2013 students were more happy with results of training rather than in 2012 (table 1).

Table 1. Indicators of satisfaction with training program, pers.

	2012, pers.	2015, pers.
4 points	11	32
3 points	68	83
2 points	29	9
1 point	7	

The data shows that in 2015 almost 93% of students were satisfied with training completed, while in 2012 this index was 68.7%. It is also notable that in 2015 there were no students who strictly replied that they did not like training, they remained dissatisfied.

Assessing a comfort of the educational environment in 2012 students scored the highest marks to such indicators as "class schedule" and "comfort of study rooms", in 2015 - "teaching technologies", "content of training program" and "expertise of teachers".

In 2012 only 6% of students had experience in training with remote technologies, while in year 2013 this number considerably grew up to 14%. As an age group of students remained almost the same this shows that, by getting both basic and additional professional education, students increasingly meet innovative (including distance) teaching technologies more and more.

Evaluating distance technologies used in the training process the following ones were deemed to be the most interesting:

- "mutual evaluation of practical and team works through "VKontakte" program;

- webinars;
- video lectures.

In addition, respondents noted such technology as video materials in the Internet with references thereto given by teacher.

Answering question "What challenges did you face in the process of training on the distance?" students noted that the biggest problem is self-organization, time management skills, ability to schedule a day so that one could have time to do tasks, join team work online on time.

Among expenses that had to be incurred by students due to learning using remote technologies is a purchase of web camera and Internet connection.

Students recognize that learning by remote technologies is much more difficult than using traditional auditor ones.

Speaking about advantages of distance learning, respondents called such "pluses" as:
- opportunity to choose their own time to learn material;
- possibility to re-watch video materials and materials put on the Internet;
- reduction of costs for traveling to place of training;
- additional knowledge obtained while studying materials suggested by teacher.

To disadvantages of remote learning respondents included the following:
- mental difficulty in learning by such technologies ("however, we were used to standard classes: desk, blackboard, teacher near boards, he lectures - we write down an abstract");
- inability to use a computer in a degree sufficient to pass tests;
- inability to ask teacher a question during a course of study of material.

In general, as study showed, distance technologies in training of unemployed citizens are promising, highly appreciated by students themselves.

As for teachers 100% of specialists who participated in the program of professional retraining of the unemployed citizens "Human Resource Management" answered “Yes” to the question "Is it supposed by subject taught by you possibility to conduct several lessons on a distance?”

In spite of this fact, in 2012 12 of 17 teachers did not conduct remote lessons referring fact that:
- have no corresponding tools (computers, Internet connection, webcam, software, etc.);
- have no experience in conducting remote lessons;
- do not consider such lessons as appropriate;
- consider remote lessons inefficient.

In 2013 the situation has changed significantly. Since the questionnaire survey conducted among students showed that, in general, distance technologies are evaluated positively by students and should be developed, in 2013, when creating staff of teachers, one of initial requirements to their professional competence was availability to conduct lessons in a distance form and develop appropriate methodological support. Therefore, in 2013 only 2 teachers out of 21 did not use remote technologies while teaching.

Difficulties that teachers faced while conducting lessons are as follows:
- collection of materials that can be presented to students in remote form;
- development of methodological and didactic support;
- intermediate and final control.

Concerning directly to process of conducting lessons, the main difficulties noted by teachers are following:
- low discipline of students during video and on-line conferences;
- late "put" of self-guided works in related resources;
- inability of students to use relevant programmes and resources of the Internet;
- inability of certain citizens (mostly older ones) to self-development and learning of computers and other programs.

However, absolutely all teachers who used remote technology in the process of teaching their subjects, noted the prospectivity and effectiveness of these technologies and their use in training of unemployed citizens.

Conclusion

According to available results of the experiment, the following main advantages of the distance learning system applied to unemployed citizens can be singled out:

- opportunity to practice at own convenience, in convenient place and pace (a special period of time for learning of discipline);
- access to many sources of educational information, as well as communication by email with each other and with teachers;
- focused presentation of educational information in the form of modules and multiple access thereto that increases efficiency of learning;
- equal educational opportunities regardless of place of residence, similar quality of educational services;
- improve of creative and intellectual potential of students through self-organization and desire for knowledge;
- maximum differentiation and individualization of education on the basis of individual needs of students, level of education orienting to development of needs for self-acquisition of knowledge and skills;
- reliance on life experience of student and previous set of knowledge that allows to individualize training and, as a result, to cut learning time without affecting quality of learning process, self-study skills;
- update and upgrade of role of teacher in accordance with new developments and innovations.

Distance learning is a promising way to obtain education of good quality for unemployed citizens and unoccupied persons living away from territorial entities where scientific and educational centers are focused. However, organization of remote learning in employment service system requires appropriate methodological skill of teachers and their desire to use innovative remote learning technologies in educational process.

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Interactive forms of teaching “pilgrim tourism”: creation and use in distance training of managers of tourism

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Abstract

The main part of the manual represents an interactive map of Russia with the main places of pilgrim tourism applied on it - the holy sites, monasteries, cathedrals, mosques, synagogues and other cult objects. The map is a practical manual for drawing up a route, calculation of a tour, creation and development of new pilgrim directions and their information support.The students using separate modules of this program are capable to make own algorithm and the guide to a certain route, to create the excursion story about the main stages of development of that, or other pilgrim place of interest, to examine interesting historic facts, myths, stories and beliefs. Brief information on a condition of this or that monastery, the temple complex, church, etc., statistics of their attendance, state programs and grants for the solution of problems of protection and support of pilgrim places in Russia are also listed in the manual. The data of sociological research on efficiency of using this manual in the system of distant teaching of students in the Tourism and Hotel Business directions are provided in the article. The main quantitative indices, data of focus groups and expert interviews of teachers concerning their professional pedagogical experience of applying the manual are also presented.

Keywords: tourism, pilgrimage, online training, virtual tour

1 Introduction

Presently it is quite often possible to hear such phrases as "pilgrim tourism", "pilgrimage tour", "pilgrim excursion" and so on. All of them result from misunderstanding of an essence of pilgrimage, from its rapprochement with tourism on net external similarity. Both the pilgrimage, and tourism are connected with a travel subject. However, despite similarity, they have the different nature. Even visiting the same holy sites, pilgrims and tourists do it differently.

Tourism — this travel with the informative purposes. And one of popular types of tourism is tourism religious. The main thing in this type of tourism — acquaintance to history of the holy sites, life sacred, architecture, church art. It is told about all this at excursions which are the most important element of travel for the tourist.

2 Features the study of tourism disciplines

Pilgrim tourism as one of types of tourism is studied in total with other types of tourism by students of tourist specialties of higher education institutions.

Training in tourist specialties in Russia to which "Pilgrim tourism" in modern higher education institutions belongs assumes use of forms and methods of interactive training.

In training process it is necessary to pay attention first of all to those methods in case of which listeners identify themselves with a training material, join in the studied situation, are induced to active actions, endure a condition of success and respectively motivate the behavior. Most interactive training methods meet all these requirements.

The educational process relying on use of interactive training methods will be organized taking into account an inclusiveness in process of knowledge of all students of group without exception. Joint activities mean that everyone makes the special individual contribution, in a work progress there is a knowledge sharing, ideas, activities methods.

Will be organized individual, pair and group work, the project work, role plays is used, work is carried out with documents and various sources of information. Interactive methods are based on the principles of interaction, activity of trainees, a support on group experience, obligatory feedback. The environment of educational communication which is characterized by openness, interaction of participants, equality of their arguments, accumulating of joint knowledge, possibility of a mutual assessment and control is created.

The leading teacher together with new knowledge carries participants of training to independent search. Activity of the teacher gives way to activity of students, creation of conditions for their initiative becomes his task. The teacher refuses a role of the peculiar filter missing through itself educational information and executes function of the assistant in operation, one of information sources. Therefore interactive training is urged to be used initially in intensive training enough adults who are trained.

3 Interactive forms of learning pilgrimage tourism

Interactive ("Inter" is mutual, - to work with "act") – means to interact, be in the mode of conversation, a dialog with someone. In other words, unlike the active methods, interactive are oriented on broader interaction of students not only with the teacher, but also with each other and on domination of activity of students in training activity. The teacher's place on interactive occupations is reduced to activity of students on achievement of the objectives of occupation. The teacher also develops the plan of occupation (usually, it is interactive exercises and jobs during which execution the student studies material) (Voronkova, 2010).

Interactive training — is the special form of the organization of cognitive activity. It implies quite specific and predicted purposes.

The purpose consists in creation of comfortable conditions of training under which the student or the listener feels the success, the intellectual competence that does productive training activity, to give knowledge and skills, and also to create basis for operation according to the solution of problems after training ends.

In other words, interactive training is, first of all, dialogue training during which interaction between the student and the teacher, between students is carried out.

Tasks of interactive forms of education are: awakening at trained interest; effective assimilation of a training material; independent search by pupils of ways and candidate solutions of the set educational task (a choice of one of the offered options or finding of own option and reasons for the decision); establishment of influence between students, training to work in the command, to show tolerance to any point of view, to respect the right of everyone for a freedom of speech, to respect its advantages; formation at trained judgements and the relations; formation of life and professional skills; an output on the level of conscious competence of the student.

There are also other types of interactive training in tourist specialties (techniques "Take a position", "Decision tree", "Pops-formula", trainings, a socratic dialog, group discussion, interactive excursion, a video conference, focus group, etc.), which can be used in training activity of students.

Besides, the teacher of chair can apply not only nowadays existing interactive forms, and also to develop occupations, new depending on the purpose, i.e. actively to participate in enhancement process (Vislobokov, 2016).

The principles of operation on interactive occupation: occupation – not lecture, but the general operation; all participants are equal irrespective of age, the social status, experience, an operation place; each participant has the right for own judgement on any question; there is no place to direct criticism of the personality (only the idea can undergo criticism); all told on occupation – not the guide to action, but information to speculation.

We will call the disciplines, most important for study, "Pilgrim tourism" of the form of interactive training. It: compilation of the electronic dictionary, creation of an interactive map in pilgrim places of Russia, interactive excursion, a video conference.

Occupation excursion is such form of education in case of which trained perceive and acquire knowledge on the location of the studied objects (in this case with pilgrim places of Russia, etc.) and direct acquaintance with them. The principal advantage of virtual excursions – without leaving audience to examine the objects located outside an office, the city and even the country. It increases informtiveness and productivity of educational activities.

During excursion the audience not only sees objects on the basis of which the subject reveals, hears about these objects necessary information, but also seizes practical skills of independent observation and the analysis. Virtual excursions are a new effective presentation tool by means of which evident and fascinating demonstration of any real place of the general public – whether it be the country, the city, national park, the museum, a pilgrimage place is possible.

Video conference.Technique of interactive occupation in the form of a video conference is conference. Visualization and use of a video conferencing belongs to use of information communicative technologies in education (Antoni, 2014).

The video conferencing is two-or polygonal communication for audio delivery and the image which can be used for all types of meetings when in addition to audio delivery visualization is necessary. Participants are partitioned geographically, but all the same, can see and hear each other. Video conferences can be carried out between two or several studios as within the country, and between the different countries. Polygonal conferences it is often coordinated by the external organization.

The format of a video conference opens new opportunities for participants. First, not always there is an opportunity to go to business trip for some days to other city to appear at a seminar. The video conference allows to appear with the report without costs of time and forces of traveling. Secondly, this format of meeting allows to integrate participants not only from the different cities, but also from the different countries that, certainly, promotes exchange of experience.

For successful carrying out video conference sessions, practical and pedagogical preparation is necessary. Speakers and listeners shall have opportunity to analyze training and to give a constructive assessment of carrying out conference.

Carrying out video conferences in training activity requires special knowledge in the field of electronic pedagogics. As the video conference assumes interactive communication of the teacher with students, the electronic pedagogics imposes special requirements to psychology and pedagogical preparation and the organization of the most educational process as from the teacher, and listeners. Therefore in the trained audience there shall be an employee (tutor) who helps to organize training activity in audience. For the organization of educational process in the form of a video conference the teacher shall be prepared not only with methodological, but also from the technical point of view that requires knowledge and abilities to work with the computer, with other managing directors of systems for switching of the mode of monitors, different applications (Chepyzhova, 2016).

Compilation of an interactive map of pilgrim places of Russia is a development and creation of the site, already on the basis of available separately lighting these or those places and routes of pilgrimage of Russia. The interactive map of Russia with the main places of pilgrim tourism holy sites, monasteries, temples, cathedrals put on it, is the important practical manual for compilation of a route, calculation of round, creation and development of the new pilgrim directions and information support of a route.

The students using separate modules of this program can make own algorithm and the guide to a certain route and the main stages of development of this or that pilgrim sight, to examine interesting historic facts, myths, stories and stories and beliefs connected to some terrains or sights, for compilation of the booklet or advertizing for excursion bureaus and agencies and involvement of both collective tourist groups, and personal pilgrims.

There are brief information on a status of this or that monastery, the temple complex, church, etc., statistics of their attendance, and also the main problems of pilgrim tourist clusters and state programs and grants for the solution of problems of protection and support of pilgrim places in Russia are listed (Shvyrina, 2010).

In case of research of practical application of this manual the increase in interest of students in this type of tourism was revealed.

4 The guides work on pilgrimage

So, in practical operation on independent development of a route use resources of this interactive manual in aspect of historical information about places of pilgrim tourism of 45% of the polled students (from 130 respondents), electronic helps about geographical features of terrain, about types and duration of journey and possible placement of pilgrims – 38% from the same number of respondents, the help information about important religious and historical dates and the traditional for these place marked dates connected to history of the holy site and own holidays of places of a pilgrim route – 17%.

This analysis gives the chance to draw a conclusion on importance of framing on the basis of further use of the interactive manual "Map of Pilgrim Tourism of Russia", such competence-based approaches in professionalising of future managers of tourism as need of independent development of a route, ability to compare a price policy of movement, living and seasonality of relocation, in these or those areas and edges in the territory of which there are pilgrim sights, and on the basis of the systems and complex analysis to build perspective of attendance of the holy sites with attraction of an external and internal tourist flow.

The main sites for creation of an interactive map of pilgrim places of Russia the following:

- orthodox monasteries and video about them: http://tours-tv.com/ru/typew/Orthodox-monasteries;
- orthodox rounds - http://everydaytravel.ru/m-08.htm;
- pilgrim routes across Russia - http://www.marshruty.ru/Travels/TravelGoogle.a spx?TravelID=cf678a6c-ad25-4cec-8cfe-4ebd2b015adf;
- pilgrim tourism in Russia - http://www.tour52.ru/Vidy-otdyha/religi os/palomnicheskiy_turizm_v_rossii.html;
- pilgrim services in Russia - http://palomniki.su/adverts.htm;
- the holy sites in Russia: pilgrimage/ an information portal - http://www.paloma.tkks.ru/%D1%81%D0%B2%D1%8F%D1%82%D1%8B%D0%BD%D0%B8/holy-russia.html;
- interactive map of Islam in Russia - http://dumrf.ru/regions/77/event/5373;
- the orthodox pilgrim - http://www.palomniktour.ru/tury/palomnichestvo/krym/, etc.

Conclusion

- Thus, implementation of interactive forms of education – one of the most important directions of enhancement of training of students in the modern higher education institution. Now for the teacher it isn't enough to be competent of area of the specialty and to transfer huge the knowledge base in the audience filled with the students who are eager for knowledge.
- And though new views on training aren't accepted by many teachers, it is impossible to ignore data of many researches confirming that use of the active approaches is the most

effective way promoting training of students. In simple terms, students investigate easier, understand and remember material which they studied by means of the active involvement in educational process. Proceeding from it, the main methodical innovations are connected using interactive methods of training today

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The use of e-Learning technologies in orphans training programs

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Abstract

There is an increasing number of orphans and children left without parental care worldwide according to national monitoring as well as individual scientific studies. Education helps to improve the efficiency of children's social adaptation and expand their world outlook. The research was carried out in 2016-2017 on the territory of three large regions of Russia (Belgorod, Saratov, Zabaykalye), and was based on the use of in-depth interviews with Information technology school teachers. The interviews of teachers (n = 84) confirmed the effectiveness of using multimedia with children without parental care at school training programs, especially in rural areas where they can have an access to different kinds of professionals, such as psychologists, social workers, practitioners, etc. via Internet resources, as well as they can create a virtual group of classmate and other children to share the learning materials, to discuss the most important issues concerning the children's adaptation and the methods of communication with their biological parents, potential foster parents, and another orphans. The remote training is conducted solely by posting information on the web-site of the organization, the use of tutorials, videos and audio materials. The most effective distance education technologies are videos, themed movies, cartoons, short stories. One of the main factors of learning by using video is that every Information technology school teacher can create his/her own video to share the experience of solving typical problems based on real life events.

Keywords: E-learning technologies, Children without parental care, School, Education.

1 Introduction

Currently scientists and practitioners agree that orphans and children left without parental care should be placed in foster care instead of institutions, if their biological parents' rights are terminated. The situation is exacerbated by the fact that only 15% of children have lost their parents while 85% of them have parents who are alive, but do not responsible for them (Ananchenkova, 2011).

In Russia the number of children left without parental care much higher than the number of foster families. The majority of adoptive parents prefer newborns or toddles with good fiscal and mental health, without siblings. Other children are forced to live in orphanages until 18 years. In this connection, it is necessary to create the favorable environment for children, living in institutions for their full adaptation and integration into the society. According to the research about 10 % of residential institutions' leavers are successfully socialized; the rest join the ranks of homeless, offenders, or commit suicide (Abelbeysov & Akimova, 2013).

In order to increase the efficiency of orphans' social adaptation it requires the implementation of new e-learning technologies in educational process of institutions, focused on independent life after leaving. Some of them are successfully used with different categories of children, for example, migrants. First, migrants have difficulties to maintain their ethnic and cultural identity in the host country, it is especially truly for migrant children who much faster than adults can integrate into the host community and lose their ethnic and cultural identity. Secondly, the Internet provides to children an access to wide range of educational resources regardless of the area of their residence. Most of these trainings are conducted in native language, in the traditional ethno-cultural context. Third, the content of distance learning can be individual, depending on age, previous education, personal interests, etc. Fourth, distance education can be used by migrant children as well as the whole migrant community. Fifth, distance education can include a range of disciplines and activities specific to particular ethno-cultural groups of migrants (linguistics, religious studies, history, literature, cooking, crafts, etc.) (Volkova, Besschetnova &Ostavnaja, 2017).

There are many educational tools that can help children to become active in their construction process of their knowledge and one of them is the concept of cartoon. Cartoon can be interpreted as a teaching resource that combines visual elements with textual information and then makes use of contextual clues like gestures, dialogues and animations to interpret a certain topic (Fun Learning, 2017).

Nowadays, scientists, computer engineers, and educators develop a special rank of electronic resources which help working with children with special needs (Fun Learning, 2017; Kid Game Learn videos for Kids, Toddlers & Babies., 2017; Elearning animation, 2017).

2 Data and methodology

The purpose of the research was to study Information technology school teachers' opinions about the problems and possibilities for the implementation of e-learning technologies in the educational process to improve physical, mental, emotional development of orphans. The research was carried out in 2016-2017 on the territory of three large regions (Belgorod, Saratov, Zabaykalye), located in Russia. The methodological focus was qualitative, based on an exploratory study. We used in-depth interviews with 54 Information technology school teachers who work in secondary schools where children left without parental care studied together with home children. The type of sample was solid. The vast majority of interviews were made in the working places of the respondents. Participants were guaranteed full anonymity and confidentiality of information.

3 Empirical results

The way of life inside the institutional care forms some negative personal characteristics such as parasitic attitude to other people, government or social services; warps their values; prevents from socially approved behavior regarding getting well education, well-paid job, family creation. Most of them are focused mainly on themselves, rarely to peers, and almost never on the society outside the institution (Abelbeysov &Akimova, 2013).

Modern distance education includes such main ways of information's transmission as electronic mail, television, information communication networks. The most popular e-learning technologies used at school are those which, on the one hand, do not require significant financial costs or technical conditions, and on the other hand, meet the goals and objectives of the study. Due to limited funding some schools cannot afford to buy licensed software (e.g., Soft E-learning, Upside Learning, Adobe, NetOP, etc.), but having the connection to the Internet, they can provide the educational activities of well quality.

Thus, we can identify inexpensive and available Internet technologies, provided by schools through distance education to children left without parental care:

1. Skype. This software allows to support video chat, video conferences in real time. Using Skype the teacher can control and compare results at one-time (for example, the total dictation, contest papers, workshops, etc.) as well as bring together several participants for a group work project.
2. Video broadcast. As a rule, students are interested in such educational materials as master-classes, screenings of sport or creative activities (dancing, yoga, gymnastics, cooking lessons, crafts, etc.). In addition to that, one of the most popular types of activities is an invitation of a special guest (coach, instructor, master, etc.), and organizing a discussion.
3. Teleconferences. They are a kind of video broadcast and are used for making various kinds of competitions or trainings (presentations in the TED style, debates).
4. Cartoons. They entertains children in their learning process in a way that they do not even know they are learning. It helps them to work out their imagination especially through the use of colourful characters, funny animations and proper music. In short, the children are doing fun learning activities and at the same time building proper knowledge (Fun Learning, 2017).

Working with children, we recommend the use of electronic resources that contain cartoons, short stories, training programs (Fun Learning, 2017; Kid Game Learn videos for Kids, Toddlers & Babies., 2017; E-learning animation, 2017). The study shows that the introduction of e-learning technologies in educational process allows children to be enrolled in residential facilities, to expand the knowledge of the world, to get the access to information resources, to develop communication skills as well as self-presentation.

Information technology school teachers have identified some specific physical and psychological characteristics of children left without parental care which can be corrected by using e-learning technologies (Table 1).

Tab. 1 – Physical and psychological characteristics of children left without parental care by using e-Learning technologies

	Characteristics of children	Answer (%)
1	Unstable academic motivation	92 %
2	Increased emotional sensitivity to other people' opinions	75 %
3	Unpredictable emotional and behavioral reactions	78 %
4	Low motivation to sports activities	87 %
5	Low motivation to the world' exploration	89 %

The use of distance learning technologies allows to diversify methods of studying school subjects and to form an active learning environment (Table 2).

Tab. 2 – The directions of education, used by Information technology school teachers

	Directions of education	Answer (%)
1	Modernization of existing educational programs	87 %
2	Approbation and introduction of innovative technologies (information and communication, problem-search)	96 %
3	Empowering virtual space to meet socially approved interests of children	91 %
4	Improving the system of monitoring and information security	98 %

Thus, according to the respondents' answers, e-learning technologies help children, living in out-of- home care better learn the material, supporting it by audio and video effects; to improve their academic achievements; to make easier the process of adaptation to the new school environment; to increase self-esteem and personal social status.

The results of the research can identify several groups of children's educational and creative interests in the virtual space (Table 3).

Tab. 3 – Children's educational and creative interests in the virtual space

	Children's interests	Answer (%)
1	Sport events, physical training exercise, yoga, etc.	19 %
2	Dance events, fashion show, learning dance moves	21 %
3	Technical art, modeling, handmade crafts	7 %
4	Training sessions for artistic creation, the formation of practical art skills (embroidery, beading, patchwork)	18 %
5	Information technologies and practical skills (search the information in the Internet)	17 %
6	Reading (scientific, academic literature, fiction, etc.)	2 %

Along with advantages, we should highlight some disadvantages of distance e-learning education which are typical for children living in institutional care (the absence of the personal computer and the open access to the Internet; insufficient computer literacy training; the lack of strong motivation and hard self-discipline; small practical experience about the real life outside the institution).

Conclusion

Thus, the integration of modern information technologies into education system of institutional care for children left without parental care allows solving the following problems:

(1) to improve the quality of education through the access to many information resources and interactions with highly qualified teachers, tutors and other professionals in order to fill the gaps of missing skills on the school subjects;

(2) to receive supplementary education which will contribute to the development of their creative abilities and socialization;

(3) to develop initial professional skills by using the latest computer technologies as the basis of their future profession;

(4) to get the experience of communication with other peers, to get involved in different kinds of social approved activities outside the institutions;

(5) to equalize chances for getting good education for children leaving in institutions compared with home children;

(6) to create the network of students' social contacts living in different boarding schools or residential care, located in Russia' regions;

(7) to participate in scientific, creative competitions, festivals, group work, discussions with their peers abroad.

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Application of educational technical tools foranalysis the color of essential oils from white oregano

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Abstract

The analysis of known literature show that there are a few publications related to measurement of color of white oregano essential oils. There are no known publications in accessible literature of measurement of color of these essential oils by document camera. Established is the possibility of measuring color with document camera in direction of determining the color characteristics of essential oils.The effectiveness of this type of measurement is confirmed by the study results.

Keywords: Color measurement, Document camera, Principal component analysis, Discriminant analysis

1 Introduction

Extracts and essential oils are an alternative, especially in the treatment of resistant strains of yeast. They have anti-tumor and immunomodulatory activity, mainly due to their various phenolic and terpenoid antioxidant compounds, some of which exhibit antimicrobial activity Color of these essential oils is important for their commercial value(Ali et al., 2015; Georgieva et al., 2016).These properties reveal potential opportunities for searching for Bulgarian essential oils with inhibitory action.

The white oregano (*Origanum vulgare subsp. Hirtum (Link) Jetswaart*) belongs to the family *Lamiaceae*. Most of the family members, including white oregano, contain essential oils, which determines their wide use as spices, medicinal plants, raw materials in perfumery and cosmetics (Dobreva, 2005).

The production and analysis of essential oils of white oregano are the subject of training and research at the Department of Food Technologies at the Faculty of Techniques and Technologies in Yambol, Bulgaria. The training in the direction is done with modern means of presentation.

The document camera enables the presentation persistently on objects with high accuracy and speed. The device can in like manner be used to make pictures or video of objects and substances, a couple of models are totally organized with the software tools and hardware of interactive white boards. The document camera can be used for view of static and dynamic objects for showing of examinations, increase picture and presentation amplified microscopic objects(Stoykova, 2014).

In addition to the main features of the presentation, the contemporary level of science and technology, in the available literature (Nedeva et al., 2013; Baycheva et al., 2016) it is stated that a document camera can be used to measure the color, dimensions, surface characteristics of biological objects, food and technical products.

The aim of this report is to establish the possibility of measuring color with document camera with direction of determining the color characteristics of oregano essential oils.

2 Exposure

30g of the fresh plant, dry leaves and 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.

To obtain the color characteristics of essential oils from different parts of the plant, an Epson DC-11, 5MP camera using diode lighting is used.

To distinguish between oils of different parts of the plant can be used in different color models. One of the tasks is to determine what color model allows the subject to be detached under the specific conditions.The following color models are used: RGB, HSV, Lab, LCH, CMYK.

Method principal component analysis (PCA) is used to select the color features.

To distinguish the individual essential oils a discriminant analysis with three non-linear separating functions is used (Mladenov et al., 2015).

3 Results and discussion

Figure 1 shows the developed experimental setting for measuring the color of essential oils with a document camera.The system consists of a personal computer with image acquisition, processing, and image analysis software that sets the color components for the white oregano oils tested.

The orientation of the image is adjusted by a rotating mechanism of document camera.

Presented are samples of essential oils of fresh plant, dry leaves and inflorescence.

From the analysis of the principal components, it was found that the informative color components for the analyzed white oregano essential oils are B (RGB), G (RGB), H (HSV), L (LAB), L (LCH), M (CMYK).These color components are used as features for classification of the three types of essential oils.

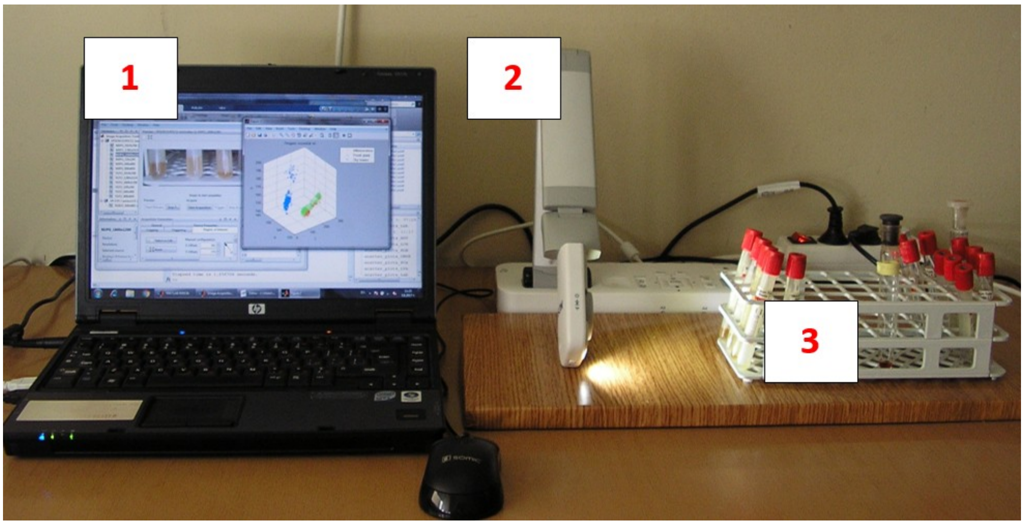
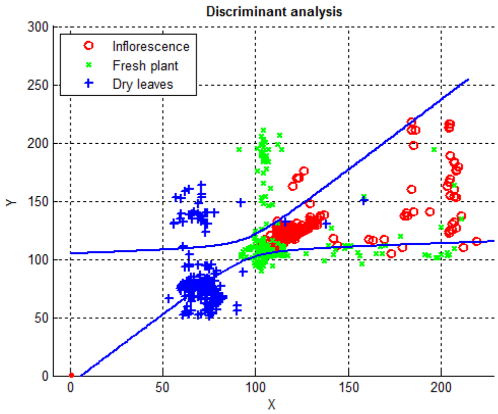
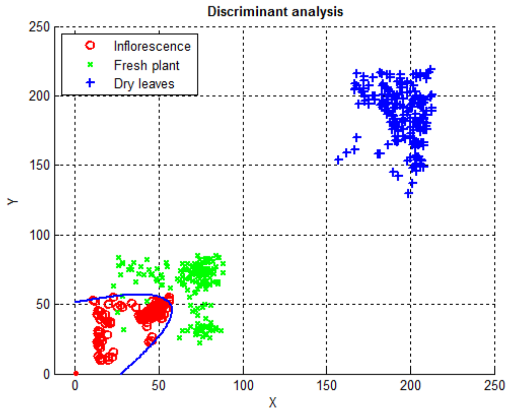


Figure 1. Laboratory setup for measurement of white oregano essential oil color
1-personal computer with software; 2-document camera; 3-measured samples



a) byL (Lab)color component, e=18%



b) by M (CMYK)color component, e=2%

Figure2. Examples of separability of essential oils by color components by nonlinear discriminant analysis

Figure 2 presents results for the separability of essential oils from different parts of the white oregano plant by non-linear discriminant analysis.In the example shown, using the L (Lab) color component, there is overlapping the values of this color model for the three types of essential oils.Using the M (CMYK) color component, a clear distinction is made between dry-leaf essential oil pixels, while the fresh stem and dry inflorescence pixels partially overlap.
Table 1 lists the values of the common classification error among the color components of the three types of essential oils.High values of this error are observed, reaching up to 53% when using the L (Lab) color component.With error of up to 5%, the three types of essential oils of M (CMYK) and B (RGB) color components can be simultaneously distinguished using a quadratic separating function of the discriminant classifier.

Table 1. Common error (e,%) with simultaneous classification across classes

Color component	**Discriminant function**	**e,% between p1- dry inflorescences; p2 - fresh plant; p3 - dry leaves.**
G (RGB)	Quadratic	19%
	Diagquadratic	21%
	Mahalanobis	26%
B (RGB)	Quadratic	5%
	Diagquadratic	16%
	Mahalanobis	19%
H (HSV)	Quadratic	43%
	Diagquadratic	51%
	Mahalanobis	50%
L (Lab)	Quadratic	53%
	Diagquadratic	49%
	Mahalanobis	39%
L (LCH)	Quadratic	32%
	Diagquadratic	29%
	Mahalanobis	31%
M (CMYK)	Quadratic	2%
	Diagquadratic	13%
	Mahalanobis	22%

Conclusion

The report presents results from analysis of the possibility of measuring color of white oregano essential oils by document camera in course of deciding the basic features of these oils.

A laboratory set-up has been developed to facilitate the measurement process.An advantage of this arrangement is that a learning technical tool is used. No additional equipment for measuring the color of essential oils is required except for a document camera which also serves to present the results of the measurements.

It has been found that a suitable color feature to distinguish essential oils from different parts of the white oregano plant are the M (CMYK) and B (RGB) color components, because in their use the common error of the simultaneous classification of the three essential oils is up to 5%.

Research will be continued with an assessment of the possibility of applying spectral characteristics in the visible range using the full spectrum of essential oil images.

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Online Collaboration for Improving the Quality of Training Course for Craft Tapestry In Egypt

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Abstract

The courses for Craft Tapestry in Egypt meet the required standards for the preparation of the students from Kafrelsheikh University, Egypt - Performance standards, Textiles and Apparel standard and Technological standards, when applying the electronic forms for training. The report are examined and analyzed the various forms for online collaboration solutions which shall be selected according to the specificity of each task which have to fulfill the students during their training. Presented are the most popular programming applications for sharing of knowledge, which are the most adaptive. Traced are the main stages for the implementation of the instruments for online collaboration. It was separated from the place of open source, shareware and free collaboration tools. They are made outlets are their role in improving the quality of the training in the conduct of the course in craft tapestry in Egypt.

Keywords: e-learning, online collaboration, training, Craft Tapestry

1 Introduction

Collaborative learning is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product. Collaborative learning is based on the idea that learning is a naturally social act in which the participants talk among themselves(Srinivas, 2011a).. The concept of collaborative learning, the grouping and pairing of learners for the purpose of achieving a learning goal, has been widely researched and advocated - the term "collaborative learning" refers to an instruction method in which learners at various performance levels work together in small groups toward a common goal. The learners are responsible for one another's learning as well as their own. Thus, the success of one learner helps other students to be successful(Srinivas, 2011).

The broadest definition of 'collaborative learning' is that it is a situation in which *two or more people* learn or attempt to *learn something together* (Dillenbourg, 1999).

The purpose of the report is to describe and analyse the opportunities that students have learned in the Craft Tapestry course for online collaboration in order to achieve a higher quality of their training to accomplish their learning tasks.

2 Materials and Methods

This course is an introduction to drawing the Tapestry a variety of materials. The focus is on using visual elements, and proportion and symmetry, for raw materials, and studying this course, students must be able to demonstrate proficiency in drawing the Tapestry figure, and by completion of the training program crafts men are able to: understand the composition of Tapestry design with lines and colors, textures and design structure/properties, and performance relationships of couture tapestry, Conscious relationship couture configure design elements (mixing colors and raw materials) understand the composition of couture configure Tapestry to configure elements of tapestry.

The aim of the course is: to give craftstudents the basic knowledge and skills of fashion design techniques, and aims to increase knowledge and skills in the visual field of fashion design. And attention to focus on the basics of fashion design (color, lines and textures "body proportions", and design elements, and structural composition of components of uniform, students should be able to explain the different methods and their application in couture on representational images:

- The crafts men qualify for and pass the high level design systems clothes and fabric textures and properties, and textile design, and on the human body.
- Give and develop the ability to sense perception fantasizing on expression and translation of ideas into fashion design models
- Professionalization and development of capacity to implement and apply models couture garments industry contributes
- Learn how to identify different kinds of designs for clothes according to job performance and its relation to the structural composition of the human body.
- Emphasis on implementation and simple layout structures of the human body.
- Identify methods of couture clothing fabrics formed on the body similar to the human body, elements of human body structure and fabric structures and prepare their constituents.
- Hands and skill development configure design elements (fonts, colours and materials)
- Learn how to configure the human body;
- Learn how to configure elements of human body structure;
- Professionalization and development of skill for the relationship between colour and structure components of the human body;
- Emphasis on fashion design with lines and colours and textures coating systems on the human body. To produce innovative models for garments.

There are learning expectations for students from training course for craft tapestry: analyze the significance of tapestry and fashion; examine the impact of fashion trends and forecasting on tapestry and products; examine tapestry styles and features; analyze the impact of technology on textiles and tapestry design, production, and sales.

According to Performance standards students have to:

- - Examines the psychology, symbolism, and terms related to tapestry color;
- - Practices using color schemes and illusions effectively in tapestry;
- - Chooses colors of tapestry than enhance physical appearance;
- - Identifies elements and principles of tapestry design;
- - Explains how to use principles and elements to enhance the appearance of tapestry;
- - Explains how principles and elements of design are used in tapestry design and construction;
- - Describes silhouette and its effect on appearance.

There are Textile and apparel standard that required student to demonstrate design skills in textiles and apparel selections.

According to International Society of Technology in Education (ISTE) there are ISTE Standards for students. We can resume them as follow (ICTE, 2017):

1. **Creativity and innovation.** Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.

2. **Communication and collaboration.** Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

3. **Research and information fluency.** Students apply digital tools to gather, evaluate, and use information.

4. **Critical thinking, problem solving, and decision making**. Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

5. **Digital citizenship**. Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

6. **Technology operations and concepts**. Students demonstrate a sound understanding of technology concepts, systems, and operations.

For Collateral Development a**n** eLearning community may work towards (White, 2017):

- Documentation of best practices and standards for eLearning in an organization;
- The development of precedents for eLearning, i.e. storyboards and session plans;
- Development of competency standards for eLearning professionals that can underpin business-wide stewardship in this area.

The methods used to achieve the goals set in the report are monitoring students' work, analyzing the results, discussing and interviewing them during and after the completion of their tasks.

3 Discussion and results

First and foremost, you should focus on usability and accessibility when selecting collaboration tools for your eLearning course or deliverable. Another key consideration to keep in mind is how the collaboration tool will serve your primary learning goals. Ideally, you want to choose a collaboration tool that is going to be user friendly for all of your learners, and can be accessed on a variety of different devices, such as mobile phones and tablets. The collaboration tool should also fit in with your strategy and allow learners to gain skills, insight, and experience that will help them to achieve the learning objectives of the eLearning course (Pappas, 2014).

3.1 Sample performance tasks for students training

Sample performance tasks for students training in Craft Tapestry are as follow:

- Participate in a “colour analysis of tapestry”.
- Work in pairs to develop a personal analysis. Identify personal features to consider when selecting tapestry.
- Using a computer analysis program, determine tapestry styles appropriate for various types of silhouettes.
- Select different examples of texture and patterns; explain how the tapestry would affect one’s personal choice.
- Determine most desirable/flattering colours by using tapestry swatches for individual skin tones and how these colour schemes can be used in personal tapestry choices.
- Forecasting and cerate samples of the ancient history of school of tapestry arts and indicator of simple.
- The modern school of tapestry arts and indicator of simple.
- Forecasting markets needs of design tapestry.

3.2 Collaboration tools for students of Craft Tapestry

For the collaboration, the students in the specialty use the social media and platforms they are familiar with.This is realized with the help of their mentors who monitor the work process in order to assist students and to gather necessary personal impression of the participation of each student in the process of realization of the given task.

Facebook.Through Facebook groups students remain organized as a team.The creation of Facebook closed groups takes place after the assignment of the tasks and the team formation.Thus, formed the group allows students to communicate and collaborate form anywhere.They can also have feedback with a mentor and exchange information with each other.In certain cases, when working on a particular project, not a task a Facebook page can be made. The possibilities and limitations can be represented by the following way (Burt, 2011):

Table 1.Comparison of Facebook Groups and Pages

Groups vs. Pages	Groups	Pages
Publish to users' live streams	✓	✓
Share photos, videos, and events	✓	✓
Include discussion forums and comments	✓	✓
Make group private and manage members	✓	×
Allow / Limit messaging between group members	✓	×
Edit group docs wiki style	✓	×
Group chat all at once	✓	×
Maintain complete control of what is posted	×	✓
Use widgets on your blog/website to promote	×	✓
Choose from thousands of 3rd party apps	×	✓
Automatically publish blog posts and tweets	×	✓
Access "insights" or user stats	×	✓

For communication and information sharing, students can also use Facebook Messenger: to share photos or share them at the moment of creating with a built-in camera; quick sharing of where they are located; send and receive audio notes and voicemail, print group chats, and search for messages in conversations already made. Conduct of online discussionfor each student's group or topic.This can be done in a variety of ways, but especially popular and easy to use are Facebook, Skype, TeamViewer or Google groups.

Discussions should be held on a topic set at a specific point in time, or with provocative questions that provoke interest and lively discussion to challenge students to make their point of view and their suggestions for discussion.It is desirable for mentors to give guidance on the conduct or to offer previously developed rules in order not to deviate from the subject and to respect each point of view. Students can discuss, but be clear to the author of the suggestion at a given time.

For online collaboration, it is important to provide online mentorship.When performing online training mentor and student can communicate through various platforms, for example. video conferencing tools.

There are free and open source conferencing tools, for example Big Blue Button.Even if a Moodle e-learning platform is used, Big Blue Button can integrate into its learning environment and start and use it with the courses and groups created on this platform. If online mentorship is used, the next meetings can be planned, a calendar of upcoming events can be created, and information disseminated to students interested in the field.

YouTube can be used to share recordings from video conferencing and other video material. Video tutorials can be offered to students to watch online tutorial. YouTube video channel material can be shared through social media and groups.

G Suite for Education. Especially suitable for online collaboration is ***G Suite for Education.***The main services that can be used after the registration of the University in G Suite for

Education: Classroom, Gmail, Drive, Calendar, Vault, Docs, Sheets, Slides, Forms, Sites, Hangouts. After creating a profile and email to everyone can use: Account, Contacts, YouTube, Photos, Meet, Google+, Translate, Keep, Groups.

There are a number of other benefits to G Suite for Education:

- Inaddition, G Suite for Education is completely free. Google plans to keep the core offer of G Suite for Education free. "This is a user-friendly course for future incoming students. As it is known, Google was founded by a research project at Stanford University, and this is just one way we can give back to the educational community" (Google G-Suite Training, 2017);
- G Suite allows easy collaboration: anyone can create, share and edit their files in real time. At the same time all can workonthesamepageanditisauto maticallysavedinthecloud.;
- G Suitecanbeusedonanydeviceatanytime - a computer, tabletorphone.

All applications for using the services provided by Google for Education are completely free and are developing continuously. A wealth of experience has been gained that can be explored and used. Suitable for collaboration are courses designed by Google Classroom. Benefits of Classroom: save teachers time, communicate and collaborate with other teachers (up to 20) and students andeasy support for administrator.

Additionally, there are a number of third party applications that can be used and new ones can be created using Google Apps script - a programming language integrated in G Suite for Education. Lecturers can use different application with Classrooms as GeoGebra, Khan Academy, EDpuzzle and other.

3.3 Using collaboration tools to improve training quality

Proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking. There is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than learners who work quietly as individuals. The shared learning gives learners an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers(Srinivas, 2011).

Collaborative learning is an important part of eLearning. It allows learners to benefit from the experience of their peers, become fully engaged in their own learning experience, and more effectively acquire and retain information (Pappas, 2014).

- Findcollaborationtoolsthat are easy to use, accessible, and ideal for your learning goals.
- Explainhowthelearner can benefit from the collaboration tools.
- Replace old practices with new collaborative ones.
- Incorporate scenarios and real world examples that boost engagement.
- Hold live virtual events that facilitate group discussion.
- Keep in mind that collaboration tools are also great support tools.
- Create assignments based around video chats, instant messaging, and emails.
- Encourage learners to work together by creating shared projects.
- Ensure that everyone is aware of expectations, timelines, and objectives.
- Remember that you are the facilitator not an active participant.

Regardless of the collaboration tools that you will decide to use while developing your eLearning courses or deliverables, by keeping these collaboration tool tips in mind you will have the ability to take full advantage of the features they offer. Whether you are designing for K-12, private institutions, or corporate training, collaboration tools can provide a number of advantages to your learners.

Here are 8 ways that you can facilitate knowledge sharing through a thriving online learning community (Pappas, 2017):

- Create Topic-Centered Social Media Groups;

- Integrate Online Group Collaboration Projects;
- Start An Online Discussion Forum;
- Host Monthly Live Webinars;
- Develop A Mentorship Online Training Program;
- Create Peer-Based Online Training Teams;
- Launch A "Moment Of Need" Microlearning Library;
- Encourage Learner-Generated Blogs.

Dynamic **web** based learning groups depend on consistency and continuous correspondence. In that capacity, they do require some upkeep. Make people group rules to clear up desires and a presenting plan on consistently support learning sharing. You ought to likewise keep up a dynamic nearness inside the social learning stages in order to show others how it's done.

Conclusion

The report presents the training of students in the Craft Tapestry course describing the purpose of this course, the knowledge and skills that students must possess and the expected results that they must achieve after completing it.Performance standards were considered.

During the training, students have tasks, some of which can be solved by working together online with their colleagues.For this purpose, they can use Facebook Groups or Facebook Pages, Facebook Messenger, Gmail for Education - Classroom, Google Groups or Google Drive and Docs.

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The Benefits of G Suite for Education on the Experience of Trakia University – Stara Zagora

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Abstract

The social media are used more successfully in the training. Despite the different views is an indisputable fact that their application increases the interest and the success of the students. Google Apps for Education is established before ten years with the idea to help the teachers and students to study and to share the materials in a new innovative way. With the addition of new tools such as Google Classroom and Hangouts for example, G Suite for Education offers more comfortable functionalities for training. They are designed with new smart features. In the report are represented and analyzed the instruments of G Suite for Education and their use in the education in Trakia University - Stara Zagora, Bulgaria by the registered domain name www.trakia-uni.bg. Special attention was devoted to the access to the Quality Management System and Integrated Management Information System by mail created solely by this domain. It is presented and the experience of teachers who have used Google Classroom in the preparation of the students in the Medical Faculty and the Faculty of Techniques and Technology - the town of Yambol. On the achieved results and the prospects for future application conclusions are made.

Keywords: G Suite for Education, G Suite apps, Learning, e-learning, Classroom

1 Introduction.

In the condition of the knowledge society many universities develop new policies and standards for the use of new digital technologies and social networks in the education. They prepare the conditions for the successful administration and conduct of the training of students from the new digital generation through them.

Social networks, the proposed platforms and open source software moving universities and education into the Future. G Suite for Education is one such the initiative of Google. With G Suite for Education can create interactive learning environment for our students, faculty, staff and administrators.

The aim of this report is to present the advantages of G Suite for Education and to describe the experience and demonstrate the possibilities of applications used in the teaching and learning processes in Trakia University - Stara Zagora.

2 Advantages of G Suite for Education.

In Trakia University - Stara Zagora (TrU) students and lecturers use social media in different ways depending on their preferences. At the same time with this all have the opportunity to use the applications of Google for Education (new version was G Suite for Education) for universities for which the domain was registered - www.trakia-uni.bg.

The main services which can be used by this site are: Classroom, Gmail, Drive, Calendar, Vault, Docs tab, Sheets, slides, Forms, Sites button, Hangouts. After the establishment of the user account, profile and electronic mail all can use also: Account, Contacts, YouTube, Photos, Meet, Google, Translate, Keep, Groups.

There other advantages and specific features of G Suite for Education:

- G Suite for Education is completely free. Google plan to keep the core offering of G Suite for Education free. "This offering includes user accounts for future incoming students. As you may know, Google was founded by a research project at Stanford University, and this is just one way we can give back to the educational community." (Google, G-SuiteTraining, 2017)
- G Suite allows easy collaboration: anyone can creates, shares, and edited files in real time. At the same time all can work on the same page and it will automatically be retained in the cloud.
- G Suite can be used on any devices at any time – computer, tablet or phone.

Here is a comparison chart of G Suite for Education vs. G Suite Basic (Table 1.): (Burt, 2011)

Table 1. Comparison of G Suite for Education and G Suite Basic

Comparisonby	**G SuiteforE ducation**	**G SuiteBasic**
Cost	Free!	Feeperuser
GoogleSites	100 GB	10 GB + 500 MB per number of paid users
Storage for Google Drive, Gmail, and Google Photos	Unlimited	30 GB
GoogleVault	Alsofree!	$5 add-on fee per user or included with upgrade to G Suite Business

Classroom. Google Classroom is designed to help teachers and students communicate and collaborate, manage assignments paperlessly, and stay organized.(Bell, 2015) The lecturer can create his course in Classroom and description it. Class folder are automatically created also and Calendar is integrated. The author of course add Class Materials – Google docs, Slides, Google Drive folders that students can re-use during the year. Students can join with class code generated by the Classroom. Students can be invited by Gmail too. Lecturers can add Announcements, Assignments, Question for Discussion and Posts too. Students can post and comment. Teachers can managing and grading Assignments in the Stream.

Benefits of Classroom: save teachers time, communicate and collaborate with other teachers (up to 20) and students and easy support for administrator. Lecturers can use different application with Classrooms as GeoGebra, Khan Academy, EDpuzzle and others.

Gmail. The creation and use of mail at trakia-uni.bg has all the features of Gmail, but there are a number of advantages in comparison with personal created electronic mail at Gmail, as follow: Access to resources and courses created by the Classroom which are created only by G Suite for Education; professional electronic mail in the name of this domain of TrU – name.family.20XX@trakia-uni.bg; sharing of documents, folders, calendars and etc.; additional storage for each user across Gmail, Google Photos and Google Drive. Each user has unlimited storage for Google Drive, Gmail, and Google Photo; services without the inclusion of commercial advertising; 24/7 operation maintenance of mail; 99,9% guaranteed updates; full administration of all user profiles; enhanced security of access.

Google Drive. Google Drive (GDrive) is a cloud-based storage where files, photos, video, and web content can be stored and shared with other G Suite users, as well as Gmail users outside the organization. The content can be organized into diferent folders and subfolders, be archived automatically, be searched and and be sorted by certain characteristics. The main advantages of using them are:

View and open files; Back up photos and videos automatically in Google Drive; Play video in GDrive; Share Microsoft Office files, and search their content; Save web content to GDrive; Convert PDF and photo files to text; Sync files on users computer; Manage maps in GDrive; Manage & restore mobile device from backups in GDrive.

Calendar. With Calendar the users can create and organize events, classes, tasks and deadlines. They can create group calendars that will remind all participants for an event - business, meeting or holiday. They can send invitations to colleagues for an event that they organize. Users can add can add whole Calendars to their own Calendar, e.g Calendar of a discipline, project, etc

Google Docs. Google Docs is a very powerful real-time collaboration and document authoring tool. Multiple users can edit a document at the same time, while seeing each others' changes instantaneously. All changes are automatically saved as the user type. Users can produce text documents, slide presentations, spreadsheets, drawings, and surveys. The formats used are compatible with Microsoft Office and Open Office, so users can switch between these programs as needed. All interactions and files are contained in Google's Internet servers (the cloud), and are accessible from within a web browser window.

Sheets. All benefits of a Spreadsheet program can be used in the Sheets App of на G Suite for Education. Besides these common benefits, the advantages of Sheets app are (Google, 2017a): Mobile Friendly - by a downloadable Google Drive app (Android, iOS) all user’s Sheets can be accessed directly from their phone; Offline availability - working without an internet connection; Easy to make copy of the sheet file or share the file with everyone; Colorful charts and graphs, suggested to the user by the Sheets app which analyses the data in the sheet automatically - an Explore panel offers an overview of the data, from informative summaries to a selection of pre-populated charts to choose from; Built-in formulas, pivot tables and conditional formatting options; Wide variety of budgets, schedules, and other pre-made spreadsheets; Revision history.

Slides is an application analog to Presentation programs. Besides the advantages similar to those of Docs and Sheets, Slides can be presented to Chromecast, Hangouts, and AirPlay. A very useful function of Slides is the ability to share presentation with students, who can leave comment or ask questions in each individual slide.

Forms. With Google forms lecturers can easily gather personal email addresses of staff and students, oversee occasion enrollments, make a fast survey and/or receive a feedback, send a quiz to their students. Responses are automatically collected in Forms, with ongoing reaction data and diagrams. The responses can be transferred to spreadsheet in Sheets for a further analysis.

Sites. This application provides an opportunity for staff and students to create themselves Web sites and to share them with colleagues or with whole world. They have rapid access to their websites and to those shared with them by means of the bar for control when they are in their mail.

3 Experience of Trakia University in the use of G Suite for Education

3.1 Google Apps script

Google Apps script (GAS) is a JavaScript-based scripting language integrated with G Suite for Education. It is a powerful instrument that lets administrators and any user with enough scripting skills to extend the potential of the G Suite applications. With the help of GAS many repetitive actions could be automated, as well as, completely new functionalities could be created.

The applications of GAS Trakia university are as follows:

3.1.1 Creating the accounts of staff and students

Related G Suite Applications: *Sheets, Mail, Admin.* The accounts are created from lists of personnel names and lists of students names containing also their private emails and the faculty they belong in. The names are in the original transcription with cyrillic letters.

It should be noted that the Admin application is offering the opportunity to create multiple accounts by uploading a csv-file with the names, emails to be created and passwords. However with this functionality the cyrillic letters are converted to unreadable characters. On the other hand when the accounts are created with GAS the names provided in the list in Bulgarian and written with cyrillic letters remain unchanged and appear as provided in the email accounts along with the created email. The lists are imported in a Google Spreadsheet, in which there is a bound script organized in different functions (macros). The following actions are accomplished by these macros:

A. Transliteration of the names from cyrillic letters to latin letters. This function gets the data from the spreadsheet and row by row transliterates the provided whole name of the person, recognizes the first and last name, and uses them to create the email address of the kind *name.family@trakia-uni.bg*for the staff or *name.family.20XX@trakia-uni.bg*for the students. The first and last name in Bulgarian are used to be added to the account email. Random password is generated too. This same function reads the faculty name of the person and creates a text string containing the "Organisational unit" to which the account should be added. The OrgUnit could be an existing unit created previously in the Admin G Suite App, as well as, could be created by the GAS script. The account names, email, password and OrgUnit are generated as text strings and saved in separate columns in the same spreadsheet in order to be used by the script functions to be performed afterwards.

B. Creating the Accounts. In a loop manner this script function gets row by row the generated account names, email, password and OrgUnit from the cells in the corresponding columns in the Google spreadsheet and creates all the accounts of the persons in the list.

C. *Staff and student notification for the account created.* With this script function a notification letter is sent to the personal emails of all staff and students with newly generated accounts. The message contains an advisory text, login and password, and instructions for initial access of the account.

3.1.2 Creating and organizing courses in the Classroom App

Related Applications: *Sheets, Classroom, Admin.* In addition to the custom way of creating new courses in the Classroom App and invite students, the process can be automated with Google Apps Script. This is especially useful when the number of student groups is large, and respectively, when there is a need of a large number of individual Classroom courses to be created. For this purpose, we are using again a script bound to a spreadsheet in the Sheets App. Two separate sheets were created in the spreadsheet. The first one is to introduce the names of the courses that should be created for different student groups, and the account emails of the teachers who will lead the courses. The second sheet is a list of students containing their account emails and the student group they belong in. The script consists of several macros that perform different functions.

A.Creating the courses.

From the sheet with the list of courses the script function reads the names of the courses, the main teacher and co-teachers. In a loop manner for each line of the list the script creates the course with the main teacher, called "course owner". Once the script has created the course it records in the dedicated columns the server-ascribed characteristics of the course - ID, code enrolment code, status, Alternate link. The script can also set the status of the newly created class - Active or

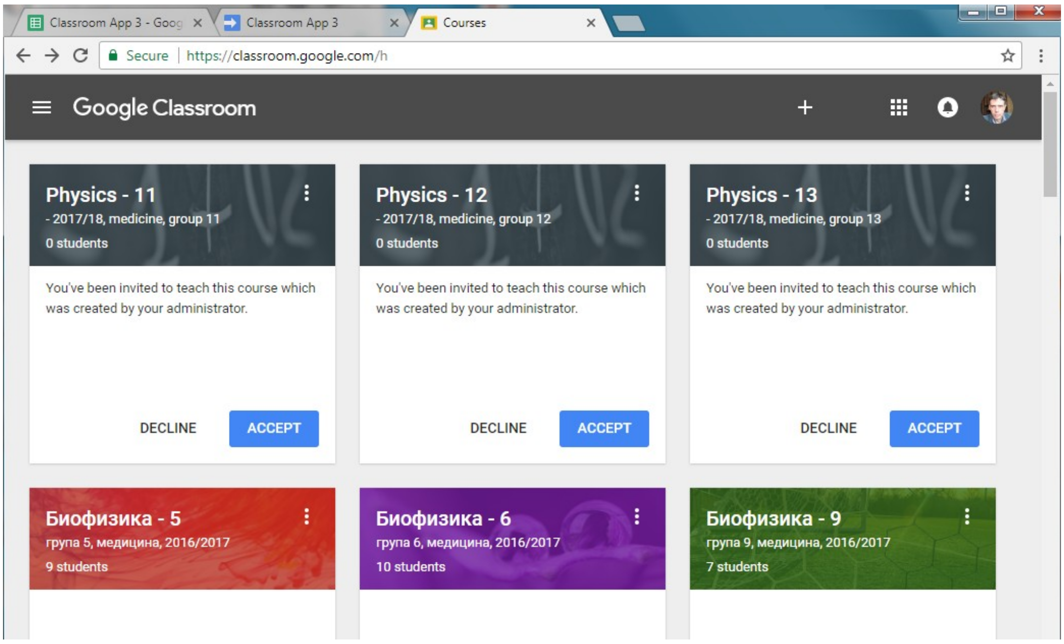
Provisioned. In a second loop the courses are updated with the co-teachers. The newly-created courses appear in the application of the teachers. If the course status is set to Provisioned, the teacher must "accept" the course (Figure 1)

B. Invitation of students.

This script function sets invitations for the corresponding course to each student from a given student's group. The script reads the list of students from the student's sheet and sends invitations according to their student's group number provided in the list

After running the script, the course appear in the student Classroom App, asking for accepting and following the course.

Figure 1. Three courses created by GAS and the way they appear initially in the teacher Classroom App



C. Adding all students set to participate in a course.

Students must accept the invitation sent by the above-described script in order to be fully-manageable participants in the course. This includes receiving all announcements and assignments, as well as, the teacher's ability to set marks for the assignments. Some of the students are delaying the adoption of invitation calls, so this script function is used to add them directly to the course without requiring any action from their part.

3.1.3 Script scheduling of classes

Related Applications: *Sheets, Calendar.* This script generates classes as "events" in a given calendar. The script is bound to a Spreadsheet, that has columns with the name of the course subject, type of the class (lecture or lab), the student's group number, start time of the class, end time of the class, hall of conduct, teacher. It is necessary to have a column in which cells to set the predefined ID of the calendar, to which the event will be added. The Stsript reads successively the data from each row in the sheet and creates the corresponding classes.

3.1.4 Script for enrolling of students in exam

Related Applications: Sheets. With this script a Standalone Web app is generated (Ferreira, 2014). The deployed web app receives its own URL (https://goo.gl/92b8ab), which can be sent to those who wish to enroll for the exam. The script is using a Google Sheet with the names and account emails of the students that have to attend the exam. On a separate sheet are recorded the available dates for that exam. Two adjacent columns are set for recording the maximum number of students that can attend the exam on that date, and the places already occupied. The script contains several html-files that open following various scenarios. Upon opening the URL of the main script recognizes the user account. If the user is not pre-signed in his G Suite account, the script opens html-form that invites it to sign in and provides a link to the trakia-uni sign-in page. If the user account is recognized as G Suite accounts the script look up for that account in the students list. If the account is not in the list, the Web app displays a notification message to the user. In the main scenario the user is recognized both as G Suite user and as student able to attend the exam. The script opens an html-form with radio buttons for the available dates that have available places for more students to attend. The availability of seats is determined by the cells in the two columns of the sheet - for the maximum number of seats, and for the seats already occupied.

When the students chooses a date and sends the form, the number of the occupied seats increases by 1 in the corresponding sheet cell. The chosen date is written in a cell in the row with the student's data. When the limit of seats has been reached the script does not serve radio button for that date. At each URL visit the app checks if the student already has an exam reservation, and if so, the relevant date is displayed in the form. The student has the right to change the date that has been chosen, as the script makes changes in the relevant columns in the Sheet.

3.2 Gmail at trakia-uni.bg

Students and teachers from Trakia University have the opportunity to register online at www.trakia-uni.bg to gain access to a personal e-mail. Only through the mail domain www.trakia-uni.bg they have access to the Integrated Management and Information System (IMIS) of the Trakia University. IMIS is used for students online application in Trakia university. Starting the autumn of 2017 enrolled students could track in IMIS their academic works, test scores and achievements according to their curricula; their current academic transcript; apply for scholarships and university accommodation.

3.3. Google Drive (GDrive)

Teachers and staff have access to shared folders in GDrive. TrU has adopted and is applying now for six years a Quality Management System (QMS), which is certified according to ISO 9001: 2008. All documents and forms of the QMS are available in a GDrive folder that is shared throughout Trakia University. By using GDrive and its ability for document version control, the QMS maintains updated information on the actual and obsolete versions of all QMS documents.

GDrive folders are also used to share teaching materials of any kinds with the students.

3.4 Google Groups

With the Groups App groups of colleagues, employees or students could be created. Each group has its own "forum" where messages are exchanged and seen by all or by a certain members of the group. Each group has its own email address to which all group members are automatically subscribed. A letter sent to this address is received by all members of the group. Each employee and student of Trakia University can be a member of many groups.

Conclusion

G Suite for Education, formerly Google Apps for Education, is used for more than four years in Trakia University - Stara Zagora. To meet the expectations of the university users we have developed scripts through which part of routine processes were automated and access and services to students and teachers has improved. Many courses have been created in Classroom App, which accumulates a useful experience, that is analyzed continuously and its results are to be published. In some cases students have been attracted to participate in developing materials by assigning specific tasks.

There are many external applications work with Google Classroom using Classroom API. Benefits from these can be to engage students with interactive teaching tools, use interactive learning materials, teach coding and STEM (**STEM** is a curriculum based on the idea of educating students in four specific disciplines — science, technology, engineering and mathematics — in an interdisciplinary and applied approach.)

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The Benefits of Combining Social Media and e-learning for Training Improving in FTT Yambol

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Abstract

In recent years, social media have become more and more popular in both business and education. Their use has a number of advantages that students are familiar with and apply on a daily basis. The report examines the most commonly used social media and the opportunities for their application in education. The purpose of the report is to present the way in which some of the most popular social media combine with e-learning conducted at the Faculty of Techniquesand Technology (FTT) in Yambol. The advantages and disadvantages of using them are analysed, and conclusions on results and prospects were made.

Key words: social media, e-learning

1. Introduction

In recent years, social media usage by students has increased to a level that requires its role in education to be better-understood (Ahern et al., 2016). Computer-mediatedtechnologies facilitate the creation and sharing ofinformation, ideas, career interests and other forms of expression viavirtual communitiesandnetworks. The variety of stand-alone and built-in available social media services, introduces challenges of definition; however, there are some common features (Obar&Wildman, 2015). The common definition of social media is: "a group of Internet-based applications that are build on the ideological and technological foundations of Web 2.0 and support teaching and learning activities (Kelly&Antonio, 2016).

Social media is defining asa variety of networked tools or technologies that emphasise the social aspects of the internet for communication, collaboration and creative expression (Dabbagh&Kitsantas, 2012).The aim of the article is to analyse the common bounds anddefine the advantages and disadvantages of using social media combine with e-learning in education.

2. Outline for using social media in education

Studies show that social network tools support educational activities by making interaction, collaboration, active participation, information and resources sharing, and critical thinking (Ajjan& Hartshorne, 2008; Mason, 2006; Mazman & Usluel, 2010; Selwyn, 2007).

Social media technologies offer the ability to create collective content (Griesemer, 2014), andinvolved:

- ✓ *Weblogs or blogs* - allow authors, instructors and students to publish to the Internet instantly and communicate easily;
- ✓ *Wikis* - collaborative web space, where anyone can add or edit content;
- ✓ *Really simple syndication (RSS)* - allows users to subscribe to news, feeds originating either from blogs or more traditional web spaces like newspapers and magazines;
- ✓ *Social bookmarking* – allow users to save and archive entire web pages;

- ✓ *Online photograph galleries (OPG)* – allow posting of photographs that support sharing of ideas and experiences;
- ✓ *Audio/video casting (AVC)* – makes easy to produce digital voice and video files, as well as to publish and distribute over the Internet;
- ✓ *Twitter* – a powerful tool for connecting with others and sharing content easily;
- ✓ *Social networking sites (SNS)* - help teaching the network literacy.

Facebook, Twitter, LinkedIn, YouTube, Google Plus and many others have become almost everyone's second nature (Pappas, 2013).

Many schools and teachers are utilizing social media in the classroom to engage students in the learning process and to make their classroom more attractive, relevant and culturally diverse (Beidelman, 2015).Social media allows students and teachers to access a variety of knowledgeable sources, which might not otherwise be available (Carpenter&Jeffery, 2016).

3. Using social media and e-learning for improving the quality of training courses

Social media is a natural collaborative element and students use it as Facebook and Twitter to communicate, plan events and obtain social support (Beidelman, 2015; Glanz et al., 2015). Social support is any type of communication that helps persons feels more certain about a situation. It is a communication, which can take place either verbally or non-verbally between the provider and the recipient of the support. Social support reduces uncertainty in a situation and enhances the person's perceptions on life control, which helps for better motivation and improves achievements in any task. The main features of social support are: *communication*; *uncertainty reduction; enhanced control*. A network and providing information are considered as social support and tangible help is a form of social support (Junker & Shutterstock, 2011).Students use social media to associate with group and keep all team members fully intricated (Griesemer, 2014).

Social media is a great way also for teachers to get feedback on assignments as well as to post new tasks. The assignments can be posted online or in the VLE, students receive an alert on their mobile orcomputing devices. Most students have social media applications installed on their smart phones and that makes education more accessible.

3.1. Facebook

Social media platforms like Facebook supports group interaction toward establishing communities, creating and exchanging content and also gain a unique position as a learning technology for educational purposes (Haefligerer al., 2011 Mazman&Usluel, 2010; Tess, 2013; Tiryakioglu&Erzurum, 2011; von Krogh, 2012).

The students from FTT Yambol use Facebook make open or closed groups, where share lecture notes, time-tables, events, pictures, scheme, projects, and communicate about their everyday live. Everyspecialty creates its group on Facebook,and the professors are also invited to participate in the groups.It is a place for informal sharing of information.Students use Facebook for non-formal learning to communicate with their teachers and administrative staff. ThroughFacebook, groups distributedata from course managers about placements and learning practices, job offers and etc.

Exploiting the Facebook improve the attendance of courses, due to the virtual communication and better organization of the students via social media. Students can also contact with the relevant groups by messages made from e-TrUni (http://edu.uni-sz.bg).Usually one or several students in the group perform administration.

Every speciality of FTT has the opportunity to create a page, but creating a group is a preferred way of communication and has different uses and a number of advantages over the Facebook page (fig.1).

Table 1.Comparison of Facebook Groups and Pages

Groups vs. Pages	Groups	Pages
Publish to users' live streams	✓	✓
Share photos, videos, and events	✓	✓
Include discussion forums and comments	✓	✓
Make group private and manage members	✓	×
Allow / Limit messaging between group members	✓	×
Edit group docs wiki style	✓	×
Group chat all at once	✓	×
Maintain complete control of what is posted	×	✓
Use widgets on your blog/website to promote	×	✓
Choose from thousands of 3rd party apps	×	✓
Automatically publish blog posts and tweets	×	✓
Access "insights" or user stats	×	✓

TheFacebook page is mainly utilized to promote the opportunities of knowledges and skills of speciality for the realization of the students.

Facebook is a fascinating platform to inspire language development, interpersonal communication, group collaboration, and ICT skills improvement.The applications such as Flashcards, Courses, etc. make it easy to adapt and create learning tools for students.Facebook can be used more effectively as a source of information for students, which is organized by the teachers. Facebook supports a wide selection of pages and groups by interest,in which are offered materials.In order to be usefull, the materials are checked by the tutors before to be published in the page of University. ThroughFacebookcan be organized open lectures and prezentations with the participation of teachers from other universities around the world, as well as FTT can propose lectures from relative academies. During a scientific conference Facebookcan be offered conducting of on-line communication. ThroughFacebookinvestigations and surveys can be made obtainable to the potential participants.

3.2. Facebook Messenger

The best features of Facebook Messenger is: *take pictures or video instantly with the built-in camera; image search shares pictures from the web; location feature to quickly show where you are; send quick audio notes and eliminate voicemail; use pinned group chats to find mass messages easier.*

This app can be used for collaboration, itconnects directly to Facebook's chatting system, so students can send and receive messages more quickly than if they were going through a mobile browser.Facebook Messenger allows users to send files and links with easewithout the cost, make calls and ability to speak within groups, keep students and tutors in touch with each other if they are working on a project together.

3.3. Blog

Blogging expresses the importance of social and peer interaction as focus of the learning community. Instructors of courses rooted in a knowledge discipline can use blogs to lead students through the foundations of that discipline.

As a receptive learning tool, blogging can be used to frame assignments within a theoretical context that encourages students to acquire information and report what they have learned. Because of their public nature, blogs can be useful as a directive-learning tool to provide students with equal access to important information, to expand students' understanding of specific issues, and to direct students to explore additional material (Nedeva&Nedev, 2010a).

Blogs also lend themselves extremely well to the response strengthening inherent in directive learning because the comments form attached to each entry allows instructors to add content and additional prompts. As a valuable e-learning tool, blogging can be used in a number of ways to engage students in discussion, exploration, and discovery. It is appropriate for both hybrid and fully online courses. As my institution's primary support person for instructional blogging, as well as an instructor who has integrated blogging into his teaching, I can attest that it works best when integrated into a coherent pedagogical approach, vested in an appropriate educational theory, and updated regularly by participants(Nedeva&Nedev, 2010a).

3.4. Wiki

Students can share and collaborate on documents without special software or training. The wikis are web pages, making links to references very handy. Anyone can browse or modify the wiki only with web browser. Also students can easy add, modify, or delete material from the wiki. There is no need to learn HTML or any programming interface. The functions “Save” or “Edit” are performed in very simple way. A wiki is essentially a database created by a group rather than an individual. Structuring the initial content in such a database for easy access can be a challenge - one that faculty might not have encountered before. For instance, howto accesses information on the wiki, how to navigates the site, or creates internal and external links to additional information.

Another shortcoming of a wiki (albeit a minor one) is that it represents the collective perspective of the group that uses it - wiki has a collaborative bias. Over time, the values, perspectives, and opinions of its users can become embedded in a wiki. Wikis are well suited to reflecting current thoughts but perhaps not as effective in obtaining unbiased perspectives on rapidly evolving topics or issues (Nedeva&Nedev, 2010b).

For example, in the e-business and e-government course, students can choose what format to present for their teacher and their colleagues their course assignment. They have the opportunity to opt for an open-source platform to create an e-shop that describes functionalities, relevance to different e-business models. Typically, they choose to create a block or wiki. This is assessed by each student in the group and by the lecturers. Each personal assessment of the participating students reflects the overall final assessment. At the same time, students create an e-shop on their chosen product or service group, which is also being evaluated for peer reviewing.

3.5. Wikipedia

The learning with a Google Search or Wikipedia is an example of joint social media and education. Social media provides (Dron & Anderson2014):

- ✓ *reduce attrition through social support of peers, teachers, education systems and external networks;*
- ✓ *opportunities and expertise in social capital building;*
- ✓ *opportunities for learners to develop lifelong learning networks and social skills;*
- ✓ *tools for creating, locating and tagging learning objects, artifacts and portfolios;*
- ✓ *extend and enhance learner achievement and collaborative learning expertise;*
- ✓ *create and sustain networks of teachers, administrators, business and professional colleagues.*

3.6. YouTube -it is an excellent resource for eLearning, which is free and can be used to support a class through videos that can be part of a course.In many courses, lecturers offer their own videos uploaded to YouTube and shared for e-TrUni students. In other cases, the materials are developed by the students with a specific course assignment proposed by the lecturer and performed by the student according to the project.

3.7. WordPress

Open source WordPress has been incredibly successful and risen from a handful of users to the most-used blog tool in its category. However, it is the open source package that as easy-to-use as we could make. There was still a barrier in that it requires a hosting account, a database, FTP, and a whole alphabet soup of acronyms that make normal people dizzy.

WordPress.com is under very active development, and we roll out updates almost every day. New features and services are driven by you so please use our feedback form to let us know what you want. Almost everything on WordPress.com is free, and things that are currently free will remain free in the future, but they do offer paid upgrades for things like CSS editing and custom domains. WordPress.com is run by Automattic, blog services, Akismet anti-spam technology, and hosting partnerships (Nedeva&Nedev, 2010a).

The students, who study „Open Source Software for Management of Content“,got the assignment at the beginning of semester to create web pages or blogs in WordPressas a part of their semester examination.The theme of the site is chosen by the students, but there are obligatory requirements: picking the site type according to the selected topic; using three system menus; one main menu with five tabs; at least 8 web pages as three of them to be in different type; form for contacts; two photo galleries with pictures - slideshow and „mosaic“ type; five posts or news related to the created site or its topic.During examination the student presents his/her site to the colleagues and teacher, and after that answers to the all questions. The site evaluation is made with the participation of the students group. On the figure below is represented one of the sites created by the FTT students.

Figure 1. Student Web site in WordPress

Conclusion

In the present report are performed the social media, which are applied to the training of students in FTT - Yambol. They are combined with the different forms of e-learning on the specialized platform of the Thrakia University - Stara Zagora, e-TrUni (http://edu.uni-sz.bg). In that way attains effective media utilization by combining the advantages of e-learning and the social media.That is imposing, because of increasing popularity among the teenage digital generation, who daily utilized these technologies and knows their advantages.

The methodology to using social media has yet to be developed and improved. The idea is to apply them increasingly in the research projects with the participation of the students and in conducting online discussions and questionnaires on the topics or discussed problems. Simultaneously, attempts will be made to apply and combine social media with other software applications.

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Options for e-evaluation of the theoretical training of students of pedagogical disciplines

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Abstract

The article examines the possibilities of e-evaluation of the theoretical training of students in pedagogical disciplines. Effective options are sought for the control and evaluation of academic education. The advantages and disadvantages of traditional forms and methods of assessment are considered. The e-evaluation is probated through the Moodle e-learning platform. The results of this form of control as well as comparative analysis with traditional forms are presented. Conclusions are made on its feasibility in the theoretical training of future pedagogues.

Keywords: e-learning, theoretical pedagogical training, test, e-evaluation, effectiveness

1. Introduction

Testing (examinations) in its various forms and the assessment are an integral part of the training with significant formative and educational contribution. They have their undisputed place in professional pedagogical training. Part of their system of functions is also to provoke the immediate interest of the students in the disciplines studied, which will be projected into formation of system of professional competencies.

Traditional forms of control of students' theoretical training have their definite positive but also significant drawbacks. Problem in examination of students are large groups of 30-50 students. This fact does not allow developing and realizing the forming and learning possibilities of the classical version of the combination of a written test with the *oral interview*. It is particularly suited to control the preparation by the theoretical pedagogical (humanitarian) disciplines as it establishes and develops communication skills, the freedom to work with pedagogical categories and concepts, with the educational content in dependence detection, application in specific situations, and solving case studies. When working with large groups, however, it requires a great deal of time for both the lecturer and the students and in practice becomes difficult to apply. *Test examination* compensates for the shortcomings of the oral test with its efficaciousness and economy from viewpoint time, but it has its shortcomings. A significant limitation of e-learning as an assistive technology in pedagogical training is the difficulty and insufficient effectiveness of control through test checks of students' knowledge. The nature of pedagogical issues and competences requires future teachers not to learn definitions, make calculations, or give other types of accurate, fixed answers but 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, c.14-15) Another part of the constraints are related to the incorrect attitude and behaviour of part of the students and companies offering different services on the territory of the university (make a copy of the variants, transcription or learning of the correct answers, etc.), as well as a significantly more laborious process of creation and reproduction of personal variants of paper tests. Recent circumstances often make checking and evaluation unobjective and formal, and the resources invested (time, professional effort and funding) - unjustified.

In the search for efficient options for organizing and conducting the control over the pedagogical disciplines studied, taking into account the advantages and disadvantages of the traditional forms and the contemporaneity possibilities of the computer and information technologies (D. Minchev, V. Hristov, K. Ivanov, D. Keremedchiev, Y. Peneva, etc.) are developed and approbated variants of Andragogy tests through the e-learning system.

2. Methodology of the study

2.1. Object of research

The object of study is the process of monitoring and evaluation of students' theoretical knowledge.

2.2. Subject of research

The subject of the study is the possibilities of e-evaluation of students' knowledge on pedagogical disciplines.

2.3. Purpose of the study

The aim of the study is to intensify the processes of control and evaluation of the theoretical pedagogical preparation of the students and to increase the quality of their education.

2.4. Methods of research and Toolbox

The challenge is not so much the very fact of e-testing and evaluation at all, but the making of such **didactic tests** on pedagogical disciplines, which will ensure the intensification of the verification and evaluation process, on the one hand, and, on the other hand, the objectivity of the assessment. The difficulty lies primarily in the humanitarian nature of the school subjects. The learning content is narrative, descriptive. Unlike the technical and natural-mathematical sciences, the essential in it is difficult to express through numbers and formulas. An additional difficulty is the multivariate of the authors' wordings, which increases the degree of complexity in formulating the answers given in the program. Depending on the specific content, when formulating the questions with given answers, it often falls into both extremes:

- questions of an extremely low level of complexity that make them inclusion in the didactic test frivolously and elementary;
- Questions with a very high degree of complexity because the answers are very close and require considerable concentration and precision to capture the details. This makes them largely misleading. Considering the tension during the exam and the limited time to solve the test, one can also assume the high degree of error in solving these questions. The inclusion of such issues is limited in view of ensuring the level of complexity of the test that also complies with the quality criteria in assessing student achievement.

Very often, in order to outline the characteristics and dependencies, students need to make a description. The nature of pedagogical issues and the assessment of competencies and skills require providing opportunity students to formulate and propose their own solutions to a particular situation or case.

These circumstances require different types of questions to be included in the test:

- with *built-in* answers - both with one correct answer and with many possible answers, but not all answers are correct. Reporting responses these questions is readily and automatically based on the pre-set values in the system by the lecturer and with the possibility to immediately shape the current result.
- with *free* answers. Reporting on these questions is more specific. Automatic verification is not possible and additional individual reading and assessment is required by the lecturer. This process requires time resource and is delayed over time.

As a final result, the overall assessment is not formed immediately after the test is completed and after the teacher's assessment and evaluation of the free answer questions. It is generated in the e-learning system and is accessible to every student.

In *this study*, the *test* includes 10 questions, only from the first group - with given answers. Its results are just one of the components of the overall assessment on the discipline. Other components include student activities, offsetting the limitations of the test form of control and evaluation.

For the purposes of e-testing, bases of underlying problems (categories) are compiled, each of which includes a series of questions. An advantage of this way of evaluation is the rapid automatic generation of an individual test version from the question base and the given answers. This option greatly reduces the risk of copying, prompt, memorizing and other options of not objectivity and abusive over the control of students.

At the beginning of the students' work, instructions are provided for the implementation of the text. Navigation is current and final. It is extremely convenient and detailed, helps and facilitates students' orientation, verifying the answers, correcting them if necessary, etc.

The character of the questions allows the report and the evaluation as feedback to be generated immediately after handing over variation with the responses. This feedback ensures the implementation of the training functions of the control, making it economical from viewpoint of time resource and efforts of the lecturer. At the same time, however, it limits the personal and creative expression of the professional-pedagogical competencies which are formed.

To solve the test, students have limited time available depending on the total number of questions in the test, as well as the degree of their complexity. In the course of their training on the respective discipline the students have the opportunity to make two attempts to solve the test. The final semester assessment is the higher.

Electronic testing is conducted in computer cabinets in a network. The teacher performs the attendance control required for the first conducting the test. The functions of this control are:

– directing, assisting, clarifying and instructing students on the implementation of the procedure;
– ensuring objectivity and preventing abuse.

It is possible to conduct the test and remotely by negotiating between the lecturer and the students the time of opening the test.

Is used the e-learning platform Moodle, which is applied at the Thracian University - Stara Zagora. 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 research method used is the *comparative analysis* that compares the results of the control by e-testing, the paper test and the oral examination.

2.5. Contingent

The contingent of the study is 25 students of the third year of specialty Social Pedagogy. In the framework of the present study, their knowledge and competences in the course Andragogy were checked and evaluated by e-testing. Besides the mentioned main contingent, the comparative analysis uses the results of the evaluation through various forms in the course Andragogy from the previous courses in Social Pedagogy.

2.6. Criteria and metrics of the study

The main criteria of the study are success, intensification and objectivity in conducting e-examination of students.

3. Survey results

3.1. Objectivity

Objectivity in evaluating students' theoretical training through e-testing is achieved on the basis of:

- generating individual test variants;
- effectiveness of overcoming abuse by students;
- conformity the test with the nature of the learning content;
- ensuring the necessary working time;
- reported minimal percentage of randomly answered responses - only in 13.33% of the proposed response variants reported a random incidence within the range of 8.13-33.33% of the cases;
- overcoming subjectivism in the evaluation;
- reporting close results between the two test-solving experiences for students who have repeated the performance.

3.2. Intensification

Intensification in e-learning education during the assessment of students' theoretical training is realized in:

- the work of the *lecturer*:
  - automatic generation of variants (saving a considerable amount of time and effort in manual preparation of paper variants);
  - automatic verification and evaluation of the closed questions;
  - time savings (oral examination deficiency);
  - saving of material resources;
- the activity of the *students*:
  - time savings (oral examination deficiency). Almost all students completed the test before the end of the set time.

3.3. Success rate

Figure 1 presents the results obtained in the e-test of the students.

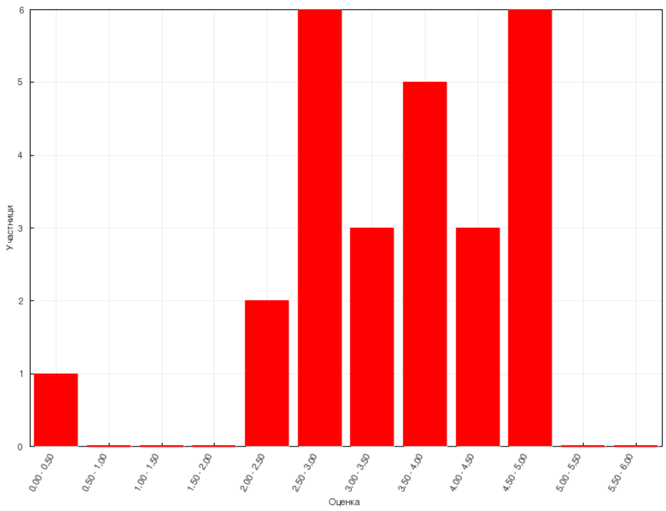

Figure 1. Number of students achieved the given evaluation intervals

The results obtained are satisfactory and correspond to the quality of work and participation of the students studied, also evaluated by other methods. The fact that only 16 students have made a second attempt to solve the test is an indicator of relative satisfaction from the assessment and by students. This figure includes mostly undergraduates with poor ratings (9) and only 7 for promotion. They also correlate with the results of students from previous school years.

Table 1. Comparative analysis of success through different forms of evaluation

Year	E-test	Test (paper)
2017	3,68	-
2013-16	-	3,59

Table 1 presents the total average grade for the student group's theoretical preparation through the various forms of control. The analysis of the results does not show a significant difference between the options. This fact leads us to the conclusion that the test is balanced and ensuring a sufficient degree of efficiency in the different forms of control.

Conclusions

Based on the analysis of the research results, it can be concluded that e-testing in verifying the theoretical training of students in pedagogical disciplines ensures the effectiveness of the procedure, has its significant advantages and grounds for applicability as assistive technology.

This study is pilot. Depending on the achieved results it is envisaged the application of e-test for other majors and disciplines, led by the author. Its high efficiency is expected for majors with large groups of 30-50 students and more.

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Metasystems Learning Design Theory and Information Visualization

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Abstract

This paper presents the extension of Metasystems Learning Design Theory on Information Visualisation. Based on the hypothesis that educational norms have shifted considerably over the last decades, it is explained an innovative approach based on Lean Startup Theory. Within the context of global education, this chapter explores the Metasystems Learning Design Principles as a response to the research question: What is the information visualization from the perspective of Metasystems Learning Design Theory? The chapter incorporates results of a survey regarding the students' opinions of specific information visualization features of Metasystems Learning Design Theory and its practical application for university courses: "Computational Chemistry", "Knowledge Management" and "Scientific methodology and ethics of research". This research serves the purpose of clearly illustrating the specific characteristics of information visualization criteria in the higher education. Conclusions are provided at the end.

Keywords: Metasystems, Applied Learning Theory, Instructional Design, Learning Design, Open Textbook

1 Introduction

Higher Education has shifted considerably over the last decades as an impact of informational and communicational technology and globalization. In many fields, the life of knowledge is now measured in months and years"(Siemens, 2004). Half of the current jobs can easier be automatized. Today, the most of the educational resources are freely available. Universities are changing his role from being scientific and cultural centers to global-ranking centers for building start-ups and internationalization centers of studies. The global trend is to offer educational services. In such context, open learning creates better opportunities for skills development.

At the World Economic Forum (2017) was mentioned that education and training systems, has remained largely static and under-invested in for decades, are largely inadequate for new needs. From our point of view, university pedagogy cannot be based on behavioral-cognitive-constructivist principles and norms. No student could ever make much progress in his or her education unless the various disciplines were subdivided into the manageable chunks. The focus should be on *meta competence*, including the development of hard and soft skills. These are the core skills (Klein, Edge, and Kass, 1991, pp.4-5). The core skills vary from knowing an algorithmic (technical) to applying sophistical (intelligent) skills in an uninspected and in-structured educational situation.

An important contribution in meta skills development could be attributed to *information visualization norms*. This article gives an overview of information visualization norms and compares with Metasystems Learning Design Theory. It was highlighted some intersections in order to enrich understanding of university pedagogy.

2 Information visualization as an emerging research field

Information visualization is a new, but distinctive inter-disciplinary and far-reaching field of research. It is related to information retrieval, hypertext and www, digital libraries, user interface design, data structures and algorithms, human-computer interaction, simulation modeling and so on. As was noted by Chen (2013, p.1) the information visualization field represents one of the latest streams in a long-established trend in the user interface design. The common research issues rely on:

- *identification* more suitable strategies, tactics, and tools in order to visualize and understand a particular type of information;
- *summarization* the generic criteria to access the value of information, from the perspectives of a single individual and of a group of individuals.

Ellis and Dix (2007, p. 1216) observed that information visualization is about gaining insight into data through a visual representation. The important problem is that information visualization is more about insight and less about the pedagogy. The problem is that actual data is often multivariate and increasingly and the datasets are very large. An explosive grown of digital information has demonstrated a need to develop a new didactical model of open textbooks for teaching and learning. To help explore this model may be applied an instructional dynamic and flexible strategy.

One more problem is that the newest open textbooks products shouldn't even be called "digital textbooks." Certainly, it would be valuable to students to reap the benefits of digital reading. But, is a real need for such products? For which situations? Why should be developed customized textbooks for each student? Why should open textbooks be used to grade homework? Why should be developed "personalized learning experiences". All these questions rely on frontier research in information visualization. In sum, the information visualization criteria is a challenging task not only for designers but also for professionals in frontier pedagogy.

3 Frontier pedagogy for the open educational system &environment

Educational system&environment are more open than ever. Frontier pedagogy is based on principles that work in an open educational system & environment. While considerable efforts are undertaken around the world of openness, it has created also a unique niche to address the paradox that education is open, while teaching and assessment methods are mostly the same as was a century ago. In our age, many parts of the life, economy, and ideology are dissolved in an open global system & environment that are interconnected. For learning is important to have developed meta-skills (e.g. *metacognitive knowledge* and *metacognitive experience*).

Who is the learner? First, this is an individual who requires practical skills because of living in a turbulent data river and, in order to survive in this situations should learn fast and should apply what was known, even recently. Second, the learner has a genetic background in reading print books and textbooks. Researchers have different opinions regarding these challenges. Some researchers report that printed pattern is less intensive than digital and that time-on-task effects in digital reading are nonlinear and are moderated by persons' skills and tasks' demands. It is noted that digital patterns provide more opportunities for a deeper learning through more interactive options like converted into a digital form and/or listening of printed text using digital devices; animation augmented reality and 3D printing.

Kucirkova, Littleton, and Cremin (2017, p.1) note that the creative dispositions for digital learning have four dimensions: pluralities, possibilities, playfulness, and participation. So, ‘4Ps’ is for active, market-driven and creative players on the digital stage in order to reveal new perspectives on actual childhood. With the advent of open textbooks, reading has become multifaceted and the learning environment – more attractive for meta skills development. One of these ways is Metasystems Learning Design approach.

4 Metasystems Learning Design approach and Lean Startup Theory

The main idea of the metasystems learning design is a totally functional (meta)cognitive mechanism. Theoretically, the idea of metasystems refers on something that occurs after *X or* is a prerequisite for *X*. The expression "Meta X" denotes that *X* has been changing and it is used as a common expression for a learning object and a cluster of learning objects that include some parameters. Learning is viewed as a complex processing of the environmental stimulus (*stimulus*) through students' intelligence and its practical application in one specific project (*response*).

The digital open content, as a container for knowledge, should provide an intensive information-energetic stimulus in order to have materialized in a deep, but generic knowledge. Regard to information visualization norms this is a call for new principles that could be implemented in an open learning environment. In such an environment learning is self-determined. Otherwise, the learner will ignore the provided stimulus.

The principles of metasystems learning design are, as follows:

- *the principle of self-regulation* - automatic regulation of learning process through activation of metacognition using didactical and psychological methods, cybernetics techniques and management systems;
- *the principle of personalization* – individualization of learning objects through increasing formation of the individuals as a self and as a member of the global learning community;
- *the principle of feedback diversity* – electronic education context needs to be evaluated through immediate and delayed feedback;
- *the principle of clarity* – formation of a structural skeleton of the content with powerful interconnected concepts;
- *the principle of dynamism and flexibility* – active inclusion of the learner in the elaboration of the content in order to provide the competence development skills;
- *the principle of ergonomics* – computer-based learning and assessment are guided by ergonomic interfaced and take place in the ergonomic work place.

Metasystems learning design principles can be implemented in the course design. The open textbook has the role to provide additional information. According to the commonly used definition, *the open textbook is an open educational resource that can be read and developed in terms of the open license*. But, in the case of metasystems principles, the term "open textbook" means more than reading online and sharing information for free. "Openness" also implies the availability "to work together" in order to create a common product. And in response to this idea, the student is pivoting away from classical methods of learning because the aim of the metasystems learning design is to develop *metaskills*. From this instance, the highly competitive open textbooks should be integrated into university courses or in a student's all-inclusive portfolio.

The management dimension of the Metasystems Learning Design Theory is *Lean Startup Theory*. The reason for this choose was stressed in (Muller and Thoring, 2012): "in catering for needs of learners changing the time e-textbooks can be used for delivering information, receiving constituent information from e-libraries, and for purposes of developing metacognition and self-regulated skills". Lean principles were developed in the early seventies by Toyota in order to optimize production processes. The vehicle to create a Lean Startup is a cycle of *ideas build* products → *measure* data → learn (*ideas*). At the meta-level, there are some similarities between the Lean Startup Theory and Instructional Systems Design models. Thus, "build" in a lean startup is equal to develop a prototype and measure is similar to observe or to test. However, there are also many differences. Therefore, the Lean Startup Theory means understanding or having an individual point of view. This can be understood as a consequence that open content of textbooks may offer better outcomes that reading from digital.

The content of open textbook isn't only for reading. Wrapped within the social changes, personal computers and the Internet, the static content of the open textbook "migrates" to multimedia and digital communication. However, the most acclaimed feature is in *self-regulated learning*. This issue is based on efforts to reach understanding via learning because transferring the printed pages into .pdf provide a convenient access to distractions. Lean Startup Theory offers a solution for this issue: *personalized content*.

There is no disputing that open textbooks will fuel all educational systems of the next decades. But, what kind of open textbooks play in helping the students achieve meta skills? We see an example of how can be used open textbooks for learning in the philosophical ideas. One of them is that digital marks immense transformations, those impact explodes all frames of thinking. As was not noted by Peirce (2009, p. 83) "the old world is slow because of separation, gaps, and fear". The problem is that most open systems need to be faster for learning because life is so instantaneous. Nowadays, an open learning environment is a co-environment where accelerated speed allows the extension of self-regulated learning features. This is a model of metasystems thinking that is equivalent to the application of Lean Startup Theory on project management.

5 Regarding some issues of information visualization

Information visualization refers to the study of the visual representation of abstract data within visual instruction and audiovisual communication. It is well known that a picture is more than a thousand of words. But, how important is the linkage between these words? Information visualization, the art of representing data in a way that it is easy to understand and to manipulate, can help us make sense of information and thus make it useful in our lives. There are two ways: visual instruction and audiovisual communication. Therefore,

1. *Visual instruction* is associated with interactive images and behaviorist methods of teaching. In addition to motion pictures and interactive scenarios represented through animation and virtual reality, it is used "virtual excursions", photographs and prints, exhibits, graphic arts, maps, and globes.
2. *Audiovisual communication* refers to materials and techniques that do not depend upon the printed word. The sound, animation, and videos are used to supplement written communication. Radio is a method of audiovisual communication.

Whether information visualization enhances learning depends upon how the information is designed. For example, the ideas that are awkward to communicate in words are better to be presented as a visual representation. In simple terms, information visualization is more about concept mapping. But, this abstract map is focused on deep learning. If so, how important is to use the concept mapping before writing the content? There is the "dark side" to the presentation of information for understanding the core concepts.

Not less important issue refers to the fullness of the content. By choosing what information to represent and what information to leave out – this is an important issue for learning designers. In order to solve this issue, it is important to decide where the social values and the ethical boundaries are in persuading people through information visualization. Moreover, information visualization techniques can be useful to understand and to analyze data and correlations both similarities and differences between data.

Previous research of digital textbooks has highlighted the role of *immediate feedback*. The term "programmed textbooks" are used to describe textbooks used to allow students to progress at their pace with the aid of specialized features. These important features are clear learning objectives, small steps, logical sequence of the content, active responding to the clear designed content of stimulus, immediate feedback. How can be transferred these norms in the process of the open textbooks use and development? Information visualization is designed to make sense out of available data. It can be used to explore the relationship between data, to confirm ideas we hold about data or to explain data in easy to digest manner. From this perspective, is important to confirm the linkage between norms of information visualization and principles of nano learning.

6 Nanolearning in university education

Nanolearning is a method of learning when the content is divided into smaller pieces than usual (Masie, 2006). An example of a nano-learning pattern is a 2-3 minutes presentation when is presented a core concept and a question. The specific features of nano learning are short learning situations; which are focused on a topic, narrow concept or idea that can be presented in the form of an idea that generates an activity, a game, a discussion.

Nanolearning is important in university education because in the first minutes we are ready to perceive complex information and to learn.

Although multiple advantages of nanolearning are estimated, there is insufficient research to know whether nanolearning is efficient for metaskills development and what forms of training are the most efficient. This question was investigated in the design of the university courses "*Computational Chemistry*", "*Knowledge Management*" and "*Scientific methodology and ethics of research*". For this, the presentation developed by Google educational patterns was "dismantled" into smallest parts that integrate only the learning objective of understanding in order to be accomplished with discussion. It was provided link to course materials and practical aids (e.g. self-assessment tasks and practical activities). The idea was to immediately put into use the presented core concepts and to enrich understanding of the core concepts. After interactive discussions students work on their individual projects that integrate the course concepts in a holistic whole.

At the end of courses we ask students to provide a feedback about the efficiency of nanolearning. For this case, it was developed a survey via Google Form. According to students' answers the most useful strategies for learning is *group discussion.* Students appreciate the learning design of the course content and the practical activities.

Conclusions

In this study, we used metasystems design approach to highlight the importance of information visualization field in the area of frontier pedagogy and, especially in digital (open) textbook use and development. The results indicate that open textbook has the potential to achieve such a desire for better learning outcomes.

Nano-learning refers to a content that have 15 minutes long that is highly targeted and self-contained and covers a single objective. When for developing a nano-learning solutions are used open educational resources, the obtained pattern can be viewed on a range of devices and be easy to find. The nanolearning pattern may include text, video, sound and images. As was noted by Simmons (2017), nano-learning is a strategic learning solution in a world where less is more. More research is needed to understand the pedagogy of nano-learning and its application in open educational environment.

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Incorporating Group Projects in E-Learning: Challenges for the Educators

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Abstract

As the demand for online courses escalates and more and institutions of higher education offer online courses and programs, demandsare growing for the content developers and teachers who can retain the students' attention. Simple talking-heads and text-heavy PowerPoints slides are ineffective in online delivery. Creativity, visual variety, and engaging assignments will separate the successful courses from the failed ones. The challenges for the online teachers are further complicated by the demandsof the employers who want employees with skills in team work and collaboration. Cooperation is deemed more important than leadership. Previous research has shown that learners in traditional classroom settings tend to view group work as non-productive, wasteful, and experiences lacking in inputs from other group members, thus, frustrating the active participants. Many teachers leave the students somewhat unguided on how to complete the assigned group projects. The result: dissatisfaction among the learners, and projects that are of average or below-average quality. This paper offers some suggestions for effectively incorporating group projects in face-to-face teaching and in onlinecourses.

Keywords: Collaborative learning, Teaching strategies, Online courses, Cooperation and Culture

1 Introduction

Many American and European college students experience a dichotomy when faced working in teams or collaborating in group projects. On the one hand, the students are encouraged to compete to earn the highest possible grades, especially if the grading is on a curve, i.e., so many will get 'A's, so many 'B's, and so on. When the same students are put in groups, they may perceive that by collaborating with others they are helping the others get a better grade. Such is not in one's best self-interest. Plainly put: Why should one help one's competition? For this reason, most of the students are reluctant to participate in group projects and cooperate with other students.

On the other hand, an estimated 80% of all employees work in group-settings (Attle & Baker 2007), thus, the students are reminded that the employers are seeking candidates that not only have the highest grades but also possess effective oral and written communication skills, and the ability to work effectively within diverse groups (Finelli et al, 2011).

The present authors surveyed the college students in Poland and Romania about the students' experiences with groups projects and their attitudes towards groups work. We have used this data from our surveyto identify the common problems in group work and attempted to explain the difference in attitudes based on cultures. We have noted that despite the cultural differences, the concerns voiced by the students are identical, i.e., the problems in groups projects transcend beyond

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cultural boundaries. Hence, the first section of the paper is a descriptive comparison of attitudes of students from the two countries. In the second section, we offer suggestions for addressing the common problems encountered in group work and the extra effort that is necessary to create 'virtual' groups when students enroll in online courses.The third section makes use of the Cooperation Index developed by Dzionek-Kozłowska & Rehman (2017) instructuringthe groups. Thus, the last two sections of the paper areintended as prescriptive.

2 Group Work

In the past four decades, a vast body of literature has evolved supporting the value of learning in groups. Taylor (2011) argues the group work may improve learning and prepare the students for life experiences. Weimer (2013) lists five advantages of learning through group work: The students master the material through discussions; develop a deeper understanding of the content through interaction; learn the behaviors that enhance group productivity; come to realize that groups make better decisions than individuals do, and; learn how to collaborate with others.

Based on a meta-analysis of over 168 studies, Johnson et al. (2014) concluded that students working and learning in groups had greater knowledge acquisition, higher retention of material, and better problem solving and reasoning abilities than students working alone did.

Group work, however,is not without its opponents. Some of the common concerns and hesitations toward group work come from students and teachers (Feichtner& Davis, 1984). The biggest concern for the students is that the other group members are either incapable of the required work or are indifferent to the task. The students fear that they will end u carrying most of the work while other will simply 'free ride'. The students are also concerned that without proper training in group-work, most participants will gain little.

The literature on group learning makes a distinction between *cooperative learning*and *collaborative* learning.

Cooperative learning is a strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. In cooperative learning, students work together in small groups on a structured activity. They are individually accountable for their work, and their collective work is assessed. Cooperative groups work face-to-face and learn to work as team members.

Collaborative learning is an approach to teaching and learning that involves groups of students working together to solve a problem, complete a task, or create a product. As such, the students work together to explore a topic or create a meaningful project. This is a useful strategy for engaging students in face-to-face interaction, as well as when students are working together over the Internet on a shared assignment.

3 The Present Study

Using the same paper-and-pencil, self-administered questionnaire, the data were collected from 186 Polish university students, and 155 Romanian university students: total N= 513.The data was collected during the academic year 2016-2017. The instrument was developed by Rehman and Hinojosa (2016) to study the Hispanic-American students' attitudes towards group work. A study that concluded that their sample held strongly negative to negative attitudes towards group work, however, 91 percent of their respondents admitted that the group projects were completed and over 60 percent agreed that they would have done better had they receivedtrained in group-work, and if the assignments were better structured.

Our aim was to compare the values regarding cooperation in twoEuropean cultures. We focused onthe individualism vs. collectivism aspect of Cultural Dimensions theory (Hofstede,

Hofstede, and Minkov, 2010) which suggests that people from an individualistic culture such as Poland,are less likely to collaborate with others than the people from a collectivistic culturesuch as Romania are.The Individual versus Collectivist Scale (IDV) ranges from 0 - 100 with 50 as a mid-point. A country with the score under 50 is labeled as "Collectivist" and above 50 as "Individualist."Thus, a culture with a score of 46 (Japan)is collectivist but less so than another culture with a score of 20 (China).

The IDV for Poland is 60, and for Romania, 30 (Hofstede, Hofstede, and Minkov, 2010). We hypothesized that the Romanian students would be more likely to work in groups than their Polish counterparts. We also made comparisons based on gender.

Our second goal was to offer some recommendations for designing a learning environment where the students would appreciate the value of group work and produce worthwhile projects. For this, we relied on the Cooperation Index developed by Dzionek-Kozłowska & Rehman (2017).

4 Descriptive Data and Analysis

The Polish sample (N=186) consisted of 61 men and 125 women. The Romanian group (N =155) was composed of 42 men and 113 women.

In both countries, the students harbored less than favorable attitude towards group work. However, 92 percent of the participants from Poland and Romania reported that the group projects were completed. When identifying the common problems experienced during group projects, both samples listed issues such as antipathy towards group work, free-riding, lack of group work skills, uneven contribution by group members, procrastination, stress, having to do other group members' portion of the work, and a total indifference to the value of group work. These findings confirm the previous studies (Roberts and McInnerney, 2007;West, 2008; Chiriac&Granström, 2012).

More than three-fourth of the Romanian students declared their willingness to work in groups as compared to 47 percent of the Polish students. The calculated Chi-square (χ^2 = 18.971; p-value .000076; $p < .001$) shows this to a significant difference at .001 level, i.e., the Romanian students' willingness to cooperation is higher than their Polish students.

The Cooperation Index (Dzionek-Kozłowska& Rehman, 2017) scores for the two samples reaffirm this difference.

The average CI value for the Polish students was +0.53; for the Romanian students, it reached +1.24. (see Table 1.)

Table 1. *The Cooperation Index for the Polish and Romanian Students*.

	Polish students (N=186)	Romanian students (N=155)	Difference
Average	+0.53	+1.24	0.71
Males (N=103)	–0.09	+1.46	1.55
Females (N=238)	+0.83	+1.16	0.33

Source: Authors' calculation based on their 2016-2017 data.

More than 80 percent of the respondents agreed with the statement: *Group work will be ineffective unless people know how to work in groups*.Calculated Chi-square (χ^2 = 6.014; p-value .04944; $p < .05$) revealed this difference to be significant at .05 level.

From the above analysis, we may conclude that our data support the Cultural Dimensions theory: People from collectivist cultures are more likely to cooperate and work together. We also used the CIs to trace any gender differences. As per Table 2, the CIs are higher for the Romanian women versus the Polish women, and for the Romania men versus the Polish men.

Despite other cultural differences, the socialization of girls and boys differs in many cultures around the globe. Parents treat children of different genders differently, not only in dressing them differently in boy colors and girl colors but in also encouraging them to engage in different activities and play different games. Boys are encouraged to participate in competitive (win-lose) games while girls are encouraged to play together and share their toys (Tannen, 1990; Martin, Eisenbud & Rose, 1995; Van Volkom, 2003). It is, therefore, not surprising that women from both cultures are more willing to work in groups and collaborate. Our data also lend support to the gender socialization theory suggesting that boys and girls grow up with different values and attitudes towards competition and collaboration (Ivy & Backlund, 2004).

5 Application

The literature on group work and learning in groups points to problems on both sides of the equation. The students are reluctant because they trust neither the motives nor the abilities of the others. Students also fear that since the others may not do their share of the work, they may end up doing the work for the others as well. Add to all this, the reservation about helping the competition. The students' hesitation is understandable. However, 80 percent feel that with proper training in group-work the outcomes could be improved.

To incorporate group projects, the teachers need to work with the students' attitudes and perceptions regarding cooperation and group work. The teachers also need to organize the projects with attention to several details that are addressed in the following section. Lastly, group formation is critical. For this, we recommend using the CI discussed above to assess and use information about the students' attitudes in creating productive groups.

5.1. Students' Perceptions of Group Work

Some students Group may feel that group projects are a waste of time, therefore nothing worthwhile can be gained from these. In such a case, the teachers need to explain the importance and need for cooperation in one's personal and professional life. Humans accomplish a great many things through interdependence and collaboration. The students need to be made aware that more gets done when working together, the quality of work improves, and groups make better decisions than when people work alone.

The students need to be reminded that the value of working on group projects extends beyond a particular course or a grade. The skills acquired while working in groups will be directly applicable in work life. Team players are desirable to the employees and such individuals often receive the important assignments and promotions. A teacher needs to demonstrate the importance of teamwork and motivate the students to actively engage in group-projects.

The students have four common apprehensions regarding group projects:social loafing, free riding, conflict, lack of trust in other group members' intentions and abilities.

5.1.1Social Loafing

Thisoccurs whenindividualsinvest less effort toward achieving the group goal than if they were to work alone. Groups with more than five members have a greater tendency for social loafing to occur since each individual's specific contribution becomes less visible. When the students feel that their work is not likely to be recognized and appreciated,they are less likely to be motivated to perform, or they take the attitude that someone else will do the work.Social loafing leads to dissatisfaction toward the non-participating members and resentment by the team members doing most of the work. With social loafing the groups fail to become cohesive or bonded teams.

5.1.2Free Riding
This occurs when one or more group members leave all or most of the work to a few, more industrious members, forcing them to work harder or accept a lower grade. Free riding erodes the long-term motivation of hard-working students and negative repercussions for the team’s well-being and productivity.

5.1.3 Task interdependence
In group projects where the participants depend on one another to complete a task have a higher risk of conflict and mistrust that in groups where students work independently.

5.1.4 Conflict
Incompatibility of goals among the group members, their need for interdependence, and interaction (or lack of it) can create conflict and cause members to withdraw or become counterproductive. Free riding may be the cause or result of conflict.

5.2 The Teacher’s Role in Assigning Group Work

In incorporating group projects in traditional and online courses, the teachers should consider the following five aspects.

5. 2. 1 Manageable Projects.
Even though the projects are completed by four or five students, it does not necessarily mean that five people together will be able to do more as a group than individually. The synergy laws don’t always apply. The purpose is to help the students acquire the skills for working together. The end result of a group is of secondary significance. The learners need to be challenged but not beyond their collective potential. Allow class time for group meetings to avoid conflicts with work and family commitments.

5. 2. 2 Group Composition and Structure
Groups should consist of no more than five or seven people. An odd number is recommended to avoid any ties in making decisions. Every member should be able to bring something to the group. The groups should be created by the instructors after they have determined that abilities and potential of each student. Self-selection by the students may only result in cliques and fragmented groups.

5. 2. 3 Evaluation Criteria
The group should be informed about the specifics of the criteria for the evaluation of the various elements of the finished project. Each group member should also receive tasks based on their interest and expertise. Explain to the students about their individual responsibility and the group responsibility.

5.2.4 The group members
This should be limited to five or seven. Larger groups become challenging in making meeting schedules. Keep the groups at odd numbers to resolve any ties. We recommend using the Cooperation Index (Dzionek-Kozłowska & Rehman, 2017).

5. 2. 4 Teaching Process Skills
Effective group work requires to students to acquire communication, coordination, and conflict resolution skills. Either the teachers take on this responsibility or encourage the students to take

appropriate courses/s in Applied Communication. Some instructors may be reluctant to deal with the interpersonal issues that can arise in groups. However, some sort of a plan needs to be in place to deal with such issues.

5. 2. 5 Evaluating the Individuals and the Group

Group members should have the opportunity to evaluate the work of other team members. This will also uncover any social loafing and free riding. These peer evaluations should be used for grading the groups as well as the individuals.

6. Using the Cooperation Index

If one group has five members with hostile attitude toward group work and another team has five members that are enthusiastic about group work, the outcomes of the two groups are easy to predict. The first group may benefit nothing from the exercise but waste their time and energy and receive a poor grade. The second group is likely to produce a better end product and receive a higher grade.

We believe that such unevenness can be corrected by using the Cooperation index. On the first day of a senior class in Communication Campaign Development, we ran the CI instrument to measure the individual scores. As expected, a small portion of students scored 'High' on their willingness to work in groups, a majority scored 'Low'. A good portion fell somewhere in the middle. We created the groups by includingat least one student with High score, two to three with middle score, and one with low score in each group. The resulting four groups were told that they will be competing against the other groups. The groups were assigned to develop a media campaign to launch a new independent movie by a local company. The groups were given the criteria for assessment of various elements of the campaign and individual group members were charged with specific tasks. Judging from the group interactions and the quality of resulting projects, we feel confident in stating that the Cooperation Index may also be effectively used in online courses requiring group projects. The Cooperation Index instrument may be obtained (free of charge) by emailing the authors.

Conclusion

This paper has stressed the value of group work and collaboration. We have identified the advantages and challenges associated with teaching using group projects. We have also highlighted some of the common learner apprehensions and strategies for addressing these concerns. A well-planned group project requires effective use of learners' time, communication and conflict management skills, and a demonstration of the importance of group work and collaboration in personal and professional lives. Based on our own success in conducting group projects with the help of the Cooperation Index, we recommend its use by other teachers and facilitators.

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Identity Criteria, Knowledge Formation and Conformity Conceptsin Learning Space

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Abstract

The study of knowledge formation is presented in this paper under the perspective of the compliance and conformity concepts. Conformity and nonconformity versus compliance and noncompliance are all approached, within a learning space, to define how and when the knowledge formation occurs and what are possible adverse effects developed for the case of nonconformity or noncompliance. Research methodology goes on the theories of Experiential Learning, Knowledge Space and Conceptual Space. This approach had reduced, but enlisting only, the importance of the teacher or learner perceptions as these comes with subjective arguments into the theme herein. The definitions of conformity and compliance within learning space are constructed based on certain formulas introduced about learning process, the ontological nature and typology of existing mental objects within the specified conceptual space. The achieved results showed a specialisation over the considered concepts, depending upon the involved mental objects got a physical representation or not. Achieved definitions apply regarding a domain which extends related scope over the education system boundaries and shown that the learner status should be gained within the learning process as a starting trigger of the process. Therefore, the learning process has been understood from ubiquitous perspective.

Keywords: Knowledge space, Experiential learning, Compliance, Conformity

1 Introduction

Learning represents a complex concept for study and research. From definition to practical implementation, learning theory comes in large and complex approaches from the literature. We can enlist here studies on learning and innovation, on knowledge versus competencies formation by learning (Murray and Blackman, 2006), and on knowledge – behaviour (belief) – attitude (Ernest, 1989). Experiential learning theory (Kolb and Kolb, 2005; 2009), critical thinking (Gokhale, 1995), intelligent learning environment and skills modelling (Desmarais and Baker, 2012; Dias and Diniz, 2014), learning versus teaching and learning versus understanding (Robson et al, 2013; Entwistle, 2016), blended learning (Dias and Diniz, 2014) and the influence of social networks on the learning process (Doignon and Falmagne, 2015) are also major highlight.

Learning then is "…a process of becoming a member of a community of practice through legitimate peripheral participation (e.g. apprenticeship)." (Kolb and Kolb, 2005).

1.1 Terminology

The identity criteria should be embedded in the present project to define the concepts and first attempt in this line starts with the consideration of identity and truth (Tarski, 2001; Halpin et al, 2010; Carrara and Gaio, 2012). The conceptual space theory (Gärdenfors, 1996; Decock et al, 2012) and Strong Ontological Realism (SOR) developed by Devitt (Tarski, 2001) can refine the above. The conceptual space deals with the information representation. Intuitively, we can connect the information above with a set of prior defined objects. Ontological operators can achieve a refined effect over these objects and information. The entities involved in the learning process can be understood in this extend as part of a specified domain of discourse and Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) ontology (Masolo et al, 2003) is referenced here.

The paper is structured as follows. Section 1 offers an overview of the most significant concepts in the literature regarding the process of learning with the coordinates of cognition and learning. Section 2 develops an ontological view of the learning process, developing formulas and definitions over the involved concepts. It also formulates the definition of conformity and compliance as applicable for a given learning space.

1.2 Learning as cognitive activity

Introspection into literature survey (Vygotsky, 2000; Fabrigar et al, 2006;Rusu, 2007; Nelson, 2008; Young, 2009;Ionescu 2011;Desmarais and Baker,2012; Iancu, 2012;Robson et al, 2013;Entwistle, 2016) shows primary attributes of learning. The process is holistic and cognitive. Simply, the learning process is a mental activity having different states or routes. Various perspectives (e.g. the teacher or the learner perspectives) emerge into the definition of the learning process.

Theories of Piaget (Piaget, 1952; 1956; Rusu, 2007), Vygotsky(Vygotsky, 2000) and Kolb and Kolb (Kolb and Kolb, 2009) apply, but the present work relies on Experiential Learning (*ELT*) and Knowledge Space (*KST*) theories. Learning process transforms information captured from experiments, experience, observations and concepts into knowledge. Knowledge formation comes as the result of any learning process. A two-coordinate conceptual space, outlined by the experiment-observation and the experience-concept axis, is involved to define the learning process. However, the knowledge creation mentioned here is also a matter of relearning (Kolb and Kolb, 2009), thus explaining the learning process as being iterative.

1.3 Learning as cognitive activity

Any learning management system, described in the framework of this paperwork, should establish the learning as a path: from the current state (K_i) to the new state of (K_{i+p}).

To define the path above, we will apply *KST*. The primary definitions involved, proposed by *KST*, are the concepts of knowledge structure, knowledge state and learning space (Doignon and Falmagne, 2015).

Under the *KST* perspective, considering the domain of knowledge structure (Q) embedding the knowledge space$\mathcal{K}$, then a knowledge state (K) would exist as subset of a knowledge state (L) with the properties:

[1] $\forall K \in \mathcal{K}, \exists i, p(1 \leq i \leq p, |K_i \setminus K_{i-1}| = 1)$

[2] $\forall K, L \in \mathcal{K}, K \subset L, \exists k \in K\ (K \cup \{k\} \in \mathcal{K} \rightarrow L \cup \{k\} \in \mathcal{K})$

The two goals above focuses on the learning space creation and considers the definition supplied by *KST*: any knowledge space $\mathcal{K}$ satisfying the conditions [1] and [2] is a learning space (Doignon and Falmagne, 2015).

To define the learner perspective, the image to be managed is far more complex. The concepts in the theories of *ELT* and *KST* apply, but also, there come certain factors influencing from a psychological point of view the efficiency of any learning system as perceived by learners. This complexity is not to be attempt under the scope of this work, but results of particular research can be used to reduce this complexity up to a reasonable level. Usually, these research aligns different questionnaire (Iosif et al, 2015; Entwistle, 2016) addressed to students in various domains and grades.

Entwistle research captures those criteria defining the way in which learners perceive the process and the environment of learning. The student perception is structured by following: empathy, enthusiasm, explanation, clarity, structure, level and pace. Students will evaluate the effectiveness of the information received, depending with the perceived usability of the acquired knowledge (Entwistle, 2016).

2 An Ontological View on Learning Process

Consider the conceptual space, noted as *CSp(p)*, defining a learning space (§1.3). The components' identity over *CSp(p)* will examine these elements in the category of Mental Objects(*MOB*) (we will return to this definition in §2.2 and §2.3).

Learning process definition proposed by Kolb and Kolb (§1) can be understood as the function intended for the learning outcome, this will be further identified in ontological extend (Mizoguchi et al, 2016), and the notation of *Func(f)* refers to this point.

Regarding the *MOB* entity, defined as the outcome of a specified learning process, there are several conditions to be expressed and met. Furthermore, these circumstances claim for a specified *LRN(w)* entity (the learner, individual or collective Social Object, identified as *SOB*) requesting (*Req*) acquisition of particular *MOB* to satisfy the *Func(f)* above defined.

Then, for a specified learning process with *MOB* defined by Feature (*F*), Quality (*Q*) and Qualia (*q*), relation [3] holds between the *MOB*, *LRN*, *Req* and *Func*(*f*):

$$[3] \quad MOB(x) \rightarrow \exists a,b,c\,(F(a) \wedge Q(b) \wedge q(c) \leftrightarrow LRN(w) \wedge Req(x,f,w) \wedge Func(f))$$

It is to note that an individual argument defines all entities described in [3], but three arguments specify *Req* object: *x*, *f* and *w*. This fact suggests the *Req* object plays an integrator role in relation with the entities of *MOB(x)*, *LRN(w)* and *Func(f)*.

Formula 1:	The entity describing the request is the trigger for any learning process.
Argument:	Straight from (3), $LRN(w) \wedge Func(f) \wedge \neg Req(x,f,w) \rightarrow \neg MOB(x)$

2.1 On the nature of entity *Req(x, f, w)*

The particular importance (§2) of the *Req(x, f, w)* object about the learning process has been proved. Certain specific features come to identify the addressing *Req* entity.

To define the entity playing the role of learning process trigger, we shall call for *DOLCE* (§1). We shall note from the beginning about the arguments used by *Req* entity,*x*, *f* and *w*. The arguments *x* and *w* are both part of the endurants: *MOB(x)* and *LRN(w)*. Argument *f*classifies the function in the process of becoming a member in the specified community of practice - representation of the learning definition (Kolb and Kolb, 2005).

It suggests that *Req* entity plays a role of a perdurant, as this entity has a space-time definition, explained by the particular moments when we can observe the existence of involved arguments. The order of arguments existence is *w*, *f* and finally *x*, as shown by ELT (Kolb and Kolb, 2009). The other argument needed to prove the space-time existence, the learner endurant *w*, is called to demonstrate the relation of participation between endurant and perdurant.

It is to note the relation of '*possible that*' ($\Diamond$) applying for both *f* and *x* existence. On the moment identified by t_1, an individual or a composite social object (*SOB*) applies to become a member in the desired community of practice. This selection is just '*possible that*', but once the *f* existence is proved, then it occurs at a later time t_2. At the same time, *SOB* entity will get the transformation to *LRN* entity as defined in [3]. The subsequent time t_3 has again a '*possible that*' relation determined by the *Req* existence,see [4].

$$[4] \quad SOB(w)_{t1} \xrightarrow{select} \Diamond Func(f)_{t2} \rightarrow LRN(w)_{t2} \xrightarrow{Req} \Diamond MOB(x)_{t3}$$

It results that *Req* entity relates a particular process. It is not present from the beginning, as input for the learning process, but the future learners should *gain it*. Once gained, we can call that *w* - the attendance, becomes*w* - the learner.

Formula 2: $\exists t'(Req(x, f, w) \subset EV(w, t'))$
Argument: Straight from (4), $t' = \{t_2\}$

2.2 Learning: trigger, process flow and outcome

To define a model of learning trigger, process flow and related outcome, we shall call for the conceptual space specified in §2. This conceptual space comes tied with the Domain of Discourse -*Dd(P)*. A supplementary hypothesis identified by *SOR* (§1.1) is involved in this construction, with the meaning of a real existence of the related objects so that the presence of these objects is mind-independent (Figure 1).

Strict identity criteria should apply to distinguish among the objects in *Dd(P)*. The identity should act also from transitivity and granularity point of view. This refinement will allow a complete identification of related objects with the set of part-whole relations. A particular taxonomy will then define the domain of discourse: *knowledge*, *behaviour* and *attitude*. These mental objects will refine the considered conceptual space constituents (Figure 1).Features, qualities and qualia as defined by [3] qualify the mental objects. Any mental object represents the outcome of a learning process. Thelearning process is identified in ontological extend by the notation of *PRO(v)*. Also, the eventive perdurant entity *EV( )* is used (§2.1). The entity of *Req(x, f, w)*, a subset of *EV( )*, highlights the occurrence of a particular state during the learning process.

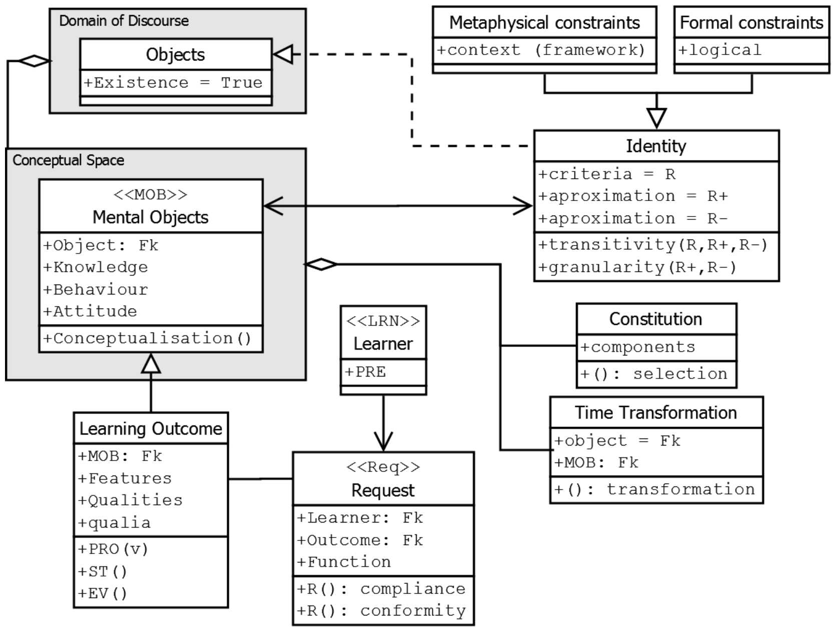

Figure 1. Learning trigger, process flow and outcome

The attributes of conceptual space, the objects of *knowledge*, *behaviour* and *attitude* should be characterised by a precise *equilibrium*, to preserves the learning paradigm. The concepts of compliance and conformity address the learning outcome (Figure 1).

Formula 3: (compliance)	Learning process relates a conceptual space made of mental objects to classify any *existed*, *existing* or *may exist* objects in the domain of discourse.
Argument:	$\forall P, \exists p(CSp(p) \leftrightarrow Dd(P))$
Formula 4: (conformity)	A physical representation of the objects in conceptual space should meet the characteristics of the related *existed, existing or may exist* objects in the domain of discourse.
Argument:	$\neg MOB(x') \wedge (POB(x'') \not\equiv POB(x))$

2.3 The concepts of compliance and conformity

Compliance and conformity claim the conceptual space above, and the one identified by the notation of $\mathcal{K}$(§1.3), with the property:$\mathcal{K} \subset CSp(p) \wedge \mathcal{K} = \bigcup MOB(x)$.

The mental objects forming the learning outcome explains the compliance concept. It focuses on offering a quantitative measure over the fulfilment of the *Req* entity. If [3] holds and *x* is described as requested entity, then a process, identified as *PRO(v)* – the learning process, should be defined to supply the *x'* object to satisfy requirement *x*.

Other way said, the two entities: *x* and *x'* are constraint by a particular relation of *equivalenceR* [5].

[5] $$\forall x\ \exists v, x'(PRO(v) \rightarrow MOB(x') \wedge MOB(x) \wedge R(x', x))$$

If [5] holds, by consequence we have [6] holding as well, in meronymic extends. It presumes that any non-atomic mental entity can associate a specific structure, so relation [6] shows the two mental entities as 'families'.

[6] $$\forall x\ \exists x'(\neg At(x) \wedge \neg At(x') \wedge MOB(x') \equiv MOB(x))$$

If *MOB(x')* in [6] exists, the result of applied acquired knowledge is shown by [7]:

[7] $$LRN(w) \wedge MOB(x') \rightarrow ASOB(w) \wedge POB(x'')$$

Relation [5] defines a mental object (*x'*) participating with a particular perdurant and resulting into an endurant (*x''*), equivalent to a specific real object in *Dd(P)*. It has the meaning that, once the mental object participates, it makes real the existence of a physical object, bearing of specific identity criteria, and determines the transformation of the social object – the learner – into an agentive social object – the practitioner.

Based on Formula 3, the definition of compliance is shown by [8.1], and conformity definition comes by [8.2] applying Formula 4.

[8.1] $$Cmp(x', x) \leftrightarrow MOB(x') \equiv MOB(x)$$
[8.2] $$Cnf(x'', x) \leftrightarrow Cmp(x', x) \rightarrow POB(x'') \wedge R(x'', x)$$

It is to note that just the negation of [8.1] or [8.2] will not obtain definition of noncompliance or nonconformity and there is a specialization for these terms: *noncomplying* ($\neg Cmp(x', x)$) versus *nonconformity* ($\neg Cnf(x'', x)$).

Both noncompliance and nonconformity pose a substantial temporal basis. Relation [7] makes the difference, whichcan be considered only regarding the term of nonconformity. For the term of noncompliance, we can consider as datum relation [6].

If the term of noncompliance apply, there is no *POB(x'')* to be stated as in [9]. Relearning solves eventually the noncompliance, but for nonconformity, solving requires a more deep procedure to apply for both entities of *MOB(x')* and *POB(x'')*.

Any noncompliance can evolve potentially into a nonconformityas in [10]. Therefore,for the nonconformity definition,relation [11] applies.

$$[9] \quad MOB(x') \perp MOB(x) \rightarrow \neg Cmp(x',x)$$
$$[10] \quad \neg Cmp(x',x) \rightarrow \Diamond \neg Cnf(x'',x)$$
$$[11] \quad \neg Cnf(x'',x) \leftrightarrow MOB(x') \perp MOB(x) \rightarrow POB(x'') \wedge \neg R(x'',x)$$

From the relations above, comparing [8.1] with [8.2] and [9] with [11], it comes out that compliance refers to an *acquired* mental object (*x'*), but conformity relates to an *obtained* physical object (*x''*) with material implication from *x*.

Conclusion

The present work goes with the definition of compliance/conformity under the context of learning space. There are certain formulas used to express the desired definitions, such as those in Formula 1 to 4. The concepts of compliance and conformity were defined as a specialisation of the equivalence relation. These depend upon the existence of a specified physical object having a material implication of acquired learning outcome.

For the case of noncompliance identified within a learning space, the associated cost is minimal as the primary action to overpass the detected *event* relies on relearning; as this being part of learning, it does not come with additional expenses. A particular learning method (trial-and-error) just emphasises this characteristic. If not addressed properly, any noncompliance can evolve to nonconformity.

Learning process detailed within the work should verify certain conditions to prevent the occurrences of noncompliance and mainly it should prevent the cases of nonconformity. Identified with the term of learning management system, it should focus on achieving the conformity as the relation [8.2] defines the concept. But, this particular system is itself the outcome of a learning process, where conformity also applies in the same extends as considered in this research.

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Chaos as Art principle - Reason for Composition Imbalance

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Abstract

Art is a human activity, product or idea of that activity associated with the senses, emotions and intellect. Art is inherent in humans making them separate and different from the other living beings. This conception of art as an autonomous activity is as a product of artists who are looking for beauty, dates back to ancient times.The simplest definition of the term art is that it is a human creativity. Although today the term art commonly involves visual art, the concept of what art is has constantly changed over the centuries. Perhaps the most consistent definition is the most general one - the notion that art refers to all creative and artistic actions of man.As a product of visual arts, the artist creates a composition that is a work of art. Composition means combining elements and principles in making a creation.The principles of good design are tools that the artist uses to create an effective composition. Whether a design is weak or strong depends on the knowledge of the artist designer for principles, and his ability to apply them. Based on the layout, there may be several types of composition. But when the elements do not have a proper arrangement, it is a chaotic composition.

Key word: balance, chaos, art, composition, contrast

1 Introduction

The composition is a set, assembly of parts into a whole artistic development of an idea in accordance with the requirements of materials and resources in a particular kind of expression.

In music composition, means creating and composing a piece of music. Composition in painting work, means there are several elements in a unified whole. In non-figurative art, the composition constitutes a relationship of form, color and space, and in technique and technology, composition of different alloys that create a compact mass. In everyday practice, the composition is composed of parts that make up a whole.

Harmony of the parts that make up a whole in the nature has long been studied. Preserved artefacts from Paleolithic and Neolithic are extremely well-designed forms of tool. So today we talk about composition culture as a level of understanding and ways of setting something against someone.

Figure 1.Composition - Fernand Leger

The underlying meaning of a composition can be seen by how much and how the elements of composition exceed the randomness and to what extent the realized relationship suggests recognizable personal style and features of the time in which it emerged. Although today the term composition indicates different phenomena and situations (ex., composition of certain spices), it always suggests the meaning of the result achieved with this composition.

When creating a composition with multiple elements which should create a whole, it is difficult to achieve perfect harmony and a good composition, but it is also hard and maybe even harder when creating a composition with a small number of elements. In contemporary art is the minimal art that deals with such phenomena (art of minimal expression).

As a rule, every composition creation requires two or more elements, so that some relation is established between those elements and the space. If, however, the composition consists of only one element, then the composition consists of this sole element and the space itself. The purpose of the composition is satisfied if a relation is established of something against someone, and the composer freely elects the means and ways through which he or she expresses them.

In visual art, composition means combining elements of art and principles in creating a work of art or visual arts. When creating a work of art, the artist makes more several sketches that help him show his own idea in a suitable way.

Figure 2.Composition - Robert Delaunay

There are a vast number of opportunities to create a composition. Proper composition can do a lot in producing a work of art, which is not only meant to represent a picture, but a work of art. So, any art slowly comes to the point where, thanks to its own assets, it becomes able to express what can best be expressed.

A composition is a harmonious and orderly arrangement, thoughtfully arranged order of visual elements - elements of composition within a space and shape, in which unity prevails of techniques, materials, and ideas.

Composition means arrangement of masses, lines, shapes, colors and other elements with interrelations of repetition, harmony and contrast, symmetry and asymmetry in different rhythms etc.

The main objective of every composition is for the artist to express his idea more efficiently. Synthesis means unity, and unity is what makes creation leave strong impression even at first contact with the observer. Given that the first and strongest impression is created by the elements that act directly and instantly upon the feelings of the observer, the artist should seek his expression to flow more through them than through thematic content.

After all, the thematic content observer reads on intellectual way and gradually afterwards. The principles of good design tools that, the artist used to create an effective composition or design. The difference between weak and strong design is the result of knowing the artist for the design principles and his ability to apply.

After all, the thematic content is what the observer reads in an intellectual way and gradually afterwards.

The principles of good design are tools that the artist uses to create an effective composition or design. The difference between a weak and strong design is the result of the artist's knowledge of the designer principles and his ability to apply them.

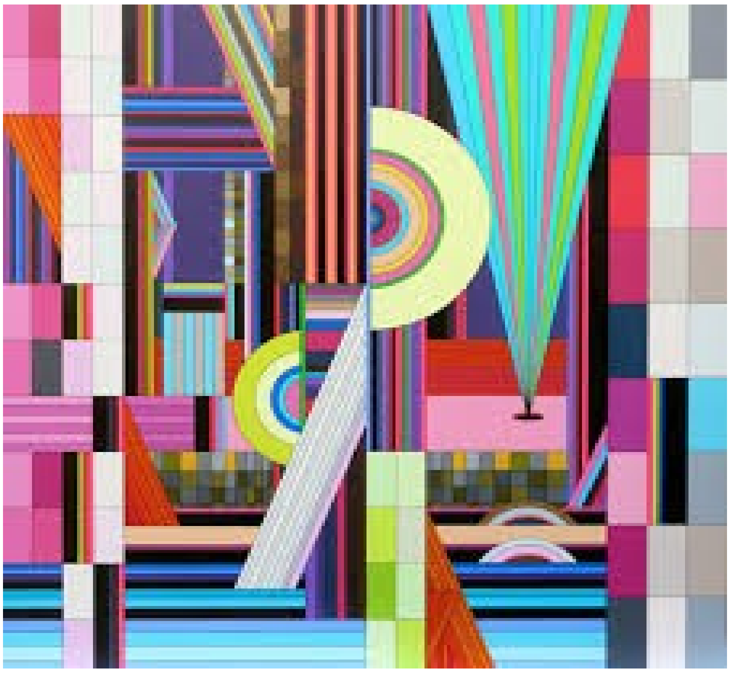


Figure 3.Composition

Basically, every design is arranged by the design elements of the application designer principles. Taking into account all these components, a composition, appearance or design is created that should be pleasing to look at. Upon average sensibility, ordinary objects exert superficial effect, while the ones we look at for the first-time cause impression. The human soul reacts when it is touched in its most sensitive spot.

We know that it is skeleton of the human body that is the structure that supports all the muscles and other parts of the body, it is the beams in engineering that support the whole building and in arts it is the composition that unites all elements in itself. The canvas, line, shape, tone, color or other visual element can be put in many places, but the question is where?

This issue becomes resolved by the arts composition itself. What we see at the composition is an integral part of it. As the initials idea of the artist gets born, as more or less clear vision, so starts the process of creating the artistic work. Even in this first phase, the basic thematic relations are present. The unnecessary gets marked, analyzed and removed.

The area that limits the artist is the physical plane in two dimensions, having only length and width. Such a surface without depth is called the work space, the design-field or format. Before starting the realization, the artist needs to decide how to organize the unity of format and its form. The format is defined by the horizontal and vertical margins. By determining the format and defining the theme, the realization begins of the very idea.

Harmonious and pleasant relationship of elements is achieved by rules for their proper arrangement:

- Geometric center
- Optical Center and
- Rule of thirds, etc.

The format is determined by its final four vertices, and its fifth vertex, the center, is determined as the invisible point located at the intersection of the diagonals of the format or the intersection of the lines that divide the format into two equal parts. The central arrangement of this type should direct the observer's eye from the peripheral parts towards the center. By placing the object in the center, the observer will not be motivated to study the rest of the image.

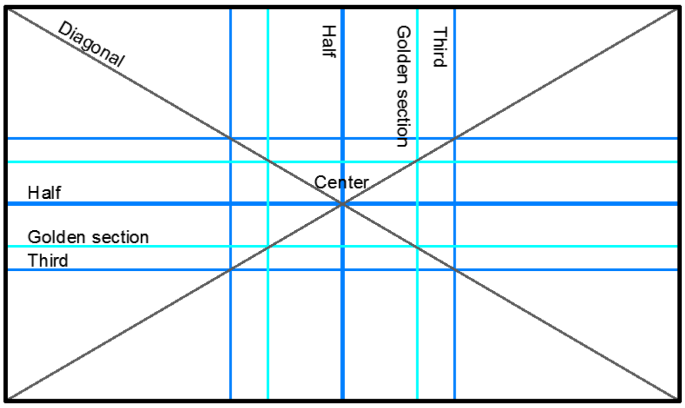
The optical enter represents the place where the lines intersect of the golden-intersection, vertical and horizontal. The shape placed in the optical center acts dominantly while the composition, simple and unique.

The rule of thirds is often used with two horizontal and two vertical lines dividing the format into nine equal parts, and their intersection receives four important points which should accommodate four main items of the composition. The theory says that if the object of interest is placed at the four points, or along the imaginary lines, the composition becomes balanced, and the human eye naturally glides over it.

Perception of space, forms of elements that will make up the composition and setting are the most important segments in forming the composition. It is these features that represent the skillfulness of creating a good composition. The elements of the composition are classified according to form and direction.

By the time of the Renaissance, painters have always laid their elements in the center. But later they started to perceive and to use some new elements. The lines are perhaps the most important element of the composition. When used effectively, they visually guide us through the "scene".

There are three types of lines: horizontal, vertical and diagonal, and each creates a different dose of energy and movement in the composition, and hence different effects.



The horizontal lines give steadiness, stability and calm. The composition receives an idyllic effect. The setup of the horizon in the composition has three positions: in the middle (middle cut), which divides the composition into two equal parts horizontally.

Centrally positioned horizon is commonly avoided in theory, but it is a very powerful tool especially when it comes to displaying symmetry (eg reflection). The symmetry is displayed horizontally, while vertical asymmetry.

The second position of the horizon is (low cut), it is positioned on the lower third of the composition. In this position, the action takes place in the upper two thirds of the frame. The last position of the horizon is (high cut), the upper third of the composition. This horizon is used when the action happens in the lower two-thirds. Vertical lines add movement and energy of the composition, which becomes much more powerful and expressive.

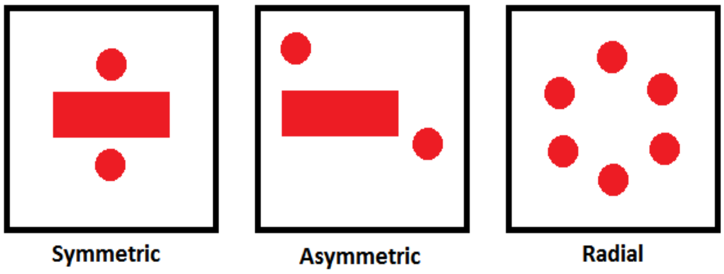
Diagonal lines produce the most energy and movement than any other type of line. Diagonals get us directly into the scene much more aggressively, creating a visual tension as a final result of the perception. Diagonal lines can imply a distortion of perspective.

Balance as an artistic principle

Balance or equilibrium is an art principle which governs the arrangement of elements in the whole. One of the wishes of artists is creating a balanced composition.

Balance does not only apply to the composition, but to the selected motifs, their proportion, color, contrast and many other factors as well. Only when a composition is balanced, it is stable and appears properly. The three common principles of composition in the balance are: symmetry, asymmetry and radially. In art, symmetry generally conveys a sense of harmonious or aesthetically pleasing proportionality and balance, and it reflects beauty or perfection.

Symmetrical balance is most stable in a visual sense. Symmetry is achieved when both sides of the artwork are almost the same on the horizontal or vertical axis of the composition. In a symmetrical way, we build symmetric equilibrium with color, texture, line, form, in a way that we seek visual balance of the right and left half of creation. The converse of symmetry is asymmetry.



The purpose of the asymmetrical balance is the same, to make contents both on the left-hand and right-hand side equal in value to the line, tone, color, texture, size and shape, while their setting is different on both sides. Balance in the composition is achieved by a simple combination of the proper shapes, colors, light, darkness that complement one another so that the composition is balanced.

So, a composition emerges with balanced sense of peace, calm repetition and harmonic division of all elements. If we desire to achieve a mysterious, disturbing, weird feeling, imbalance can be more efficient than the balance in the composition.

It can be obtained by combining different forms, shapes, contrasts, or by placing items with no order or rule. In fact, the elements are "scattered" chaotically. It is defined as the compositional chaos resulting in imbalance.

Chaos as permanent instability

The term "chaos" in the old view of the world refers to the notion of an endless source of future events. Hesiod considered it as an early content of the world in a state of uncertainty. Later Aristotle defined chaos as "free space", but since then dominates the idea of order and determination, and chaos is perceived confusion and mess.

Between 17th to the 18th century, the adjective "chaotic" appeared. Development of chaos theory created a new perspective to better understand the chaos and its complex processes. The theory of chaos is one of the most fascinating, most influential and most promising scientific and cultural paradigms in the last fifty years. Although the activities in this area are no longer covered by the media as ten years ago, opinions of the importance of this type of research "chaos" do not differ.

Chaos exists everywhere in nature, sometimes in heart rate. Under certain circumstances, the heart can beat chaotically. Heart beats are smooth and regular, but sometimes it happens that it does not work as it should and then longer and shorter intervals appear between heart beats. In more extreme cases, heart rhythm becomes irregular. Little change in the timing of a heartbeat causes major changes in what follows.

Heart rate becomes chaotic and could threaten survival. This is a good example of transition from proper motion to chaos as a result to changed conditions. Chaos is the opposite of geometrical order. Geometrical order expresses harmony, seriousness, while chaos gives a special dimension to the composition. The balance between them is always needed and necessary, because if chaos prevails in the composition, it leads imbalance.

Chaos is opposite of geometric order, it is represented by forms and relations that are complex and difficult to describe by classical mathematics. From the perspective of spatial perception, two graphic compositions are given. The average density is the same in both compositions. In the first picture, the correct order of points forms a circular area, and the background is chaotic, and in the second picture it is opposite, the background is in proper arrangement of dots and circular area is a chaotic set of points.

This example enables us to conclude that the chaos is interference in the geometric order which represents interference in chaos. They are tightly linked together. Chaos is permanent instability. Instability is part of our own environment and culture. Chaotic movement contrasts with the regularities that we could see in the universe on a broader scale.

People have always wondered about the order of the seasons, the way the night changes into day and the precision how, it seems to us, the stars and planets move across the sky. All these celestial phenomena have origins in the regularity of movement of the Earth and other planets, which more than 300 years ago were explained by Isaac Newton in his laws of motion and theory of gravity.

Under these laws, the current positions and velocities of the Sun and planets are determined by the positions and velocities of all past and future times. Newton's laws of motion are classic examples of determinism, which stipulates that future is solely determined by the past. When scientists look for this kind of order in the universe they usually find it. But as we know, the order is not universal; we need to understand disorder too.

Pierre Simon de Laplace, born in Normandy, is one of the first scientists who studied the disorder. Pierre completely believed and relied on Newton's views of the cosmos, but is credited with establishing the theory of disorder, or probability, which describes how many phenomena appear to relate in a typical way even when the individual effects are unpredictable.

Chaos appears in all scientific disciplines. Biologists find chaos in changing populations of insects and birds, in the metabolism of the cells and the spread of impulses along our nerves. Physicists find chaos in the movement of electrons in atoms and molecules and atoms in the gas, and the theory of particles.

Even engineers have to consider chaos as it can disable electrical circuits. It can lead to loss of particles of an accelerator or plasma, or it can overturn a ship at seas. The chaos comes from the reaction in the system of opposite effects; the "feedback" creates complex dynamics in simple systems. Artists find chaos in the sloppiness of composition elements.

Over the last thirty years, Chaos has been one of the most exciting areas in science and one of the most interesting. It is still young and we do not know to what extent it will change our view of the world. It is certain that theory of chaos underlies the cross-disciplinary nature of marginal research. Chaos leads to the creation of kitsch. This idea gets widely used in the XIX century and comes from the German word (kitchen), which means to do something, and it looks seemingly worthwhile, too crowded and decorative.

It can be said about the concept of kitsch to be an expression of bad taste, where certain artistic values are replaced by superficial impressions of art, where the artistic values leave no trace. In the new era kitsch is explained in detail by extensive literature and authors all agree on one thing: the kitsch is the person itself. Kitsch today is a pervasive reality in all walks of life, so today kitsch can be recognized everywhere where there are humans.

When creating compositions, chaos can lead to the creation of kitsch in all areas of design. The interior design kitsch occurs with improperly combining shapes, colors, materials and etc. The designer can use any shape to express himself. However, this form should be consistent with the space and other items in it. The contrast can have infinite power. But you have to stay at the same moral level.

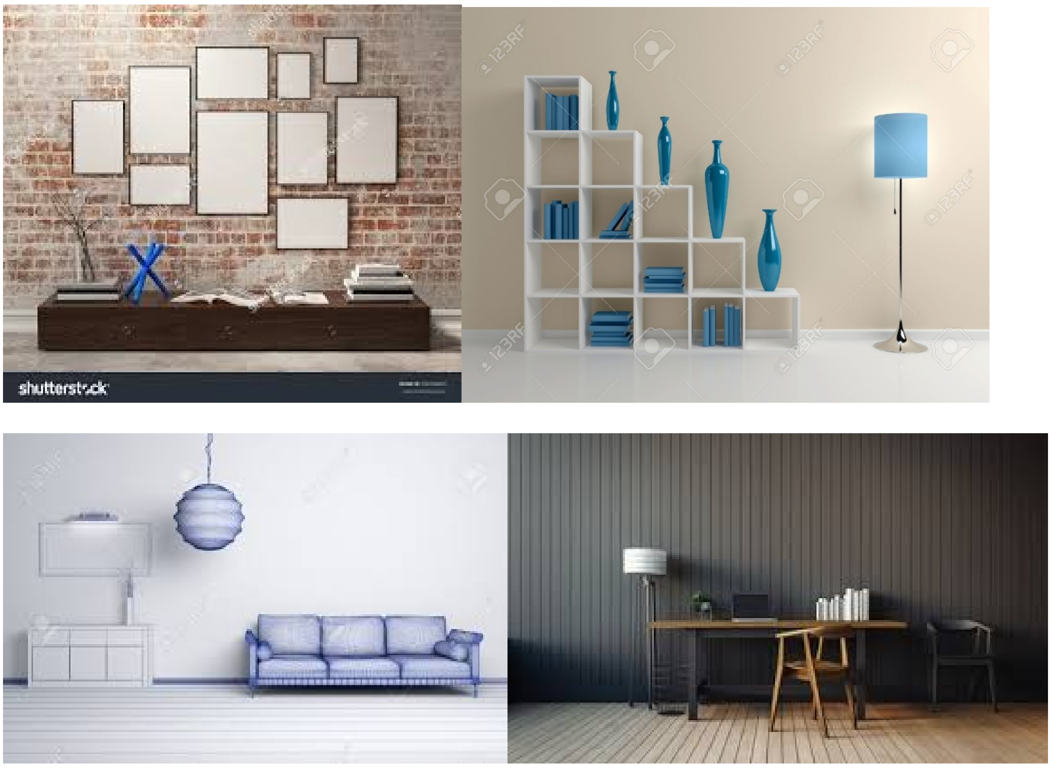


Figure 4.Composition interior

Recommendation for removing chaos from a composition

1. Aims and the ideas in creating a composition.
2. Following certain rules to create a composition.
3. Beauty emerges from the inner necessity of the soul. Beautiful things have inner beauty.

Conclusion

Before starting of any artwork, the artist or designer should keep in mind that each composition starts with an idea. If designer principles are to be used effectively and correctly, it is necessary for the artists to have a particular idea or goal. Without a goal, no matter what principles have been applied, the result will be an uninteresting work of art.

Having an idea, we can create a beautiful composition even if we forget the principles or apply them intuitively. Every artist should aim to create a composition that is unique and interesting to watch. When the designer has a good idea, the effective application of designer principles will aim to achieve unity of the artwork. Whether designers apply the principles consciously or unconsciously, unity should be the goal of every artist.

Harmonization of the whole canvas is what realizes artwork. There is no doubt that the eye and mind perceive balanced composition much more easily. But the artist does not always create what the mind requires.

Sometimes elements are combined to create an imbalance in the composition accompanied by chaos and in rare cases when chaos affects composition positively. In that sense, only works that possess aesthetic values are considered to be art, regardless of how they are performed and their artistic technique.

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Similarities and differences between design and artwork

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Abstract

The crowd of people very rarely makes a distinction between the concepts of art and design and is very common confusion and mixing them. Elite and avant-garde designers like, theorists, critics through practice and theory for years tend to bring together the various philosophers to the table through various interactive examples. Industrialization as the main culprit enables these two separate disciplines to get directions and to develop within its meaning. The design works in the field where it is happening everyday practice and commerce, unlike art which allowed greater experimentation with ideas. The design is a victim of the entertainment industry. He's seen and experienced by almost everyone throughout the day. The design is communication and function in visual form, designed for the general population or a segment. Designer addresses specified needs and solves problems. Art is elitist; it means that you can view in galleries and museums, displayed far from the mainstream of everyday experience. One who sees art may or may not have significant experience. Both disciplines are visual and belong to the broad categories of visual art. Both include aesthetic principles. Both are highly creative activities including processes that require time, observation and reflection.

Keywords: landscape, architecture, design, art

Introduction

The theme of investigation that opens in the following opens a lot of questions that surround the concept of design. In order to discuss the relationship between reality and viewer in the field of design, it is first necessary to point out some definitions that are mentioned in this concept, then to distinguish from the concept of artwork with which the design has and quite Common countries.

Design

What is Design? - Design is an inherent effort directed to the established order. The figurative design of functional elements is called design i.e. Of one functionality when adding natural values. With a line a form is created and the shape is the reason for the design.

In order for a matter to be drawn, it must first be the result of a designer's idea. By definition, the design is a preparation of a preliminary sketch or a plan for the shape or structure.

All people are designers. Everything we do is the design of the basis of all human activities. Planning and shaping each action in the direction of the desired goal, the design is the process. Every attempt to separate the design, as well as some special disciplines, is at odds with the real starting value.

Fig. 1 Colours and Design

Value of Design

The design includes a specific criterion, research and research, including exceptional creativity. Where the artist begins with empty canvas and creative will finish his way to the goal, the designer begins with a set of criteria and creates within the concrete boundaries of the concept to the end result. Design is not a decoration, and the designer does not require to express an opinion, but to determine exactly who and what he designs. Design influences and convinces in the field of popular culture. It is created for the table and will always have a commercial purpose. The designer suited the concept of functionality, while the artist puts it in decorative style.

The design value is how design works for the public, i.e. The people, the market, and the businesses they represent in our everyday life without which we cannot function because all of our receptors have occupied them with all their new trends, but the main reason is that they come out with great convenience backed by technology. That is, every day we are intertwined moments of products that are intended. Importance of design

What is the meaning of today's design? Following the characteristic of design as an independent aesthetic activity gradually the scope of professional design has been expanded. Design activities are enriched with new features and tasks that lead to its differentiation, and from there there can be noticed a change in the theory and practice of design.

Today we talk about total system design. Increasing the sphere of global influence, including the range of countries with different degrees of economic and cultural development. On the other hand, modern design is characterized by inadequacy and uneven development.

All of them reflects on the subjects are obvious and direct links to practice and design theory. In a world dominated by the subject environment - abstract images of which have a specific task of expressing the reality of social relations in more or less understandable terms - the function of the designers becomes contradictory.

On the other hand, indeed, a reflective way, they enjoy the same central role as the site they are designing; otherwise, their cultural characteristics, despite being endowed with high prestige today, risk design elements being subject to instability and insecurity in their own right.

This explains the propensity for transformation of the traditional designer-designer, who often only survives as a pure spectacle in a series of coordinating activities that lead to design but which go from manufacturing to distribution, marketing, and so on.

Italian design is already numbering different examples of this type, and it would be a lot more if fashion designers are included in this category. But in other categories with the usual volume of design, a central spot is confirmed by the use of usable objects, it wants to be constantly transformed while remaining in the possession of its substance of the original function; And the task of expressing the cultural, aesthetic or semiotic values, that act behind the transformation of a specific designer's duty. At this precise point of the idea' design culture ' is still unclear, which would make it possible to tackle the problems involved in designing today.

The role the designer shares with the subject, in addition to the centre, is illusory, so the same threat of disappointment and rapid consumption also hangs over him. If the object is anything other than a photo, its design would be a photo-design; if the image is ephemeral associated with this pure form of good design would be an abstract obsessed with fashion ' ready stoke

If the culture of design means explaining the culture of the question, there is a need to share the fate of the question. And since the facility in our system is both a sign of social identification, a communication tool, a used photo or a fetish and instrument, the project cannot help to be a tool of social analysis the field of invention in everyday life, language, fashion, form theory, Fetishism and material goods.

And its strength and weakness lies in what is at the same time a key moment in the social development of everyday life and the insignificant aspect of production, the source of culture and the culture of existing values. For the present, nothing can be done to remain fully aware of this contradiction, even though it is conscious that it hurts.

The main purpose of this phenomenon in design is when new features are added to the objects of mass use demanded and desired by users. Increasing the aesthetic value of products as a way to increase profits is the thesis created by Raymond Levy in the 30s. Particular attention is paid not only to the inner shape of the product, but also to the appearance, packaging and advertising.

In parallel with style in modern people's life, the design also develops, referring to traditional methods of creating a form of material environment. The task of this design approach is to address the real needs of people, the shape of the objects that build the material environment, not to manipulate the consumer's mind, but to inform them about its qualities.

Art

Art is a special place that offers the opportunity to get acquainted with and experience in the creative process from the concept of thinking and realization. Activities are based on the formation of experience supported by the knowledge of art theory, art history, art theory, social reality and aesthetics. When the main expression of art is based on an instrument called impulse, creativity, because this basic activity. Art values the relationship of space and brings legality and order to things. The art progresses and evolves into the formation of independent original forms of learning and creative activities, where the issue opens. The problem of art and visual culture.

Humour is psychological. It can be reduced to the perception of an object of visual stimulation that is predictable with regard to the potential response of the target audience. Art is an experience based on the relationship between people and the world. Art includes such links that are between the viewer and the artistic object, the artist and the viewer, the society and the artist, the unconscious and the consciousness, and the expansion of the creative consciousness of their contemporaries.

Art is especially human behaviour towards the aspects of a world that are defined with the best thing one can experience as feelings and meanings of great intensity associated with other objects or aspects of our environment.

The qualities of these aspects of our world include the master's ability to include in its aesthetic stimulating formations to others the quality of unity (to what extent does the work create a sense of integration and unity with the viewer), consistency (elements of the working form of a compatible whole , Both in graphical and numerical composition, intensity (creation of emotional charge through both forms and content of work), originality (the value of novelty through creativity, which leads to a new aesthetic experience).

The artist facilitates the aesthetic perception of the viewer, the next one who has to take responsibility for the aesthetic evaluation of the artist, who created the stimulus, to his sensible and internalized relationship with an artistic object.

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Fig.2 Art in open space

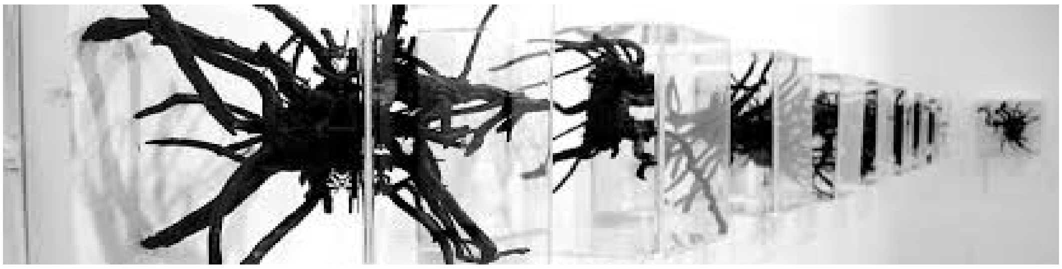

Fig.3 Art in indoor space

Also, there are social interactions between the artist, the artistic object, the viewer and the community. The artist creates incentives for other people who respond to emotional and intellectual. If most observers identify their feelings extracted from the perception of the site as aesthetic and of a rare quality, this work of art is associated with art by artists other than artists.

The public's response thus provides feedback to the artist as to the effectiveness or success of his attempt to make art, which leads to a definite rejection or approval. If this does not correspond to public consensus as a work, creativity may still be aesthetic although it is not applied arts.

The acclaimed aesthetic elements of time and place combine to provide aesthetic climate and culture for a larger group, making it a standard of excellence or acceptance to judge the future of works of art.

The line that divides design and art

The mass of people very rarely distinguishes between concepts and art and is often the appearance of confusion and mixing of the same. Elite and avant-garde, as designers, theoreticians, critics through practice and theory have for years been willing to bring the various philosophies to the table through various interactive examples. Industrialization as the main culprit has allowed these two disciplines to get separate routes and to develop within their meaning. Design works in the field where everyday practice and trade occur, unlike the art where they are allowed in a thought experiment.

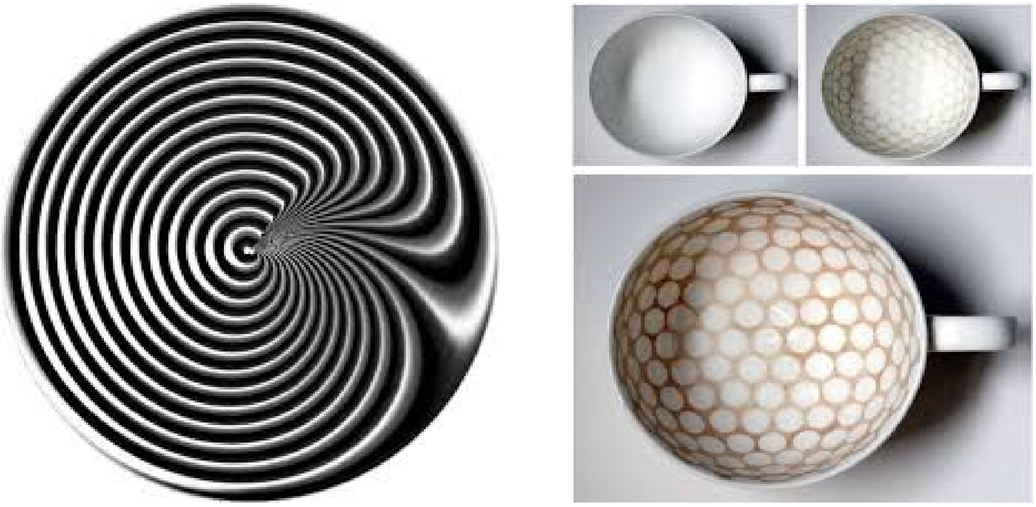

Fig.3 Art in design and design in art

„ what connects these two disciplines are the following characteristics

• Both disciplines are visual and belong to wider categories of visual arts.

• Both include aesthetic principles.

• Practitioners in both disciplines need knowledge of history, past movements and current trends.

• Both have high creative activities, including processes that require time, observation and thinking.

The boundary between design and art is drawn with the purpose of the same

• Art allows the artist to express himself. The artist decides what he wants to challenge and goes to him. And that's what the artist says.

Design is a visual communication and function designed for the general population or a segment of it. The designer addresses the identified needs and solves problems.

• Art can fully rely on aesthetics, and artists go to research trips and experiments.

Design is associated with aesthetics in operation to achieve its goal.

• Art is open for viewer interpretation.

Design cannot be interpretive, but they need to communicate specifically and clearly their audience.

• Art is elitist, it means you can see in galleries and museums, which are far from the mainstream of everyday experiences. The one who sees the art can and should not have a noticeable experience.

The design is a victim of the entertainment industry. It is watched and tested by almost everyone within one day. Everyone uses design. Websites, packaging, billboards, print ads, newspapers, fashion, inscription, interior, phone applications, products and appliances are all designed for visual presence and practical necessity.

• Art exists only for itself. Innovative, expressive and sometimes shocking. The design is practical and carefully crafted. Supports business, marketing, marketing, entertainment, journalism, communications and challenges

• The artist is behind his job and can sign a case.

Designers are behind their work and remain unknown for the most part“

But the creative impulse has both, as the expression of a limited format is the artist's creation, while the constraints of space are the designer's innovation.

But the difference is that artwork is a subjective view of the viewer while design is an objective function of the user. The principle of admiration for the two types of things is reduced to the same, i.e. Pleasure from the beautiful.

Conclusion

- Change and development are a distinctive accent on our time. They also set out the basics of designing in the future, as well as finding forms that can be developed as a way of changing operating processes. As a way out of the principles of the open form, it is possible to allow, in the end, to be given the opportunity to change, to rethink the meaning and to satisfy new features that even a designer at the beginning did not doubt.
- The audience lives in a visual world where, if the designer and viewers have the same taste, the design automatically becomes invalid.
- All arts as a translation of reality are mediators between design and viewer and with the intent to integrate the viewer with the modern reality, a guiding principle of every age.
- The goal of designers is a passive viewer to become a participant in the dynamic work experience. This way of connecting the viewer is placed at the centre of the events, especially including directly in all events on a global scale. When the viewer perceives the net, he touches the space, touches things, and feels their surface and contour. Their perceptual structures structure the information they receive about the specific forms. He understands it because such structuring and layout are part of our reality.

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Developing Ontology-based Mental Models for Virtual Learning

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Abstract

Mental models play important role in virtual learning, and it is an important issue of mapping students' mental models (which may be flawed) to the ideal mental model(s). On the other hand, ontologies also play important role in virtual learning, and the relationship between ontologies and mental models should also be studied In this paper, starting from a survey of selected research work on these topics, we propose an approach of developing ontology-based mental models for effective virtual learning. A brief research agenda towards our goal is also presented.

Keywords: Ontologies, Mental models, Virtual Learning

1 Introduction

A mental model is an explanation of someone's thought process about how something works in the real world. It is a representation of the surrounding world, the relationships between its various parts and a person's intuitive perception about his or her own acts and their consequences. Mental models can help shape behavior and set an approach to solving problems and doing tasks (Wikipedia, 2017). Mental models play important role in virtual learning, and it is an important issue of mapping students' mental models (which may be flawed) to the ideal mental model(s). On the other hand, ontologies also play important role in virtual learning, and the relationship between ontologies and mental models should also be studied In this paper, we provide a brief survey of selected research work on these topics. We are not intended at a complete survey; rather, we want to find out what researhcers have believed among these three important things: ontologies, mental models and virtual learning, particularly how the first two can contribute to the effectivenes of virtual learning. Research work on these issues are scattered in the litterature, but usually only addresses two out of three (e.g., ontology and virtual learning, or mental models for virtual learning), and now we want to find a way to *put all* three important things together: ontologies, mental models and virtual learning. We propose an approach of developing ontology-based mental models for effective virtual learning, and define a set of operations on mental models in a virtual learning environment, which can also serve as our research agenda, because ontologies can play an important role in each of these operationcs.

2 Ontologies and Virtual Learning

In philosophy, ontology refers to a study of the nature of being, becoming, existence, or reality, as well as the basic categories of being and their relations. In information science, an ontology formally represents knowledge as a set of concepts within a domain, using a shared vocabulary to denote the types, properties and interrelationships of those concepts. Ontologies are the structural frameworks for organizing information and are used in artificial intelligence, semantic web, etc. Several important concepts, such as concept hierarchy, are also closely related to the study of ontologies in information science.

The importance of ontologies for virtual learning has been addressed by many researchers. For example, Dong and Li (2005) presented their work on an ontology-based information integration in virtual learning environment (VLE). Relevant concepts extracted from domain ontology provide ontology based browsing space that allows users to browse and select relevant terms of interest and increases the degree of relevancy. In this environment, by using web services to integrate learning materials from heterogeneous public domain data sources, the internal structure and working of public domain data sources are hidden from the users.

Since collaborative learning in is an important aspect in virtual learning community, Yang et al. (2004) studied ontology-enabled annotation and knowledge management for collaborative learning. The authors developed an ontology enabled annotation and knowledge management to provide semantic web services from three perspectives: personalized annotation, real-time discussion, and semantic content retrieval. From the first two perspectives, the semantic content retrieval can utilize the ontological relations constructed from the personalized annotation and real-time discussion for finding more relevant collaborators and knowledge.

3 Mental Models for Virtual Learning

A rich literature exists for the study of mental models. According to Wikipedia (2017), a mental model is a kind of *internal* symbol or representation of *external* reality, hypothesized to play a major role in cognition, reasoning and decision making. Some authors such as Shute and Zapata-Rivera (2008) used the term concept maps to refer *external* representations. They comprise the output or product emanating from the process of “concept mapping,” which is a popular technique used for visualizing the relationships among different concepts. In contrast, mental models are the *internal* representations of reality that people use to understand specific phenomena

Mental models structure knowledge in a way that integrates ideas, assumptions, relationships, insights, facts, and misconceptions that together shape the way an individual views and interacts with reality. In addition, these models help people abstractly reason about the particular knowledge domain: its objects, groupings, interrelationships, sequences, processes and behaviors (Elatewiki, 2016).

One view of human reasoning is that it depends on mental models (Wikipedia, 2017). In fact, both learning with mental models and learning with virtual realities have been identified as effective ways of learning for teaching (Davis and Arend, 2012). Usually students learn more if the method of instruction matches their learning style, Trindade (2002) discussed the implications of visual learning in designing strategies to cater for differences in learning modes.

4 Ontologies and Mental Models

In the two previous sections we have seen the importance of ontologies and mental model to virtual learning. In fact, ontologies and mental model are also related to each other. What is the simplest way to describe their connection? It has been noted that “a formal ontology is for reconciling your mental model with everyone else's” (https://semanticarts.com/blog/a-formal-ontology-is-for-reconciling-your-mental-model-with-everyone-elses/).

It is somewhat surprising to note that studies on relationships between ontologies and mental models are not easy to find. Nevertheless, although not a well-written paper, Mohammadi et al. (2015) at least realized the need for developing a conceptual model for ontology-based mental model. Less explicitly, other authors have hinted the importance of ontologies in mental models, particularly in a team environment. For example, Harrington (2009) used the term meta-ontology to emphasize the need for synthesis and organization of divergent material and endorsed the idea of shared meta-ontology, The notion of a shared mental model (Catholijn et al., 2010) is used to explain team functioning. The idea is that team performance improves if team members have a shared understanding of the task that is to be performed and of the involved team work. The shared understanding cannot be achieved without a common ontology or meta-ontology. In addition, the work by Shute and Zapata-Rivera (2008) presented an approach which involves joining and extending two assessment approaches—evidence-centered design (ECD) and concept mapping (CM). ECD will be extended beyond single, static proficiency models to dynamic models of learning over time. We believe that ontologies will definitely play an important role in this process, particularly in the task of concept mapping between different mental models.

5 Development of Ontology-based Mental Models for Virtual Learning

As noted at the beginning of this paper, we are interested in three important things: ontologies, mental models and virtual learning, and how they are related to each other; in particular, we want to know how ontologies and mental models are usueful for virtual learning. The brief literuature reviewed in previous sections show that researchers have revealed many important aspects among them, but apparently more studies are still neeeded. There is no doube that ontologies can open the potential of learning the same concept through different mental models, thus widening the chance of effective learning. In this sense, we believe the conceptual change as discussed in Chi (2008) can play a ritical role in ontology-based models for virtual learning, because ontologies may help establish useful mappings between misconcepts and correct concepts, thus have the potetial of converting a fualty mental model to a correct one. Here we would also like to note the work by Wu et al. (2012), who proposed a curious learning companion in virtual learning environment to detect interesting learning objects tailored to the learner's current level of knowledge and to prevent learners from experiencing possible confusion. We believe that this interesting idea should be embedded in any ontology-based mental models for effective virtual learning.

Virtual learning environment (VLE) should provide oppotunities for learners to build correct mental models on the to-be-learned subjsects, and correct flawed mental models. We now propose an approach involving the following operations on mental models in a virtual learning environment. The study of these operations can also serve as our research agenda, because ontologies can play an important roles in each of these operationcos.

- *Creation* of new mental models. Even the subject matter could be completely new, it would be beneificial to build a new model in terms of familia concepts to students, and ontologies (which provide common vocabulary) can bridge the new concepts and familiar concepts.
- *Revision* of existing flawed mental models. In this case, the concept hieararchy behind the involved ontologies can help tracing the common aspects and differences between the flawed concepts and desirable concepts in the mental models, thus contributing to the revision of the flawed mental models.
- *Completion* of partial (i.e., incomplete) mental models. In case of the missing part of student mental model has some similarity with what a student already knows, ontologies can help extend or ammend the existing mental models through an analogy-like effect.
- *Mapping* two mental models. The objective of this mapping is to find commonalities as well as differences. Since there is no reason to compare two completely unrelated mental models, the result of mapping is one of three possibilities: partial overlap, inclusion of one mental model in another mental model, and complete overlap (in this case, the models are equivalent, or there is an isomorphsim from one to another). Ontologies can perform mapping between a flawed mental model and correct mental model, or between two flawed mental model, thus may offer useful suggestions to correct the flaws. Mapping may also be useful to some other operations on mental models, such as merging (see below).

- *Merging* two mental models. In case that two mental models are part of a larger picture but students are not aware of their connections, ontologies can reveal the common aspects shared by both mental models. Therefore, through this overlap, two mental models can be combined into one.

Conclusion

We now summarize key points of this paper as follows. We have conducted a brief survey of the current research on the relationship among three important things: ontologies, mental models and virtual learning. We believe all three are closely related to each other, but our general imporession from this survey is that researches usually emphasize only two out of three at a time. We feel there is a need to combine all three important things together, and propose the development of ontology-based mental models for virtual learning, which is composed of a set of operations on mental models in which ontologies play critical roles. The proposed approach is still in its enfancy, which requires a lot of work, including a formalism and experimental studies.

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Get to Know Your Own Mental Model: On the Role of Term Projects in Graduate Level Computer Science Courses

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Abstract

A mental model is an explanation of someone's thought process about how something works in the real world. As such, students' mental models on a particular subject play a critical role in all kinds of learning (including virtual learning). An effective virtual learning environment (VLE) for learning a particular subject should aim at meximizing opportunities for students in developing good mental models for that subject. In addition, f2r the best outcome of learning, we also believe for computer science courses, granudate students should be able to check correcness of their mental models by themselves (even the term "mental model" is not necessarily explicitly introduced to students). In this paper, we explore the important role of conducting term projects in graduate-only Database Management Systems (DBMSs) for mental model development. Starting with an examination on mental models and their relationship with virtual learning environment, we discuss the rationale of designing term projects for these courses, and ways of doing it. We then present several case studies and present observations and lessons we have learned from these cases. We would like to encourage our colleagues from various parts of the world also pay good attention to the idea of "checking your own mental models" for effective learning, as well as for developing effective environments for virtual learning.

Keywords: Mental model, Critical Thinking, Virtual Learning

1 Introduction

A mental model is an explanation of someone's thought process about how something works in the real world (Wikipedia, 2017a; Elatewiki, 2016). As such, students' mental models on a particular subject play a critical role in all kinds of learning (including virtual learning). An effective virtual learning environment (VLE) for learning a particular subject should aim at meximizing opportunities for students in developing good mental models for that subject. In this paper, we start with a brief review on the importance of mental models to virtual learning, paying particular attention to the notion of conceptual change in the learning process as emphasized in Chi (2012). In addition, based on our understanding of mental models in the general learning process, for the best outcome of learning, we also believe for computer science courses, granudate students should be able to check correcness of their mental models by themselves (even the term "mental model" is not necessarily explicitly introduced to students). In this paper, we explore the important role of conducting term projects in graduate-only Database Management Systems (DBMSs) for mental model development. We discuss the rationale of designing term projects for these courses, and ways of doing it. Although these case studies are conducted in conventional learning enviroment (i.e., not virtural learning), they shed important light for virtual leanring, which is discussed in a later section.

2 Focusing on Conceptual Change in Science Learning

Chi (2008) noted that learning of complex material, such as concepts encountered in science classrooms, can occur under at least three different conditions of prior knowledge: (a) prior knowledge is *missing*, and learning consists of *adding* new knowledge; (b) prior knowledge about the to-be-learned concepts is *incomplete* so learning can be conceived of as *gap filling;* and (c) prior knowledge is incorrect, and is "in conflict with" the to-be-learned concepts. The first two cases can be referred to as enrichment type of learning, while the third one can be referred to as of the type *conceptual change*. For conceptual change type of learning, some of the key issues need to be explored are: the ways in which knowledge is misconceived, the reason of such misconceived knowledge often resistant to change, aspects constitutes a *change* in prior knowledge, and design of instructions to promote conceptual changes. We believe that building mental models in learning should focus on above-mentioned conceptual changes, in both conventional and virtual learning environments.

3 Self-Examination of Mental Model for Effective Learning

Based on our understanding of mental models and the discussion on conceptual changes above, we believe for the best outcome of learning, in computer science courses, granudate students should be able to check correcness of their mental models by themselves (even the term "mental model" is not necessarily explicitly introduced to students). Of course, the need for assessing mental models is not new. For example, Shute and Zapata-Rivera (2008) proposed an evidence-based approach to assess mental models. Assessment can be done by instructors or using some objective measures. However, we believe for graduate students, self-assessment or examination of mental models is equally important, because this gives them a chance to figure out what is missing or what is wrong by themselves. This is possible because comparing with undergrad students, graduate students in general are more mentally matured. Self-examination of mental models can be done in a number of ways, such as grading homework answers (written assignments) among themselves before the final grading done by the instructors. However, since self-examination of mental models is better carried out in a longer duration through more complex tasks than conventional homework, self-designed term projects should be able to offer better opportunities for graduate students to examine themselves and correct missing and flawed concepts.

4 Case Studies for Term Projects in Graduate Level Database Courses

We have conducted term projects in graduate-level Database Management Systems (DBMSs) to explore students' mental model development. Below are three case studies, reflecting our experience in past years. Background information used is taken from Silberschatz et al. (2010) if not indicated otherwise. In each case, we inform students the general learning objective for term projects, letting students choose the specific topics in the designated scope. Usually the duration of each project is five to seven weeks (in the second half of semester). Weekly reports are reqiored, because this will not only let instructor trace the progress made by students, but also give them a chance to review their recent activities or the change of their mental models by themselves. The final report of each term project should not just report the results, but also a retrospective examination of their thinking process during the entire project (for example, students were encouraged to report failed attempts and how the problems were fixed).

4.1 Developing learning tools by students

Using Armstrong axioms to compute canonical covers in relational database design theory could be challenging for some students, so designing a learning tool to assist this kind of learning is given to graduate students as a volunteer project. In order to make this paper self-contained, here we brielfly introduce some necessary background.

Definition of Functional Dependency (FD): Let $\alpha \subseteq R$ and $\beta \subseteq R$ be two sets of attributes. The functional dependency (FD) $\alpha \rightarrow \beta$ holds on R if, in any legal relation $r(R)$, for all pairs of tuples t_1 and t_2 in r such that if $t_1[\alpha] = t_2[\alpha]$ then $t_1[\beta] = t_2[\beta]$. Intuitively, this is to say that if two tuples agree on α, they should also agree on β.

Armstrong axioms – basic rules: (α and β are two sets of attributes):

- *Reflexivity rule:* $\alpha\beta \Rightarrow \alpha$
- *Augmentation rule:* $\{\alpha\rightarrow\beta\} \Rightarrow \{\alpha\gamma\rightarrow\beta\gamma\}$
- *Transitivity rule*: $\{\alpha\rightarrow\gamma, \gamma \rightarrow\delta\} \Rightarrow \{\alpha\rightarrow\delta\}$

Armstrong axioms -- Additional rules:

- *Union rule*: $\{\alpha\rightarrow\beta, \alpha\rightarrow\gamma\} \Rightarrow \alpha\rightarrow\beta\gamma$
- *Decomposition*: $\{\alpha\rightarrow\beta\gamma\} \Rightarrow \alpha\rightarrow\beta$ and $\alpha\rightarrow\gamma$.
- *Pseudotransitivity*: $\{\alpha\rightarrow\beta, \gamma\beta\rightarrow\delta\} \Rightarrow \alpha\gamma\rightarrow\delta$

Canonical cover: A *canonical cover* for F is a set of dependencies F_c such that

- F logically implies all dependencies in F_c, and
- F_c logically implies all dependencies in F, and
- No functional dependency in F_c contains an extraneous attribute, and
- Each left side of functional dependency in F_c is unique.

It is not uncommon for students to have misconception on Armstrong axioms. One of common errors is cancel common attributes γ from both sides of $\alpha\gamma \rightarrow \beta\gamma$ to “derive” $\alpha \rightarrow \beta$. This can be considered as a combination of missing type knowledge and incorrect prior knowledge: Although most students did not have prior knowledge on Armstrong axioms, many of them confused functional dependencies with arithmetic multiplication of $a \cdot c = b \cdot c$, from which c can be canceled from both sides, so a = b can be derived. Since in the surface Armstrong axioms somewhat resemble arithmetic operations, students may incorrectly “borrowed” or “extended” knowledge related to arithmetic operations to operations of FDs, and they may not realize these are wrong. Term projects have been an effective way for students to achieve desired conceptual changes by themselves.

4.2 Implementation of Join Algorithms

Implementation of join operation in relational databases is probably the most typical example illustrating the difference between definition and computation of an RA (relational algebra) operator. Join is defined as Cartesian product followed by a selection (and then project operation). For example, natural join |X| on R(ABCD) and S(BDE) is defined as:

$r\ |X|\ s = \prod_{r.A,\, r.B,\, r.C,\, r.D,\, s.E} (\sigma_{r.B = s.B \wedge r.D = s.D} (r \times s))$

But in reality join is never implemented this way. Even in the most primitive implementation of join operation, the select operation is incorporated into the Cartesian product (rather than treated as two separate steps).

As for actual implementation, join algorithms differ in several aspects:

- Types of join (theta join, equijoin, outer join, etc.): Some algorithms are more general (such as theta join), some are more restricted (such as for natural join only)
- Underlying techniques used (such as algorithms not based on sorting or hashing, and algorithms based on either sorting or hashing)

In a recent offering of an advanced DBMS class, all students (about 20) were divided into three approximately equal-sized groups to simulate the implementation of three algorithms in distributed enviroments (data are fragmented at several sites, with partial duplication): block-nested loop join, hash join and merge join, and apply their implemented progreams on test data in a simulated distributive environment. The objective of this term project is to give students an opportunity to undrstand detailed steps of these algorithms (particuularly in a correct and efficient way of manipulating blocks in I/O access), and correct potential errors in their initial mental models formed from lecture notes. These errorrs or misunderstanding may never be discoverered if no such simulation programs are conducted. Since little detailed information of implementation or simulation can be found online, students have to largely work by themselves. All students submitted completed working programs, but not all of them work correctly. Some of the errors were related to issues related to coding, but many other errors were due to misunderstanding of the algorithms in their mental models. Even they were not able to correct bugs in the duration of the term projects, the projects still gave them a chance to recognize errors in their mental models. So even they may not be able to fix all the erros in their programming code, they still got a chance to correct errors in their mental models. Some projects have achieved results exceeding the instructor's original expectation. For example, a student explored "Two way semi-join" in distributed DBMS which was not covered in the course lecture. The algorithm extends standard semi-join in considering non-matching tuples.

4.3 NoSQL Products for Understanding Management of Big Data

Recent developments in big data have advanced from traditional SQL to various SQL products for big data, along with NoSQL and NewSQL. The traditional standard for reliable transaction processing is summarized by the acronym ACID (Atomicity, Consistency, Isolation, and Durability). In contrast to traditional systems such as banking databases that require the ACID properties, systems such as the social-networking system for analysis are said to require the BASE properties: Basically available, soft state and eventually consistent. *NoSQL* databases are finding significant and growing industry use in *big data* and real-time web applications. A NoSQL database provides a mechanism for storage and retrieval of data that employs less constrained consistency models than traditional relational databases. Motivations for this approach include simplicity of design, horizontal scaling and finer control over availability.

Since the tight schedule in covering traditional matrials in ACM cirrriculum, there is very little time to cover new development related to NoSQL in class lectures. Starting from a general introductory article such as Wikipedia paper (Wikipedia, 2017b), studnets were asked to first explore the general landscape in NoSQL by themselves, and then identify an appropriate NoSQL product for hands-on exploration. Most students worked on popular products such as MongoDB. However, some students chose other products such as MarkLogic or PostgreSQL. Students re-implementd SQL projects in NoSQL products, so that they have a chance to figure out some important differences in these different approaches and compare key features of SQL versus NoSQL. Different from the two projects described earlier in this section, the main objective of this project is not to discover and correct what were wrong in their mental models, but to establish new mental models on NoSQL. Yet this is not to say that there is nothing to do with compoaison of mental models. In fact, although most students spent their time in projects to learn how to make NoSQL queries work, some students had made good attempts to design a kind of environment so they can observe and explore the differences between BASE properties (particularly on the property of basically avialable) vs. ACID properties.

5 Implications to Virtual Learning

Chi (2008) discussed three types of conceptual change, namely, belief revision, mental model transformation and categorical shift. It is noted that refuting false beliefs can lead to belief revision. For flawed mental models, multiple refutations can cause multiple belief revisions, the accumulation of which can result in transformation from a flawed mental model to the correct model for a majority of the students. In addition, there are numerous concepts across a variety of domains; therefore, there is a need for categorical shift from awareness which leads to building a new category of belief. Self-designed student projects offer good opportunities for students explore their own conceptual models and make necessary conceptual changes.

Although the projects described in previous section were conducted real classrooms (i.e., not in a virtual learning environment), they share a number of interesting insights potentially useful to the devleopment of VLE.

1. Two apparent objectives of building a VLE are: (a) Introducing new concepts and (b) let studnets know what is correct and what is wrong. However, it is naive way to think that a VLE should simply tell students: "This is correct, that is wrong. Follow this, and avoid that." Our experience in conducting term projects indicates that there is no single way of building a good mental model for the subjects to be learned. Instead, each learner has his or her own way of learning and unique way of building mental models. Term projects have made this possible, because they can stimulates students to ask themselves new questions, discover what are hidden in their mind (particularly those related to errors) and find ways to connect new concepts with exisitng existing knowledge, and correct various kinds of errors. The implication for building an effective virtual learning environment (VLE) is that VLE should offer an environment to allow students to explore on different directions, to stimulate their thinking, to ask themselves questions and to find solutions by themselves. A VLE should not simply instruct students: "This is the way to go;" instead, it should show students that there are various kinds of opportunities which can lead to different kinds of solutions.

2. Conducting term projects also tells us that it is important to remind students to correct any mis-conceptions in a timely fashion. For example, for the computation of canonical cover as described in the first case study (Section 4.1), some students had a tendency of rushing to a conlcusion, but were not able to clearly indicate those intermediate steps, including how to appropriately represent a set. This is apparantly due to mis-conceptions obtained while taking prerequisit classes such as discrete math. Correcting mis-conceptions of old mental models while learning new materials is a task much more challenging in VLE than classroom learning, and has been overlooked somehow in the literature related to virtual learning. One challenging issue is *how* to recognize these mis-conceptions in the prior-knowledge before get them corrected. There may be no simple solution to this issue, so it deserves further exploration.

3. Incorporating advanced techniques to assist virtual learning. Through term projects we have learned the complexity of learning a new concept. So another important implication to VLE is the need to take a divide-and-conquer approach to identify sub-concepts or micro-concepts in the mental models to be built. It could be an interesting task to observe how students build their mental models through their own sub-concepts or micro-concepts, to find commonalities of these models, and compare them with the desired mental model. This also implies the potential of using some advanced techniques, such as state space search as discussed in artificial intelligence (AI) (Russell and Norvig, 2016), to map student mental models (which may contain flaws) to a desired mental model, where each mental model consists of states which represent sub-concepts or micro-concepts of the subject materials to be learned. The rules used to accomplish these mappings may shed important lights for us to reveal hidden knowledge related to achieving required conceptual changes.

Conclusion

In this paper we discussed the importance of conducting term projects so that students can examine their own mental models and correct errors for needed concepual changes in learning new materials. We also discussed the implications of our findings to building more effective virtual leanring environments. We would like to encourage our colleagues from various parts of the world also pay good attention to the idea of "checking your own mental models" for effective learning in general, as well as for developing effective environments for virtual learning.

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E-Portfolio - a complementary assessment method in continuous training programs

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Abstract

In this study, we aim to present the virtues of the digital / electronic portfolio, seen as an electronic collection of evidence: scientific papers, essays, reflections, factsheets, abstracts, records, cognitive maps etc. in the evaluation of pre-university teachers who are involved in the continuous training programs. As a research method, we used the questionnaire survey managed through Google Docs to 30 participants in one of the in-service training programs offered by the institution I represent. E-Portfolio seen as an alternative assessment method supports the development of digital competences and online communication, contributes significantly to the development of critical thinking, visible learning, self-reflection etc. The electronic format of the documents allows learners to be evaluated through different storage media of the portfolio: internet, CD, DVD or USB. Electronic portfolios have become an effective alternative to paper-based portfolios, as it offers the opportunity to review, communicate, and provide feedback in a flexible and dynamic manner.

Keywords: E-portofolio, critical thinking, visible learning, self-reflection

1 **Introduction**

The portfolio is considered in the didactic practice a tool focused on the needs of the subject evaluated, but also a complementary-integrative method of evaluation aimed at a threefold perspective: cognitive, behavioral and of attitude.

According to Ştefan (2006), the portfolio represents a "modern technique for evaluating the results of the educational process, which consists in bringing together the materialized products of several forms of activity .... it can also be used in the training of teachers, ~ may include planning, didactic projects, reading sheets, elaborated methodical and scientific works, etc. "

As a result of the study of the specialized literature we identified a series of arguments that support the use of the portfolio as an alternative method of evaluation:

- "Portfolio is an alternative to standardized valuation and serves purposes that are very different from traditional assessments by the fact that it presents an essentially creative and reflective process.
- Portfolio is a great way to illustrate performance through a variety of outcomes, providing a richer, more complete description of the learner's understanding of one-rating measurements.
- The portfolio illustrates promptly and effortlessly an important outcome that the traditional approach overstepped - the student's improvement over time; condenses school progress to a particular discipline / course, within pre-agreed time limits (semester, school year).
- A student's portfolio reveals patterns of behavior that are only seen when considering more examples, etc. "(Nastas, 2013).

2 Why the e-Portfolio?

Due to the unprecedented development of information and communication technology (ICT), interdisciplinary, multidisciplinary, trans-disciplinary and cross-curricular integrated approaches to contemporary education, the electronic portfolio has been a logical continuation since the first decade of the 21st century.

An e-portfolio (digital portfolio, electronic education portfolio) is both a method and an evaluation tool involving a well- articulated set of digital components (evidence) offline or online, or a combination of the two, such as: ideas, iconic evidence, essays, reflections, curriculum products, comments, strategies, development plans, feedback, etc. of a person's learning or skills. "It can have tools to support the processes involved in it, such as capturing and storing evidence, planning and setting goals and reflection " (Sutherland, Powell, 2007). In our case, the e-portfolio is in fact a personal digital collection of information that describes and illustrates the knowledge, career and experience of a teacher regarding continuous professional development.

"T. Wiedmer (1998) defines the digital portfolio as a collection of digital works illustrating the individual effort, progress, and acquisition of a student in a given field. In the digital portfolio, students can create, conserve and manage various products and processes. Depending on the storage capacity, the content of the digital portfolio can be played on CD, DVD or on a website " (Fat, 2015).

In recent years, digital portfolios have gained interest by creating a complex experience for the person that has access to them, an active involvement focused on different tools such as Facebook, Myspace, Twitter, or Linkedin.

Depending on the goals pursued, e-portfolios can be of several categories. The e-portfolio generally consists of three types, depending on the goals of portfolio design:

- **Presentation Portfolio**, which includes a selection of the most important documents.
- **Activity Portfolio**, in fact a collection that contains all the elements that are carried out during the activity.
- **Evaluation Portfolio**, including objectives, strategies, evaluation tools, synthesis tables, etc." (Élthes, 2012).

From the overview of Jisc activities (a nonprofit organization providing educational services in the UK), we can indentify a number of key milestones of a learning path that the e-portfolio could support:

- **Application** - Provide evidence in support of admission to college or for employment;
- **Transition** - giving a more complex and immediate view of the student's potential to facilitate the transition process;
- **Assessment** - supporting the learning process through reflection, formative discussions and assessments, and providing evidence for summative assessment;
- **Planning** for personal development and continuous professional development - supporting and highlighting the exercise and realization of personal or professional skills

However, electronic portfolios are more than evaluation tools and have a key role in the learning process. Behind any presentation, there are complex processes of reflection, planning, synthesis, sharing, discussion, giving and receiving feedback. For the successful implementation of electronic portfolios, it is imperative to clearly identify the purpose of e-Portfolios and to integrate into practice.

The e-portfolio is both beneficial to the evaluator and also to the subject evaluated. The learner will develop learning, assessment, reflection and development planning skills and the trainer can monitor professional development in view of the fact that the e-Portfolio is a tool to support lifelong learning.

3 Methodology and results

This study aimed at identifying the advantages and limitations of using the e-portfolio in the final evaluation of the in-service teacher education programs in the pre-university education and obtaining feedback from the learners in order to improve the use of such an evaluation method in the continuous professional development.

We started from the hypothesis that the use of e-portfolio in the final evaluation of the participants, to the detriment of the classical (letric) portfolio evaluation, increases the attractiveness of the teachers towards participation in the continuous training courses.

As the main research method, we used the survey based on a questionnaire administered through Google Docs to a non-probable sample of 30 participants in one of the continuous training programs.

Respondents in the sample have completed a 120 hours continuous training program, and the digital portfolio method has been called up at the final evaluation. Portfolio components have been delivered via data storage devices, CDs, DVDs or USB sticks, and learners have the ability to keep training evidence.

Through the questions addressed to the respondents we have obtained the following advantages of using e-Portfolios in the final evaluation of a continuous professional development program:

- stimulating investigative spirit;
- development of critical thinking;
- active participation in the learning process and improvement of attitude towards it;
- increasing self-confidence;
- increased accountability to your own professional development;
- enhancing digital and communication skills;
- getting a quick feedback from the evaluator;
- promoting visible learning through existing evidence in the portfolio;
- exploiting multiple intelligences;
- providing a longitudinal perspective on the work of the teaching staff, in the sense that it presents an image of progress, continuity over time, and evidence-based professional profile;
- promoting reflective spirit;
- more efficient management of physical space;
- eliminating necessary logistics (paper, printer, folders, etc.) and related costs;
- the ability to easily store the portfolio and evidence of training;
- contributes to the development of metacognition.

Although above mentioned many arguments supporting the use of e-portfolio in training activities, the respondents also mentioned a series of limitations of this alternative evaluation method, among which we mention:

- increased attention to the protection of the e-Portfolio as a personal document;
- E-portfolio specific tasks require some digital skills;
- in some situations, there is no possibility of procuring the logistics necessary to carry out the work tasks;
- evaluation of these portfolios could become very personal if there are no e-portfolio evaluation standards.

Conclusions

By supporting lifelong learning, e-Portfolio becomes an increasingly popular alternative to traditional paper-based portfolios, as it offers learners, pupils, students, etc. the ability to review the e-Portfolio components according to the feedback received, to present the impact of the entire learning experience acquired in solving personal tasks, thus increasing the responsibility for their own training.

Most of the actors in education and training recognize the benefits of this evaluation tool, digital portfolios have the ability to influence the personality of the individual, will change the way people think and learn, because they contribute to building their own knowledge.

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Primary Grades Teachers' Perceptions of a Mathematics and Environmental Exploration Digital Textbook

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Abstract

The primary grades teachers' opinions about using the Mathematics and Environmental Exploration (MEE) digital textbook for the 2nd grade, edited by CD PRESS (2014) were collected by means of using a questionnaire. 16 primary grades teachers, who used the textbook during classes, agreed to complete the questionnaire voluntarily and anonymously. The research material consisted of the answers to the 10 items in the questionnaire. They focused on the following issues concerning the respective digital textbook: ways of choosing the digital textbook, frequency of its use during classes, types of the provided interactive multimedia activities, elements characteristic of this digital textbook, its technical and functional features, procedures necessary for using it, procedures that can be realised on the text, observing the rules for writing the text, observing certain quality criteria/indicators, and the roles of digital textbooks in instruction.

Keywords: Primary education, Digital textbook, Mathematics and Environmental Exploration Subject, Romania, Survey

1. Introduction and Theoretical Approach

In 2014-2015 school year, in Romania appeared new printed and digital textbooks for the 1st and 2nd grades. From the technical point of view, the digital textbook is a software product (application) that can be used online or offline on any type of technology (desktop, laptop, tablet, phone), operating system and browser, being independent of the e-Learning platforms (Vlada, 2014).

The specialty literature in Romania focused especially on analyzing the school curriculum for Mathematics and Environmental Exploration (MEE) (Dulamă and Magdaș 2014), on planning learning activities at Mathematics (Magdaş, 2014) and on environmental knowledge (Dulamă, 2011), on assessing competences of planning Mathematics and Environmental Exploration (MEE) (Dulamă, Ilovan and Maroşi, 2015), on assessing printed textbooks (Dulamă, 2009), and there are rare studies about digital textbooks (Manasia, Pârvan and Paraschiveanu, 2013; Vlada, 2014; Magdaș and Drîngu, 2016). Studies conducted prior to the introduction of digital textbooks indicated teacher reluctance for their use in teaching, because they felt they were not sufficiently trained for it (Manasia, Parvan and Paraschiveanu, 2013). Other studies also found out that teachers had difficulties in using digital textbooks both in Romania (Magdaş and Drîngu, 2016) and in other countries (Greenfield, 2013).

Digital textbooks were developed based on the requirements set by the *National Assessment and Examination Centre* in the *Ministry of National Education and Scientific Research* of Romania (*MNE*), through the Tender Book (2013). According to it, textbooks must be presented in print, digital, and online versions. The digital version should be similar to the printed version through observing the scientific content, the order of themes, and the graphic style. The digital textbooks include full print textbooks content and, in addition (or in place of printed illustrations), specific elements such as interactive exercises, educational games, animated movies, and simulations that bring an additional cognitive benefit.

Based on these considerations, we carried out a study among teachers to identify how familiar they were with the digital textbooks they used to train their pupils. In our study, we chose the textbook of *Mathematics and Environmental Exploration* (*MEE*) for the 2nd grade, CD PRESS Publishing House (authors: Iliana Dumitrescu, Nicoleta Ciobanu, and Alina Carmen Birta). Starting from the specifications of any textbook that was approved by *MNE*, we realised a questionnaire addressed to primary school teachers who used the specified textbook with their pupils. Their responses were the basis from which we started to draw the conclusions of the experiment.

2. Material and Method

2.1. Data Collecting, Procedure and Research Material

Data were collected through a questionnaire survey. Eight multiple-choice items collected data about participants. Ten items (two items with multiple choice, six items with dual choice, and two items with choosing an answer on a five point Likert scale) collected data on the use of digital textbooks of *Mathematics and Environmental Exploration*, the 2nd grade. The questionnaire realised on Google Drive was sent to participants in May 2017 via e-mail and Facebook. The collected data were processed statistically with the Excel spreadsheet editor. The research material is represented by the answers to the questionnaire.

2.2. Participants

16 primary grades teachers who used the textbook during classes agreed to complete the questionnaire voluntarily and anonymously. Respondents belong to different categories according to the following criteria: gender (93.3% are female and 6.7% are male), age (62.5% between 31-40 years old, 31.3% between 41-50 years old, and 6.3% over 50 years old), educational level (93.8% have a Bachelor's degree, 6.3% have a Master's degree), didactic degree (31.3% of them have the definitive didactic degree, 12.5% have the second degree, and 56.3% have the first degree, which is the highest level of the teaching career), years of teaching experience (6.3% of them have under 5 years, 12.5% between 5-10 years, 50% between 11-20 years old, and 31.3% have over 20 years old), location (12.5% of institutions are in urban area, while 87.5% are in rural areas). Teachers come from six counties (Bistriţa-Năsăud with 10 respondents, while Cluj, Harghita, Mureş, Sibiu, and Suceava have one respondent each). Even though the number of respondents is small and does not cover the entire country, the years of teaching, the teaching degrees and their experience ensure the pertinence of their opinions about the digital textbooks.

3. Results and Discussions

Choosing the Digital MEE textbook for the 2nd grade. Most respondents (87.5%) chose this digital handbook after a consultation with school teachers. A teacher (6.3%) chose the digital handbook alone, comparing it to other textbooks, and another one chose it without consulting the others and without comparing it with other textbooks. The textbooks were not imposed by the County School Inspectorate.

The frequency of classroom use of the MEE textbook for the 2nd grade, CD PRESS Publishing House. Table 1 shows that half of the teachers use the specified textbook in each lesson or frequently and the other half sometimes or rarely, which shows that many teachers are reluctant to use digital textbooks for various reasons.

Table 1. The Frequency of Classroom Use of the MEE Textbook

The frequency of classroom use	% teachers
During each lesson	6.25
Frequently	43.75
Sometimes	43.75
Rarely	6.25
Never	0

Types of interactive multimedia learning activities in the MEE digital textbook for the 2nd grade, CD PRESS Publishing House. According to the Tender Book (2013), the interactive multimedia learning activities (IMLA) a digital textbook must contain fall into four categories:

- *static,* having a l+ow degree of interactivity: drawings, photos, etc. These must be present in the digital textbook, in number of at least 90;

- *animated* that include animations and animated films over which the pupils have limited control by sequencing running Play, Stop and Pause. These must be present in the digital textbook in number of at least 60;

- *interactive*, which include educational elements with a high degree of interactivity: simulations, problem solving, educational games, etc. These must be present in the digital textbook in number of at least 30;

- *complex* that additionally offers a continuity of accumulation / competences acquired by the pupils for the entire duration of use, from a conceptual perspective. The number of such applications a digital textbook must contain is not specified, only that they provide an immersive function of the continuos learning process through discovery.

Teachers know the types of IMLA they frequently use, namely: 93.7% of the respondents report the presence of both *static* and *animated* activities. *Interactive* multimedia activities are less known to teachers, with only 47.3% of them reporting.

Animated or interactive multimedia resources in the MEE digital textbook for the 2nd grade, CD PRESS Publishing House. Table 2 shows that animations are best known by teachers, followed by interactive exercises, and educational games. This situation is predictable because these multimedia resources have the largest share in the textbook. 6.2% of the teachers specified simulations which were not present in this textbook. This shows either that teachers do not know school textbooks in detail or that they do not distinguish between different categories of multimedia resources.

Table 2. Specific Animated Multimedia Resources Identified by Respondents

Animated multimedia resources	% teachers
Animations	93.7
Interactive exercises	81.2
Educational games	56.2
Movies	18.7
Simulations	6.2

Technical and functional characteristics of the MEE digital textbook for 2nd grade, CD PRESS Publishing House. Most of the respondents believed that the MEE digital textbook for the 2nd grade incorporated multimedia elements at the required technical and functional level. Thus, 15 of the respondents, representing 93.7%, stated there were appropriate navigation tools in the digital textbook. 13 teachers (81.25%) stated that the search tools and the direct access ones to predefined locations are incorporated in the digital textbook.

The operations necessary for the navigation in the MEE digital textbook for the 2nd grade, CD PRESS Publishing House. Over 87.4% of the teachers who participated in the questionnaire survey agreed that the navigation in the digital textbook worked as required. It was possible to carry out all the operations that led to a correct and easy navigation. All teachers found out that they could move directly to the page number indicated on any page in the textbook, while 93.7% of them found out that it was a fast moving from the current page to the previous or to the contents. These high percentages indicate that most of the teachers have the technical knowledge needed to use digital textbooks.

Meeting text editing standards in the MEE digital textbook for the 2nd grade, CD PRESS Publishing House. 93.7% of the respondents consider that text editing standards in the digital textbook were met: writing the basic text using the normal model font, highlighted writing (italic, bold, semibold) for relatively small fragments, adapting font size to pupils' age. 87.5% of the respondents said that the scripts were written without serifs and the capitals were used only in titles, for highlighting. Also, according to the teachers' opinions, splitting the words into syllables to move from one row to another was avoided.

Compliance to the quality criteria / indicators in the MEE digital textbook for the 2nd grade, CD PRESS Publishing House. We were interested in the respondent teachers' opinions of the compliance to some quality indicators of the MEE digital textbook for the 2nd grade. We gave our surveyed teachers a list of quality indicators and asked them to give a score from 1 to 5 (see Table 3). For all indicators, teachers awarded scores above the 3-point average, which shows teachers' satisfaction with these issues.

Table 3. Respondents' Opinions on Some Quality Indicators in the Digital Textbook

Quality indicators	Average scores
Presented content corresponds to the curriculum	4.18
Information is scientifically correct	4.12
Information is adapted to the pupils' level of knowledge and understanding	4.00
Language is appropriate to the pupils' level of knowledge and understanding	3.93
Illustrations have a good quality	3.93
Illustrations are appropriate to the theme and to the pupils' level of knowledge and understanding	3.56
Icons, graphic controls, and navigation elements are suggestive	3.60
Multimedia resources / applications (audio, video, animation) have good quality (sufficient resolution, colour and adequate illumination, contrast, clarity and good sound quality)	3.53

The training roles of the MEE digital textbook for the 2nd grade, CD PRESS Publishing House. From the respondents' point of view (see Table 4), on the first two places are the roles of the textbook to enable / stimulate the reception and the memorization of information. This is explained by the fact that any textbook must contain structured and validated knowledge, which has to be transmitted. In the middle of the hierarchy are situated the roles to enable / stimulate pupil-centred learning. These issues have achieved scores between 2.80 and 3.18, so around the average.

We can therefore infer that teachers believe that in the digital textbook the active component is quite well present, with tasks that directly involve the learners in their own learning, but there is room for improvement. This situation is correctly identified by the teachers and has the explanation in the fact that, although there are more than 30 interactive multimedia activities, there is a lack of simulations or educational games that would have a higher interactivity degree. We can also deduce that teachers have greater expectations about the interactivity the digital textbook should have.

However, an analysis of the textbook shows that it often allows the problem solving approach and the discovery of knowledge, but teachers do not have a methodological guide to help them in this direction. In this ranking (see Table 4), the interaction components of the textbook with other educational sources and instant access to on-line resources received the lowest scores, close to value 2. These scores reflect the existing situation, namely that although the Tender Book (2013) specifies that "the electronic version is in relation to the online platform that hosts both a notebook and a portfolio of personal works", the "online platform information is provided only for information" and, as a consequence, this information is not mandatory.

Table 4. Respondents' Opinions on the Roles of the Digital Textbook in Instruction

Roles/ functions of the textbook	Average scores
To enable / stimulate receiving information	4.18
To enable / stimulate memorizing information	3.70
Learning activities are appropriate to the pupils' needs	3.50
To enable / stimulate the immediate discovery of information (without the teacher's / parents' help)	3.18
To enable / stimulate individual training of specific *MEE* skills	3.10
To enable / stimulate self-learning	3.06
To provide feedback after solving tasks	2.93
To enable / stimulate directly learning	2.93
To enable / stimulate optimal integration of the information and presented content	2.93
To ensure / enable self-evaluation	2.93
To enable / stimulate interpreting / explaining information	2.81
To enable / stimulate analysing information	2.80
To provide interaction with other digital or printed educational sources (exercise notebooks, problems books, tests for (self-)assessment)	2.10
To provide instant and unrestricted access to other online resources / online educational libraries	2.06

Conclusions

The primary education teachers' opinions about the use of the digital textbook of *Mathematics and Environmental Exploration*, for the 2nd grade, edited by CD PRESS Publishing House (2014) were collected through a questionnaire survey. Based on the data collected from the teachers, we can conclude that about half of these teachers use textbooks frequently or even during each lesson. Teachers are well familiar with the digital textbook and have no technical difficulties in using it. However, we have identified that, from a theoretical point of view, they have difficulties in discriminating different categories of multimedia resources. Teachers also have a correct image of the roles the digital textbook has and to what extent they are achieved. Through the scores provided by the respondents, we can also deduce that teachers have higher expectations regarding the interactivity that the digital textbook should have. We indirectly identified the teachers' need for methodological or textbook guides to help them design more interactive lessons.

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Interactive Multimedia Learning Activities (IMLA) in a Digital Textbook

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Abstract

The aim of our research was to analyse the primary grades teachers' opinions about the animated interactive multimedia learning activities (AIMLA) within the Mathematics and Environmental Exploration digital textbook for the 2nd grade, published by CD PRESS (2014). We collected teachers' opinions, who used the textbook during classes, using a questionnaire that 16 teachers completed voluntarily and anonymously. We focused on the following issues concerning the AIMLA: constituent elements of dynamic AIMLA, methods and text types used during AIMLA, efficiency degree of AIMLA, according to the text type and its presentation, quality of the assessed activities according to 23 criteria, advantages and disadvantages of the AIMLA.

Keywords: Primary education, Mathematics and Environmental Exploration textbook, E-learning, Instructional animation, Videos

1. Introduction and Theoretical Approach

The transition from the classic textbook to the electronic one (on digital format, enriched with animated images, videos, and interactive exercises), and then to the digital textbook (conceived with the digital language and for the Web) was relatively long.

In Romania, the first digital textbooks appeared in the 2014-2015 school year, also including the 1st and 2nd grades textbooks (Vlada, 2014). Similar to teachers abroad, Romanian teachers consider that they have not been prepared enough to use digital textbooks (Manasia, Pârvan and Paraschiveanu, 2013; Magdaş and Drîngu, 2016; Greenfield, 2013).

The specifications for editing the 1st and 2nd grades textbooks (MEN, 2014, p. 5) include the requirements for editing of school digital textbooks. They point out that the interactive multimedia learning activities (IMLA) represent the most important novelty of the 1st and 2nd grades digital textbooks. These are structured in four complex classes: the static, the animated, the interactive, and the complex one. The animated IMLA (AIMLA) category includes animations or movies over which the learner has limited control related to what the sequencing of the illustration (through Play, Stop, Pause) is concerned.

Mayer & Moreno (2002, p. 88) defines *animation* as "a simulated motion picture depicting the movement of drawn (or simulated) objects." The quoted source underlines the differences between animation and video that is a motion picture depicting the movement of real objects. In scientific literature (Dulamă and Gurscă, 2006, Dulamă and Ilovan, 2007), the instructional animations have the following components: the instructional content/message, the special effects such as graphics, motion, sound and texts, the instructional design, a user's management programme of the animation, and maybe a tutorial.

The aim of this research we realised in 2017 was to analyse the primary teachers' views concerning the AIMLA in the Digital Textbook of Mathematics and Environmental Exploration, 2nd grade, published by CD PRESS (2014) (authors: Iliana Dumitrescu, Nicoleta Ciobanu, and Alina Carmen Birta). In addition, we aimed to identify, based on the collected answers, whether the digital textbook enjoys the teachers' appreciation, knowing the fact that, in general, pupils still prefer printed textbooks to electronic textbooks (Millar and Schrier, 2015).

2. Material and method

2.1. Data Collecting, Procedure and Research Material

Teachers' opinions on the IMLA were collected through a questionnaire survey. The questionnaire was made up of 5 dual-choice items and 2 items with a 1 to 5 Likert scale of values. The AIMLA study within the digital textbook focused on the following aspects: the IMLA's composition; the AIMLA methods and types of texts, the AIMLA degree of effectiveness depending on the type of text and its presentation, the quality of the assessed activities based on 23 criteria, the AIMLA advantages and disadvantages. The questionnaire realised with Google Drive was addressed to teachers who used the textbook in their teaching process. The questionnaire was delivered by e-mail and via Facebook in May 2017. The collected data was processed in Excel. The research material includes the answers to the questionnaire.

2.2. Participants

The research was realised with 16 primary school teachers as participants, who used the textbook in the classroom. The respondents completed voluntarily and anonymously the questionnaire. 93.3% of respondents are female and 6.7% of them are male. There are no respondents under the age of 30, 60% are 31-40 years old, 33.3% are 41-50 years old, 6.7% are over 50 years old. Regarding their educational level, 93.3% of these teachers have a bachelor degree, 6.7% graduated master's studies and there are no teachers with a PhD. Regarding didactic degrees, there are no beginners among the respondents, 28.6% have a permanent teaching certification, 14.3% have the 2nd teaching degree, and 60% have the 1st teaching degree. Regarding the teaching experience, there is no respondent having less than 5 years of experience, 13.3% have 5-10 years, 53.3% have 11-20 years, and 33.3% have over 20 years. 20% of the teachers work in urban institutions and 80% in rural areas. All teachers work in public schools. These primary school teachers come from six counties: Bistriţa-Năsăud (10), Cluj (2), Mureş (1), Sibiu (1), and Suceava (2). Even if the number of respondents is not enough to make a generalization of the research results, taking into account their teaching experience and their teaching degrees, we consider their opinions (about AIMLA found in digital textbooks) reliable and representative.

3. Results and Discussions

The AIMLA layout. The respondents agree that the animations are part of the multimedia interactive learning activities in the analysed textbook. Most respondents (93.3%) consider that AIMLA in this digital textbook include a set of drawings or photos with audio presentation (exposition) and only 26.2% of them claim that they contain documentary films.

Regarding the management of IMLA in this digital textbook, all respondents agree that they offer the following options: Start, Stop, Pause, and Play. A large percentage of respondents argue that these activities include some inferred support options such as: full-screen expansion options (93.3%), return to original size (93.3%), and resolution adjustment (86.6%), so the user has few possibilities to manipulate images.

Types of texts and methods used in AIMLA. 86.7% of the respondents say that the informative text and the exposition method are the most frequently used in AIMLA, indicating a passive, low participation of the pupils during the activity. There are very few respondents who think that the explanatory text and the methods of explanation (6.7%) and demonstration (6.7%) were the most used in these AIMLA – as it could be necessary in order to make the activities to contribute effectively to the comprehension of the content and learning. There was no respondent thinking that the text, including the dialogue and the conversation method, has been the most used in the AIMLA provided by the digital textbook. Considering the fact that the textbook has a content that can be managed with multi-function software, it is possible for the e-learning to become the main learning method which can be used by the pupils (Dulamă and Gurscă, 2006).

The efficiency degree of AIMLA depending on the type of the text and how it is presented. According respondents' opinions, the highest efficiency degree of AIMLA belongs to the demonstration method which is based on the explanatory text (average score of 3.86). Still, only 6.7% of the respondents consider that they have used the most in AIMLA. According to their opinions and to the efficiency degree, on the second place (average score of 3.53) are the AIMLA in which the conversation method and the text with dialogue are used. We underline that the didactic methods used during AIMLA determine the pupils' mosly passive role, while the literature in the field points out the exercise as relevant for forming the competences characteristic of a certain school subject (Ciascai, 2001, 2007; Ciascai and Dulamă, 2013; Dulamă, 2011, 2012; Magdaş, 2014).

Table 1. The Efficiency Degree of IMLA Depending on the Type of Text and How It Is Presented

The explanatory text and the demonstration method	3.86
The dialogue text and the conversation method	3.53
The explanatory text and the explanation method	2.93
The informative text and the exposition method	2.20

The quality of AIMLA. The teachers' opinions, while considering the proposed quality indicators, underline that the highest scores were obtained as follows: 4.26 for the correctness of information/ explanations/ definitions in AIMLA, 4.26 for the agreement between the AIMLA title and content and 4.16 for the clarity of images (drawings/ photos). For 13 quality indicators, the average scores were between 3 and 4 and at 6 indicators, the average scores were between 2.6 and 3. The average scores under 3 were obtained for the following indicators: the speed of the images and the exposition, the IMLA conception, the time, the portrayal of phenomena and processes dynamics from reality, enabling learning through the teaching procedures used, the marking of the point in the image to which the exposition refers to in each moment, the stimulation of thinking development through watching and listening to the IMLA exposition.

The lowest score was achieved by the item which refers to enabling learning through the IMLA tasks (1.3).

Table 2. The Quality of the AIMLA

	Average scores
Correctness of the information/explanations/definitions in the AIMLA	4.26
Agreement between the AIMLA title and content	4.26
Clarity of images	4.16
Suitability of images to the learner's level of comprehension and skills	3.93
Suitability of text to the learner's level of comprehension and skills	3.83
Information contents in an image	3.73
Quality of exposition	3.73
Relevance of images for the lesson topic	3.73
Aid of perception through watching and listening to the exposition in the AIMLA	3.66
Stimulation of memory development through watching and listening to the exposition in the AIMLA	3.66
Composition of each image in particular	3.60
Informational completeness of each AIMLA	3.53
Stimulation of curiosity through watching and listening to the exposition of the AIMLA	3.46
Simultaneity between each image and exposed text at the moment of the presentation	3.13
Overall agreement between images and text in the AIMLA	3.13
Suggestiveness of AIMLA	3.06
Rending speed of images and exposition	2.96
Conception of the AIMLA	2.93
Time	2.86
Portrayal of the dynamics from reality of the phenomena and processes	2.73
Enabling the learning process through the teaching procedures used	2.60
Stimulation of thinking development through watching and listening to the exposition	2.45
Marking point in the image to which the exposition refers to in each moment	2.60
Enabling learning through the AIMLA tasks	1.30

The AIMLA advantages. All the questioned teachers consider as advantage the watching process in different places (at school, at home) and on different devices (laptop, PC, tablet, Smartphone), but also the possibility of replaying the presentation whenever the user wants that. 86.7% of the teachers consider as advantage the possibility of interrupting, in every moment, the slide-show playing, but also the zoom option (zoom-in or zoom-out the images).

The AIMLA disadvantages. All the respondent teachers consider as one of the first disadvantages the impossibility of inserting other images (drawings, photos) in AIMLA (this option would increase their quality). 86.7% of the respondents consider the impossibility of soundtrack completion as the second AIMLA disadvantage. Many teachers consider as disadvantage the impossibility of changing the soundtrack (80%) and the images (drawings, photos), or their order (80%). The impossibility of AIMLA download represents a disadvantage for 66.7% of the teachers. The impossibility of passing from the slideshow directly to the lesson is another disadvantage for 13.3% of them.

Conclusions

Multimedia instruction uses presentations involving words and pictures that are intended to foster learning (Mayer, 2009, p. 5). The animations, as a category of interactive multimedia learning activities, represent an alternative to purely verbal presentations from the school textbooks.

The present study focused on AIMLA in the digital analysed textbook enabling the learning process. The answer seems to be a negative one, because of the following considerations:

a) According to the respondents' opinions, the animations, including explanatory text and which refer to the use of the demonstration and explanation methods, are scantily presented in the textbook, being preferred the animations including the informative text and the exposition method.

b) The AIMLA quality is appreciated by the respondents as being a good one (the average scores being over 3) for the majority of criteria. But, there are some highly important criteria (the achievement concept, the portrayal of phenomena and processes dynamics, enabling the learning process through the teaching procedures used, the stimulation of thinking development through watching and listening to the exposition) whose average scores are between 2 and 3.

c) The respondents appreciate that the animations use the images and sound effects, respectively a predefined text so it is impossible to adapt them to the classroom particularities (i.e. pupils' level of skills, needs and interests) or the development in the field of knowledge and ICT skills.

As a result, based on the respondents' expressed views, we consider necessary the revision of the AIMLA in the digital textbooks, taking into account the recommendations found in the specialised literature (Byun et al. 2010; Clark and Mayer, 2008; Mayer, 2009; Ainsworth, 2008). The received answers concerning the AIMLA positive aspects, but also the ease of using it in different contexts, encourage us to believe that teachers really appreciate the usefulness of this digital analysed textbook in the classroom.

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A Comparative Docimologic Perspective on the European and Romanian Education Landscape

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Abstract

Improvement of education quality and effectiveness lies at the core of the education policy debate, both nation- and European Union-wide. According to the Lisbon strategy on social progress and cohesion in Europe, the quality of education and training is on top of the list of chief EU objectives until 2020. Enhancing performance in compulsory education, in particular improving science, reading and mathematics literacy, and in general equipping young people for a knowledge-basedsociety are the main drivers in the framework of today's education.

Key words: assessment, areas ofassessment, performance, tests

1. Background

According to the National Education Law, the purpose of assessment is "to guide and improve learning". All assessments rely on the national assessment standards specific to each and every subject. As of the school year 1998-1999, in primary school, learning outcomes are measured according toa rating system which uses descriptors. Exception is the preparatory school year, where no grades or ratings are awarded. Upon completion of this year, the class teacher draws up an individual evaluation report for each pupil. The general and specific rules of student assessment, grading and promotion are laid down in the *Regulations for the Organisation and Operation of Pre-University Education Institutions* (Minister Order 4925 / 2005).Assessment, like teaching and learning, is competence-based and designed to offer students actual feedback, lying at the centre of personalised learning plans.

According to *ROOPUEI,* student assessment should span over the entire semester, in a consistent and systematic fashion, and teachers should give equal importance to all subjects (whether compulsory or optional). Each semester coverstime dedicated to reinforcing and assessing student acquired skills (formative and summative evaluation) – scheduled by the teacher of the class. As a rule, such periods are scheduled towards the end of semester, and teachers focus on:

- improving teaching-learning outcomes;
- strengthening students' knowledge;
- stimulating students with poor and very poor performance.

Assessment methods and tools are selected by the teacher depending on students' age and psychological traits, in consideration of the specific area of study. Assessment can be oral or written, it can rely on practical tasks, papers and projects, assignments and interviews, or on other forms, either devised by the class teacher and approved by the principal, or designed by the Ministry of National Education and national school boards.

2. PISA standardised assessment

According to the "OECD Programme for International Student Assessment – PISA National Centre Report", the student international assessment programme is an international standardised test, jointly initiated and designed by all OECD (Organisation for Economic Co-operation and Development) member countries, and later adhered by a number of non-member, partner countries. It measures the extent to which students are equipped to rise to the challenge of today's society, active life or educational dynamics. OECD PISA proposes an extended approach to the evaluation of knowledge, skills and attitudes, which reflects the changes in education systems worldwide, attempting at an out-of-school approach. It places emphasis on the manner in which such skills are applied in the tasks and challenges of everyday life, building up the foundations for lifelong learning. To turn this objective into reality, the assessment process monitored by all participating countries looks for a common denominator to the education policy concerns, applying the scientific expertise both at national and international level. PISA combines "the evaluation of field-specific cognitive areas, such as Reading, Math and Science, with information about students' home environment, about their approach to learning, their perception of the learning environment and their computer literacy."

2.1. PISA- part of OECD programme

PISA is an important part of an ongoing OECD programme aimed to monitor and report learning results based on educational indicators, announced for the first time in the 90's in the annual OECD publication, *Education at a Glance*. OECD developed a set of indicators of the human and financial resources invested in education, and of the manner in which education systems operate. PISA emerged from the need to obtain systematic and reliable information about education outcomes across different countries, in particular with regard to the assessment of students' capacity. Since it is part of an ongoing reporting programme, one of the PISA objectives is to track performance trends over time. PISA operates in testing cycles, being first administered in 2000 in 43 countries. The second time, in 2003, it was administere from 41 countries, the third time, in 2006, in 57 countries, and in 2009 and 2012 it was administered in 65 countries (34 OECD countries and 31 partner countries). In the history of PISA participation, Romania was initially part of the PISA+group of 11 countries associated to OECD member countries which administered the test in 2000. Romania also participated in the PISA assessment cycles in 2006, 2009 and 2012, in both compulsory phases, the pre-assessment and the actual test administration.

2.2. Features of PISA assessment programme

As of 2000, the assessment programme measures students' capacity to apply the knowledge and skills acquired during compulsory education, with aview to continuous, lifelong learning. It means that PISA does not focus on assessing students' curricular capacities, but rather on what they know and are able to do in practical and real-life situations, as well as on the capacity to reflect on theirown learning experiences. The areas of assessment (Reading, Math and Science) cover:

- content or structure of knowledge in each area;
- processes that can be performed based on students' knowledge;
- the contexts in which the target knowledge and skills are applied.

Examinees' performance is measure successive levels of performance in the given competence field. Each PISA cycle deals with all the three areas subject to assessment, which become in turn *main subject area* and *secondary subject area,* respectively. In 2000, the main focus was on Reading literacy, while 2003 was the year of Mathematics, 2006 the year of Science; in 2009Reading came under focus again, and so on,within a rotating cycle.

PISA builds a dynamic assessment process, pursuing the chief goal of lifelong learning, where the knowledge and skills required to adapt to an ever-changing society are acquired throughout the entire life. “The assessment focus falls on what examinees know and can actually do with what they have learned in time”.

With each PISA cycle, one area of assessment comes under focus (the main subject area), and is dedicated up to two thirds of the testing time, while the other items address the secondary subject areas. Each student is allocated two hours. At the end of the test, students are encouraged to fill in a context questionnaire, about students’ social and educational background.

According to the Ministry of National Education, in Romania the assessment tools were “traditional” and the test was paper-based: each examinee was handed a test brochure with two hours’ working time, containing a mixture of items testing their competences in Science, Math and Reading literacy. 30 types of test brochures were administered overall, containing combinations of tasks/items from the relevant fields. Students also filled in a social and educational background questionnaire, with a response time of 35-45 minutes. The principals of the participating school units filled in a questionnaire examining the school ethos from the perspective of thelearning environment, the educational offer, learning opportunities, etc.

PISA performance scales cover 6 levels, with the 1st level being the lowest, and the 6th level being the highest-performing level. The scale is so designed that the mean score for OECD countries is set at 500 points, and the standard deviation is 100. Students rated at Level1 are capable to solve tasks allocated to this level, but are unlikely to solve higher-level tasks. Students rated at Level 6 of the scale can solve both tasks allocated to this level, and all tasks allocated to Levels 1-5.

With reference to the PISA 2012cycle with focus on Mathematics, the PISA 2012 international report highlights that “PISA 2012 provides the most comprehensive picture of the mathematics skills developed in schools that has ever been available, looking not just at what students know in the different domains of mathematics, but also at what they can do with what they know. The results show wide differences between countries in the mathematics knowledge and skills of 15-year-olds. The equivalent of almost six years of schooling, 245 score points on the PISA mathematics scale, separates the highest and lowest average performances of the countries that took part in the PISA 2012 mathematics assessment. However, differences between countries represent only a fraction of the overall variation in student performance. The difference in mathematics performances with in countries is generally even greater, with over 300 points – the equivalent of more than seven years of schooling – often separating the highest and the lowest performers in a country. Addressing the education needs of such diverse populations and narrowing the observed gaps in student performance remains a formidable challenge for all countries.”

3. PISA performance in Romania

The table below presents the scores obtained by Romanian students in comparison with the average score of OECD countries, according to the statistics in “PISA, Results in Focus”, compiled for the PISA cycles 2006, 2009, 2012 and 2015.

	ROMANIA			OECD			Romania’s ranking
	Math	Science	Reading	Math	Science	Reading	
PISA 2006 (Science)	451	418	396	498	500	492	47th out of 57 countries
PISA 2009 (Reading)	427	428	424	496	501	493	49th out of 65 countries
PISA 2012 (Math)	445	439	438	494	501	496	45th out of 65 countries
PISA 2015 (Science)	444	435	434	490	493	493	48th out of 70 countries

Fig. 4*Romanian students' performance in 2006, 2009, 2012 and 2015 PISA cycles*

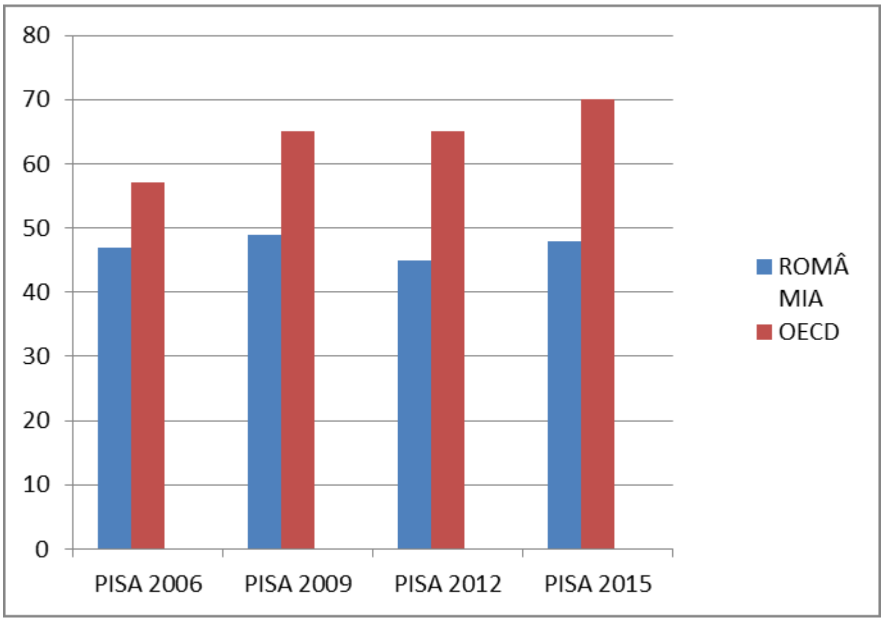

Fig.5*Chart of Romanian students' score in Mathematics assessment items*

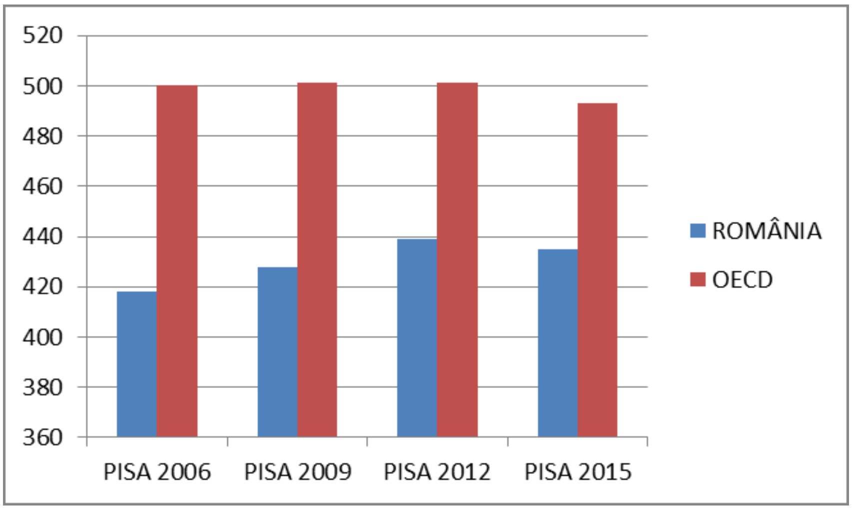

Fig.6*Chart of Romanian students' score in Science assessment items*

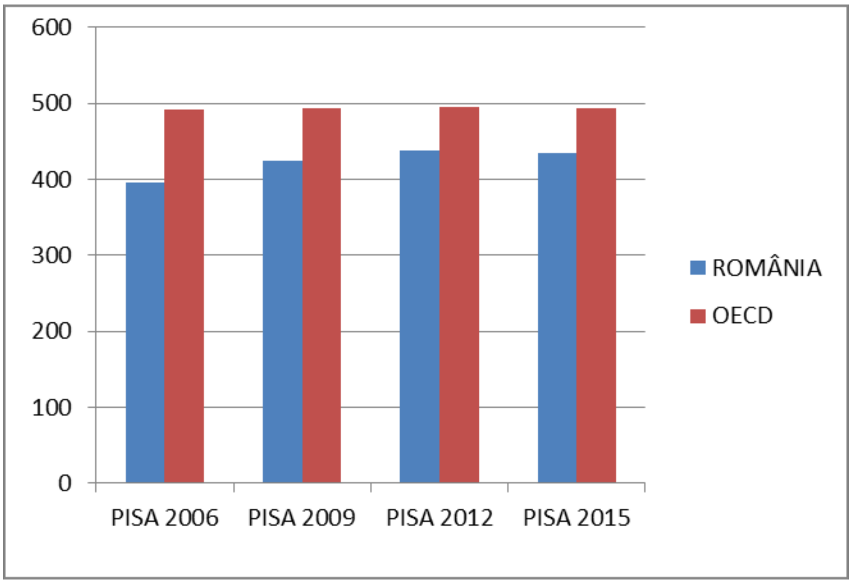

Fig.7 *Chart of Romanian students' score in Reading assessment items*

As it results from the above charts, even if 2015brings forward an improvement in Romania's ranking in the PISA assessment hierarchy (48th of the 70 participating countries), we are still behind the OECD average. Figure 6 highlights Romanian students' challenges in the assimilation of knowledge about the environment, in general, and scientific knowledge, in particular. If instruction was rooted in the social context and everyday life, if students' educational experiences were focusedon theknowledge acquired so far, if education contents were closer to students' interests, if teaching and learning were more active and interactive, if students were the subject of their own development, then Romanian education would make huge steps up the hierarchy of European countries with tradition in education.

Conclusions

The international student assessmentis a standardised test, using tools for the systematic measurement and follow-up of students, schools and national education systems. National assessment tests are designed and evolve consistent with the national education policy and social background, being highly interconnected with other forms of evaluation. Student assessment is regulated by special legislative documents, curricular guidelines, teacher manuals. Their role is to outline the basic principles of assessment, as well as the assessment objectives and criteria.

One of the chief roles of assessment is diagnosis, since it provides qualitative data about students' learning progress, as well as about their learning challenges. Assessment results provide feedback to the teacher, in particular, and to the national education institutions, in general, on the degree to which knowledge is internalised, and on longitudinal follow-up of academic performance trends.

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Social Learning Impact of 3D Computer Animated Movies for Children - Means of Curricular Adaptations through Integrated Activities in Preparatory Classes

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Abstract

Actual society surrounds children with many influential models, such as parents within the family, characters on children's TV, friends within their peer group and teachers at school. These models provide examples of behavior to observe and imitate. 3D animated movies industry has grown in the last decade, offering sources of informational contents and popular animated characters became social models. According to SLT (Social Learning Theory), new behaviors can be acquired by observing and imitating others. Learning is a cognitive process that takes place in a social context and can occur purely through observation or direct instruction, even in the absence of motor reproduction or direct reinforcement. Nowadays, integrated curriculum is the major concern of primary school teachers. The current paper presents ways of integrating informal educational contents from 3D computer animated movies in Romanian curricular activities through the impact such movies have in children's life.

Keywords: computer animated movies, Social Learning Theory, curricular integrated activities

1. Introduction

Factors that sculpture children's way of thinking are found mostly in the environment where they grow up. These include daily events, memorable experiences and peak feelings. Cartoons are one of the daily habits for children; studies have proven that an average child with a facility of a TV and a satellite connection at his home watches approximately 18,000 hours of television from kindergarten to high school graduation. (Habib, Soliman, 2015)

3D animated movies industry has grown in the last decade, offering sources of informational contents and popular animated characters became influential models.

Albert Bandura's Social Learning Theory (1977) posits that people learn from one another, via observation, imitation, and modeling. The theory is considered a bridge between behaviorist and cognitive learning theories because it encompasses attention, memory, and motivation.

Therefore, using positive animated movies characters as models or turning to advantage contents within 3D animated movies can become successfully resources in integrated teaching activities.

2. Media's Influence in Young Children's Life

Electronic media, particularly television, have long been criticized for their potential impact on children. One area for concern is how early media exposure influences cognitive development and academic achievement.

Animated movies/cartoons prove to be having a huge space concerning children daily schedule and weights a lot in the first experiences that sculpture the children brain (Habib, Soliman, 2015).

Animated movies or cartoons are some of the strong factors that does affect an individual's childhood, and takes considerable time from the young toddler schedule (Habib, Soliman, 2015).

When studies control for important confounding variables such as income and parent education, they often fail to find significant linear relations between television viewing and subsequent achievement. In fact, the association appears to be curvilinear, with achievement increasing to a peak at low levels of television viewing (one to two hours a day), and then declining with heavier viewing. The most important mediator appears to be content of the programs viewed. Educational programs are positively associated with overall measures of achievement and with potentially long-lasting effects, while purely entertainment content, particularly violent content, is negatively associated with academic achievement. Age may also be an important mediator (Kirkorian, Wartella and Anderson, 2008).

These media resources can become double edged weapon; they could ruin an individual's childhood through excessive exposing to sexual & violence content, or could aid in raising a balanced child with a proper mental state (Habib, Soliman, 2015).

Animated movies or cartoons could act as a home school, to teach a kid the life experience that is not gained from parents or from school, due to facilities that are lacked in the normal academic way or in parents' orders (Habib, Soliman, 2015).

2.1. Social Learning Theory

People learn through observing others' behavior, attitudes, and outcomes of those behaviors (Bandura, 1977). "Most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action." (Bandura) Social learning theory explains human behavior in terms of continuous reciprocal interaction between cognitive, behavioral, and environmental influences.

Necessary conditions for effective modeling are (Bandura, 1977):

Attention — various factors increase or decrease the amount of attention paid. It includes distinctiveness, affective valence, prevalence, complexity, functional value. One's characteristics (e.g. sensory capacities, arousal level, past reinforcement) affect attention.

Retention - remembering what you paid attention to. Includes symbolic coding, mental images, cognitive organization, symbolic rehearsal, motor rehearsal

Reproduction - reproducing the image, including physical capabilities, and self-observation of reproduction.

Motivation - having a good reason to imitate. Includes motives such as past (i.e. traditional behaviorism), promised (imagined incentives) and vicarious (seeing and recalling the reinforced model)

Bandura also considered personality as an interaction between three components: the environment, behavior, and one's psychological processes (one's ability to entertain images in minds and language).

2.3. Animated movies role in children's social learning

Kirkorian, Wartella and Anderson (2008) summarize relevant research and provide suggestions for maximizing the positive effects of media and minimizing the negative effects.

The authors point out that producers and parents can take steps to maximize the positive effects of media and minimize the negative effects. They note that research on children's television viewing can inform guidelines for producers of children's media to enhance learning. Parents can select well-designed, age-appropriate programs and view the programs with their children to maximize the positive effects of educational media.

Educational programs are positively associated with overall measures of achievement and with potentially long-lasting effects, while purely entertainment content, particularly violent content, is negatively associated with academic achievement.

Today 3D animated movies for children are more likely to increase children attention because their graphics, stories become more and more captivating.

Attention

Children cannot learn from educational messages to which they do not pay attention. Moreover, viewers learn more from television programs when they can pay sustained, unbroken attention (Burns and Anderson, 1993). Researchers have identified several means of maximizing children's attention to a program, some having to do with program content, others with formal features such as camera techniques and sound effects. As noted, one way to increase attention to a program is to maximize comprehensibility of the content (Anderson and others, 1981). Although viewers of all ages respond to formal features, Huston and Wright's theory (1983) predicts that content becomes increasingly important with age and formal features consequently less important except in so far as they are used to help process content.

Comprehension

Just as children cannot understand an educational message to which they do not pay attention, they cannot learn from content that they do not understand. Shalom Fisch (2000) proposed what he called the capacity model of children's comprehension of television programs based on the limited cognitive resources people have available for processing information at any given moment. Fisch makes a distinction between a program's narrative content—its story—and its educational content—its informative messages—and emphasizes the potential competition between the two types of content for the cognitive resources needed to process the program. To maximize the cognitive resources available to children to process educational content, Fisch suggests that producers integrate narrative and educational content as much as possible, making the educational message a central part of the ongoing story. For example, characters may have to solve a particular problem before advancing to the next chapter in the story. In this way, narrative and educational content can capitalize on the same resources rather than compete for them.

Repetition

One reason why media can be such a powerful educational tool is that content can be easily and cheaply repeated. Literal repetition of episodes can enhance comprehension and subsequent learning. Children also increasingly interacted with the content (in terms of audience participation) as the episode was repeated (Williams and others, 1982; Crawley and others, 1999). Similar benefits of literal repetition have been reported in other studies (Skouteris and Kelly, 2006).

Viewer Characteristics

Some studies of media effects suggest that a variety of viewer characteristics, including but not limited to intelligence, socioeconomic status, and gender, can mediate the effects of media on learning and academic achievement. To the extent that producers of children's media can take these characteristics into account during program design and production, they may enhance educational value. For example several correlational studies suggest that the negative impact of heavy television viewing on academic achievement may be stronger for girls or for individuals with higher intelligence (Keith et al, 1986). Other studies suggest that television viewing may have differential effects on children from different socioeconomic groups. Specifically, television viewing is associated with higher achievement in children from lower-income homes and lower achievement in children from higher-income homes (Comstock and Paik, 1991: Fetler, 1984). A longitudinal study that separately analyzed different content types found that the positive association between exposure to educational programs at age five and later achievement was significantly stronger for boys while the negative association between violent content and later achievement was stronger for girls. The authors interpreted this finding in the context of socialization. For example, because socialization of girls generally places more emphasis on academics, early exposure to educational programs may help boys become relatively more prepared for school (Comstock and H. Paik, 1991; Fetler, 1984) Although these studies are often correlational and rarely conducted for the express purpose of investigating individual differences such as race or gender, they highlight some possible mediators of the effects of media on children.

Transfer of Learning

Direct learning of specific information from educational media is certainly useful, but a goal of most educational initiatives is to empower children to apply what they have learned to real-life problems. Thus children must transfer to the real world what they learn from the media context (for example a television program set in a fantasy environment). Researchers now know relatively little about transfer of learning in young children, particularly with respect to television and interactive media, though some evidence suggests that even preschoolers can transfer video information to real-life problems (Crawley et al, 1999; Fisch, 2005; Hodapp, 1977). In a discussion of ideal conditions for transfer from television based on transfer of learning and analogical reasoning in children more generally, Fisch argues that transfer can be maximized not only by repeating the educational messages in the course of the episode but also by varying the contexts surrounding each presentation. He suggests that presenting the same lesson, such as a specific problem-solving strategy, several times using different types of examples can increase the flexibility of a child's mental representation of that strategy, thus enhancing the child's ability to accurately select and apply it in different real-life situations (Fisch, 2004).

Adult Coviewing and Mediation

Just as media producers can increase the educational value of electronic media, so parents and other caregivers can also play an important role in increasing the effectiveness of educational media. Coviewing adults, for example, can enhance the effectiveness of educational programming by drawing attention to the most important aspects of the program and by extending lessons presented in the program. Some studies suggest that coviewing with a parent or other adult may increase a child's learning from educational television, particularly when the coviewer actively mediates by explicitly drawing attention to the program and by asking and answering questions (Friedrich and Stein, 1975; Valkenburg et al, 1998). Although some studies fail to find a benefit of adult coviewing or mediation, to children's knowledge, no evidence suggests a negative link between such parent involvement and learning from television. With respect to interactive media, findings are mixed. Although learning from educational software may be enhanced, when an adult provides feedback or extends the lessons, it seems that children still need to be free to control the interactive experience themselves to maintain interest in the activity (Haugland, 1992; Shute and Miksad, 1997; Calvert et al, 2005). Taken together, adult coviewing and mediation are most likely to have a positive effect on learning from educational media.

3. Educational Media in Schools

Although most research on electronic media focuses on use at home, some initiatives are evaluating the use of educational media in the classroom. Efforts have been made to create school curricula that integrate educational television programs, and a massive set of evaluations of such initiatives is now under way (Ball and Bogatz, 1973). Ready to Learn, a public broadcasting initiative to enhance school readiness through educational television programs and online resources, offered workshops for parents and educators showing how to extend lessons from television programs through practice and repetition. A five-year evaluation of Ready to Learn found a modest but positive link between the workshops and the time adults spent coviewing PBS programs and reading books that extended lessons in the programs (Boller et al, 2004). Although analysts found no evidence that children's language and cognitive abilities benefited from the coviewing, the findings nevertheless hold some promise. The apparent benefits of adult mediation may provide a new area for extending the lessons of educational media.

3.1. Means of Curricular Adaptations of 3D Animated Movies for Children in Integrated Activities in Preparatory Classes from Romania

In 2012, under European Proceedings preparatory primary level grades were introduced in Romanian Educational System and also integrated activities became the main teaching trend enforced by the curricula.

Integrated approach allows learners to explore, gather, process, refine and present information about topics they want to investigate without the constraints imposed by traditional subject barriers (Pigdon and Woolley, 1992).

In Romania, defining integrated curriculum has been a topic of discussion since early 2000 that is still going on.

Integrated activities gave creative teachers the opportunity to elaborate motivational learning contexts, such as using 3D animated movies for children in curricular activities.

3D animated movies for children bring teaching benefits through creating motivational opportunities for the children of 5-7 years, because their social informal activities involve watching those kind of movies.

Two useful types of organizing integrated activities applicable in preparatory classes, on Romanian Curriculum, are presented below.

- *Multidisciplinary Integration*

Multidisciplinary approaches focus primarily on the disciplines. Teachers who use this approach organize standards from the disciplines around a theme taken from an animation movie. It involves a relationship of different subjects to each other and to a common theme from animated movies. There are many different ways to create multidisciplinary curriculum, and they tend to differ in the level of intensity of the integration effort.

Theme-Based Units

Theme-Based Units were observed to be the most effective way of using animation movies in projecting integrated activities. Going beyond sequencing content and plan collaboratively for a multidisciplinary unit, the theme was chosen around an animated movie children like. A more intensive way of working with a theme as theme-based was observed. Often three or more subject areas are involved in the study, and the unit ends with an integrated culminating activity. Units of several weeks' duration may emerge from this process.

Numerous benefits were observed, such as the following: students’ motivation increased;

students exhibited excellent on-task behavior; students worked collaboratively; students were engrossed both as presenters and as the audience; students used a wide range of presentation products, such as video, debate, sculpture, and so on; students demonstrated depth of understanding of topics as a result of their sustained interest around various questions; fewer recess problems occurred during this two-week period; teachers enjoyed the process and the results;

Teacher’s role is significant in organizing such activities and selecting the most effective contents, excluding scenes of violence or sexuality from the movies and turning to account the animated contents.

In conclusion, electronic media are powerful influences on the lives of contemporary children. With advances in technology such as larger screens that provide images in high definition, three-dimensional surround sound, and greater possibilities for interaction, the power of media will likely only increase for the foreseeable future. The influences can be both for good and for ill. Researchers are beginning to understand which aspects of media should be reduced and which enhanced, but further research is required. Ultimately, however, the question is whether society has the ability and will to enhance the positive aspects of media and reduce the negative (Kirkorian et al, 2008).

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New E-learning Platforms and Projects to Re-shape Modern On-line Education

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Abstract

The paper uncovers modern and even revolutionary e-learning projects and initiatives intended to re-shape the contemporary educational domain. The comparative analysis of these projects is based on several main criteria like: best use of IT&C, e-learning sustainability, engineering & IT innovation, scalability and overall impact. In terms of the digital content, the taxonomy of these platforms and projects for e-learning process reveals several main categories: Fundamental and Engineering Sciences, Life Sciences, Natural Sciences, Social Sciences, Arts & Humanities. In terms of the e-learning IT&C technologies used for implementation and the initially designed main scope, the taxonomy presents the following categories: IT&C Tools for E-Learning, Teaching & Assessment, IT&C Support & Services, Hybrid E-Learning, Professional E-Education and Training, Teaching Applications for Education Delivery.

Keywords: e-learning, IT&C, Teaching & Assessment, Professional E-Education and Training, Teaching Applications for Education Delivery

1 Introduction

This paper analyses and categorizes 33 award-winning E-learning Projects covering all modern education fields and levels in terms of Education Models & Methodologies (M&M), Education Technologies (Ed-Tech) and Education Domains & Audience (Ed-Dom&A).

Paper Contributions

The taxonomy of the analysed projects includes the following categories: E-Learning Projects, Hybrid Learning, High-Level Digital Content, Special Applications for Education, Special Teaching Applications for Education Delivery, E-Learning Assessment, Effective Use of IT&C, IT&C Support & Services for Professional Development Projects, Learning & Teaching Instruments for IT&C, Primary and Secondary School E-Learning Projects, Employability Support & Development, Potential Ubiquitous E-Learning, Professional & Sustainable E-Education and Training, and Curiosity Development.

2 The Taxonomy of Education Projects

2.1 E-Learning Projects

TABLE 1. *E-Learning Projects*

Project, Author, Country	Models & Methodologies	Education Technologies
"Inspark Teaching Network", Inspark Teaching Network, USA, www.inspark.education	➢ Cognitive Models: Model Tracing, Constraint-Based Modelling ➢ Collaborative Virtual Learning ➢ Design and Development of Online Courseware	➢ Adaptive eLearning Platform ➢ Intelligent Tutoring System
"Pedago", Smartly Pedago, USA, http://www.pedago.com.	➢ Online Learning ➢ Online Education and Training	➢ Innovative Web-based Teaching and Learning Technologies ➢ Web-based Education and Training ➢ Mobile E-Learning/ e-Competences
"Redefining Teacher Professional Development", Arizona State University, USA, http://www.asu.edu.	➢ Online Professional Development ➢ On-Demand Modules ➢ Online Research-Based, Personalized, Experiences	➢ Adaptive eLearning ➢ Advanced Distributed Learning ➢ Mobile E-Learning/ e-Competences
"A Problem-Solving Approach to Science Education", Cogent Education, USA, www.cogenteducation.com	➢ Online Education and Training ➢ Problem-solving Modelling ➢ Collaborative Virtual Learning ➢ Gamified Educational Models	➢ 3D Videogame Engine ➢ Software Authoring System ➢ Mobile E-Learning ➢ Web-based Education and Training
"Free Personalized Learning through Mathematical Algorithms and Crowdsourcing", Expii Inc., USA, www.expii.com	➢ Online Personal Learning ➢ Quantitative Algorithms Model	➢ Computer Graphics and Computational Geometry ➢ Innovative Web-based Teaching and Learning Technologies ➢ Mobile E-Learning ➢ Streaming Multimedia Applications in Learning

"Inspark Teaching Network", Inspark Teaching Network, USA, www.inspark.education. Inspark Teaching Network is the gateway to a world-wide teaching network of visionary education institutions and world-leading researchers committed to advanced science teaching and learning, creating and sharing Next-Generation Science Courseware, digitally-powered by Smart Sparrow (www.smartsparrow.com). Inspark fundamental goal is not only to master the world of knowledge as it is today, but to transform and to revolutionize science education and teaching process to the its ultimate scope: the exploration of the unknown. Inspark has created three next-generations of Smart Courses for higher education:

- BioBeyond an interdisciplinary introductory biology course, with two release versions: Fully Online and Blended Learning;
- HabWorlds an introductory astronomy and general education science course exploring the formation of stars, planets, Earth, life in the universe, intelligence, and civilization;
- Chem Beyond a chemistry principles course based on the interplay of matter and energy. It explores a wide area of problems from nuclear fusion to nuclear power, connecting abstract principles to concrete applications.

The network is led by a partnership between the Center for Education Through Exploration (ETX) at Arizona State University and Smart Sparrow, with grants from the Bill & Melinda Gates Foundation and NASA.

Smart Sparrow is an Adaptive eLearning Platform an education technology created by the Adaptive eLearning Research Group, School of Computer Science and Engineering, University of New South Wales in Sydney, Australia. This platform implements an Intelligent Tutoring System that combines two cognitive models: Model Tracing (the process of learning based on a generic student model dynamically generated by knowledge tracing) (Kodaganallur et al, 2005) and

Constraint-Based Modelling (the process of learning from performance errors consisting of two phases: error recognition and error correction) (Kodaganallur et al, 2005; Mitrovic, 2012).
The web-based design platform, supported by Smart Sparrow, develops adaptive learning content and applications, delivers education material to students and analyses how students learn from their responses to the courseware quizzes. It uses computing devices as interactive e-learning media and personalizes educational material according to students' learning needs. Smart Sparrow has two sections:

- PLATFORM (the learning design platform to create rich, interactive and adaptive e-learning courseware);
- STUDIO (the learning design studio to develop interactive courseware projects, custom services, pedagogical consulting, scalable strategy formulation, research, evaluation, online support, regular webinars, and dedicated training).

2.2 Hybrid Learning Projects

TABLE 2. *Hybrid Learning Projects*

Project, Author, Country	Models & Methodologies	Education Technologies
“Students as Producers @ LSE”, London School of Economics, UK, http://lti.lse.ac.uk/students-as-producers-lse	➢ Collaborative Virtual Learning ➢ Design and Development of Online Courseware	➢ Linked Projects Platform ➢ Co-Authoring System ➢ Student Co-producers and Co-constructers Environment
“Caseworx”, California State University, USA, http://www.caseworx.co/corporate-learning	➢ Interactive Case-Study E-Learning ➢ E-Pedagogy ➢ Multimedia E-Learning ➢ Experimental E-Learning	➢ Scenario Learning Environments ➢ Mobile E-Learning/ e-Competences ➢ Streaming Multimedia Applications in Learning ➢ Web-based Education and Training
“X LAB”, MIT Sloan, USA, http://mitsloan.mit.edu/actionlearning /labs/x-lab.php	➢ Randomized Controlled Trial Business Projects ➢ Online Professional Development ➢ Online Personal Experiences	➢ Experimental Innovation X-Lab ➢ Virtual Laboratory in MBA ➢ Mobile E-Learning/ e-Competences ➢ Web-based Virtual Laboratories

2.3 High-Level Digital Content Projects

TABLE 3. *High-Level Digital Content Projects*

Project, Author, Country	Models & Methodologies	Education Technologies
“ELSA”, ELSA Corp., USA, www.elsaspeak.com,	➢ Interactive Virtual Learning ➢ Cognitive Modelling and Intelligent systems	➢ Speech Recognition Technology ➢ Deep Learning Technology ➢ Artificial Intelligence Technology ➢ Mobile E-Learning/ e-Competences
“Interactive Video Course Manhattan Prep”, Manhattan Prep School, USA, www.manhattanprep.com	➢ Interactive E-Learning ➢ Multimedia E-Learning	➢ Branching Video ➢ Adaptive Technology ➢ Streaming Multimedia Applications in Learning ➢ Mobile E-Learning/ e-Competences
“Lecturio Medical Education”, Lecturio, Germany, www.lecturio.com	➢ Comprehensive Medical School e-Learning ➢ Online Professional Development ➢ Online Personal E-Learning and Training ➢ Multimedia E-Learning	➢ Custom Built Integrated Video System ➢ Question Bank E-learning ➢ Mobile E-Learning/ e-Competences

“Lecturio Medical Education”, Lecturio, Germany, www.lecturio.com. Lecturio.com enables healthcare students and professionals to become fluent in medical concepts and keep their knowledge up-to-date with video lectures, quiz questions and text reviews by award-winning educators from around the world. Having entered the US market in 2015, Lecturio.com is used in 85 different countries. Lecturio.com system education contents cover the entire Medical Curriculum (pre-clinical and clinical): Medical School Survival Guide, Aging, Anatomy, Behavioral Sciences, Biochemistry, Embryology, Epidemiology and Biostatistics, Histology, Immunology, Medical Genetics, Microbiology, Molecular and Cell Biology, Nutrition, Pathology, Pharmacology, and Physiology. The learning material is delivered in over 500 hours of TV-Quality Videos (with optional closed captions), over 10.000 recall & exam/case-questions and over 1.000 textbook articles (www.lecturio.com/curriculum).

Lecturio.com is a comprehensive Medical School e-learning system to help students to Learn (with high-yield video lectures), to Memorize (with recall questions), to Reinforce (with high-yield textbook articles) and to Prepare (with special style questions) their difficult exams for either graduate level:

- USA Medical Licensing Examination (USMLE)
- Medical College Admission Test® (MCAT® exam)
- Bachelor of Medicine/ Bachelor of Surgery (MBBS)

Technical specifications and Web technologies used by Lecturio.com.

Lecturio.com is a custom built integrated video and QBank (Question Bank) learning system, using the following Web technologies:

- Symfony framework (PHP)
- Apache & Nginx web servers
- Elasticsearch
- Hybrid topology - Linux servers + Cloud services
- CDN for asset delivery

Both Mobile e-Learning Applications includes the same functionalities as the web-based approach and two supplementary features: offline learning and bookmatcher feature (indexed books and scan any book with OCR & content matching):

- iOS https://itunes.apple.com/us/app/lecturio-study-for-medical-school-usmle-mcat/id1067957933?mt=8 and
- Android https://play.google.com/store/apps/details?id=de.lecturio.android.LecturioMed&hl=en

A brief architectural and functional description of Lecturio.com e-learning system with the functional modules and parts of the system is presented in this block diagram (Fig. 1).

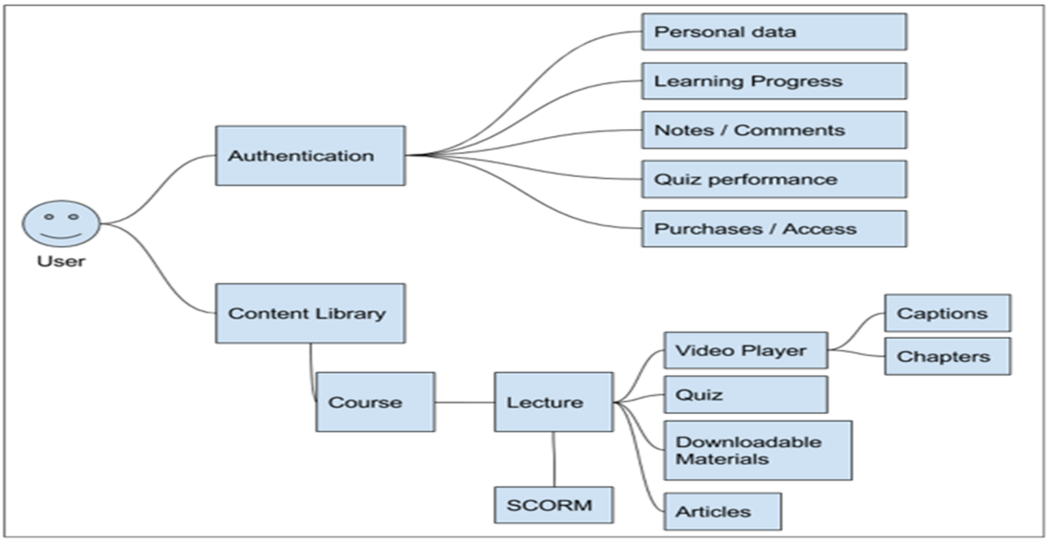

Figure 1. *Lecturio.com functional block diagram*

2.4 Special Teaching Applications for Education Delivery Projects

"BYJU's The Learning App - Making millions fall in love with learning", BYJU's The Learning App, India, www.byjus.com. Models & Methodologies(M&M): Highly effective and adapted e-learning curricula. Education Technologies(Ed-Tech): India's largest e-learning application. Education Domains & Audience(Ed-Dom&A): Primary and secondary education. Over 6 million users and 270,000 annual paid subscribers since 2015. Financial support from the Chan-Zuckerberg Initiative.

- "Duolingo", Duolingo, USA , www.duolingo.com. (M&M): Science-based free language education platform. (Ed-Tech): Mobile E-learning. (Ed-Dom&A): Online Languages Learning. Selected by Apple as iPhone App of the Year, by Google as Best of the Best app for Android, and by TechCrunch as Best Education Startup. Over 160 million users.
- "Memorang": Levelling the playing field in higher education", Memorang Inc., USA, www.memorangapp.com. (M&M): Adaptive Instruction, Premium Content, Peer-to-peer Learning, Gamification, Deep Personalization. (Ed-Tech): Web-based and Mobile E-learning Platform. (Ed-Dom&A): Any topic Higher Education. Over 120,000 students from over 210 countries. Over 16 million facts uploaded. Over 60 million answered questions.

2.5 E-Learning Assessment Projects

"DigiExam", DigiExam, USA, www.digiexam.com. Models & Methodologies (M&M): Leading Digital Assessment Provider for Creating, Delivering and Grading Academic Tests. Exams Preparing and Grading. Education Technologies(Ed-Tech): Comprehensive, Integrated set of e-Assessment instruments. Education Domains & Audience (Ed-Dom&A): Allows all-level students to take tests more efficiently. Encourage sustainability by reducing paper waste. Over 1,800 universities and schools served by DigiExam system.

"Branching Minds", Branching Minds Inc., USA, www.branchingminds.com. (M&M): Learning Science and Technology Combination. (Ed-Tech): Web application. (Ed-Dom&A): School districts streamline. An intervention solution in 30 school districts across nine states (USA); over 120,000 educated students. Help school districts focus, and personalize the way they support struggling learners.

"Adaptive Comparative Judgement", Digital Assess, UK, www.digitalassess.com. (M&M): Student courseware Assessment. Replaces formal test marking with the collective professional judgments of assessors. (Ed-Tech): Unique Web-enabled Approach. (Ed-Dom&A): Applied Law of Comparative Judgement. Developed in conjunction with Goldsmiths College, University of London as part of the e-Scape research project (focused on GCSE-Level Design & Technology).

2.6 Effective Use of IT&C Projects

"Professor Avatar: Telepresence Model". Tecnológico de Monterrey, Mexico, www.profesora vatar.com. (M&M): Telepresence Model. Distance Education Enhanced Teaching and Learning. Humanization and Reappraisal of the Social Presence of the Professor and Students in Distance Learning. (Ed-Tech): Web-based and Mobile E-learning. (Ed-Dom&A): Higher Education. Over 2,300 students.
"Collaborative Learning with Technology - Peer Instructions with Clickers for Large Classes", Hong Kong Polytechnic University, Hong Kong S.A.R, China, www.polyu.edu.hk. (M&M): Interactive and Mobile E-Learning. (Ed-Tech): Peer instruction (PI) Program. Assisted Student Response System (SRS). (Ed-Dom&A): Sustainable solution for large classes in education institutions.

2.7 IT&C Support & Services for Professional Development Projects

"Personalized PD for K-12 Teachers", 2gno.me, USA, www.2gno.me. (M&M): Teachers Professional Development. Skills Assessement and Skill Gap Addressing (ISTE Standards for Teachers). (Ed-Tech): Personalized web-enabled Approach. (Ed-Dom&A): 8 USA districts.
"Whetstone Observation and Coaching Platform Whetstone", Whetstone Education, USA, www.whetstoneeducation.com. (M&M): Teachers Professional Development. (Ed-Tech): Web-based unified platform to capture observations, share feedback with teachers, set goals, and analyse data. (Ed-Dom&A):. Over 310 schools all-over USA.
"The Ideas Box", Libraries without Borders, France, www.ideas-box.org. M&M): Mobile Library, School, Media, Community Center. (Ed-Tech): Portable multi-media kit. Curated IT&C Tools. (Ed-Dom&A): Libraries Without Borders partnered with UNHCR. Support the world's refugees or isolated and under-resourced communities.

2.8 Learning & Teaching Instruments for IT&C Projects

"Game-changer", Labster, Denmark, www.labster.com. (M&M): Virtual lab simulations. Interactive Advanced Lab Simulations. Open-ended investigations Based on Mathematical Algorithms. (Ed-Tech): Virtual Reality. Personalised 3D Virtual High-tech Laboratory. (Ed-Dom&A): Labster has a growing two-section catalog (University Package and High-School Package) with 64 simulations for the following scientific domains: biology (biochemistry, biotechnology, cellular and molecular biology, ecology, evolution and life diversity, genetics, microbiology, psychology), chemistry, engineering, physics, medicine, general science). Over 140 educational institutions (including 6 most world famous universities).
"Acarya", Acarya ORT, France, www.ort.asso.fr. (M&M): Web-based Intelligent Personal Tutor. Artificial Intelligence to Correct Learners Educational Performance Issues. (Ed-Tech): E-learning centric web-based and mobile platform. (Ed-Dom&A): Lifelong Curriculum System, including all formal, informal and non-formal education, competences and skills, on a unique digital Portfolio. 900,000 students reached since January 2017.
"SmartyPal, Inc. - Interactivity and Personalization Platform", SmartyPal Inc., USA, www.sma rtypal.com. (M&M): Educational Experience Transformation. (Ed-Tech): Interactive and personalized web-based and mobile e-learning platform. Scalable solution for highly complex educational technology. (Ed-Dom&A): Streamline the process of enhancing traditional Educational content.

2.9 Primary and Secondary School E-Learning Projects

"ThinkCERCA", ThinkCERCA, USA, www.thinkcerca.com. (M&M): Enhance students' analytical and critical thinking skills. (Ed-Tech): Personalized literacy curriculum and platform. (Ed-Dom&A): English language arts, science, social studies, and math. Post-secondary students.

2.10 Employability Support & Development Projects

“X-Culture: The International Business Collaboration Project”, University of North Carolina at Greensboro, www.x-culture.org/challenges. (M&M): Collaborative education. (Ed-Tech):New technologies for e-Competences.(Ed-Dom&A): International Business. About 360 Business professors, over 40 countries. Over 4,000 students from 120 universities participate every semester.

2.11 Potential Ubiquitous E-Learning Projects

“STIMulate: integrated maths, science and IT support for learning”, Queensland University of Technology, Australia, www.qut.edu.au/about/services-and-facilities/all-services /stimulate. (M&M): Collaborative integrated learning community. (Ed-Tech): Innovative support-for-learning program. (Ed-Dom&A): Boost success in maths, science and IT. Over 12,000 students (from January 2013 to July 2016).

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“A Problem-Solving Approach to Science Education”, Cogent Education, USA, www.cogenteducation.com.

“Acarya”, Acarya ORT, France, www.ort.asso.fr.

*“Adaptive Comparative Judgement”,*Digital Assess, UK, www.digitalassess.com.

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“DigiExam”, DigiExam, USA, www.digiexam.com .

“Duolingo”, Duolingo, USA , www.duolingo.com.

“ELSA”, ELSA, Corp., USA, www.elsaspeak.com.

“Facilitating Self-directed Knowledge Seeking and Problem Solving in the Classroom”, Institute for Human and Machine Cognition, FL and University of Maine at Machias, USA, www.machias.edu , www.ihmc.us.

“Free Personalized Learning through Mathematical Algorithms and Crowdsourcing”, Expii Inc., USA, www.expii.com.

“Game-changer”, Labster, Denmark, www.labster.com.

“Inspark Teaching Network”, Inspark Teaching Network, USA, www.inspark.education

“Interactive Video Course Manhattan Prep”, USA, www.manhattanprep.com.

“Lecturio Medical Education”, Lecturio, Germany, www.lecturio.com.

“Memorang: Levelling the playing field in higher education”, USA, www.memorangapp.com.

“Pedago”, Smartly Pedago, USA, http://www.pedago.com.

“Personalized PD for K-12 Teachers”, 2gno.me, USA, www.2gno.me.

“Professor Avatar: Telepresence Model”, Mexico, www.profesoravatar.com.

“Redefining Teacher Professional Development”, Arizona State University, USA, http://www.asu.edu .

“SmartyPal, Inc. - Interactivity and Personalization Platform”, SmartyPal Inc., USA, www.smartypal.com.

“STIMulate: integrated maths, science and IT support for learning”, Queensland University of Technology, Australia, www.qut.edu.au/about/services-and-facilities/all-services/stimulate.

“Students as Producers @ LSE”, London School of Economics, UK, http://lti.lse.ac.uk/students-as-producers-lse

“The Ideas Box”, Libraries without Borders, France, www.ideas-box.org.

“ThinkCERCA”, ThinkCERCA, USA, www.thinkcerca.com.

“Whetstone Observation and Coaching Platform Whetstone”, Whetstone Education, USA, www.whetstoneeducation.com.

“X LAB”, MIT Sloan, USA, http://mitsloan.mit.edu/actionlearning/labs/x-lab.php .

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From STEM to STEAM through flipped classroom
Imitation as a semantic mark

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Abstract

At European level and not only, they have been searching for solutions to motivate students' study within the STEM subjects (Science, Technology, Engineering, Mathematics). The initiatives carried out in this respect derive from a certain concern regarding the lack of labour able persons required by the 21st century economy. Even if STEM education could provide solutions to these problems by developing the students' ability for problem solving, critical thinking, communication abilities, etc., there is a certain resentment in the students' attitude towards these subjects. In order to acquire their motivation, A, „the power of creativity" has joined STEM's „innovation engine". Flipped classroom instructional strategy is one of the means which can lead to the development of creativity within the STEAM (Science, Technology, Engineering, Art and Design, Mathematics). The present study suggests the approaching of flipped classroom strategy to ensure the passage from imitation to creativity within the framework of STEAM specific activities characteristic to the Romanian primary education.

Keywords: Flipped classroom, STEAM, Component analysis, Primary education, Semiotics

1 Preliminaries

According to the definition proposed by Cynthia Brame from Vanderbilt University, Nashville, Tennessee (2013), *flipped classroom* is a blended learning instructional strategy, which reverses the order existing in the traditional education by supplying instructional contents beyond the classroom, many a times performed online. Initially, the strategy was developed to easen the teaching/learning of STEM subjects, yet, there are hardly a few studies in primary education to highlight the effects of the use of flipped classroom within the subjects belonging to Arts curricular area.

In recent studies, the flipped classroom has been rather a controversial topic, some researchers considering it „a future landmark in the educational practice" while others, viewing it only as „a rather inefficient and undesirable fleeting trend" (Bergmann, Overmyer, and Wilie, 2012). However, the positive effects of active learning based on cooperation, problem solving and discovery characteristic to the „mirror- classrom" are being largely enhanced (Szparagowski, 2014; Talley and Scherer, 2013).

The necessity of developing vertical partnerships due to the poor training of primary school teachers, the alignment of education to the demands of the digital society, as well as the accomplishment of a motivating learning for students, are strong arguments in favour of creating reversed or mirror- classrooms.

In the present study we shall point out:

1) the significance of the concept of imitation at an early school age in performing artistic compositions in agreement with Louis Hjelmslev's (1959) and Umberto Eco's (2008) exponential analysis patterns;

2) the way in which the flipped classroom strategy is being approached can ensure the passage beyond imitation through imitation within the context of specific STEAM activities in primary school. Such an approach is important for two reasons: a) the flipped classroom is becoming an increasingly popular educational strategy; b) STEAM is itself a solution to the skills crisis of the XXIst century society.

2 Flipped classroom strategy in primary school education

There are studies in reference literature highlighting the role of flipped classroom introduction as a solution to the problems that the students are facing (Davies et al., 2013; Missildine et al., 2013; Enfield, 2013; Beapler et al., 2014; Hung, 2015). The main issues that have been raised here are those connected to the insufficient time for teaching/learning, homework, the understanding of study contents.

The flipped classroom proposes switching activities as solutions, such as traditionally established homework to be performed in the classroom (Lage, Platt and Treglia, 2000). In a „mirror classroom", the students watch online courses at home, engage themselves and interact in online debates or perform research activities and launch themselves in concept developments in the classroom under the teacher's guidance (McLaughlin et al., 2013).

In a flipped classroom or a „mirror classroom", passive learning is performed at home, during the tutorial watching; therefore, more time is being left in the classroom for active learning focused on innovation, cooperation (Tucker, 2012; Strayer, 2008, Toto and Nguyen, 2009). As a blended-learning strategy, the flipped classroom combines face- to face learning with online learning, the contents being passed by means of tutorials. The students receive these videoclips at home, they can rewind them as many times as necessary and study them at their own pace until full understanding is achieved. They may also speed up content sequencing if already familiar/understood or they may stop and replay the most difficult passages (McLaughlin et al., 2013; Galway et al., 2014).

The flipped classroom could be viewed as an online lecture (e- lecture), enriched with visual representations: photographs, interactive graphs, video materials (Kim et al., 2014). From the point of view of communication usage pattern (Eco, 2008), this strategy may be represented as follows:

transmitter → channel → message → receiver
(the teacher) (electromagnetic waves) (sign-function) (the student)
-expression of matter-

Fig. 1 *The communication usage pattern adapted to the flipped classroom strategy*

The contents are managed through video recordings. The transmitter (the teacher / the specialist) conveys a message which is delivered to the receiver (the students) by means of a communication channel (the Internet). As far as Visual Arts are concerned, this strategy implies tutorial making by help of the arts teacher or of the specialist in which primary school students may be presented different artistic-plastic styles and manners, as for example, the impressionism, the cubism, the abstract expressionism. This vertical partnership solves the problem of insufficient initial training of primary teachers in the field of plastic arts.

You may wonder why we have stopped at the impressionism, the cubism, the abstract expressionism?

In his volume *Filosofia culturii. Cultură și comunicare* (2004) (*The Philosophy of Culture. Culture and Communication)*, Grigore Georgiu was placing the making/the understanding of the artistic image on a 3- level scale: the plastic, the perceptive and the rational- emotional level.The image is defined as a continuum between the „intuition of the sensitive reality and the conceptual activity" (Alexandrescu, 2004), and it is between these boundaries where the impressionist, the cubist, the abstract expressionist artistic-plastic styles and manners could be found. (Cioca, 2007).

Each of the 3 levels corresponds to one or more sensory- cognitive processes and the study of the 3 proposed levels develops in the 7- 9 year olds, through imitation at first, their ability to render objects perceived through senses in a personal manner.

By using a „small range of colours (with no black or sallow shades), by capturing/ rendering the retinal image not yet processed by the visual cortex structures" (Cioca, 2007, p. 145), the impressionism stands, from a plastic point of view, at the level of the emergence of the artistic image, through sensorial, instinctive, spontaneous (Signac, 2017) processing of surfaces, dimensions and colour. The colour is divided into a mix of shades out of which the on- looker's eyes composes shapes. The light plays an important part in primary processing of optical elements which include the perspective, the movement, the distance. The impressionism has been considered „... an apparent picturesque superficiality which does perceives the object only as a sum of colour sensations, the artist counting on what he/she sees from reality's background, without taking into account his/her previouisly acquired knowledge regarding reality " (Cioca, 2007, p. 142).

As opposed to the „plain and chromatic painting", the cubism brings forward a „tactile form of art against a pure vision art" highlighting volumes, perspectives, simple solid shapes, edges of spatial geometry (Delacroix, 1983, p. 395). Through passing from liniaritaty to the projection of real elements, to form perception, to quantities and qualities, to active relationships between images, this artistic movement can be placed at a perceptive and rational- active level. „The more the subject is younger and less trained, his/her drawings are more prone to the perceptive image" (Cioca, 2007, p. 107).

The expressionism swaps the attention from impression to expression, that is on the values of the inner universe (Prut, 1982), the personal, subjective feelings becoming more important than reality itself. Therefore, „in the process of artistic creation, the image acquires significance , it does no longer immitate real objects in their concrete shape, but becomes a figure characterized by the shape-significance complex, significance being in close relationship with the symbol" (Cioca, 2007, p. 194). The drawing becomes a means of communication through which own feelings are being expressed, the images being the product of processing ideal or material reality, that is a new, original product. The abstract expressionism belongs to the rational-active level as representations become part of reality, replacing direct experience with it. By the affectional-emotional cutting-out of figurative or abstract representations and their mental processing through inductions, deductions, suppositions (Georgiu, 2004), the expressionism is in search for a novel chromatic intensity, the expression of inner feelings.

3 Imitation as a semantic marker in primary school education. The passage from STEM to STEAM

Where does imitation end and where does creativity begin? Lev Semionovici Vygotsky (1927a, 1971b) was a supporter of learning through teacher's imitation to reach that proximity zone of child development. Rudolf Arnheim (1994) is against imitation, considering it wrong to influence the development of drawing in children. On the contrary, he supports the taking into account of the stages of cognitive development. Henri Delacroix (1983) asserts that the aesthetic attention can generate an imitation-prone disposition, but automatic imitation can refer only to what has been previously done.

Vasile Cioca (2007, p.148) states that „in visual-plastic education, creatively designed and carried out, the dissociation of conscience-related fact from sensitive experience and vice-versa are fertile directions and areas of stimulating the creative potential". Therefore, art acquires the ultimate function to capture reality beyond expressions, translations or symbolic representations (Delacroix, 1983).

The following aspects are thus being identified:

1. The pattern presented in the tutorials is already a schematization of real elements: the cultural notions of the elements in the pattern are neither similar to perceptive models nor to their correspondent objects. (Eco, 2008). There are objects in the surrounding environment artistically sketched in a bi-

dimensional plan and replaced or rendered (generalized) by elements specific to plastic language. The trees, household appliances, the sun, the sun rays are encoded cultural entities, visually and artistically represented through expression tricks. The process of evolution from the perceptive model to its expression correspondent includes the semantic model as a go-between. The passage from an expression model through which the semantic model is to be rendered is performed by selecting those pertinent features in the perceptive model that can make the object recognizable. Based on the Object-type/ Object token (type/occurent), the semantic model (the content) finds its expression model (shape) through transmutation by similitude.

2. The plastic representation in the tutorial, already a model of the specialist’s expression, will eventually find another model by imitation: that of the child’s. In this case, replicas (duplicats or partial imitations) or similiarities may be found. In replicas (duplicats), the degree of resemblance with the model is perfect, but the psycho-physical peculiarities in the formal operational stage (7-9 years) make this process rather difficult, being more about partial replicas and similitudes in most children. We can talk about partial replicas that retain certain composition structure elements, colour, shape, etc., to which the children’s contribution to creating different expression models are added according to their personality.

Analysing the componential tree of sign /imitation/ function, several reading paths can be followed as shown in the Reformulated Semantic Model (RSM). Taking into account two signification units, we can conventionally obtain 8 denotative (semantic) markers and 3 conotational markers for the behavioural context (referring to syle) respectively. The conotations of the <<imitation>> sign, read within the „behavioral” context, turn themselves into „recreation, reinvention, re- imagination” and supporting the opinions of the three psychologists. The students receive guide marks through the tutorials by specialist designed tutorials, but it is them who choose their „imitation” mode. The componential tree represents a working hypothesis with the aim to control the immediate semantic environment of the „imitation ” content element (Umberto Eco, 2008, p. 190).

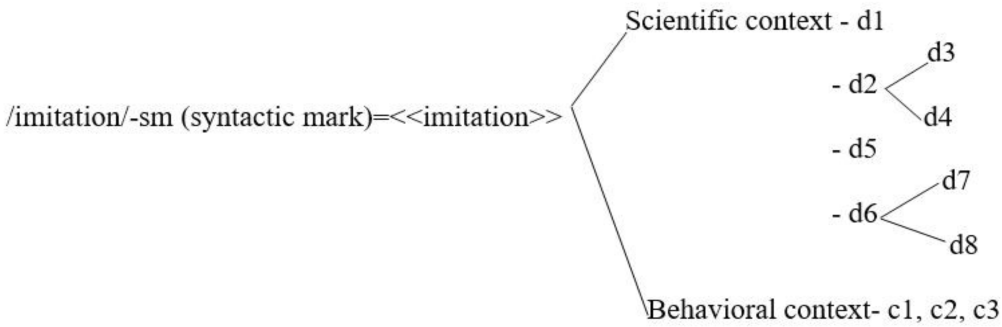

Fig. 2 *The componential analysis of sign /imitation/ function, (abbreviated from the the Reformulated Semantic Model (RSM) of Umberto Eco, 2008)*

Hjelmslev (1959) proposes a componential analysis scheme of the sign function which highlight the derivation of „two of its own contexts from two opposite positions situated on the same semantic axis” (Eco, 2008, p. 191), respectively the assignment of „copying” or „recreating” senses of learning the lessons presented in the video material. „The description of the semantic fileds and axes can be rounded off only on the occasion of the study of the conditions of a given message significance” (Eco, 2008, p. 192), respectively the establishment of the reading paths based on contexts, according to cultural conventions.

<table>
<tr><td><<recreation>></td><td colspan="3">Expression for</td><td><<copying>></td></tr>
<tr><td></td><td colspan="2">Expression for</td><td><<imitation>></td><td></td></tr>
<tr><td></td><td>//video//</td><td><<learning>></td><td></td><td></td></tr>
</table>

Fig. 3 *Learning through tutorials (abridged from Hjelmslev's semantic model, 1959)*

3. The reform in the Romanian primary school education initiated in 2012 promoted the integrated approaching of curricular contents with a view to the students' competences acquisition and development , as well as the alignment to the european education. The comprising in the primary school curriculum of Visual Arts and Practical Abilities integrated subject contributes to the development of the students' creativity by their making of products using techniques, tools and materials specific to the plastic and technological field. There are benefits of these measures both for the teachers and for the students:

a) The curricular contents are stated in general terms, allowing the teachers the chance to approach them accordsing to own styles, to the peculiarities of the each class of students, to available resources, etc.

b) 25% of the National Curriculum is alloted to the teacher's contribution and innovation .

c) The subject of Visual Arts and Practical Abilities , which has already been integrately structured in the official school documents, encourages/develops the students' creativity. Such an example would be the combination of painting in different artistic styles with the collage.

d) The integration may take place at an intercurricular level as well, thus representing a superior stage in the manifestation of creativity. All subjects may be curriculum-integrated, but there is the particular case of juxtaposing logical-mathematical subjects to the artistic ones. So this is how the passage from STEM to STEAM is made, arts bringing an additional element of ingenuity and creativity to the „rational" subjects. The contents of these subjects can be approached within the same learning situation: the attaching of a plastic composition, a spring-driven mechanism (the so-called „key-engine" toy) which spins an element out of the compositional space, manufactured from a certain painted material (cardboard, plastic foil, etc.).

How can the STEAM-related field of knowledge intercurricularly be taken into account to develop competences? This process seems difficult to make at first sight as it does not account for the possibility of curriculum integration, the making of connections between the used knowledge and the competences in the Visual Arts and Practical Abilities and Sciences curriculum. We hereby offer two examples of STEAM-integrated curriculum in the IIIrd and IVth grades. The considered general competence for Sciences is: The *Exploration of the Characteristics of Bodies, Phenomena and Processes.*

Example 1.

The corresponding specific competences,according to the Science subject curriculum for the IIIrd and IVth grades, are as follows for the IIIrd grade:

1.1. Identification of some characteristics of living and nonliving bodies;

1.2. The use of certain criteria to compare some bodies, phenomena and processes.

As content elements, We have selected „*Forces and effects – Movement and rest. Characteristics of distance (distance, duration, speed)"*

The content element of the Science subject will constitute the assignment for the artistic-plastic composition. The students will complete plastic works in which movement is highlighted, using elements of plastic language from de Visual Arts and Practical Abilities curriculum. Thus, elements belonging to both subjects are being combined. After the completion of the plastic works, a spring-driven mechanism is being attached (Fig. 4), the „replica" of a composition element cut out from cardboard. The key to the mechanism is being winded to strike movement. The mechanism sheme is being drawn and its operation process is being explained. The speeds with which the component elements of the students' compositions move are being compared. Finally, the movement and rest notions are marked out and explained.

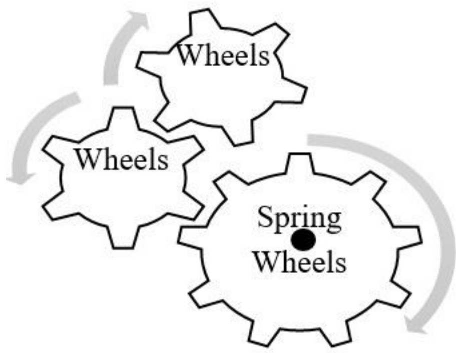

Fig. 4 *A spring and wheel mechanism. Movement and rest*

Example no. 2:
For the IV-th grade, the specific competences related to the same general competence are as follows:
1.1. The identification of some relationships between bodies among some phenomena and processes;
1.2. The use of some criteria for the ordering and ranking of some bodies, phenomena and processes, and the content elements „*Electric power. Light – Simple electric circuits*".

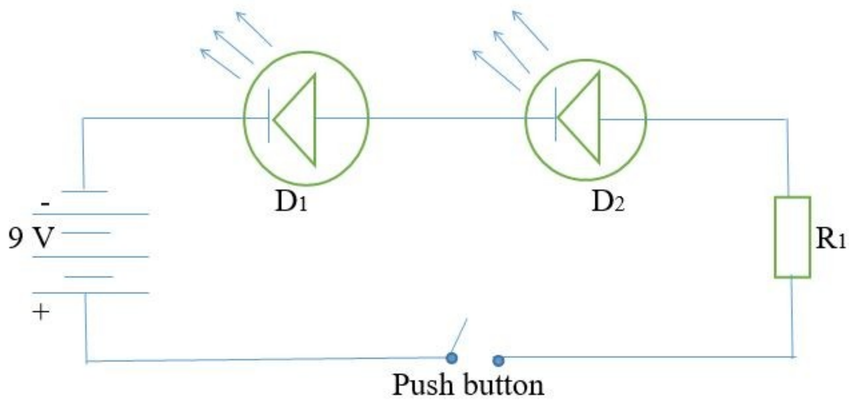

Fig. 5 *A 2 LED-electric circuit*

Necessary materials:

- 2- 5mm white or yellow LEDs (D1, D2)
- 1-470 Ω resistor (R1)
- 9 V battery
- 1 „Push-Button” switch
- 1 „mother-mother” socket connector
- „jumper” connectors
- Battery socket

For the IVth grade, the topic of the plastic composition is set similarry to the one in example I, attaching a 1-2 LED mechanism to the assignments (Fig. 5). A 9 V battery is used. A Push- Button switch is triggered. The canvas is the base on which the circuit is being painted and fixed. There is no difference between painting on canvas and painting on paper. Then, there follows a discussion about the way the electric power is led to the battery through LED connectors.The circuit scheme is being made.

Conclusions

The introduction in the educational process within the conditions of more growing demands from the economy of the XXIst centrury society of some research policies meant to bring more creativity to STEM- related subjects, is being justified by the necessity of acquiring competences and skills to labour able persons. The lack of flexibility, of the ability for permanent training, of problem-solving and critical thinking abilities require reconsiderations and restructurations in education. One of the measures taken in view of acquiring necessary competences related to social, professional, personal life is the inclusion of the A „creativity power” in the STEM „innovation engine” starting from the first stage of education. The introduction of Arts and Design in the core of scientific/mathematical subjects determines, in young students, the acquiring of some specific cross- competences, contributing to an increased motivation towards learning, thus becoming attractive and accesible.

At the same time, this procces is supported by modern strategies as well, the flipped classroom being one of them by means of tutorials used in the learning process. Even if the flipped classroom was initially used in STEM-related subjects, it can be adapted to the peculiarities of Visual Arts and Practical Abilities.

The tutorials, which render the painting styles and manners related to the impressionism, cubism, abstract expresionism, bring forward the concept of imitation at an early school age stage. However, imitation receives connotations according to given contexts or certain cultural conventions. At an early school stage, objects are represented according to the aim of the drawing and the child’s intentions, starting from global structural features. These global features (generalities) stand for what „the children see”.

In a STEAM context, the children make intra- and inter- curricular connections, having the artistic-plastic compositions as starting points, either on a canvas or cardboard base, which they will eventually turn into solutions to the real world, using for example, engineering approaches.

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Digital Competence in Learning English as a Foreign Language – Opportunities and Obstacles

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Abstract

Assuming that current university students in Romania have acquired digital competence along their education experience, by themselves or in a formal context, this paper aims at investigating whether their digital competence has been used in relationship with developing their communication competence in English as a foreign language. According to statistics, most Romanian university students have been studying English as their first foreign language, even if they have been exposed to other foreign languages during their compulsory education, due to common reasons, mainly related to the international status gained by English. Thus, drawing on recent literature covering the link that has been or should be established between digital competence and learning English as a foreign language (EFL), a small-scale questionnaire survey was conducted in order to check the validity of our assumption and also to identify the factors that might enable or block Romanian university students to develop confidence in using digital tools in this process. Our respondents' answers reveal both the opportunities and the obstacles, leading us to the conclusion that English teachers in Romania should lay more emphasis on the practical issues related to the integration of digital skills into language learning strategies.

Keywords: digital competence, communication competence in EFL, digital tools, learning EFL

1 Introduction

At present, technology is an invisible but integral aspect of language use (Chapelle, 2005): every day we use electronic devices to communicate orally or in written form, to extract or to compose information. The level of the digital skills required to perform these communication tasks is basic or moderate, as it does not presupposes developing software, applications or programming, using computer syntax or statistical analysis packages. On the other hand, due to globalization trends, English has become the worldwide lingua franca (Crystal, 2012), and, more often than not, individuals are expected to be able to use English for purposes related to work or leisure activities. Thus, under these circumstances, it is likely that the amount of communication undertaken/performed in English, mediated by technology be on the rise, and, consequently both digital and EFL skills be constantly improving.

Communication in foreign languages and digital competence represent two of the eight key competences included in the Recommendation of the European Parliament and of the Council of 18 December 2006, referring to the strategies to be adopted by Member States of the European Union, so that individuals could flexibly adapt to a rapidly changing and highly interconnected world. Recommendation 2006/962/EC specifies that 'Many of the competences overlap and interlock: aspects essential to one domain will support competence in another. Competence in the fundamental basic skills of language, literacy, numeracy and in information and communication technologies (ICT) is an essential foundation for learning, and learning to learn supports all learning activities.' Under these circumstances, in this study, we aim at identifying the Romanian students' point of view regarding the relationship that has been or should have been established between their digital competence and their communication competence in EFL, as we consider that these two competences are highly connected and maximize each other accordingly. Gaining a high level of proficiency in EFL requires more than the limited hours of instruction provided in the formal curriculum (McKay, 2002), so, in our survey, not only do we consider the formal EFL teaching context in Romania, but we also have in view those informal situations which have led to EFL self instruction, be them intended or not. In point of structure, in part one, we briefly outline the concepts we use throughout the paper (digital competence, EFL) and how these concepts are interrelated in recent literature. Part two covers the methodology employed in our study and in part three we discuss the findings of our small-scale research. The final part deals with the conclusions of our investigation.

2 Digital competence and EFL

In terms of technological developments, the past century witnessed a lot of breakthroughs and it is generally agreed that computers and the internet represent major creations. Moreover, the language that accompanied this technological revolution has been English and, at the beginning, English and computing were quite inseparable. Nowadays, even if this is no longer the case, digital skills and EFL skills are frequently associated and there are several points worth considering when approaching these concepts.

The term digital competence may have various meanings (Ilomäki, Kantosalo& Lakkala, 2011), as it is a 'a multi-faceted concept that has emerged from several backgrounds' (Gallardo-Echenique, Minelli de Oliveira&Marqués-Molias, 2015, p.1). Therefore, it is worth mentioning that the definition provided by Recommendation 2006/962/EC covers the scope of our research: 'Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet.' As for the students currently enrolled in the Romanian tertiary system of education, we could label them as 'digital natives' (Prensky, 2001), since most of them have been exposed to digital devices formally or informally, all along their education experience (Key Data on Learning and Innovation through ICT at School in Europe, 2011).

The status gained by English as a global language in the latter half of the 20th century is beyond question and the reasons for it are related to political, economic, cultural, scientific and technological power (Crystal, 2013). Thus, besides being the native or official language of various peoples around the world, the special role achieved by English is considerably due to the fact that it has become pre-eminant in politics, economics, the press, advertising, broadcasting, motion pictures, popular music, international travel and safety, education and communication (Crystal, 2012). Quantitatively, it may be quite difficult to exhibit data related to all the domains listed above. Nevertheless, recent statistics referring to the top ten languages of the internet (number of internet users by language) and five most widely taught first foreign languages in schools around the world might prove significant for this paper, as English holds the leading position in both situations: 25.5% of world internet users speak English (Internet World Stats, 2017) and 67.5% of the students at primary level, respectively 81.2% of those at secondary level studied English as their first foreign language between 1990-2005 (Cha&Ham, 2008). To particularize, in Romania, English as the first foreign language dominates both primary and secondary education at present, with a spectacular increase in the former: 73.6% of primary school students studied English in 2010-2011 school year vs. 84.8% in 2015-2016 (Romanian Statistical Yearbook, 2016). As for Romanian university students, the standards put forth by the Romanian

Agency for Quality Assurance in Higher Education in 2016 suggest that the bachelor level curriculum should comprise a foreign language, but, unfortunately, at this moment, there is no statistical information available about the foreign languages preferred by the students or provided by the universities.

Due to the fast-growing information technology and the global network society, EFL learning and teaching have been reconceptualized. The advantages to integrating technology in EFL learning and teaching are mainly threefold: (1) high exposure to English – unparalleled opportunities to practice EFL and engage with authentic real-world contexts of language use, thus doing things with language rather than just learning about language; (2) boosting students' motivation to improve their communication competence in English – a very effective way of indulging language learners in the target language and culture, as individual learning style and pace could be catered for; (3) increased learner autonomy and control, providing a more student-centered pedagogy with learners at the centre of the learning process and more actively engaged in their learning than in traditional direct instruction methods (Jewell, 2006). For example, both asynchronous (email, discussion boards, mailing lists, and blogs) and synchronous (instant messaging, videoconferencing, chat rooms, and Multi-User Domains) computer-mediated communications enable students to hone their English skills in reading, writing, listening and speaking at the same time, and get actively involved in one-to-one, one-to-many or many-to-many communication environments, free from the constraints of time and space. All these tools can be used in formal instruction, guided by an EFL teacher, or, independently, by self-tutoring. Nevertheless, there might be obstacles, blocking learning and teaching EFL by means of digital tools (Motteram, 2013): the status of 'digital immigrants' that some of the teachers have (they might be put off using technology when they are faced with classes of learners who may, on the surface at least, appear to be more digitally competent than themselves); unequal access to digital tools due to lack of material resources; time consuming, considering the vast amount of digital resources at their disposal (without proper guidance one might feel at a loss when deciding what to select for EFL learning or teaching). Hence, our paper attempts to explore Romanian university students' experience and expectations with using their digital competence in relation with learning EFL.

3 Research

3.1 Methodology

Our small-scale research stems from the assumption that using digital tools in EFL maximizes language proficiency. A 22-item online questionnaire was devised considering the need to properly identify the participants (gender, age, university, EFL proficiency by self-assessment) and to meet the objectives of our research: (1) finding out their opinion on the importance of applying their digital competence in their everyday life; (2) establishing their opinion on the importance of the communication competence in EFL in their everyday life; (3) identifying their EFL practicing habits to develop their reading, listening, writing and speaking skills and (4) determining their experience with learning/improving EFL on their own, as well as their opinion on using or not digital tools in teaching and learning EFL.

Our research used a non-probability sampling, as the participants were approached due to their characteristics: proximity to the research location, affiliation to the target group, willingness to participate. The survey participants were enrolled in their 1st or 2nd year of study, in 4 Romanian Universities (3 in Bucharest – University of Bucharest (UB), the Faculty of Administration and Business, 'Nicolae Titulescu' University (NTU), the Faculty of Economics and Technical University of Civil Engineering (TUCE), the Faculty of Civil, Industrial and Agricultural Engineering– and one in Ploiești, Gas-Petroleum University (GPU), the Faculty of Letters and Science). The students belonged to the following programs of study: Marketing and Business Administration (UB); Public Administration, Business Administration (NTU); Civil, Industrial and Agricultural Buildings (TUCE); Educational Sciences (GPU). So all these participants are university students studying EFL in an academic context (for 2 or 4 semesters), as a supplementary discipline, included in their compulsory curriculum. Even if, on May 5th, 2017, invitations to participate in the research were sent to a large number of students (i.e. all the students in the programs of studies listed above who were part of various social media groups – Yahoo, Gmail, Facebook), and a reminder one week later, by May 19th (deadline) we had only 135 valid responses. According to Eurostat - Foreign Language Skills Statistics (2015), an analysis by sex revealed that there was almost no gender gap in relation to foreign language skills, so the gender variable (42=male, 93=female) in our research proves irrelevant. As for the age, 66.7% of the respondents were below 25, and thus they could be labeled 'digital natives'. The report 'Key Data on Teaching Languages in Europe' (2012) suggest that, at the end of upper secondary education, the minimum level of attainment set forth by the curricular documents ranges between B1 and B2 for the first foreign language, so the percentages we obtained when asking survey participants to self assess their English skills (18.25% – A1 and A2; 62% - B1 and B2; 19.25% - C1 and C2) match the requirements of the Romanian curricular provisions, and hopefully they are not far from reality.

3.2 Findings and Discussion

The first set of items (6) was aimed at identifying the respondents' attitude towards using digital competence in everyday life. According to their answers, all of them own a computer and a mobile phone, and 64% also have a tablet/electronic music device/ game console and, on average, our subjects spend 2.6 hours/day in front of the computer. As for the reasons why they do so, topmost comes studying, then relaxation and socialization. They use the internet to find information necessary for their studies (recommended bibliography, writing papers) or for themselves (weather, news, practical info), to access their social media accounts, to play online games, to listen to or to watch music/films. For the fill-in item 'Computers are …', the survey participants acknowledged the paramount importance of these devices in almost any man-related activity, emphasizing their usefulness in keeping information, helping individuals advance and do tasks faster. Only two answers differ, pointing to the negative aspects ('unfortunately, an important part of our lives', 'a necessary evil'). The incomplete sentence 'Internet is …' was the last item in this group, and the responses underline the prominent role the internet has in everyone's life when it comes to finding information and communicating. Therefore, as a whole, the answers to the first set of items display the participants' positive attitude towards digital tools, to a certain extent, we might even say that the majority could not envisage life without them.

The next set of items (7) focused on the respondents' opinion on the importance of the communication competence in EFL in everyday life. Thus, first, they had to continue two sentences: 'English is …' and 'Learning English is …'. For the former, the subjects' responses could be grouped as follows: the most widely spoken language in the world (59 answers); a necessity if you want a good job in Romania or abroad (27 answers); a bridge among nations (24 answers); an indispensible tool when one needs to adapt to changes given the globalizing trends (23 answers). Two of the answers even acknowledged the 'bond' between the digital competence and the communication competence in EFL: 'the bridge between us and the rest of the internet users'; 'the language of computer science'. As for the latter sentence they were supposed to fill in, the survey students consider that it is important/essential/more than necessary/mandatory/useful to learn English, pointing once more that it could ensure one's personal and professional success (125 answers). Some of the answers mention being either easy (8 answers) or difficult to learn English (2 answers). Nevertheless, when it comes to the amount of time dedicated to studying English/week, their answers seem disappointing as compared to how much time they spend on computers: 11 of them state they allocate 0 hours and thus the average is 1.6 hours/week. Two explanations are possible: (1) some of them have already been learning English for more than 10 years at school or in private and their communication competence in EFL is satisfactory (B1 or B2), thus having reached a certain degree of self-sufficiency and, consequently, they may just need to do little from time to time to maintain their level; (2) the respondents may strictly associate learning English with the formal education setting – English is a compulsory discipline, so it is associated with the constraints resulting from accomplishing academic tasks, and most probably with assessment.

The next four survey items focused on how the participants practiced their receptive and productive EFL skills and they had the possibility to choose more than one answer. By far, reading is the most practiced skill (as nobody chose 'I don't practice this skill' option, in comparison with the items related to listening, speaking and writing), triggered by accomplishing academic tasks required by the EFL course or other university courses (123 answers) or by self choice (89 answers). When it comes to practicing their listening skills, most subjects (50.9%) indicated at least two activities from the list provided; their answers could be ranked as follows: watching TV series, movies in English with no translation in Romanian (102); listening to audio books in English (59); listening to radio stations in English (53); listening to online tutorials in English (46). To practice their writing skills, most participants limit themselves to doing the assignments / exercises suggested by the EFL practical course instructor (102 answers); a few (28 answers) communicate with their foreign friends; only one student participating in the survey indicated a language learning platform, where native speakers correct what you write (http://lang-8.com/). The item related to practicing their speaking skills receives the fewest answers, 66% of the sample subjects choosing only one alternative: 'speaking with group mates during EFL classes at university' (84 answers); 'speaking with my foreign friends' (46 answers); 'reading aloud' (21 answers); 'speaking with clients at work' (8 answers); 'speaking with other gamers while playing' (one answer). These results suggest that, as compared to receptive skills, the participants' productive skills, especially speaking, are less practiced due to lack of real opportunity, outside the formal EFL context.

The last set of items (4) investigated the survey participants' experience with learning/improving EFL on their own (Q1 = *Have you ever tried to find EFL learning resources on your own?*; Q2 = *Have you ever used EFL online learning resources?*; Q3 = *Have you ever used educational software to learn English by yourself?*), as well as their opinion on using digital tools in EFL teaching and learning (Q4 included 9 statements, pointing to advantages and disadvantages in EFL teaching and learning by using or not digital tools).

Table 1. *Independently using EFL resources*

Question	Always (%)	Very often (%)	Rarely (%)	Scarcely ever (%)	Never (%)
Q1	7	56	19	14	4
Q2	3	57	22	12	6
Q3	0	45	18	16	21

The frequency of the responses in Table 1 suggests the sample subjects' interest in identifying EFL learning resources by themselves, especially when finding general resources (Q1) or using online resources (Q2). As for Q3, 55% of the respondents state that they have rarely, scarcely ever or never used EFL educational software, leading us to assume that the access to this kind of resources is more difficult for them (probably due to costs) or that the subjects are less familiar with these digital tools or that they are less aware of the potential benefits of EFL software use.

As far as the statements in Q4 were concerned, our respondents totally agreed or agreed that: internet provides easy access to unlimited EFL online resources (100%); digital tools should be used more frequently in teaching EFL in a formal context (100%); digital media available on the internet (text, image, sound, video) help students effectively use EFL online resources (97%); using digital tools during formal EFL activities could lead to students' increased autonomy and control of EFL learning (94%); EFL is easier when they use a computer (93%); teachers should include more digital technologies in their EFL teaching activities (89%); using digital tools in formally teaching EFL could create more real life situations highly beneficial for the learners (83%); students do not know what criteria to apply when choosing online EFL learning resources (32%); students might get easily distracted when using the computer for EFL learning activities (27%). One could easily see that weaknesses could be easily overlooked, as strengths get almost total assent.

Conclusions

Acknowledging the limits of our paper (small number of respondents, covering only a few undergraduate programs in Romania, in four universities) and hoping to widen the scope of our investigation (asking for the opinion of academic staff teaching EFL in Romania on using digital tools in their teaching activities), the findings suggest both opportunities and obstacles for using the digital competence in developing the communication competence in EFL for Romanian undergraduates. In our opinion, the main findings are that using digital tools in teaching/learning EFL brings students closer to real life situations, giving them the chance to constantly develop/improve their EFL communication competence, and, additionally, that students’ motivation and interest increase if digital tools are used when teaching EFL. Although digital tools are rarely used in a formal EFL teaching context, our research results show that students independently use digital tools to learn EFL. In addition to that, students are well aware of the risks involving unrestrained usage of digital tools and that is why they need qualified guidance to help them select adequate digital tools for learning EFL. As a general conclusion, using digital tools in teaching/learning EFL comes with more advantages than disadvantages.

The findings in Key Data on Teaching Languages at School in Europe (2012) indicate that there is a positive relationship between students' exposure to foreign languages through traditional and new media and their language proficiency. Nevertheless, according to the great majority of the students participating in the survey, digital tools are not regularly used during language lessons in most EU countries. The results of our small-scale research confirm the conclusions of this report and, while gaining autonomy in EFL learning using digital tools could represent a possible solution to overcoming the infrequent usage of digital tools in EFL teaching, it does not come in handy for all types of learners. Young learners, as well as those lacking digital devices and/or internet access might not find it easy to use digital tools in learning EFL independently. We suggest that the quality of the formal EFL taught time becomes one important variable, considerably influencing the learners’ EFL proficiency. Therefore, EFL teachers should more often integrate digital tools into language learning strategies, so that learners could fully benefit.

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Computer implementation in primary school teaching

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Abstract

It is a well-known fact that the computer plays an important role in the day-to-day life of the students, while teachers have the task of exploiting this resource to enhance the quality of the instructional and educational process. Digital literacy of children is a phenomenon that, in most cases, precedes the onset of schooling, which allows for a shift from playful activities to activities that are subordinate to educational purposes. Unlike previous generations, today's students frequently use the computer for various purposes, and as a consequence, the teacher is in a position to integrate this tool into teaching, adapting their teaching strategies. Thus, we believe that it is important to know to what extent the use of computer in teaching subjects in the early years of schooling has a relevant contribution for the teacher. The present study is a research that has been conducted on a sample of primary school teachers (N = 62) in order to identify ways in which the computer integration in teaching is proven to be effective.

Key words: primary education, teaching, teaching, computer.

1. The context of research

The computer is an integral part of the modern society, representing an indispensable tool for everyday life, and the school has been open since the beginning, allowing for the entry of new technologies into the didactic activity. Thus, this modern means has developed its potential along the way, demonstrating its usefulness in various directions, with multiple purposes and functions. Numerous studies have demonstrated over the last few decades the usefulness of computers in the work of teachers at all levels of education, also revealing the positive effects on pupils and students (Făt and Labăr, 2009; Vlada, 2015; Test Global, 2015).

This study delimitates a component of the didactic act, focusing the analysis exclusively on the teaching, which it analyzes from the point of view of the efficiency of computer use. Thus, we decided to focus our attention on primary education, a sector that allows, through the presence of a single professor in the classroom that teaches a variety of disciplines, a flexible and creative approach to strategies in correlation with modern means.

The study aims to reveal:

- the frequency of computer usage in classroom activity
- the usefulness of using the computer in teaching according to the educational discipline
- types of computer materials used in teaching
- the advantages and disadvantages of computer involvement in teaching.

2. Objectives, hypothesis and methodology of research

2.1. Objectives of the study

The purpose of this investigative approach is to find out to what extent the use of the computer in teaching the subjects of the early years of schooling has a relevant contribution for the teacher.

Several objectives are subordinated to this goal, embodied as follows:

- Revealing the opinion of teachers on integrating computer in teaching;
- Capturing ways in which computer supports various school subjects in primary school;
- Highlighting the advantages and disadvantages of computer integration in teaching.

2.2. The research hypothesis

Computer use in teaching subjects in primary facilitates the transmission of information through information accessibility.

2.3. Methodology of research

This study was carried out using the survey method that used the questionnaire as a tool, which involved the collection of data from teachers working in primary education. Thus, 62 questionnaires were applied and validated in full.

3. The sample structure

The surveyed population, made up of 62 teachers in primary education, was interesting in the way it perceives and uses the computer in teaching, given that the sample had a heterogeneous structure. Thus, the subjects differ according to their age, didactic experience, the level of continuous training, the environment of the institution in which they operate, which allowed the collection of relevant data for the proposed topic.

Table 1: Distribution of teaching staff participating in the research

Criteria	Variables	Number of people
Distribution by age	18-30 years	**14**
	31-40 years	**20**
	41-50 years	**18**
	51-65 years	**10**
Experience in teaching activity	0-10 years	**12**
	11-20 years	**12**
	21-30 years	**16**
	31-40 years	**17**
	over 40 years	**5**
Teaching degree	none (Debutant)	**6**
	Definitive	**13**
	IInd degree	**22**
	Ist degree	**21**
School environment	**Urban**	**42**
	Rural	**20**

Examining the table above, it can be noticed that the sample of subjects is made up of teachers belonging to different age categories, a relevant aspect for the degree of interaction with the computer, knowing that the younger people use the new technologies more often in everyday life, as well as in their profession. Also, from the sample used in the research are subjects with different didactic experience, thus differing from the point of view of the didactic competences of establishing and putting into practice of various strategies, in which the computer can become a useful means. Complementary to the experience of teaching, the degree held by subjects reflect their interest in continuous training, and their concern for the development of skills, including the technological ones. At the same time, a significant percentage of the sample teachers perform their activity in the urban area, which is important because the good endowment of the schools in the urban area, but also a large part of the rural ones, is a favorable premise for the good use of new technologies.

4. Data analysis and interpretation

The first item highlights the frequency of computer use in the didactic activity conducted by the 62 subjects with the young school children.

Most of the subjects (24) use the computer very often (daily), 18 of them often (2-3 times a week), 12 rare (weekly), 6 occasionally, and 2 never. These data lead to the conclusion that the computer is a constant presence in establishing the didactic strategies of the primary school hours, demonstrating its usefulness. By correlating the data obtained with the age indicator, we noticed that in all the age categories discussed there are computer users in the teaching process. Thus, technological skills are present at any age, proving their necessity and usefulness in teaching.

Questioned on the purpose of computer use in teaching, 50 of the respondents say they use computer in teaching, this representing an effective alternative to traditional means. In the act of teaching, the computer offers multiple possibilities for exploitation due to its incontestable strengths, the transmission of information being facilitated by the concreteness, clarity and visual support it provides.

According to the questioned teachers, the primary school teachers benefit from the computer contribution in teaching, unequally, as follows:

Table 2: Computer use in the disciplines of primary school

School subject	Number of subjects who use the computer in teaching
Communication in Romanian / Romanian Language and Literature	35
Mathematics / Mathematics and Environmental Exploration	45
Science	48
History	40
Geography	47
Visual arts and practical skills	32
Civic education	21
Music and movement	17

It can be noticed that in teaching the disciplines of primary education, the computer is considered useful especially for the fields of Science, Geography and Mathematics / Mathematics and Environmental Exploration. Through the computer it is possible to represent and reproduce natural phenomena, relief forms, geometric shapes, difficult to replicate with traditional didactic means. The computer also proves its usefulness in teaching knowledge when it comes to socio-human disciplines: History and Communication in Romanian / Romanian Language and Literature. The fewest options were for the Music and Motion discipline because it also benefits from other teaching tools that make teaching more effective.

Several types of computer materials can be used to transmit content through the computer. Most of the questioned teachers (48) use power-point presentations because it is a material that can be easily realized and used by all teachers who have the minimum digital skills, benefiting from the combination of image, sound and animation Video, audio, and written documents were another important option in the investigation (47/35/45). Educational software has been a lesser option (20), which is justified by the fact that its use requires developed technological skills, and its own resource acquisition is another impediment.

Asked about the advantages of computer use in teaching, the majority opinion is that, in class, the computer facilitates teaching activity, fulfilling multiple functions:

Table 3: Advantages of Computer Use in Teaching

Advantages of Computer Use in Teaching	Number of subjects
It allows the teacher to better organize and systematize the contents taught	48
Supports conveyed theoretical content with concrete elements	47
Facilitates integration of contents	33
It creates a framework for interaction with the class, allowing student-centered teaching	41
Allows a wide range of modern training methods (brainstorming, learning through discovery)	37
It determines the increase of students' interest in the information taught	48
The computer network allows better customization of lessons for each student individually	38
The computer network is particularly useful for adapting learning activities for pupils with special needs or learning difficulties	23

As regards the computer contribution in teaching, the investigated teachers consider that its use allows a better organization and systematization of the taught content, supporting with concrete elements the conveyed theoretical information. Also, the computer used in teaching leads to an increase in students' interest in lessons. In the teacher's interaction with the class, the computer becomes an ally, allowing student-centered teaching. In terms of teaching strategies involved in teaching, the computer facilitates the integration of content and allows the use of a variety of modern methods.

If the school has a computer science laboratory that allows primary school classes, the teacher can adapt the teaching better according to the individual peculiarities of the pupils, adapting the activity to the needs of the pupils with special requirements and learning difficulties.

As a disadvantage of using the computer in teaching, teachers have identified the following issues: high spending time in preparing computerized didactic materials (34), poor infrastructure: poor performance equipment, poor internet connection, problems with compatibility of software and programs (20) the necessity for teachers' digital competences (12).

Conclusions

The results presented by our research have revealed that the computer is a permanent presence in schools, in general, and teaching in particular, teachers putting into practice strategies that effectively are based on the virtues of this didactic means. Through it, the teacher can create moments in which he can change his role from an information transmitter to a facilitator, guiding the student in discovering and selecting knowledge. In addition, teachers have the opportunity to approach teaching in a creative and flexible manner, integrating, as the current curriculum provides for primary education, diverse disciplines, with the use of modern methods.

It has also been found that the activities in which teaching is based on the use of the computer raises the interest of students, causing them to become effectively involved in learning. Although it was not an objective of our research, indirectly, from the analysis of the data gathered, we deduced a series of needs that primary school requires:

- The need for training of technological skills so that educational software is accessed more often;
- Existence of financial support so that school and its teachers can be in possession of adequate educational software;

- Providing schools with state-of-the-art computer equipment and creating laboratories to allow access to primary school pupils as well.

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Section

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**
- **Web-based Education (WBE), Web-based Training (WBT)**
- **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**

Blockchain technology and education

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Abstract

Blockchain Technology (BCT) is the newest challenge when consider the security of distributed databases inspired from distributed ledgers introduced in order to manage Bitcoin transactions. However, BCT is more than Bitcoin. This technology can be applied in various fields including education. In this work, not only an overview on the BCT, but many details are described when apply BCT in education not only by individual institutions, but also by groups of institutions or at national level. A short list of applications includes: school records management (Student transcript/degree/test score/record validation and transfer, including those associated with college admissions); educator credentialing/certification/re-certification (including across state and national lines); management and tracking of school assets (like property, buses, furniture, textbooks, library books/journals, and technology); management of student privacy and parental opt in/opt out permissions; management of special education/school lunch/attendance records; distribution of public programmatic funds or private grants; distribution and payment of student loans; license/dissertation/PhD thesis management.

Keywords: Distributed data bases, Data structures, Cryptography, Cryptographic hashes, Digital signatures

1 Introduction

Blockchain is an innovative technology developed initialy by (Satoshi Nakamoto, 2008). The blockchain is mainly associated with "Bitcoin", the first digital currency. According to (Don & Alex Tapscott, 2016), "the blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value." Therefore, many fields of social and economical life could benefit of this new technology.

The first implementation of blockchain was based on the Bitcoin protocol using main data structures as *transactions* and *blocks* being recorded in an encrypted distributed ledger. There are two collections of transactions: one contains incomplete transactions, the second contains complete transactions but not included yet in the blocks of the main chain. A genesis block was firstly created. Each block "aggregates a timestamped" collection of transactions to be inserted in the distributed ledger. New blocks are created by “mining,” which validates, through competition with a large computational effort, new transactions and append them to the main chain (Watters, 2016). Three categories of blocks there exists during Bitcoin transactions: blocks in the main chain containing encripted confirmed transactions, blocks linked to the main chain but not included due to , and orphan blocks (not connected with blocks from the main chain). With exception of the orphan blocks, the first two categories are included in a directed rooted tree with links towards the root (with a previous pointer). The rooted tree converges to the blockchain which, from technical point of view, is a back linked list of transactions built using hash pointers. A cryptographic signature identifies each block. A private/public key infrastructure is maintained by the network participating to BCT.

The Blockchain for cryptocurrencies like Bitcoin, Ethereum, and many others is designed in such a way there are guaranteed: (1) the transaction irreversibility (it is impossible to undo a transaction); (2) no Counterfeiting (it is impossible to increase the money supply at will); (3) no double spending (it is impossible to spend the same value more than once).

Following (Iansiti & Lakhani, 2017) by using BCT, "the ledger is replicated in a large number of identical databases, each hosted and maintained by an interested party". Moreover, the ledger is continuously updated and verified for consistency. As (ENISA, 2016) summarised, the following aspects give an improved view of BCT or the Distributed Ledger Technology (DLT):

(1) there is no central server/authority;

(2) network connections are peer-to-peer and Internet based;

3) all participants comply with the ledger rules (is possible to consider permissionless ledgers);

(4) is used a type of consensus among participants to validate a transaction;

(5) there are rules for transactions coded in smart contracts;

(6) digital signature is used to sign/encrypt the transactions on ledger (based on private/public key; key sizes depend on the implementation of the ledger);

(7) the ledger represents the evolution, in time, of all transactions.

The participants during the validation of transactions are called "miners" or "validators". Their interest is motivated by gaining digital money (the case of BCT used for cryptocurrencies) or by doing some business (the case of market-specific blockchains).

Four types of consensus protocols are mainly used (ENISA, 2016):

(1) PoW - Proof of Work (participants, as miners, are required to include transactions within one block and then compute a hash function depending on some additional parameters);

(2) PoS - Proof of Stake (participants, as validators, must own some stake in the network, and "the creator of a new block is chosen in a deterministic way", depending on its wealth/stake;

(3) XRP - Ripple protocol ("Transactions that meet the 80% threshold of YES votes are included within the following last closed ledger state");

(4) PoET - Proof of Elapsed Time (uses timestamps cryptographically signed by hardware).

According to (Devecchi et al, 2017) and (Swan, 2015), the developments of Blockchain followed three phases: (1) **Blockchain 1.0** - oriented to cryptocurrency; (2) **Blockchain 2.0** - oriented to smart contracts; (3) **Blockchain 3.0** - Applications in many fields: government, health, science, literacy, culture, education, and art. Based on a small trust-based coffee shop, (Czepluch et. al, 2015) have developed a proof of concept system as a base point for an evaluation of the strengths and weaknesses of BCT. They also, described how BCT can be used "in different domains, from finance to more general societal applications".

Next section will describe the potential and future innovations in education based on Blockchain and Distributed Ledger Technologies.

2 The potential of Blockchain in education

There are many actors working with educational assets: students, teachers, employers, acreditors, validators and testers. According to (Don & Alex Tapscott, 2017), higher education may benefit of innovations based on BCT at least in the following areas: (1) *Identity and Student Records* - Secure Management of all data related to a registered student for a study programm; (2) *New Pedagogy* - the ledger could store information on selected courses, and the graph of learning interactions in order to identify patterns of leaning, improve teaching, and develop new learning models; (3) *Fees and rewards* - to plan the funding strategy and to reward students for their achievements; (4) *The Meta-University model* - to learn how to restructure the university according to new requirements from students and employers.

As mentioned authors say, the advantage of a distributed ledger implemented using BCT , consists of the possibility "to record virtually everything of value and importance to humankind, starting with birth certificates and moving on to educational transcripts, social security cards, student loans, and anything else that can be expressed in code". In order to see official college transcripts, the employers, or the qualification validators can access the blockchain (Parker, 2015). Also (Sharples et al., 2016) emphasized that by using BCT, "organisations and individuals could gain further reputation by providing recognised services to education, such as providing open courses, or funding research". Moreover, the ledger is public and anyone can see how someone "gained educational reputation, and the rules for adding new value are agreed by consensus".

(Swan, 2015), when consider the MOOC approach, identifies three benefits of using BCT: The blockchain provides three elements toward this goal: (1) a *trustable proof-of-truth mechanism* to check if students signing up for Coursera classes actually completed them, they pass the tests, and proceed with entire educational material; (2) a *payment mechanism*; and (3) *smart contracts* on their learning plans.

It is easy to imagine that the blockchain could provide a secure, transparent and rich platform useful to create a "global network for higher learningby content exchange, co-innovation for collaborative content design, and networking toward a global educational community " (Don & Alex Tapscott, 2017).

In the following, let us review some BCT based projects for learning: Open badges, Blockchain Certificates (Blockcerts), SGE, Hyperledger, OriginStamp, and POEX.

Mozilla created Open Badges in 2011 with support from the MacArthur Foundation and a network of partners that adhere to develop a new way of learning recognition "wherever it happened". According to OpenBadges, IMS Global Learning Consortium, in partnership with Mozilla Foundation and Collective Shift/LRNG, has becoming the only one organization to manage the effort on the "development, transferability and market adoption" of the Open Badges specification, under a licence granted by Mozilla.

MIT has released a new open standard, “Blockcerts”. A short description of usecases connecting MIT, students, employers, and others, can be summarised as follows: 1) the graduate/recipient requests a certificate from its school via the *certificate wallet*; 2) The issuer prepares and issues a certificate to the graduate; 3) The recipient shares the certificate with the employer; 4) The employer may use a 3rd party to verify the certificate. Blockcerts is composed by "open-source libraries, tools, and mobile apps enabling a decentralized, standards-based, recipient-centric ecosystem, enabling trustless verification through blockchain technologies". As (Jagers, 2016) says, the Blockcerts code can be used by any school for free to implement a BCT-based certificates management. Also, software vendors can to use Blockcerts patterns to build commercial products.

According to (SonyInfo, 2016), Sony Global Education (SGE) has already developed a technology that applies BC to the educational field, "leveraging blockchain's secure properties to realize encrypted transmission of data - *such as an individual's academic proficiency records and measures of progress* - between two specified parties". Moreover, (Georgopoulos, 2017) claims that the SGE technology is built on IBM’s HyperLedger cloud service and acts as a "centralized ledger for storing educational information, such as degrees, diplomas, tests and more, while preventing fraud".

Hyperledger is a blockchain framework implementation by The Linux Foundation intended for developing applications or solutions with a modular architecture. The best of Hyperledger Fabric is allowing components, such as consensus and membership services, to be plug-and-play.

OriginStamp is a trusted timestamping service for digital files. OriginStamp calculates the unique fingerprint (hash) of a user data and store the fingerprint permanently in the Bitcoin blockchain. POEX is a "service to anonymously and securely store an online distributed proof of existence for any document".

In their paper, (Sharples & Domingue, 2016), mentioning that "the University of Nicosia is the first higher education institution to issue academic certificates whose authenticity can be verified through the Bitcoin blockchain", they refere to Learning Passports as recorded by blockchain.

(Clark, 2016) and (Brereton, 2017) present more BCT projects in education. For instance, "higher education institutions could access blockchains to obtain K–12 standardized test scores or acquire homeschooled students' progress". (Brereton, 2017) say that BCT "could change the future of K–12 education and be the backbone for creating a true learning system". The learning can be re-imagined, as (Blair, 2016) wrote.

The applications of BCT/DLT in education is better described by the project "Learning is Earning 2026" which claims that learning, earning and living will not be separated but a new world where learning will become "a kind of currency that ties together every aspect of our lives". (Hall, 2016) when discussing on the blockchain revolution, considers blockchain as the backbone of web 3.0, the new digital systems supporting secure and irreversible transactions available whenever a catastrophic event apear. The discussions on "Open University", the "Knowledge Media Institute", and "MIT" progresses on developing BCT for education was developed to make view the new tracks to follow by educational institutions, single institutions or institutions organized in consortia of heterogeneous entities.

From the above, we reveal that the easiest way to experiment with BCT for education is to work with the mentioned projects. In this context, Spiru Haret University, already participated in a group of institutions and individuals to identify and implement blockchain solutions (see http://www.ushprobusiness.ro/).

Conclusion

This paper has presented an overview on the BCT, and details on applying BCT in education.

BCT projects for education were described and the most important ideas were outlined for future practical applications.

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Integration of Ludic Educational Activities into Classroom Teaching. Gamification

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Abstract

Sometimes, involving students in educational activities can be a challenge, especially when they lack motivation for learning, when they have gaps in preparation, when the results of the proposed exercise do not seem to be immediately applicable or when the topic addressed does not correspond to any need already acknowledged by the student. Although the ideal is a participation sustained by intrinsic motivation, by awareness of the usefulness of learning acquisitions, by the undertaking of a long-term effort towards knowledge and exploration, there are situations in which the integration of ludic elements is necessary and contributes to raising interest, revitalizing openess and motivation for learning. In addition, well designed games contribute to achieving learning goals and building skills for life. The article is looking upon the influence of gamification in formal education, trying to depict the effective ways and the conditions for integration of ludic activities into classroom teaching.

Keywords: instructional design, gamification, education situations, classroom teaching

1 Introduction

Digital games and social networks are familiar to students, being a significant part of their day-to-day activities. However, although they are the "digital generation", studies show that they do not have the exercise of learning by using the new technologies and the ability to use digital resources as tools of intellectual work (Šorgo et al., 2017; Bennett, 2008). These are formed over time, and it is the role of the teacher to reveal to students the usefulness of the discipline-specific tools that will be part of their professional, social, cultural activity – online dictionaries, digital maps, virtual thematic communities, news feeds, online courses, e-books, multimedia editing software, virtual labs, simulators, etc. Furthermore, the expectations of digital natives in school are different; the learning space should be more open to the real world and provide them with resources and opportunities similar to those in their horizons of action, nowadays and in the near future.

2 Why using (digital) games in the education process

At least occasionally, stimulation through game activities is beneficial from the perspective of psychological processes that support learning – sensorial, cognitive and affective – and to create a favourable atmosphere in the classroom. Most commonly, however, the explicit purpose for which games are used in the teaching process is **to achieve learning goals** – information acquisition, attitudes development, value transfer, skills training – subsumed to the specific competences of the school curriculum for that discipline. We are talking about those learning acquisitions that are measured and whose progress is recorded in the catalogue by grades. If the game is enjoyable, it is more likely that students will learn more easily – adding a game gives them a "break" in the school program (Petsche, 2011).

Equally important, the **development of transversal skills** is favoured by playful activities, especially by the most interactive ones (Bermingham et al., 2013). The games contribute significantly to the development of the skills and abilities necessary for personal and professional development, such as teamwork and collaboration, communication, negotiation and argumentation, initiative, creativity, decision making, critical thinking, problem solving.

Introducing playful activities in the teaching process has the great advantage of **encouraging student participation**, mostly targeting those who feel uncomfortable in "conventional" educational situations. Involvement of all students in activities is an important goal of the teacher and an indicator of his/ her pedagogical competence, therefore designing activities by including educational games is an asset of which the teacher should make use at least from time to time.

The **style preferred** by some students in learning is another reason why teaching methods should be varied, and if the teacher constantly resorts to various games that allow interactivity, movement, or have visual support compensating the information content delivered orally by means of schemes, images and films, then classroom performance would most probably increase significantly. Teachers are required to provide students who prefer a style other than auditory or passive (better represented in frontal approaches) chances to participation and performance.

Last but not least, educational games have a positive impact on pupils' **emotional and intellectual development** (Korpershoek et al., 2016), contributing to self-confidence and helping them learn how to better manage their emotions.

3 Transposing an education situation into a game

There are (or there should exist) many similarities between educational situations and games, both activities being built as phases or successive activities with a given purpose, preferably interactive, which stimulate interest, which capitalize and lead to a new level the knowledge and skills already developed, which lie within the approximate horizon of experience and expectations of the person to whom it is addressed.

Generally speaking, we can say that a learning activity is a particular type of game, determined and conditioned by the psycho-physical development needs of the human being. The game can be also viewed as an elaborate form of learning activity, attractive and engaging.

The value of the game, as a "natural" learning activity, has led to the emergence of a new concept, "gamification", that has begun to be used since 2008. The most invoked definition is describing gamification as „*using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning and solve problems in a non-game context*" (Kapp, 2013), and similar attempts to circumscribe the term are built in the same manner, seeing it as a type of process to be used in designing and developing (learning) scenarios to improve participant's involvement towards a desired outcome. Therefore, we can trace the educational use of gamification back to Antiquity (Haghoj, 2013; Angour, 2013) – game play has always been an important mean to reach educational goals – as long as those education situations have been benefiting from a process of (more or less rigorous) planning.

Educational games are seen as having the following main benefits: are exciting, challenging and generate competition, can form cooperation, collaboration and negotiation skills, can offer immediate feedback and rewards, allow skills training and acquisition of knowledge in a pleasant way.

The design principles of educational (digital) games are fundamental principles, already present in the curriculum design process, but some require adaptations and they apply a little differently in order to respect the paradigm of a playful activity. Feedback in the game, for example, should be immediate or after a relatively short period, as compared to current educational practices (Dicheva at al., 2015).

In the well-designed games, students are more likely to assume the purpose and to participate voluntarily, having predominantly intrinsic motivation to take part, than they do in conventional learning activities. Therefore, **translating an educational situation into a playful form is preferable**

whenever circumstances allow. More accurately, in designing an educational situation it is about highlighting the attractive part of the learning activity, which offers reward, interesting and useful.

The circumstances refer to:

(1) time available to the teacher for designing the activity;

(2) time available for developing a learning activity through play;

(3) type of learning content;

(4) students' availability (both individual and as a group) and their level of readiness/ preparedness;

(5) external factors such as school culture, parents' expectations, physical space characteristics, or existing resources.

(1) Designing a learning activity requires more time as it is more creative and unconventional. In other words, it is unlikely that a teacher will have the time to tackle each specific competence and content unit through high value added learning activities (beneficial to development of higher order thinking skills, collaboration, innovation, critical thinking, problem solving, communication, for attitudes and values), especially when school curriculum is loaded.

Learning activities in the form of digital games can be a handy solution, as these usually provide the framework and conditions under which activities can be designed, deployed and evaluated:

- templates and examples,
- predefined modes for interactions between student-content, pupil-student, student-teacher,
- tools for assessing performance, for time measurement and for immediate feedback.

(2) On the other hand, carrying out a complex activity in the class takes a longer time – for organization, activity itself, evaluation and capitalization.

(3) There are learning contents that are less suitable for a direct ludic approach, regardless of the cognitive capacities involved in the activity - the multiplication table (memorising, understanding the algorithm/ logic of progression), the analysis of literary text (memorising the algorithm/ stages, application in new situations, identifying particular situations, practice etc.) - but any content can be "packed" into a game, even as a pretext or as a peripheral activity of the game.

(4) When we include a ludic learning activity, especially in digital form, we must consider the availability of the class for such an approach and the ability of the students to look at it as a sequence of the education process. Although very rarely, it may happen that the play-way method does not "work" – the game can sometimes remain at the distractor level, consuming more time than expected, taking unexpected turns that limit or make it impossible to be used for educational purposes.

(5) The role of games is not always obvious to everyone – there may be situations where fellow teachers, school principal, parents, or students themselves challenge the use of games within lessons. These external factors of influence are not to be neglected, favouring or hindering the educational functions of unconventional methods. Furthermore, particular conditions such as access to computers and Internet in school, technical support and space available for games, the degree of familiarization of (all) students with ICT tools are to be considered.

In the literature dealing with the theme of "serious games", the most monetized design principles of games for educational contexts are visual status, social engagement, freedom of choice, freedom to fail and rapid feedback (Dicheva at al., 2015). To these, there are some principles to be added that are rarely mentioned, because of their generally applicable character and their large use in the curriculum design process: educational purpose and personalisation of learning. Game-specific "mechanics" are an additional factor for motivation, being mainly a tool for recognition and celebration: points (for reaching goals, participation, contributions etc.), badges (for participation, for contributions, for purchases, for performance etc.), levels (successive degrees of difficulty) and rankings.

How can we actually translate a learning path into a playful experience? The step suite below is just a suggestion. Ideally, the design starts with setting the goals and thinking about the most appropriate instructional strategy, but you can start from designing the evaluation or from a particular piece of content, which can be an event or an example previously given by a student (the trigger).

1. For a specific lesson you choose, review the curriculum standards and choose your theme.

2. Set the instructional objectives – what do you want pupils to have as learning acquisitions and at what level.

3. Explore the possible applications of the themes. For example, for electric current: electromagnetic crane, hydroelectric generator alternator. You can choose examples of applications from the students' immediate horizon. You may find a lot of resources on the Internet: short films, pictures, conceptual maps, news, recent breakthroughs in the field. Of these, choose the most relevant, given the objectives you have proposed and the time available.

4. Depending on the learning objectives and the chosen applications, transform the learning content into a chain of "challenges" for students. What concrete questions should the student be able to answer or what tasks should be able to meet so that we consider each instructional objective achieved? You will actually get a training map, or an ”operationalized curriculum”.

5. Depending on the learning time available, transpose one or more tasks into a game-type format, using some of the gamification principles and game-specific mechanics.

6. To the resulted activity suite (partially conventional activities, partially game-like), add moments such as gaining attention, presenting objectives, recall of prior learning, general presentation or introduction of content elements, providing learning guidance and feedback, assessing performance, enhance retention by summarising the key elements of the lesson/ game. These can also be approached in a playful form and within the chosen theme – e.g., the teacher can play the role of one of the characters, providing feedback as the game develops.

4 When can games be used?

The games can be successfully used **at the beginning of the school year or semester** to make an initial assessment or an introduction to the suite of activities and themes to be addressed.

The onset of a teaching activity can also be engrafted on a game. It gains attention in a pleasant way, it raises interest better than in a "conventional" approach and, most importantly, can launch challenges in the *zone of proximal development*, to which each student has the opportunity to respond and is motivated to respond, thus increasing the chances that the elements of the new lesson will already be explored and (partially) understood through personal effort, with greater significance for learning.

A special success can have a playful activity developed **in pair, at the beginning and at end of the lesson**. It can be the same game with two parts – one to start teaching, the other to end it – or we can create two slightly different games. The same game can also be done twice, once when the lesson starts, followed by the “teaching”, and once again at the end, when the student will be able to respond "competently" to the proposed game tasks, following the acquisition of the new learning content. Intuition and opinions (*episteme*), used first to solve (or not) the challenges of the game, receive help from scientific knowledge (*gnosis*), confirming or refuting the initial response, and learning acquisitions are more likely to be meaningful to the student and be more persistent over time.

Short games can be **inserted within a teaching activity**, especially when this has a longer duration, to strengthen learning by pointing out key elements or by providing openings for what follows. There are *intermezzo* moments, constructive breaks, accompanying natural interruptions of attention, and which bring students back to work.

Recaps **at the end of a chapter or at the end of the semester** can fully benefit from the game-based approach. Trivia games, for example, or Flashcards, Hotspot and so on, will give a festive, funny note, will stimulate and will capitalize on the spirit of competition, making it a pleasant activity.

5 Making use of the game activities

An important suggestion regarding the integration of the game into the teaching process is to highlight and capitalize on those elements specifically addressing learning inserted in the game. Often, at least at primary and lower secondary levels, learners are not able to detach from the play activity the "lessons" that justified their use during the classroom lessons or as homework. It is compulsory that the moment of capitalisation be present as a natural extension of the game, ending it by pointing learning acquisitions from the perspective of their usefulness and the way they integrate into the general set of learning acquisitions within the discipline (specific competences) and beyond discipline (transversal skills).

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Using the NI USB-6008 DAQ Device, to Make a Traffic Light

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Abstract

A street traffic light for cars has been developed using data acquisition board (DAQ) and National Instruments LabVIEW software package.Data acquisition will be made through the NI USB-6008 development platform. Programming will be done using the LabVIEW graphical programming software. The data acquisition driver developed by National Instruments, NI DAQmx, is the software for easy hardware communication. For implement this project we will need the following materials: an NI USB-6008 data acquisition board, breadboard, 3 LEDs (Red, Yellow and Green), 3x220 ohm resistors and jumpers wires to connect.

Keywords: Traffic lights, NI USB-6008, LabVIEW, Case structure, Shift register

1 Introduction

Traffic problems now-a-days are increasing because of the growing number of vehicles and the limited resources provided by current infrastructures (Dinesh, 2013).

The data acquisition hardware used in this paper is NI USB-6008 multifunction I/O device, which interfaces to the PC through a USB connector (Bogdan, 2013). It has 8 differential analog voltage inputs, 2 outputs, 12 channels which can be used as either DI or DO (configured individually), and 12-bit resolution. A USB device was chose for simplicity, but it is one of the many different types of data acquisition devices that can be used.

Figure 1.The NI USB-6008 multifunction I/O device

This paper aims to create a virtual instrument for controlling a street traffic light.

For implement this project we will need the following materials: an NI USB-6008 data acquisition board, 3 LEDs (Red, Yellow and Green), 3x220 ohm resistors and jumpers wires to connect.

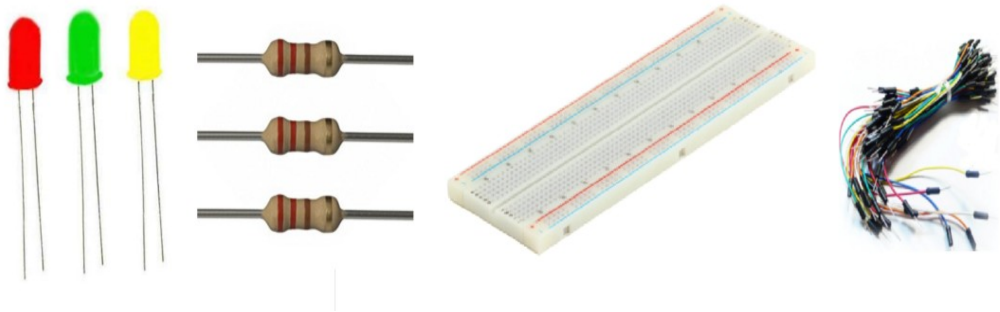

Figure 2.The components necessary for the elaboration of the technical project

Represented in Figure 3 is the hardware of the traffic light.

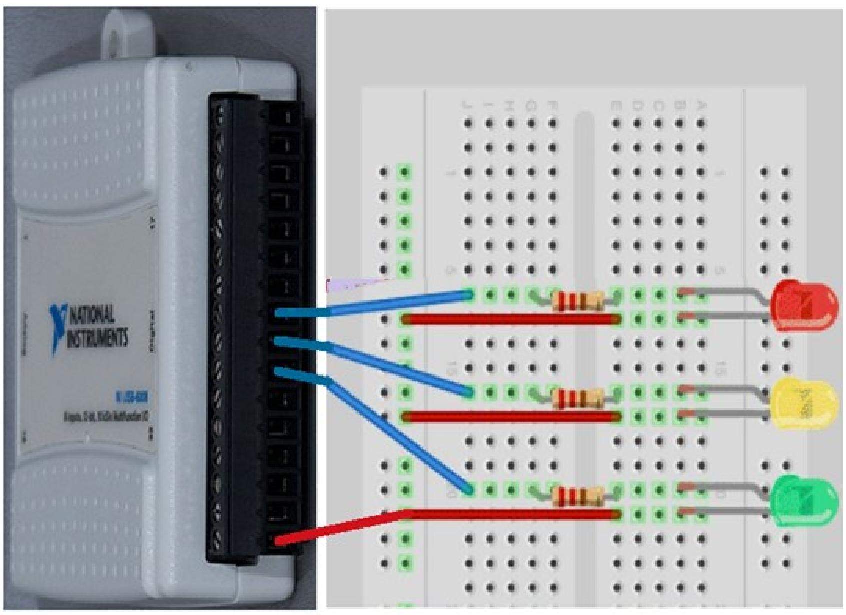

Figure 3. The hardware of the traffic light

2 The Virtual Instrument of the traffic light

Represented in Figure 4 is the Front Panel of the measuring system. It contains the following indicators and controls:

- 3xLEDs indicators, belonging to the traffic lights;
- aboolean Stop control to turn off the virtual instrument.

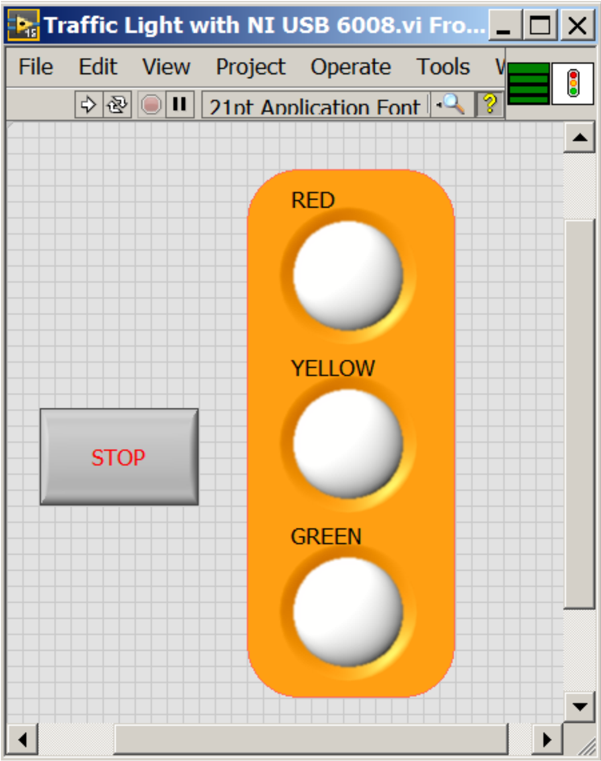

Figure 4. The Front Panel of the VI

After making the front panel of the VI, must implement the functionality of the program; the block diagram, which represents the source code of the instrument, is built.

The Block Diagram (Figure 5) consists of a While loop and a Case structure. At the borders of the While loop I created a shift register, which is initialized with an Enum constant with three Items (RED, YELLOW, and GREEN). Use shift registers when you want to pass values from previous iterations through the loop to the next iteration. A shift register appears as a pair of terminals, shown as follows, directly opposite each other on the vertical sides of the loop border (http://www.ni.com/getting-started/labview-basics /shift-registers).

The Case structure has three sub-diagrams (RED, YELLOW, and GREEN). In each sub-diagram, we created three Local Variables for each of the three LED terminals in the Front Panel. At the three variables I wired the three Boolean constants. Using the Build Array function, the signals from the output of Boolean constants will also be transmitted to the digital output (DO) of the NI USB-6008, via the DAQ Assistant.

The data acquisition driver developed by National Instruments, NI DAQmx, is the software for easy hardware communication.NI DAQmx forms an intermediate level between the actual application and the hardware, allowing for avoiding low-level programming at the registers level.An example of using the driver is the DAQ Assistant application that uses NI Express technology. DAQ Assistant is an Express VI that provides an easy interface for configuring, testing and programming data acquisition.

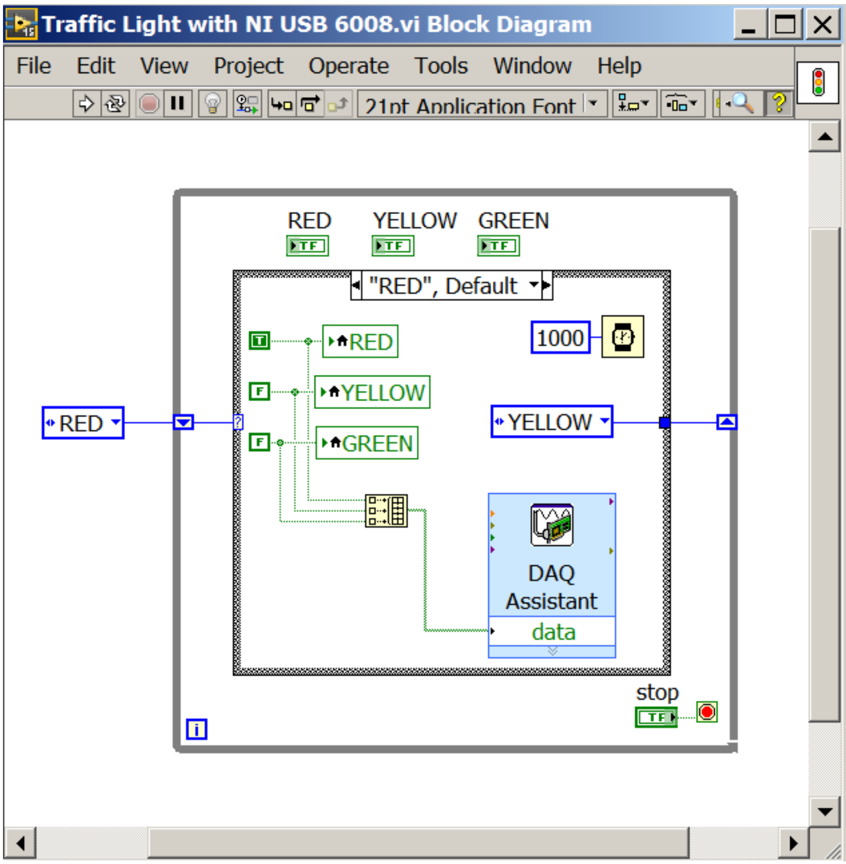

Figure 5. . The Block Diagram of the VI

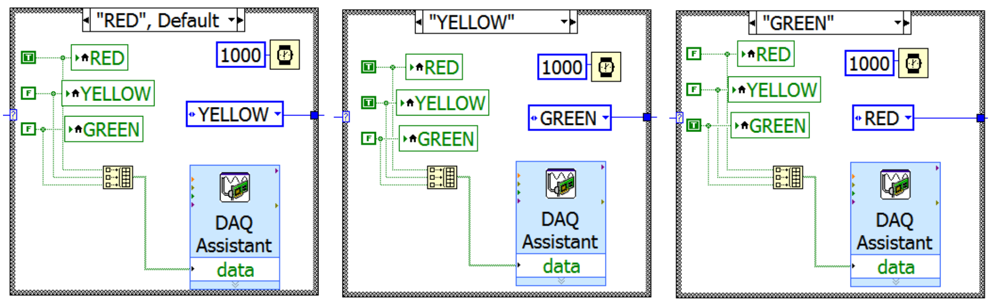

Figure 6. The three sub-diagrams of the Case structure

Conclusion

The designing and implementing a LabVIEW traffic light was very useful and successful.DAQ card along with LabVIEW are used to create the virtual instrument for designing a real time traffic light.

Compared with classical way of experimental investigation, main advantage of using DAQ with virtual instrumentation interface by LabVIEW software is in flexibility concerning requirements that could be also modify during experiments realization.Applying virtual tools makes data analysis more accurate and significantly reduces design and analysis time.

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Traffic Light Using Arduino Uno and LabVIEW

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Abstract

The purpose of this paper is to design and implement a low cost systemintended in terms of hardware and software,to make a street traffic light for cars.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, a red, yellow and green LED, a breadboard, 3 x suitable resistors for the LEDs you have (probably 220 Ohms is fine) and connecting wires. The results will be displayed through the serial interface on the computer in the LabVIEW program, and also on the three LEDs on the breadboard.

Keywords: Traffic lights,Arduino, LabVIEW, Case structure, Enum Constant

1 Introduction

Traffic light is an optical signaling device that indicates different signals related to traffic, rail, naval and pedestrian.The traffic light aims,a traffic safety(Dinesh, 2013).

This paper aims to create a virtual instrument for controlling a street traffic light.

For implement this project we will need the following materials: an Arduino UNO,breadboard, 3 LEDs(Red, Yellow and Green), 3x220 ohm resistors and jumpers wires to connect.

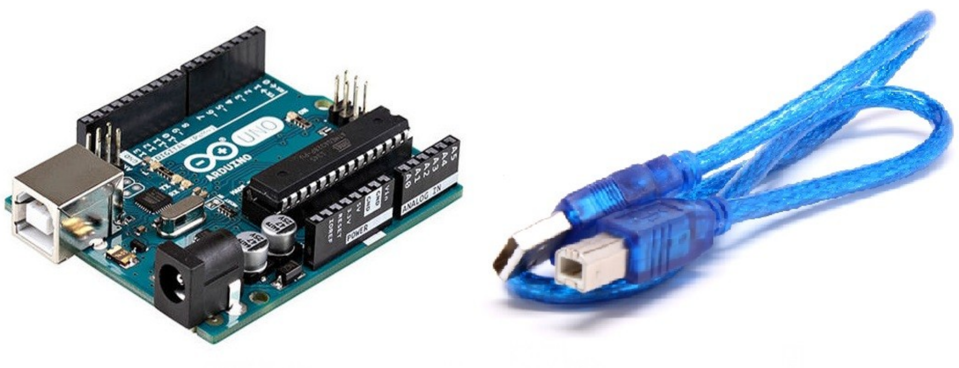

Figure 1.The Arduino Uno board

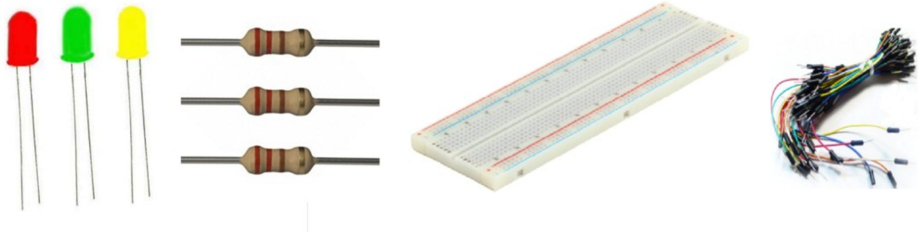

Figure 2.The components necessary for the elaboration of the technical project

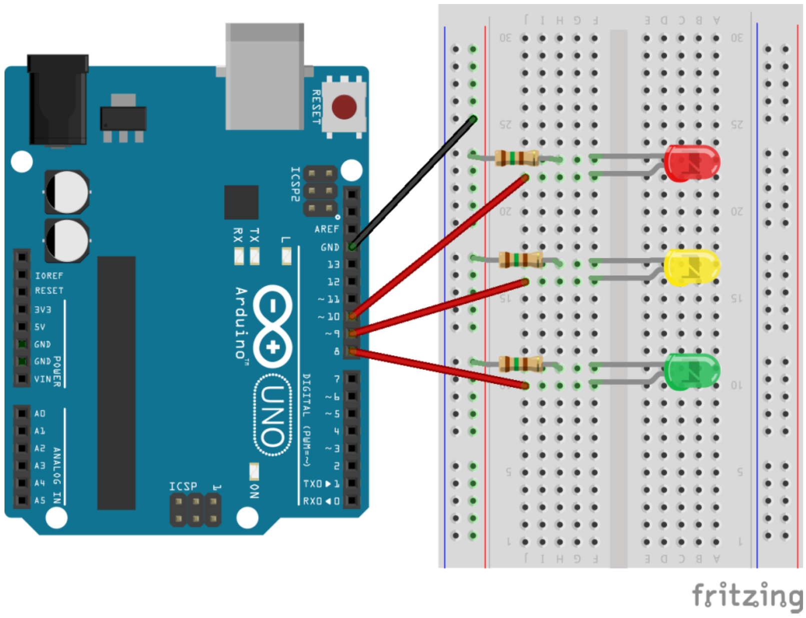

Figure 3. The hardware of the traffic light

2 The Virtual Instrument of the traffic light

Programs developed in LabVIEW are called virtual instruments or Vis, and have the extension .vi. These programs have the role of receiving data from the user or from the computer interfaces with the process, processing them and then displaying, storing or transmitting them remotely.

A VI contains the following three components:

- Front Panel—Serves as the user interface.
- Block Diagram—Contains the graphical source code that defines the functionality of the VI.
- Icon and Connector Pane—Identifies the interface to the VI so that you can use the VI in another VI. A VI within another VI is called a subVI. A subVI corresponds to a subroutine in text-based programming languages (http://zone.ni.com/reference/en-XX/help/371361H-01/lvconcepts/intro_to_vis/).

Represented in Figure 4 is theFront Panel of the traffic light. It contains the following controlsandindicators:

-A control for setting the serial port to which Arduino is connected;
- A boolean Stop control to turn off the virtual instrument;
- 3xLEDs indicators, belonging to the traffic lights.

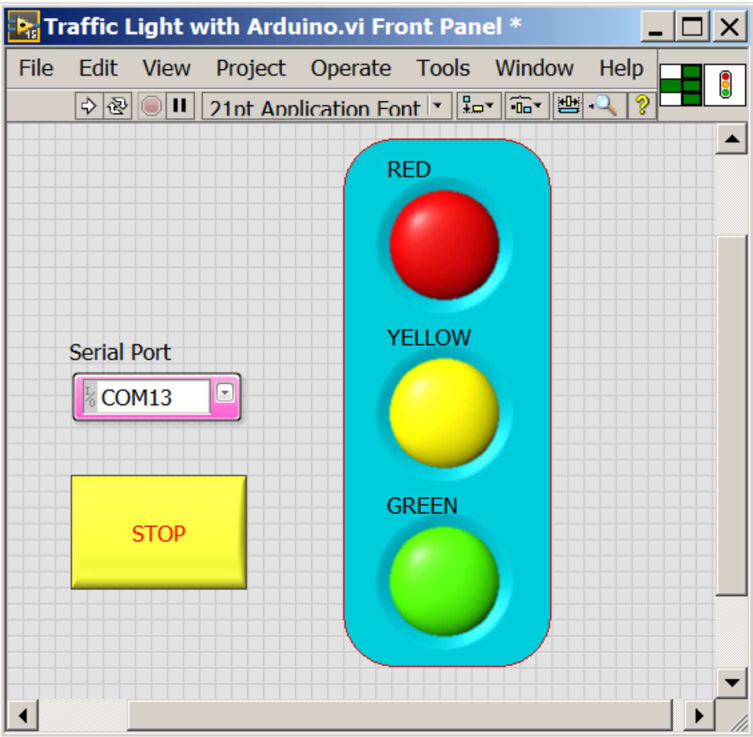

Figure 4. The Front Panel of the VI

To make the Block Diagram of the VI (Figure 5), we will use the LINX software. LINX provides easy to use LabVIEW VIs for interacting with common embedded platforms, like Arduino.

LINX is an open source project by VI Package Manager and is designed to make it easy to develop embedded applications using LabVIEW. LINX includes VIs for over 30 of the most common embedded sensors as well as hardware agnostic APIs for accessing peripherals like digital I/O, analog I/O, PWM, I2C, SPI, and UART (http://sine.ni.com/nips/cds/view/p/lang/ro/nid/212478).

The BockDiagram of the VI, also contains a While loop and a threesub-diagramsCase structure. A While Loop, executes the code it contains until a condition occurs. A Case structure has two or more sub-diagrams, or cases (http://www.ni.com/getting-started/labview-basics/execution-structures).The Case selector is Enumtype, with three items: RED, YELLOW and GREEN.At the border of the While loop I created a shift register. Use shift registers when you want to pass values from previous iterations through the loop to the next iteration. A shift register appears as a pair of terminals, shown as follows, directly opposite each other on the vertical sides of the loop border (http://www.ni.com/getting-started/labview-basics/shift-registers).

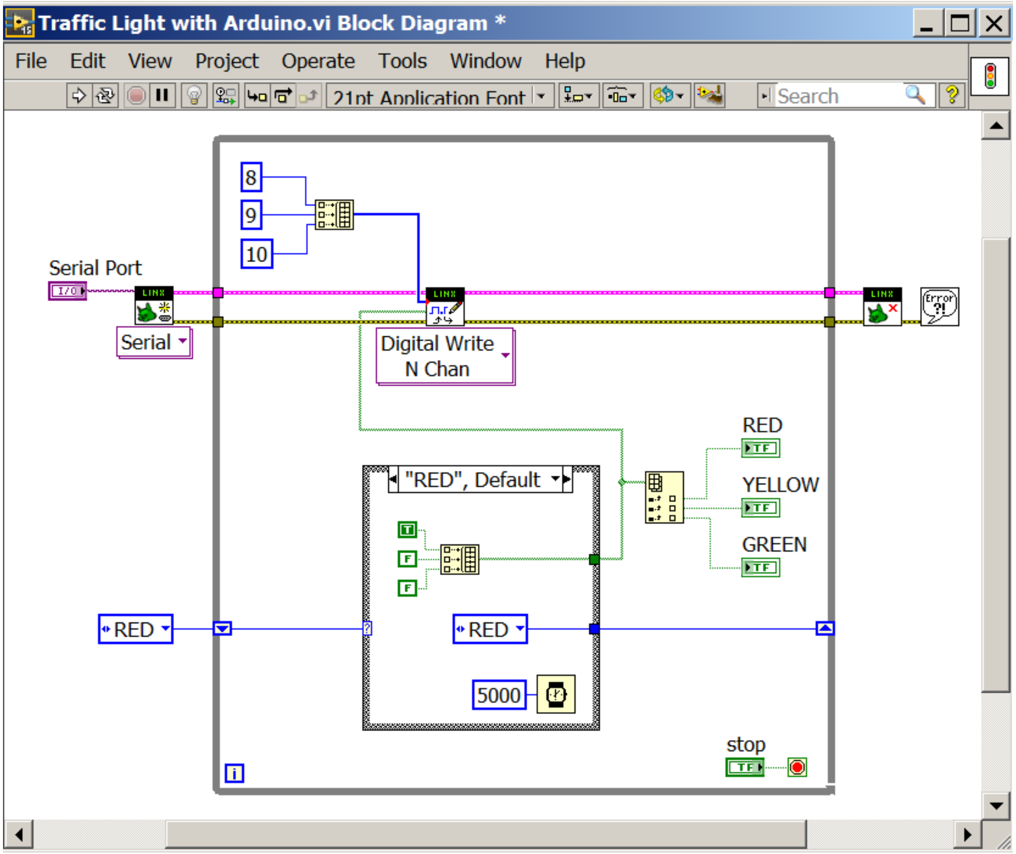

Figure 5. The BlockDiagram of the VI

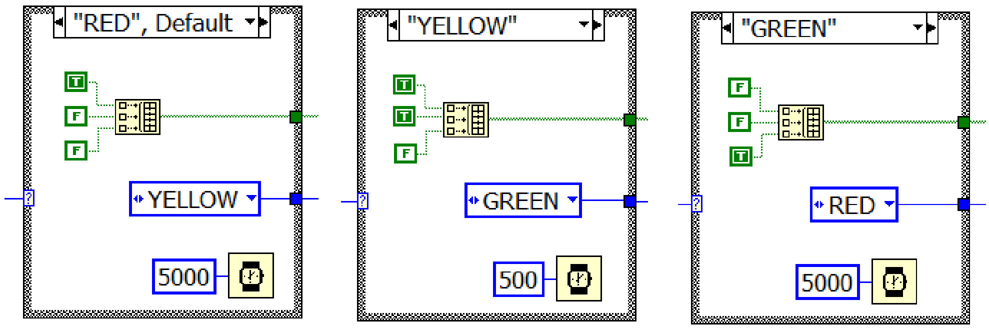

Figure 6. The three under the charts of the House structure

Conclusion

Virtual instrumentation is a concept introduced over 30 years ago, being born of the desire to use the computer to build a measuring instrument.

The main advantages of virtual instrumentation:

- does not require physical storage space;

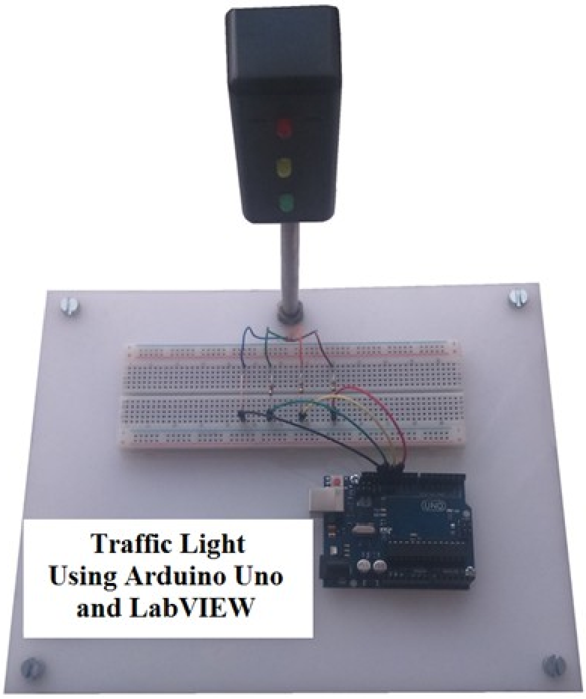

Figure 7. The Experimental Stand

- can be with distributed items (can measure in multiple places at one time);
- the data can be transmitted over the internet (the measurement lab can be located in a certain place and the analysis of the results can be done in a completely different way);
- measurements can be made in dangerous places for humans, and it is not necessary to have it in the immediate vicinity of the measuring system
- flexibility (virtual instruments can be easily transformed by programming);
- Costs are significantly reduced (a single, multifunctional DAQ device with the associated software can replace a lot of other dedicated physical instrument).

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http://www.ni.com/getting-started/labview-basics/shift-registers
http://www.ni.com/getting-started/labview-basics/execution-structures

System for Controlling a Driver's Seat

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Abstract

In the present paper I will describe the stages of realizing a system that allows the control of DC motors by PWM and the change of rotation direction using H-bridge with relays, in order to achieve the movement of the seat, the headrest and the backrest, for the driver's seat. This system also monitors current consumption of motors using ACS714 current sensor. Upon reaching an obstacle, the current will rise above the nominal value, and when the sensor response through a processing circuit reaches the set threshold, the adjustment will stop. This system will be built using the Arduino Uno development platform.

Keywords: Arduino, Motor Drive, Hall effect, Headrest, Backrest

1 Introduction

Body systems typically consist of a host of safety, comfort and convenience products which enhance the driving experience. One popular range of features that augment passenger comfort is electronic seat control, which includes features such as heated seats and driver and passenger seat and backrest position control. (http://www.st.com/en/ap plications/automotive-and-transportation/seat-control.html).

In the last decades, the car industry has evolved a lot. New technologies for car seats have led to significant changes in driving experience. The control functions of a seat are in continuous improvement, some modern systems already permitting the adjustment of up to 10 different seat regions. This can be done by using the attached buttons or using the tablet.

Integration of tablet technology has added comfort and accessibility, as it benefits both the driver and other passengers. This method allows the driver to adjust the seat before entering the vehicle or allows the rear passenger to adjust the front passenger seat through the back pad.

The block diagram shown in Figure 1 contains the following functional blocks: 12V input voltage, 5V voltage stabilizer, Arduino, signal processing, headrest sensor, back sensor, seat sensor, speed control circuit, motor drive circuits, Bluetooth module and tablet.

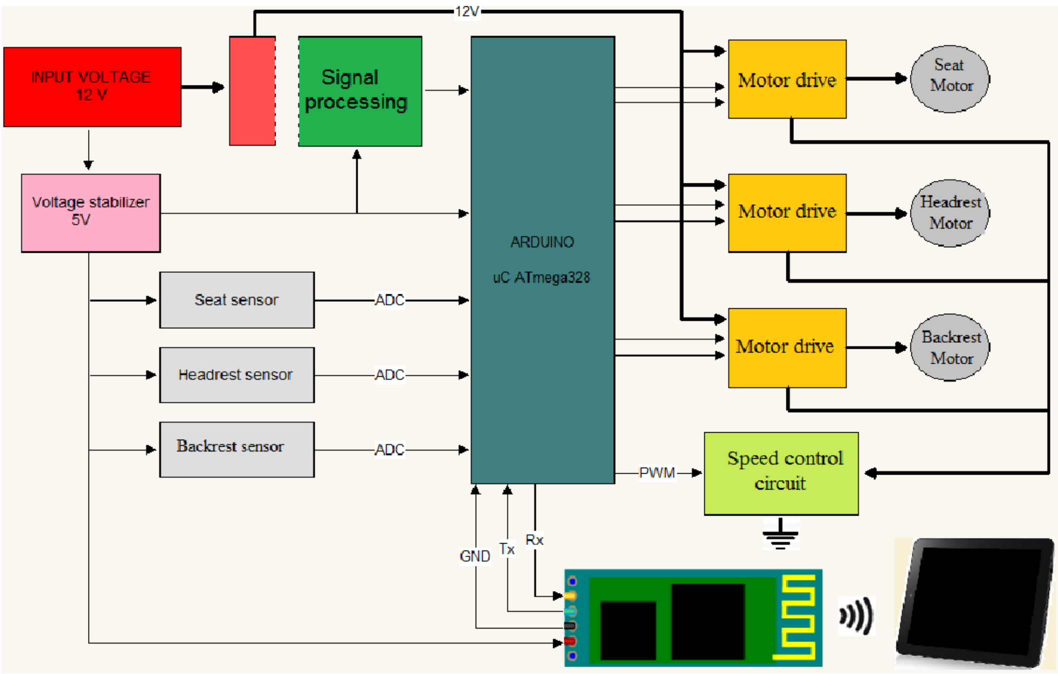

Figure 1.The block diagram of the system

2 The Components of the control system

The "Arduino" block is the main block of the system that is powered at 5V. It contains the Arduino Uno development board, based on the Atmega328 microcontroller.

The "Input voltage" block is the 12V voltage that supply the entire system. For blocks with a working voltage of 5V, the "5V Voltage Stabilizer" block, which reduces the 12V supply voltage to 5V, has been achieved.

The "Signal Processing" block is based on the Hall effect current sensorACS714. It consists of two separate galvanic blocks. The first block consists of a copper path with the purpose of generating a magnetic field proportional to the measured current.The resulting value is then read by the next block whose role is to process and form the output signal to produce a voltage proportional to the generated magnetic field. The output signal is processed and amplified to bring it into the reading range of the digital analog converter.

The "Speed Control Circuit" block is powered at 12V and is composed of a MOSFET driver and a MOSFET transistor, which is the PWM controlling power element. The driver has the role of repeating the PWM signal received from Arduino and sending it with the 12V voltage. This is necessary because it takes 10V to command the transistor, the 5V Arduino being not enough (http://www.electronics-tutorials.ws/blog/pulse-width-modulation.html).

The "Motor Drive" blocks operate according to the same principle. One block is based on two digital transistors and two H-relay relays. Each relay represents an arm of the H-bridge. In this mode, when the motor relays are actuated simultaneously, they will behave the same behavior as when no relay is actuated, that is, the motor will be blocked.

The "Seat Motor", "Headrest Motor" and "Backrest Motor" blocks represent the DC motors that move each mobile seat: seat, headrest and backrest. They are supply at 12V.

The "SeatSensor", "HeadrestSensor" and "BackrestSensor" blocks are based on a potentiometer. These are used to read the position of the seat, the headrest and backrest for the purpose of determining the end of race and stopping the movement when they are touched.

The "Bluetooth module" block communicates serially with the Arduino board using the Rx and Tx pins. It is supply at 5V, the integrated 3.3V controller ensures the required working voltage. For data transmission from Arduino to the bluetooth module, a voltage divider was required to provide the 3.3V.

3 Arduino Uno command and control module

This system will be built using the Arduino Uno development platform, which contains:

- 14 digital inputs / output pins, of which 6 pins can be used as PWM outputs;
- 6 analog inputs;
- oscillator;
- Power plug;
- Serial programming and communication on USB;
- ICSP socket (In Circuit Serial Programming);
- reset button;
- Atmega328 microcontroller.

Figure 2 shows the connections to the Arduino Uno development board, and a short description of the pins used was made in Table 1.

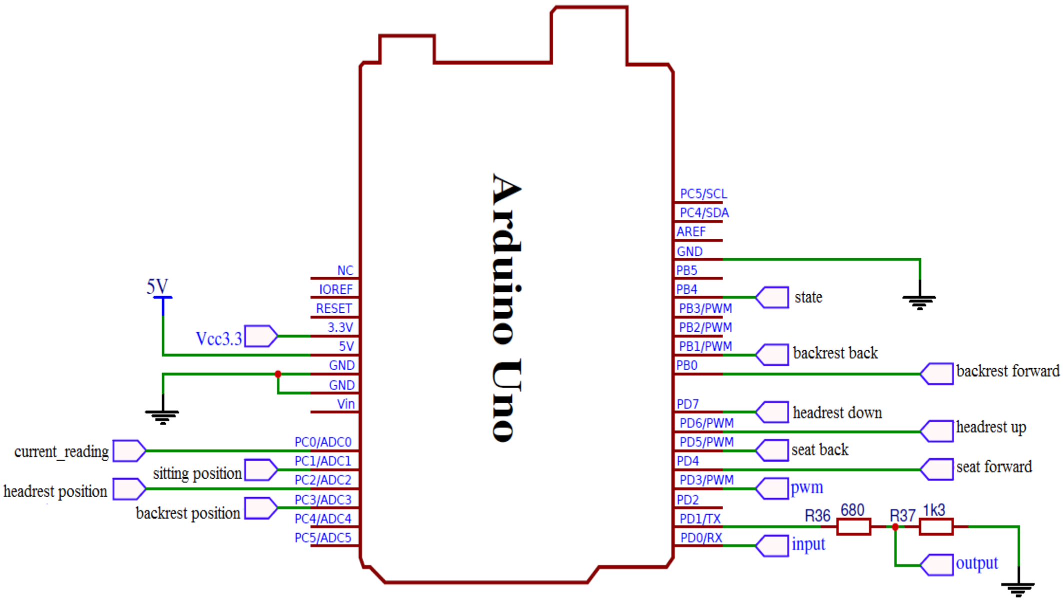

Figure 2. Arduino Uno command and control module

Table 1

Port	Pin	Label	I/O	Function
PORTD	0	Rx	Input	Receives serial data
	1	Tx	Output	Sends serial data
	3	pwm		PWM generator
	4	seat forward		Command the transistor T1
	5	seatback		Command the transistor T2
	6	headrest up		Command the transistor T3
	7	headrest down		Command the transistor T4
PORTB	8	backrest forward		Command the transistor T5
	9	backrestback		Command the transistor T6
-	-	state	-	-
PORTC	A0	current reading	Input	Read ADC
	A1	seat position		Read ADC
	A2	headrest position		Read ADC
	A3	backrest position		Read ADC
-	5V	5V	-	Supply voltage
	-	3.3V	-	-
	GND	GND	-	Ground

Conclusion

In the design of the printed wiring, we considered the positioning of the transducers and the current sensor as close as possible to the analogue-to-digital converters, becausethe signals from the output of the reading and processing circuits are easily disturbed, requiring shorter paths. Also, I did not take into account the effect of the relay on the current sensor. Due to the fact that the current sensor is based on the Hall effect, its signal is disturbed by the action of the nearby relay coil.

Another problem discovered during the measurement of the output voltage of the amplifier in the circuit for reading and processing the current signal, was sensing a voltage of about 600mV when the sensor read current was 0 because the amplifier amplified its own offset voltage.

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PLC - modern programming environment

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Abstract
The PLCs are vital control elements for automation of industrial and residential installations. They were introduced in practice with the purpose of changing from cabled logic schematics to programmable logic schematics. These devices allow different ways to be programmed. At their initial use, they were intended to be used by electricians. The programming software was adapted to what these specialists were used. Nowadays, when high level programming languages are included in the educational curriculum in all technical universities, there was developed different programming environment for these devices. The article presents few programming environments that are used now in the industrial automated installations. There are mentioned some advantages and disadvantages for each of them.

Keywords: PLC, LAD, GRAPH, SCL, programing methods

1 Introduction

The PLC were developed as means of automation of industrial processes. Their history starts in 1968 when it was the first time that one company required an electronic replacement of the electric relay electric schematics (Gawande, 2014).

The PLCs are widely used now in automation of a large variety of installations in many engineering fields of activity: automotive, agriculture, home installations, energy production, etc.Guttierrez(Gutiérrez et al., 2007) describes a system that supervises the nutrient solution composition produced by afertigation system. The system presented is composed of potentiometric sensors based on PVC membranes. The control algorithm is based on a multilayer artificial neural network that is implemented in MCU “Ferti” PLC. The result of the control is to predict the concentration values of various chemical components for an in-line assessment of nutrients and undesired components in fertigation solutions.Figueiredo(Figueiredo and Sá da Costa, 2012) describes an energy management platform for intelligent buildings using a SCADA system (Supervisory Control and Data Acquisition) that integrates different types of information coming from the several technologies present in modern buildings (control of ventilation, temperature, illumination, etc.). Steinegger(Steinegger et al., 2016) describes a method that could handle diagnostic information of decentralized control devices. The system implements a “PLC-based control architecture of a hot rolling mill."Prati(Prati et al., 2015)proposes a method for the “automatic test of cause and effect matrix specifications on PLC systems." Priyanka (Priyanka et al., 2016) presents a PID controller implemented in a Micrologix 1400 PLC. In order to obtain good behavior of the controller, they did a MATLAB/SIMULINK simulation of the system. Furthermore, they studied different design methods and compared the results.

There are various publications related to the use of PLC in educational applications (Chen and Gao, 2012)(Borgolte and Lepentsiotis, 2006)(Chen and Gao, 2012), and many others. This proves that the universities are interested to be as updated as possible with the industrial development available.

Bo (Bo et al., 2016), Saad(Saad and Arrofiq, 2012), Gizi(J.H. Al Gizi et al., 2015), and many others presented the implementation of Artificial Intelligence algorithms using different PLCs. These complex algorithms can be implemented in PLCs due to their performance both hardware (memory, inputs, outputs, etc.) and software (high level programing techniques).

2 Industrial automation

Automation industrial installations are designed with the purpose to ensure "programmable logic" control. This type of control has some advantages compared with the "cabled logic" schematics:

- Updating the schematic to process changes is much easier.
- It offers a larger possibility of control and monitor of different parameters of the process.
- It offers the possibility of visual monitoring of some parameters of the process.
- It offers the possibility to be connected to other connected processes or to a master control system.
- The price for hardware implementation is comparable in both cases if the electric installation contains several time relays.

Considering the above advantages and others, there is no surprise that PLCs have a wide spread in the industrial installations. In fact, as mentioned above, if an industrial installation has a certaincomplexity degree, the use of a PLC for control is an obvious choice for the designer. If the industrial installation has a low level of complexity, but the process requires several repetitive operations, even though the implementation price might suggest a "cabled logic" solution, PLC control is a natural choice.

For exemplification purposes, in this article it is covered the wye-delta starting of an induction motor (Table 1). The schematic allows the motor to rotate in both directions. This configuration is very wide spread in many industrial applications of many types and kinds.

2.1 Cabled logic schematic

In Figure 5 is indicated the power schematic of the installation, that contains the induction motor and the force contacts of the contactors. In Figure 6 is indicated the command schematic of the installation that contains the contactors, relays and contacts that provide the functional steps for the installation.

Table 1. Wye-delta starting of an induction motor – cabled logic schematic

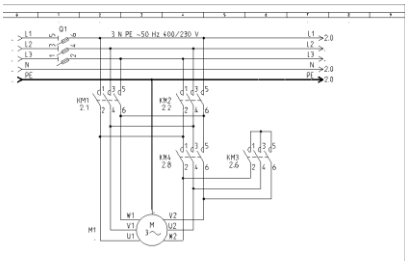

Figure 5. Power schematic

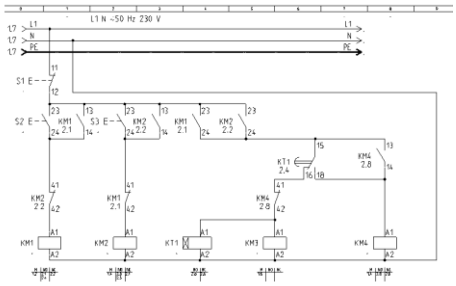

Figure 6. Command schematic

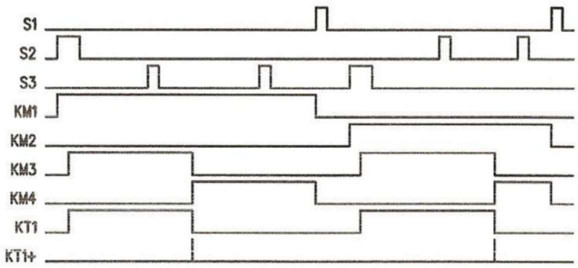

Figure 7. Functional diagram

Table 2. Wye-delta starting of an induction motor – programmable logic schematic

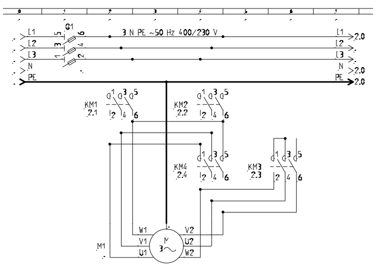

Figure 8. Power schematic

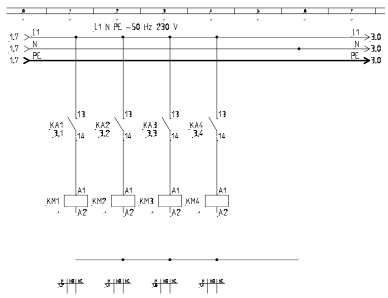

Figure 9. Intermediate command schematic

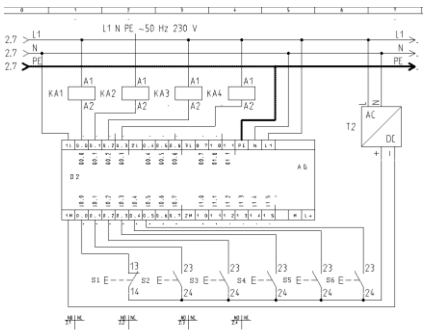

Figure 10. PLC command schematic

Figure 7 represents the functional diagram of the behavior of the schematic. This indicates the operations that can be controlled by the operator (switches S1, S2 and S3) and the response of the contactors and the time relay.

2.2 Programmable logic schematic

The implementation of the "programmable logic schematic" is indicated in Table 2. The power schematic, displayed in Figure 8 is identical as the one displayed in Figure 5. The electric motor has to behave in the same way regardless of the command installation.
In Figure 9 is displayed an intermediate schematic. It's purpose is to separate the sensible PLC output circuits from the force contactors that command the motor. The reason of such a connection is to protect as much as possible the PLC of any unexpected faults of the power elements.
Figure 10 displays the actual command schematic that contains the PLC. The PLC's inputs are connected to the S1 – S6 contacts. The PLC's software can analyze the inputs regardless of the type its contacts: normal open or normal close. Nevertheless, for the STOP command, it is preferred the use of normal close contact due to safety reasons.

3 PLC programming

Most of the modern-day PLCs are programmed using similar tools. Some of them are visual environments that allow "pick and place" operations for program construction.

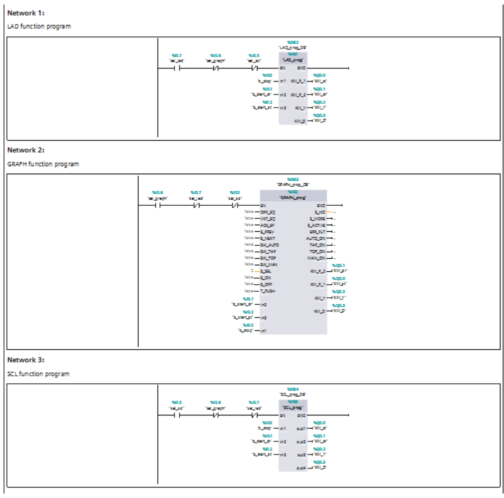

Figure 11. Main function

The programing environments or programming languages, for the most modern PLCs, comply with the IEC 61131-3 standard:

- LAD – Ladder Logic
- FBD – Function Block Diagram
- GRAPH
- SCL – Structured Control Language
- STL – Instruction List

In order to illustrate the use of some of the programming languages (LAD, GRAPH and SCL) it was written a program that appeals to three functions, as indicated in Figure 11. Each function is developed using one of the programming styles and is exclusively called only one at a certain time. The selection of the functions is done through three bits that receive an exterior signal from the user.

3.1 LAD programming

When they were introduced, the PLC purpose was to improve and replace the “cabled logic” schematic of the time. For this reason, the LAD language is very similar with electric diagrams using: relays, coils, timers, etc. This representation could be interpreted as an electric diagram whose elements should be connected to the source. If the logic conditions are true, then the instructions are executed.
This representation is familiar and easy to use, especially for programmers with electrical engineering background.

Table 3. LAD programming

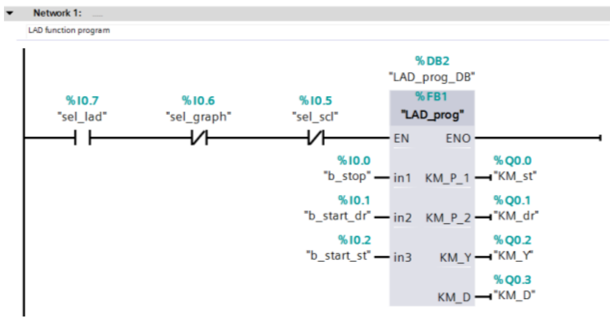

Figure 12. LAD function

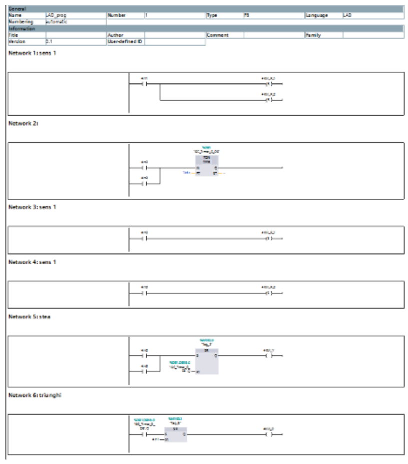

Figure 13. LAD programming

LAD is the widest spread programming language for PLCs used in industry, because of the large number of programs already in action. This is an easy to interpret and diagnose diagram.
Table 3 displays the calling of LAD function (

Figure 12) and its structure (Figure 13). The LAD function is executed only when “sel_lad” (I0.7 entrance of the PLC) is ON and “sel_graph” and “sel_scl” are OFF. If these conditions are fulfilled the variables “b_stop”, “b_strat_dr” and “b_start_st” are applied to the local variables declared in the function (Figure 13).
The LAD function contains:

- the reset command for both senses of rotation
- the set command for both senses of rotation
- the set command for wye and triangle commands for the motor
- the timer command that determines switching from the wye to triangle connection of the motor.

Table 4. GRAPH programming

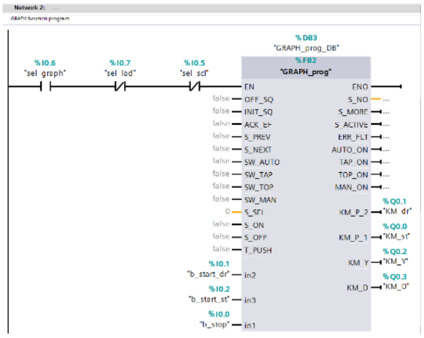

Figure 14. GRAPH function

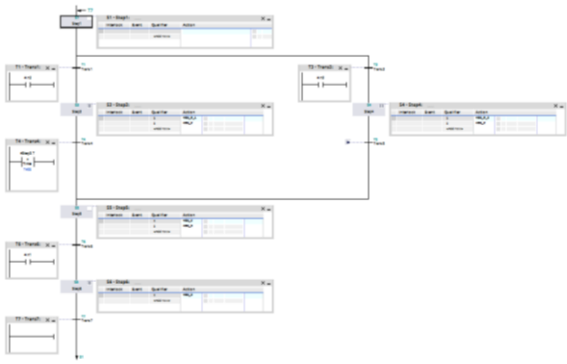

Figure 15. GRAPH programming

Table 5. SCL programming

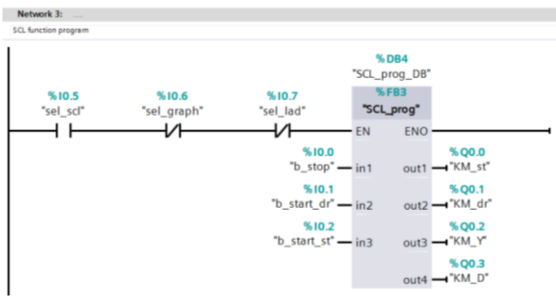

Figure 16. SCL function

```
IF #in1 = 1 THEN
    RESET(S_BIT := #out1,
          N := 1);
    RESET(S_BIT := #out2,
          N := 1);
    RESET(S_BIT := #out3,
          N := 1);
    RESET(S_BIT := #out4,
          N := 1);
END_IF;

IF #in2 = 1 THEN
    SET(S_BIT := #out1,
        N := 1);
    SET(S_BIT := #out3,
        N := 1);
END_IF;
IF #in3 = 1 THEN
    SET(S_BIT := #out2,
        N := 1);
    SET(S_BIT := #out3,
        N := 1);
  END_IF;

"IEC_Timer_0_DB_1".TON(IN:=#out3,
                       PT:=T#5s);

IF "IEC_Timer_0_DB_1".Q = 1 THEN
    RESET(S_BIT := #out3,
          N := 1);
    SET(S_BIT := #out4,
        N := 1);
END IF;
```

Figure 17. SCL programming

3.2 GRAPH programming

It is a good practice that before writing a program, it is advisable to create the logic schematic of its evolution. The GRAPH programming displayed in Table 4 consists in graphical implementation of the logic diagram of the program. It contains specific symbols that implement the designed logic (Figure 15).

The GRAPH function is called if the logic calling conditions are fulfilled (Figure 14): "sel_graph" is ON and "sel_lad" and "sel"scl" are OFF.

3.3 SCL programming

SCL programming displayed in Table 5, is the newest way of PLC programming. The SCL function is called like any other functions: if “sel_scl” is ON and “sel_graph” and “sel_lad” are OFF (Figure 16).

The SCL programming (Figure 17) is similar to high level programming languages: Pascal or C. This technique allows greater flexibility comparing to the other ones covered in this article. This programming method allows software engineers to program PLCs, regardless if they have electrical background or not.

Conclusions

There are various ways to program PLCs covered in this article: LAD, GRAPH and SCL. Each of them has its advantages and disadvantages:

- LAD is the closest to the electrical installation. It is the widest spread in industrial installations presently. This is a visual programming method that is easy to be understood especially by electrical engineers and technicians.
- GRAPH is the closest to the logic diagram. As with any program, regardless of the application field, the logic diagram is one of the first steps to be done, GRAPH is the fastest way to implement its logic.
- SCL is the latest programming method developed by the PLCs manufacturers. This method is the closest to high level programming languages. Using this method, is a way to enlarge the users' profile for these devices, in the sense that they don’t necessarily have to have the electric engineering background.

PLCs are devices largely used for industrial automation in modern-day factories of all kinds. As the technology advances, they are going to be used even more. It can be said that PLCs are the electrical engineers’ “microprocessor”. Therefore, a course dedicated to automation and particularly to PLCs should be taught in any technical engineering university. Nowadays, especially with the SCL programming method, any kind of engineer could program PLC in order to automate the processes that he/she is responsible.

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Control Systems Theory - every bachelor student should have a deep knowledge of everything?

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Abstract

Control Systems Theory is a course that is taught at most engineering faculties around the world. The objective of the course is to help the "future to be" specialists to analyze, especially the dynamic behavior of technical (but not exclusively) systems and design ways of adjusting it to fulfill the specified functional conditions. Thus, one chapter of this course is the controller design. In practice, there are few ways of doing this operation: dedicated graphical representation (root locus, frequency representation, state-space representation), specific mathematical algorithms (Ziegler-Nichols methods) and dedicated software tools. There are many complains from practitioners that many aspects they study at the university is not very well correlated with the practical aspects they encounter in most of the jobs. One of the complains is related to the Control Systems Theory course, especially because it requires more mathematical background than others.This article emphasizes the use of software packages that ease the work of the designer. Furthermore, the author would like to raise the question of the utility of a complex mathematical algorithm, versus the use of software tools that masks its complexity, for an industrial engineer.

Keywords: Control Theory, controller, transfer function, control design

1 Introduction

The control systems theory is a course that is taught in many engineering faculties around the world(Méndez and González, 2013). The importance of this course is clear as the industry is advancing to automation in every field of activity. There are few engineering fields where automation is not the headline of internal and external reports.

Engineering topics should be organized "design-orientedproject-based learning" (Zhang et al., 2016)(Kumar et al., 2013)(Patel et al., 2014) and practice oriented (Beloiu, 2013)in order to provide the biggest impact in the formation of an engineer.

Education in engineering needs to be tuned to the industry requirements and advances (Margret Bauer et al., 2014). There are times when the education falls behind the newest advances because of various reasons: financial, lack of flexibility, lack of resources, etc.

Nevertheless, there many publications that describe solutions to include automated systems similar to the industrial ones in education (Beghi et al., 2015)(Yilmaz et al., 2013), etc.

There is a dilemma in adjusting the content of educational curriculum to the day-to-day necessities of its graduates. How far and how deep should a teacher dig in the fundamental aspects of control theory knowing that most of it will not be of use to the practitioner engineer.

2 Automated systems

2.1 Automated systems representation

In order to analyze a technical system, it should be represented by mathematical equations. The Control Theory coursementions that the basis of system representation is the transfer function. For further analysis and combination with other systems, it is used the block representation. This consists in connecting blocks that represent different transfer functions that compose the system, as displayed in Figure 18. The block schematic contains the direct and feed-back transfer functions (G(s) and H(s)) and the signals that circulate in the system: input (R(s)) and output (C(s)).

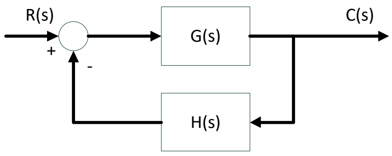

Figure 18. General uncompensated automated system

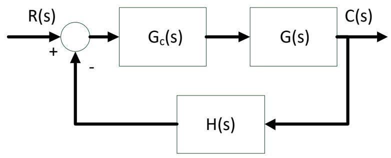

Figure 19. General compensated automated system

A compensated system consists in the addition of a compensator element in the structure of the initial system as displayed in Figure 19. Gc(s) is the transfer function of the compensator. The compensator is designed so that the whole system should have a desired behavior. One of the main topics of any control system course is the designing algorithm for the compensator and the stability of the system.

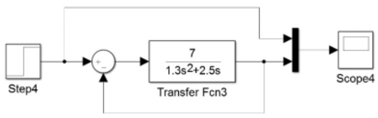

Figure 20. Automated system

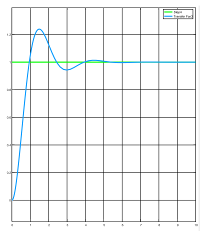

Figure 21. Time response of an automated system

There are software programs that based on the block representation simulates the dynamic of a system. One of the programs that are used worldwide in universities is MATLAB (Nystrom, 2015). Through the SIMULINK tool, MATLAB allows users to simulate the dynamic of the system. Figure 20 displays a transfer function based system implementation, and Figure 21display its behavior, both transient as steady-state regimes.

2.2 Automated systems design

The purpose of system representation is on one hand the analysis of its’ behavior and on the other had the design of a controller that will change it according to prescriptions. There are many situations when a “native” system does not react as it should, and therefore, corrective measures have to be taken designing a compensator. In the classic control theory (Ogata, 2010)(Kuo, 1997)(Dorf and Bishop, 2011)(Nise, 2011) there are few designing methods that will be discussed in the following paragraphs.

2.2.1 Root-locus method

The root-locus method is a graphical method that allows to determine the behavior of a closed loop system starting with the analysis of the open-loop parameters. The method starts by analyzing the initial behavior of the system (Figure 22). The designer establishes the new functional parameters, and therefore,it results the new system description (Figure 23). Following the established algorithm, it can be determined the parameters of the controller (Figure 24) and the response of the compensated system (Figure 25).

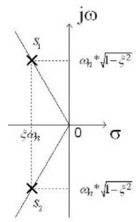

Figure 22. Initial position of the poles

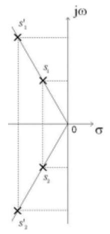

Figure 23. Desired position of the poles

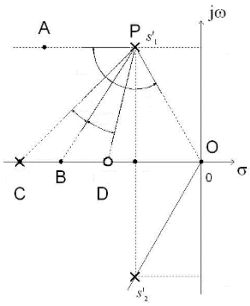

Figure 24. Design procedure

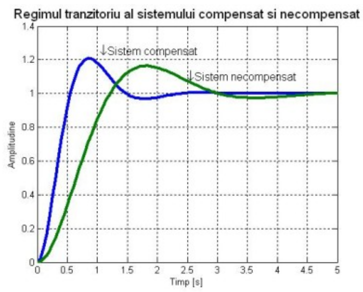

Figure 25. Time response

Following this step, the result is compared with the imposed behavioral parameters. At the end of the design process, results the transfer function of the compensator (Figure 26). The compensated system can be graphically analyzed as displayed in Figure 27.

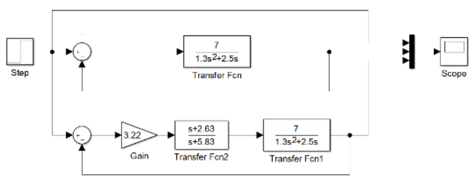

Figure 26. Example of block schematic

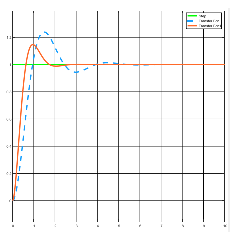

Figure 27. Example time response

2.2.2 Ziegler–Nichols method

Ziegler and Nichols determined an algorithm to estimate the parameters of the compensator based on the transient response of the system. There are two methods for this operation displayed in Figure 30Figure 31. At the end of the specific algorithm results the parameters of the compensator as indicated in Table 6 and Table 7. The compensated system is compared to the imposed functional parameters. If the difference is not acceptable, then the determined parameters are adjusted until the error is satisfactory.

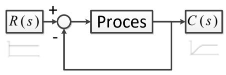

Figure 28. Block diagram

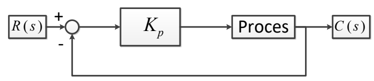

Figure 29. Block diagram

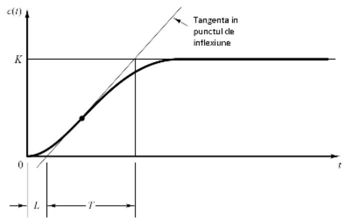

Figure 30. Generic time response

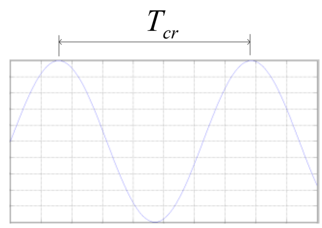

Figure 31. Design detail

Table 6. Ziegler–Nichols 1st tuning method

Compensator type	K_p	T_i	T_d
P	$\frac{T}{L}$	∞	0
PI	$0{,}9\frac{T}{L}$	$\frac{L}{0{,}3}$	0
PID	$1{,}2\frac{T}{L}$	$2L$	$0{,}5L$

Table 7. Ziegler–Nichols 2nd tuning method

Compensator type	K_p	T_i	T_d
P	$0{,}5K_{cr}$	∞	0
PI	$0{,}45K_{cr}$	$\frac{1}{1{,}2}T_{cr}$	0
PID	$0{,}6K_{cr}$	$0{,}5T_{cr}$	$0{,}125T_{cr}$

2.2.3 Dynamic parameter modification method

This method consists in a software definition of the transfer function of the system using dedicated software (Figure 32). The designing software allows the designer to change the compensators’ parameters and observe the change in the system behavior. Once the system response is acceptable (Figure 33) the compensator parameters are transferred to a simulation tool for further comparison between the original and final system configuration (Figure 34 and Figure 35).

2.2.4 Software tuning method

This method consists in defining the controlled system using SIMULINK/MATLAB as displayed in Figure 36. Once its transfer function is determined, the system can be compensated using different structures of the controller (Figure 37). The program opens a graphical window where the user can change the behavior of the system until it reaches the prescriptions. The user has to graphically indicate the time response of the system (slow and fast) and its transient behavior (aggressive and robust) as indicated in Figure 38. Once the response is acceptable, the user has the possibility to update the parameters of the controller and display the compensated system as indicated in Figure 37, Figure 39 and Figure 36.

```
close all;
clc;
G = tf(7,[1.3 2.5 0]);
T = feedback(G,1);
step(T); hold on;
%%
Kp=3.91;
Ki=0.08;
Kd=0.57;
Gc = pid(Kp,Ki,Kd);
Tc = feedback(Gc*G,1);
step(Tc);
grid on;
```

Figure 32. Software description

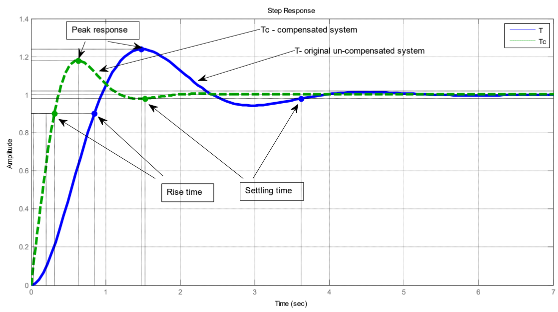

Figure 33. Time response

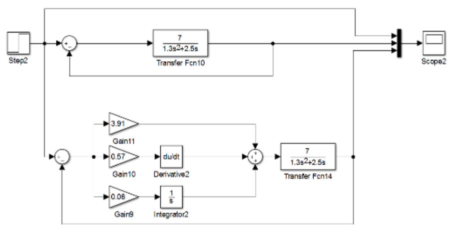

Figure 34. Block diagram

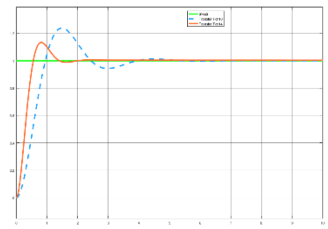

Figure 35. Time response

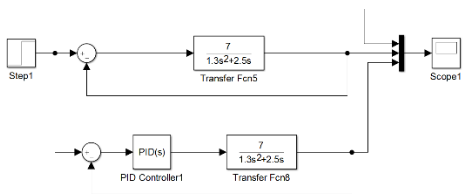

Figure 36. Block diagram

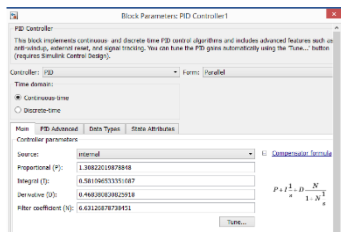

Figure 37. Controller tuning

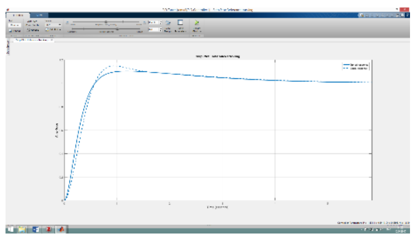

Figure 38. Parameter modifications

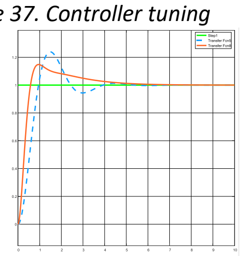

Figure 39. Time response

2.2.5 Graphical tuning method

This design method consists in software definition of the analyzed system as displayed in Figure 40. Afterwards, it is used the MATLAB SISOTOOL that opens a graphical representation environment as displayed in Figure 42 and Figure 43.

```
close all;
clc;

G = tf(7,[1.3 2.5 0]);
T = feedback(G,1);
sisotool(T);

Gc1=tf(39.188*conv([0.2
1],[0.14 1]),[0.4 1]);
Tc1=feedback(Gc1*G,1);
figure();
hold on;
step(T);
step(Tc1);
grid on;
hold off;
```

Figure 40. Software description

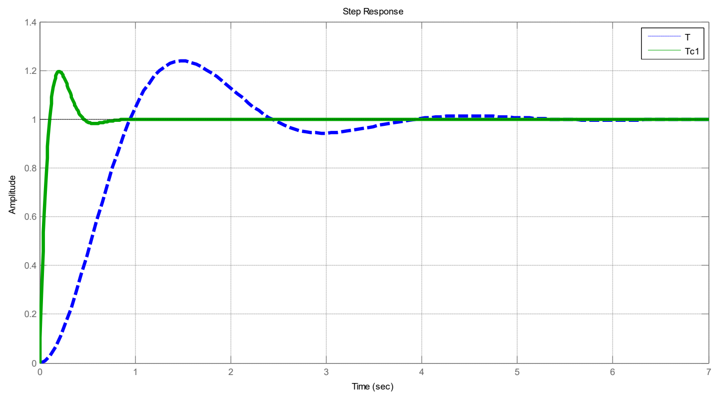

Figure 41. Time response

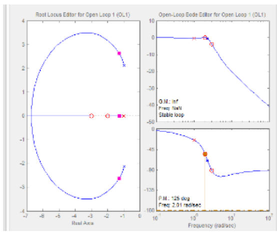

Figure 42. Initial behavior representation

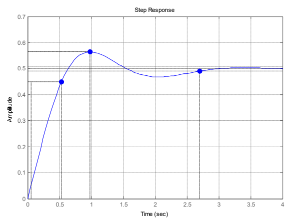

Figure 43. Initial time response

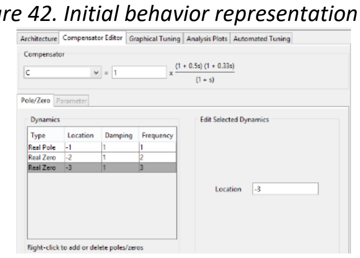

Figure 44. Initial compensator parameters

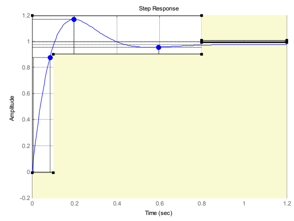

Figure 45. Imposed time response

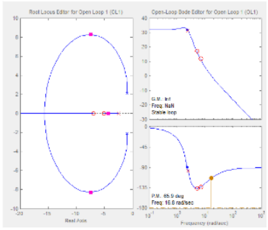

Figure 46. Final behavior representation

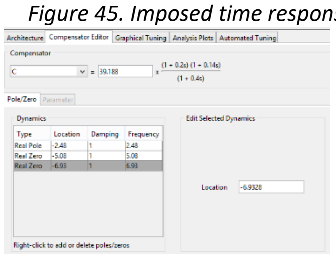

Figure 47. Final compensator parameters

The designer defines the desired domain of the transient response and the controller transfer function configuration as displayed in Figure 45. The software tool allows the designer to graphically adjust the controller parameters until the system reaches the wanted behavior (Figure 46). Once the desired error is reached, the software provides the final values of the controller parameters (Figure 47). Afterwards, the compensated behavior is compared to the initial system (Figure 41) to check the changes.

3. Discussions

Regardless the design method used, the compensator can be implemented using different means: discrete electronic elements or software implementation in programmable devices (microcontrollers, microsystems, PLCs, etc.).

The design methods exposed in this article are based on the fundamental knowledge of control systems theory. Nevertheless, there are some already widely accepted aspects:

- In the root-locus (and other similar) method, a regular control theory coursecontains the presentation of design algorithms. Nevertheless, the typical students are not presented the mathematical fundaments of such algorithms. They are presented only the steps that need to be taken to achieve the design purpose.
- The Ziegler-Nichols methods, are algorithms of determining the controller parameters without the concern of demonstration of the mathematical support for their conclusions.

The software design methods are very intuitive and easy to use. The program (in this case MATLAB) is hiding all the mathematical background from the regular user. Besides, the results obtained using these methods are more accurate than the results that could be obtained by other alternative design methods.

Keeping in mind that most of the bachelor engineers are going to be application oriented specialists, one question that arises is regarding the utility of teaching in-depth fundamental knowledge that requires a strong mathematical background. In general, the control theory course does not have many theoretical and practice hours per week, at least in electrical and electronic engineering faculties. Thus, another question arises: since the classes have to be application oriented, how deep should a teacher immerse in his/hers' lecture classes with the fundamental theoretical aspects. Should he/she focus more on the use of dedicated software than complex mathematical representations? How useful for a practitioner engineer is to know fundamental aspects of control theory compared to the knowledge of using dedicated software?

Graphical representations of systems (root-locus, frequency representation, etc.) done by following all the steps indicated by theory is a time-consuming operation. The same representations could be obtained with software programs in times of seconds or even less.

The authors' opinion is that more time should be allocated to the use of dedicated software programs. One idea is that it is more useful to read and interpret graphical representations obtained with software programs than the fundamental theoretical background that lays behind. At the same time, it is more useful in practical applications to know how to use a tool to solve a problem, then all the theory behind the mathematical apparatus required by the fundaments of that topic.

Conclusion

This paper presents several methods for controller design in automated systems. The presented methods are common in present day control theory textbooks. Furthermore, the paper emphasizes some modern design procedures using dedicated software.

The question that is raised in this paper is the level of depth that a teacher should use for the benefits of graduate bachelor engineers. As the majority of them are going to be practitioner specialists, the dilemma is the necessity of presentation of mathematical fundaments of the control system comparing to the presentation of dedicated software tools that masks it.Considering discussions with experienced practitioners, the question of the utility of a lot of theoretical considerations remains actual.

It is more useful for a bachelor engineer graduate to be able to have fast access to a graph that illustrates the behavior of his/hers' installation. Once the graph is available, it has to be interpreted and analyzed. It is useful to be able to use a software tool that can give a quick answer to certain modifications that have to be made in order to meet the functional specifications.

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Auto Resetting Multilayer Perceptron in an Adaptive Elearning Architecture

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Abstract

This paper proposes a modified internal functioning of the classical multilayer perceptron for an adaptive eLearning architecture. This research also aims to study the interaction between adaptive eLearning systems and the Knowledge Discovery in Databases process. The Knowledge Discovery in Databases process represents a sequence of steps that have as the ultimate goal the discovery of useful information in databases. This paper focuses on performing a data mining task such as classification inside the Knowledge Discovery in Databases process for an adaptive eLearning architecture. This task is achieved with a classical multilayer perceptron trained with the classical backpropagation algorithm with a small modification in terms of functioning: if the multilayer perceptron is blocked on a local minima after a number of training epochs its internal weights are reinitialized with random values. The classification problems that were analyzed were the classical data sets iris(plant classification problem), wine (wine classification problem) and conc (in this set we had two generated sets of stimuli arranged in a concentric way - one class inside the circle and the other one outside the circle). Further more we will propose an adaptive architecture that can be used in adaptive eLearning architectures. As a database management system we used MySql. In the used database we stored the neural networks as BLOBs(Binary Large Objects). This study is useful for the Knowledge Discovery in Databases process and it can be applied in many research areas such as: medical research, business, adaptive eLearning, astronomy, gaming, artificial intelligence, knowledge management.

Keywords: Knowledge Discovery in Databases; Data Mining; Multilayer Perceptron; Neural Networks; Adaptive eLearning

1 Introduction

Adaptive elearning systems are software applications that offer unique learning experiences to students, based on their individual learning capabilities. All students have unique learning styles and singular educational backgrounds. The goal of adaptive elearning applications is to use artificial intelligence algorithms in order to provide human-like tutoring capabilities for every student based on their individual backgrounds. This paper proposes a modified version of a multilayer perceptron that will be included in an adaptive elearning architecture. The training algorithm for the multilayer perceptron is the classical backpropagation algorithm with a slight modification: if the neural structure is blocked on a local minima, the weights of the multilayer perceptron would reset. The experimental application that was developed entirely in the Java programming language permitted the experimental setting of the number of epochs after which I can reset the perceptron. All this structure will be included in a future adaptive elearning module in order to provide better classification results then the classical multilayer perceptron.

1.1 Auto Resetting Multilayer Perceptron

A multilayer perceptron is a neural network model that maps input sets of data onto a set of appropriate output (Rumelhart, David E., et al, 1986). In this paper we did not modify the internal architecture of the neural structure (Figure 1). The Data Mining task(from the Knowledge Discovery in Databases Process) that was achieved was the classification one. The input data are presented simultaneously to the input layer of neurons: this is the input layer. The second layer is fed with the weighted exits from the input layer (we can multiple hidden layers). The number of hidden layers is decided experimentally. The weighted outputs of the last hidden layer are input to units making up the output layer. The output layer provides network's prediction for the given input test data (Rumelhart, David E., et al, 1986).

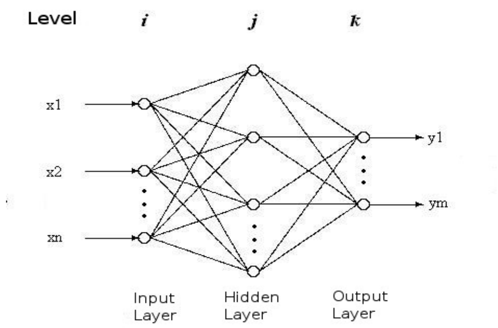

Figure 1. The Multilayer Perceptron

The auto resetting multilayer perceptron is trained with a modified backpropagation algorithm.

The algorithm is divided in two steps:

The first step is to apply the input data to the network input units; the output of this phase is obtained after processing the input data presented in the entry. In this step of the backpropagation algorithm the weights are generated in a random manner with values between [-1, 1](Rumelhart, David E., et al, 1986).

In the second stage, based on the error output calculated as the difference between the desired response and actual output, the weights of connections between processing units are modified in order to minimize error in the next training epoch(Rumelhart, David E., et al, 1986). The output error is obtained with the backpropagation algorithm. Learning takes place with decreasing output errors by modifying the weights between neurons. Once adjusted weights, the neural network has just learned from experience. In the experiments we used the classical neuron model (Figure 2)(Rumelhart, David E., et al, 1986).

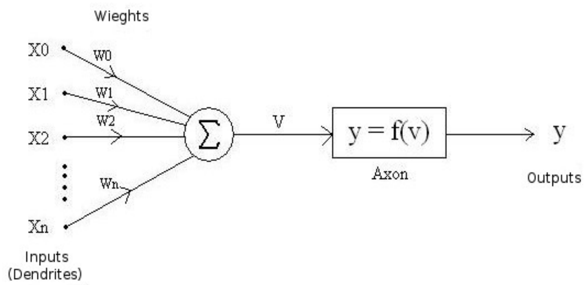

Figure 2. The classical neuron model

In all experiments we used this activation function:

[1] $$y = f(v) = \frac{\tanh(\lambda v)}{2}$$

[2] $$v = \sum_{i=0}^{n} w_i x_i$$

We also used a 50 value for λ (the grade of the activation function).

The problems that were analyzed with this algorithm were classical data sets: iris (http://mlr.cs.umass.edu/ml/datasets/Iris), wine1 (http://mlr.cs.umass.edu/ml/datasets/ Wine) and conc1 (here we have two classes of stimuli arranged in a concentric way) (Pupezescu V., 2016a). We used the division by two at the activation function because the output data of the analyzed data are scaled between [-0.5, 0.5].

For the output layer of the multilayer perceptron we have the next set of equations (η was experimentally set to a value of 0.1) for adjusting the weights (Rumelhart, David E., et al, 1986):

[3] $$e_k = d_k - y_k$$

[4] $$\delta_k = e_k \varphi'(v_k)$$

[5] $$w_{kj}(t+1) = w_{kj}(t) + \eta \delta_k y_j$$

For the hidden layers (j layer from Figure 1) the backpropagation equations are these:

[6] $$e_j = \sum_k \delta_k w_{kj}$$

[7] $$\delta_j = e_j \varphi'(v_j)$$

[8] $$w_{ji}(t+1) = w_{ji}(t) + \eta \delta_j y_i$$

The data arrangement used in experiments is shown in Figure 3:

$$TR = \{ (\underbrace{\overline{x}, \overbrace{d)_1, \ldots (\overline{x}}_{trs}, d)_{tr}}^{trr} \} ;$$

$$TS = \{ (\underbrace{\overline{x}, \overbrace{d)_1, \ldots (\overline{x}}_{tss}, d)_{ts}}^{tsr} \} ;$$

Figure 3. Data arrangement

TR stands for the training data (trs - training stimuli, trr - training response) and TS stands for the testing data (tss - testing stimuli, tsr - testing response). The analyzed data is kept in the database in the following configuration:

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

Table 1. Storage formats for the iris1, wine1 and conc1 data sets

The implementation of the application was done entirely in Java. We choose to work with the MySql database management system because of its commercial wide spread use. Another facility that we implemented in the application was the storing of the neural structures. Al the neural networks were stored entirely in the database as BLOBs(Binary Large Objects). This approach has one advantage over the classical way of creating and initialization of the weights of the multilayer perceptron(usually the weights for the optimal perceptrons are kept in text files). The neural structure is stored with all the weights in the database and we do not have to lose time with the initialization of the weights.

We had different configurations of the multilayer perceptron for the tests. In all experiments we used one hidden layer with a number of 2, 4, 6, 8, or 16 neurons. The most important parameter is PCICtest [%] (or PCICg in figures) and it represents the misclassification rate on the testing set (how many input data from the test set are incorrect classified). Other parameters that we measured were: db [ms] represents the duration of the BKP algorithm and dt [ms] represents the duration of the entire BKP algorithm (db) plus the load time of the data sets in java objects (ResultSet). Nep represents the number of epochs that took to reach the optimum result. Nep implies one training epoch followed by one testing epoch (Pupezescu V., 2016a).

The difference between the classical multilayer perceptron and the auto resetting perceptron consists in the random generation of the weight after a specified number of training and testing epochs if the neural network is blocked on a local minima. After each training epoch the neural structure is tested to see the classification performance with the TS data set. In our experiments we choose to randomly generate the weights after 50 training and testing epochs - this is done only if our multilayer perceptron is blocked on a local minima for more than 50 training and testing epochs. The advantage of this approach is that the neural network won't be blocked on a local minima. In all experiments we trained and tested the perceptrons for a maximum number of 1000 epochs. The parameter that sets the auto resetting property of the multilayer perceptron is named "reset_param" (r).

In our previous work we obtained the following experimental results(we had 12 tests and we obtained average misclassfication rates for each data set) for the classical multilayer perceptron (Pupezescu V., 2016b): iris - PCICtest_avg[%] = {20.83 (2 neurons on the hidden layer), 8.5 (4 neurons), 4.66 (6 neurons), 3.83 (8 neurons)}; wine - PCICtest_avg[%] = {33.89 (2 neurons on the hidden layer), 11 (4 neurons), 4.25 (6 neurons), 4.73 (8 neurons)}; conc - PCICtest_avg[%] = {44.58 (2 neurons on the hidden layer), 38.5 (4 neurons), 28.08 (6 neurons), 23.33 (8 neurons)}.

We repeated the same experiment for the auto resetting perceptron (the reset_param had a value of 50):

Data set	iris			
Hidden Neurons	2	4	6	8
PCICtest_avg[%]	8.33	2	2	2
Data set	wine			
Hidden Neurons	2	4	6	8
PCICtest_avg[%]	11.38	3.49	2.26	2.07
Data set	conc			
Hidden Neurons	2	4	6	8
PCICtest_avg[%]	33.41	20.83	14.58	6.91

Table 2. Experimental results for iris, wine and conc data sets

We did another test specially for the conc data set because of the increased level of difficulty in classifying this problem - we tried to resolve the problem with 16 neurons on the hidden layer and we obtained the following result (after 12 measurements): PCICtest_avg[%] = 6.91.

In the following figures we have the misclassfication function for a single run for the conc data set with 16 neurons on the hidden layer.

The first figure (Figure 4) shows the execution of the classical multilayer perceptron. In this execution we obtained PCICtest[%] = 19.99.

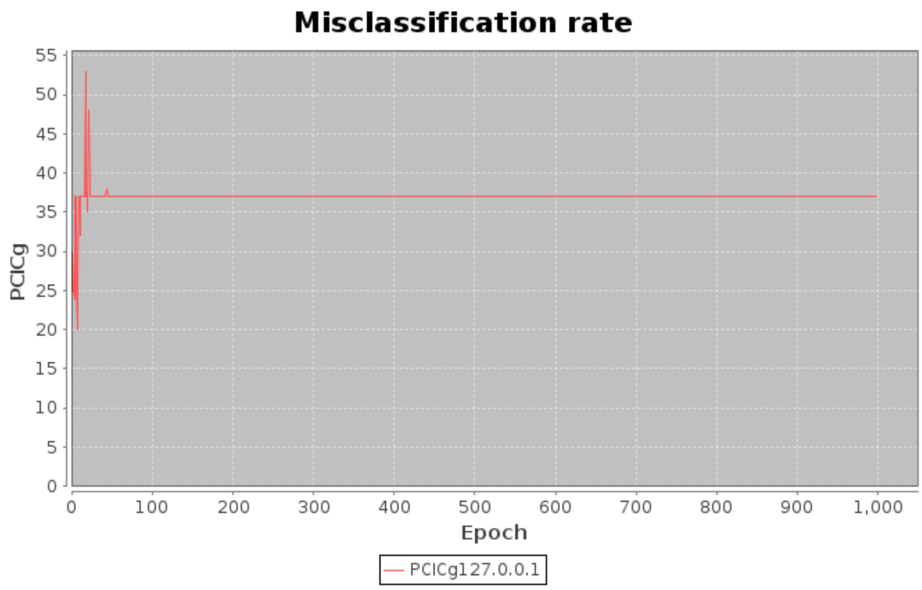

Figure 4. Execution for the classical multilayer perceptron (without the auto resetting property)

In the second figure (Figure 5) we can see the execution of the auto resetting multilayer perceptron. For this execution we obtained PCICtest[%] = 6.00. This result was obtained at Epoch = 81, dt[ms] = 110, db[ms] = 99. The duration of the entire run was D[ms] = 1066.

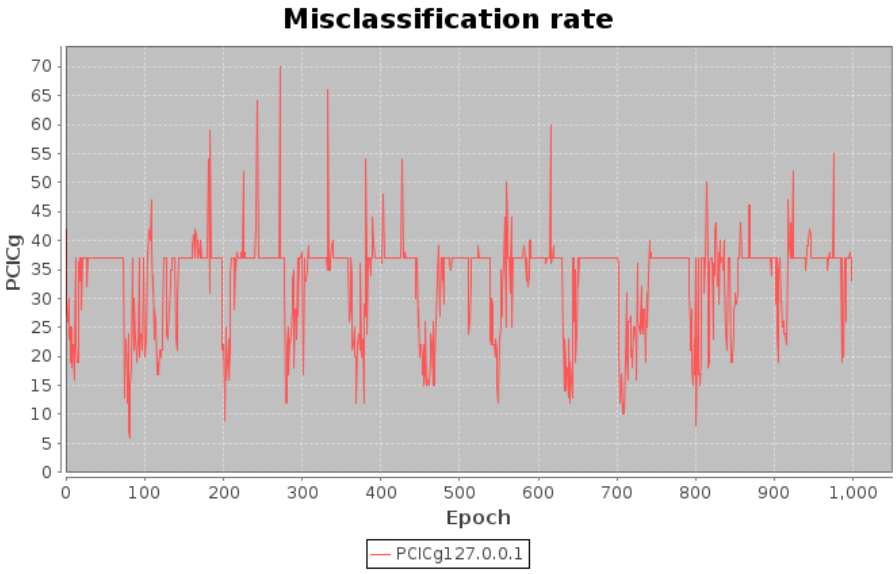

Figure 5. Execution for the auto resetting multilayer perceptron (with the auto resetting parameter set to 50)

As we can see from Figure 4 and 5, the auto resetting multilayer perceptron has much better results in terms of classification results than the classical multilayer perceptron trained with the normal backpropagation algorithm.

For all data sets (iris, wine and conc) we obtained better results when we used the new model because we prevented the blocking of the perceptron on a local minima by resetting the internal weights to new random values.

2 Adaptive elearning architecture

In Figure 6 we have modified a previous adaptive elearning architecture with the new auto resetting multilayer perceptron. First, the student will have the exam. His results will be stored in the database. This will be a part of the training data set. The auto resetting multilayer perceptron will make a decision based on the students previous results: It will raise or lower the level of the next test. The entire process will be supervised by the teacher. He will decide if the student must learn more for the test. The final application will have a performance tracking module for monitoring the educational process. One of the most important feature in this new application will be the ability for the teacher to monitor the neural network performance in real time.

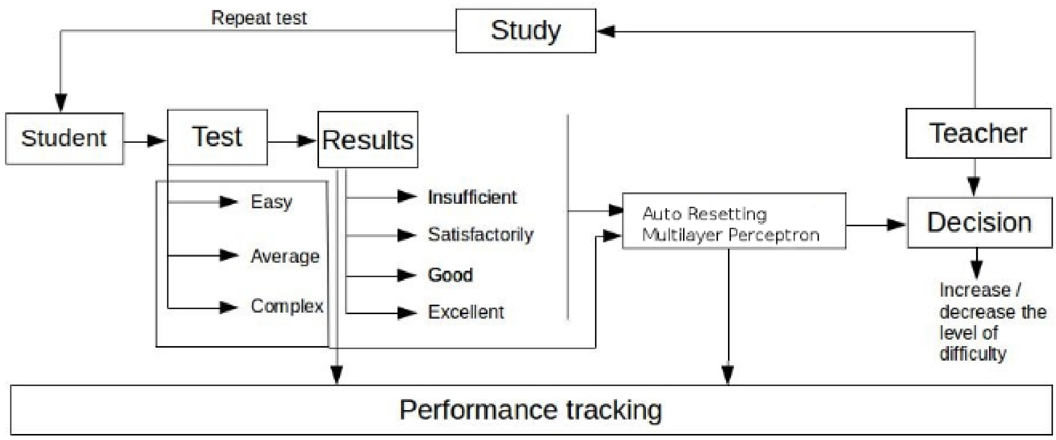

Figure 6. Adaptive elearning application

Conclusion

In this paper we proposed a new way of functioning for the multilayer perceptron and a new version of our adaptive elearning architecture. With the auto resetting perceptron we overcame the blocking effect on a local minima in a simple manner by resetting the internal weights of the neural network (this happens only if the structure is blocked for a certain number of training and testing epochs in the same point). In all the experiments our model was better than the classical multilayer perceptron.

The new elearning module permits real time monitoring of the neural structure performances (both in terms of classification and execution time).

The various research areas that can benefit from using auto resetting perceptrons are: adaptive elearning, medical diagnosing, medical research, strategies, astronomy, the knowledge discovery in databases process etc.

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Harnessing Edutainment in Higher Education: an Example of an IoT Based Game

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Abstract

In this paper the authors study the problem of designing new tools and approaches for a higher implementation of edutainment into formal e-learning. The main goal is to design an educational game in order to effectively support the teaching process in higher education. The developed game is based on Internet of things technologies and implemented as a part of a smart classroom. It includes IoT infrastructure for solving assignments within a course, a mobile application that students use to interact with the game and a component for integration with Moodle LMS. The game has been implemented within the educational process at Faculty of Organizational Sciences, University of Belgrade.

Keywords: Internet of things, game based learning, smart learning environments.

1 Introduction

Modern life is strongly influenced and rapidly changed by the development of technology and transition to the digital world. While older population finds this change hard and challenging, the younger one is growing with the technology and considers technology as an integral part of life. The young are living in a world of computers, smart phones, cameras, video games, and other devices which give them possibilities to communicate, entertain themselves and multitask.

Due to the rapid development of information technologies and Internet, education is also getting a new modern form, which significantly increases the efficiency of the educational process. Numerous innovations in modern e-education lay in the fields of smart educational environments and internet of things applications. There is an obvious ubiquity of using mobile and smart technologies in education, both formal and informal, as well as increasing interest of the academic 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 et al, 2016).

A smart environment is the one made of objects that can communicate, interact, compute, and make decisions, with the goal to automate different repetitive actions (Cook and Das, 2005). Smart learning environments are adapted to the needs of educational processes, while at the same time they present a comfortable environment for teaching and learning. These environments can be adapted dynamically with respect to the needs of the participants, the process itself, or any other criteria.

Smart environments are developed using the technologies of the internet of things (Knežević et al, 2016). Internet of things is a global network infrastructure that enables connecting physical and virtual objects to the Internet, mainly using wireless and mobile technologies (Tan and Wang, 2010; Gubbi et al 2013). In education, internet of things enables the application of modern internet and mobile technologies, which leads to a more active approach in learning. In this way, we can develop environments and tools that enable students to learn more efficiently, with an increased interest, compared to traditional methods of education.

In the research presented in this paper, we are set out to develop a smart learning environment located outside of the classroom, but integrated with educational services of the classroom. The developed environment is equipped with various sensors, devices, and software that support the learning process. In such an environment, we have developed an educational game that aims to increase the interest and motivation of students to study the field of the internet of things (Simić, 2015), and to enable them to learn quickly in an augmented reality environment, outside a traditional classroom. In a "treasure hunt" game, students are testing their knowledge in the internet of things and learning new things in a fun way.

2 Literature review

2.1 Educational games

Educational games are getting more and more used in education (MyounJae, 2016). Physical educational games are based on physical objects, and they have been used in education for a long time. However, different mobile technologies are becoming available and ubiquitous, which makes the development and application the mobile educational games easy (Ly-yi and Yan-lin, 2010). Internet of things has enabled communication between physical objects and the digital world (Xiang and Xin, 2012). Harnessing new technologies makes traditional games more interesting and adapted to new trends (Tiejun, 2007; Yan-bin and Ning, 2012)

Augmented reality and Internet of things enable design and development of hybrid games, where the elements of the physical and digital world are connected, with the goal to improve the performance and effects of traditional games. These technologies are helping teachers to create educational environments anywhere, and to adapt them to characteristics of the educational process or to students' needs (De La Guía et al, 2013).

Games easily attract attention. Their potential for application in education comes from the fun and curiosity they produce (Griffiths, 2013). Games can help the students (players) to set their goals, to exercise, to get feedback and track their progress throughout the course, while teachers can monitor students' behavior (Griffiths, 2013). Analyses have shown that there are several parameters that can be used to evaluate the quality of an educational game (Aslan and Balci, 2015):

- Acceptability: the level of completion of the learning goals;
- Challenge: the level of motivation of students;
- Clarity: the level of understanding;
- Interactivity: the level of interaction between the student and the game;
- Reward: it enables the student's satisfaction after the completion of goals.

Research has proven that playing 2D educational games gives more learning than playing 3D commercial games, which confirms that educational games do not need to be developed using expensive commercial tools and platforms (Koops et al, 2016).

2.2 Smart learning environments

Many classrooms today are connected to the Internet and have the advanced technological equipment, such as tablets or interactive boards. This type of classroom is called the smart classroom.

In a smart classroom, there is face-to-face communication, but there is virtual communication as well. Smart classroom blends human interaction, technology, and traditional learning methods, forming the environment which is innovative, flexible and motivating (Sevindik, 2010).

The smart classroom can be defined as a classroom equipped with modern technologies (for example 3G, 4G, IoT) for interactive learning, audio and video transmission, content producing and publishing, etc. Smart phones and tablets are also adequate for use in smart learning environments, so the learning can happen anywhere (Alelaiwi et al, 2014). A smart classroom is rich in technology; it connects physical and virtual learning environments and gives support, tools, and contents for different types of learning. It can also collect a vast amount of data in order to support the pedagogical decision. In addition, by using mobile and IoT technologies, a smart classroom can surpass the physical space of a traditional classroom (Petrović et al, 2016). In this way, learning can be performed anywhere in a physical or virtual world, in a smart learning environment.

An important technology for the realization of game based learning in smart environments is augmented reality. Contrary to virtual reality, where everything happens in the virtual world, augmented reality enables enriching the physical world with the information from the virtual world. The application of augmented reality in education enables students to (Liou et al, 2017):

- understand the educational content better
- consider the problem from multiple angles,
- connect the theory and practice,
- learn in real-life situations,
- achieve higher motivation and satisfaction with the educational process.

3 Game design

3.1 Project requirements

In this research, we have set out to develop a system that would enable students to learn in an interesting and motivating way, using an IoT based educational game. The game is organized in tasks, which students solve in a specific order. In order to complete the game, a student has to solve all the assigned tasks. Each task is designed to test the student's knowledge in the studied field. Each task is solved using a specific workstation places in a physical environment and integrated with smart classroom services.

The student starts the game from a starting point, where they get the first task. After solving the first task, they get a clue to reach the next location, where a workstation with the second task is located. This repeats until the last assigned task is solved.

3.2 Architecture

The architecture of the system includes a mobile application used by students, an application for administration of the system used by a teacher, equipment on the locations of each task (hardware and software). All the software components communicate through web services. Moodle learning management system is used for user management, task management, and grading.

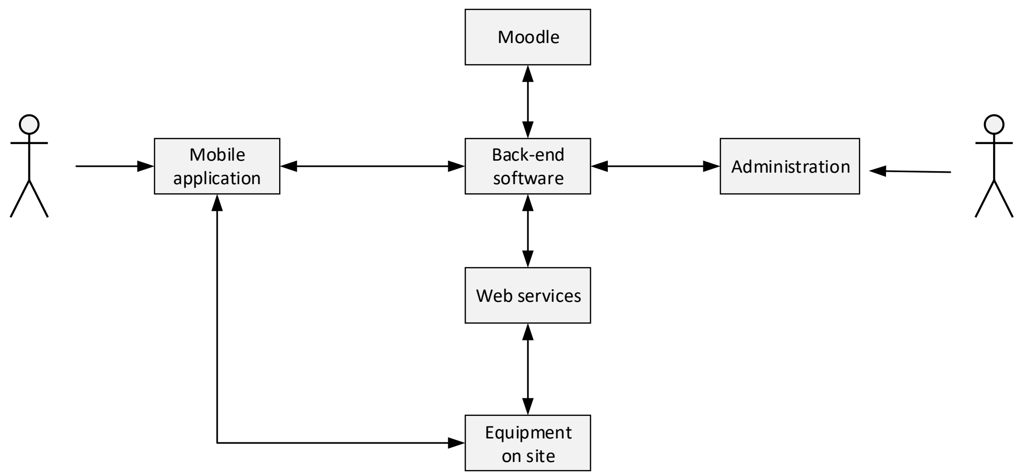

Figure 1 – The architecture of the game

3.3 Designing smart environment

For the realization of the game, it is necessary to organize a smart learning environment. This environment includes workstations on multiple locations and equipment for students.

Students' equipment consists of an android mobile device (a smart phone or a tablet) that a student uses to play the game. The device with the installed game is prepared in advance and given to the student at the beginning of the game. The student logs in with their Moodle account and interacts with the game only through this mobile interface.

Equipment on site is used for defining and solving the tasks through the game. The game is played at multiple locations, and each location has one task. Location can be anywhere, in the classroom, in the faculty building, or outside. For example, a task can be related to measuring the temperature, and the equipment can be placed in a classroom. Or, a task can be related to plant watering, so the workstation will be placed in the garden.

There are several tasks implemented within the game so far. All the tasks are related to studying the field of the internet of things and its applications:

1. A system for measuring temperature and air humidity. The student connects to the system using the mobile device and sets the parameters of the system according to the requirements.
2. A system for light control. The student connects to the light control and sets the lights as required in the task.
3. A system for movement detection. A movement is detected using a sensor, the LED screen shows the information, and a timer is started. In a defined time, the student is required to perform an action defined in a task.
4. A system for measuring the distance. An ultrasonic sensor is used to measure the distance and shows the measured value on an LED screen. The student is required to do a movement that will cause the reaction of a sensor, as defined in the task.

Besides the equipment necessary for solving tasks, each location is equipped with:

- Wireless internet. Components communicate through a wireless network.
- Hosting service. Each location has its own local database and services necessary for the hosting and realization of a specific task.
- RFID system for monitoring the progress of the students.

- The system that informs students about their progress. The yellow color is used to note that the system is in the ready state, waiting for a student to come. The red color is used to note that a system is performing an action, and no interaction with a student can be done at this time. The green color is used to signal the student that they can perform the required action.

3.4 Game scenario

After login to the mobile application, the student is shown the home screen. The student starts the game and the timer starts. The screen shows the text of the first assignment. An example of the assignment is shown in figure 2. The student is required to solve the function shown in the screen. The result should be put in the remote control on the site, so to set the temperature at the value calculated through the function.

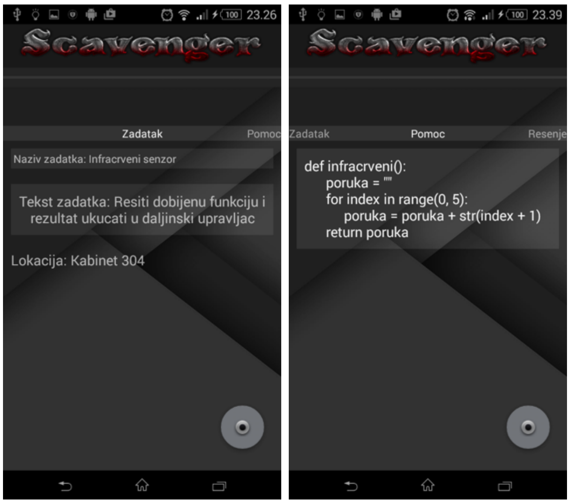

Figure 2 – An example of a task and a solution

If a solution is correct, the student checks the RFID tag and activated the next assignment. After solving the assignment, the student gets a clue how to reach the location of the next assignment. If the answer is wrong, the student is assigned another task, in a random order. The process is repeated, until the student reaches the end of the game, and solves all the tasks, or if the time elapses. The game scenario is shown in figure 3.

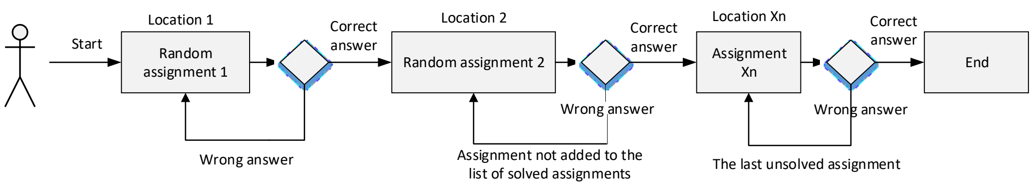

Figure 3 – The game scenario

Throughout the game, the student can review the solved assignments. After completion of all the assignments, or after the time has elapsed, the score that student achieved is calculated, shown to the student, and inserted into the administration application and Moodle.

Conclusion

This paper presents a model of an interactive game based on the internet of things. The game has been developed at the Faculty of organizational sciences, University of Belgrade. The goal was to motivate students to learn about IoT and smart environments. The main advantages of the game are related to the simplicity of use, low costs of equipment and interactivity.

Future work will be directed towards the development of a higher number of tasks, further integration with Moodle and complete technical and educational evaluation of the system.

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From open online courses to virtual learning experience, common perspectives

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Abstract

A survey of the literature dedicated to distance learning shows that authors uses most of the complex keywords, in an imprecise and improper manner. Terms like ILS, CMS, LMS, VLE or MOOC suffer some partial conceptual alteration, causing misunderstanding and confusion. Our paper has three aims: 1) to clarify at conceptual level these complex constructs specific to distance learning; 2) to offer examples for inconsistencies and conflict generating usage of these constructs expressed by acronyms and, thus 3) to offer some general guidelines and also some specific criteria for critical reading of the literature in the field.

Keywords: Virtual Learning Environment, Learning Management System, Course Management System, Massive Open Online Courses, Open Educational Resources

Introduction

Meanings of the concepts of teaching and learning

The process of formal learning implies a process of teaching, meaning organizing the conditions for learning and for guiding the learning process. The sequence of teaching-learning macro-process appears both in the conditions of the standard, face to face teaching-learning process, and also in the context of the virtual learning. If we consider the first main process, the **teaching process,** we notice a multitude of actions like: establishing the teaching goals, defining sequences or steps to teach, „translating" science into school knowledge, establishing teaching and assessment strategies, the criteria for a quality learning etc. Briefly, teaching means implementing a sequence of processes for organizing the conditions for learning (Moise C., Cozma T. 1996).

But teaching is only the starting point for academic learning. One of the main goals of the school, „equipping the individual with information", is not only an objective of the intellectual education (Moise C., 1996), but also illustrates the content dimension of any didactic activity; education, as process, „represents the way in which this content is achieved", the course of a sequence of (micro) processes of teaching-learning and assessment (Moise C., 1996). C. Moise (1996) insists on this crucial aspect of teaching-learning that precedes, prepares, assists and assesses learning. Thus, we note that teaching does not represent the entire learning process but it is only a sequence (the initial one) of the learning process.

If we understand teaching as a process of delivering or communicating information, it can develop in two main ways:

- On one hand, we have the virtual way that uses information delivered through radio wave or cable networks;
- On the other hand, we have the personal teaching, usually achieved as training.

These forms represent two *teaching models* used to deliver information to the individual.

The teaching models initiate the selection of specific *strategies* that should be reflected in learning methods of these types of information. Learning appears in the context where these ways of

teaching/training/communication of knowledge are followed by practice, documentation, continuing teaching or other forms in which the individuals enhancing their knowledge in the long term process of education.
Hereinafter, we will define the concepts used in distance learning and we will analyse them from the perspective of the learning situations, we will present several bias that appeared due to the improper use of the existing terms or to inventing new terms for already defined concepts and we will offer a recommendation for a unitary usage of the concepts related to distance learning.

Defining the keywords of distance learning

ILS_1 = Computer-Based Integrated Learning System (Bailey, G.D., 1993)
ILS_2 = „ILSs are complex, integrated hardware/software management systems using computer-based instruction" (Bailey, G.D., 1993)
General features of ILS as presented by Bailey in 1993:

a) Teaching objectives specified together with individual lessons related to those objectives
b) The lessons are included in the standard curriculum
c) The course develops on several levels in a comprehensive manner
d) The courses are delivered on a network system including micro-computers or terminals
e) **The management system gathers and registers** the results of students' performances

ILS_3 = An ILS according to Bailey's paper of 1993 adds to an educational resource available online certain instruments that collect and register the results of students' performances along with the course materials. A professor knows the difficulties that the student faces and how long does it take to cover a specific theme. Using these pieces of information, personalised remedial actions may be found for each type of difficulty.
ILS_4 = Using the computer as well, by different models of applications, the students are able to cooperate. The Bailey's research of 1993 supports on a large scale the students' efficacy while working together for achieving the academic tasks, as Bailey shown in his paper *Computer-based Integrated Learning Systems.* Bailey (1993), picking Slavin's idea (1983) claimed that: „Only when students remain individually responsible for their own achievements and productivity, the substantial improvement of their academic results will come also from the group (team) rewards or from the collaborative activity".
VLE$_1$ = Virtual Learning Environment (Wilson, B.G., 1996, Britain, S., Liber, O.,1999)
VLE_2 = a computer based learning environment (Wilson, B.G., 1996)
VLE_3 = are based on a client-server architecture (Britain, S., Liber, O.,1999)
VLE_4 = instruments like: Notice-Board, Course Outline, E-mail Tutor and Students, Conferences, Class List & Student Homepages, Assignments / Quizzes, Assessments / Grade-book, Metadata, Synchronous Collaboration Tools, Multimedia Resources Repository, File Upload Area, Calendar, Search Tools, Bookmarking, Navigation Model are suggested by Britain, S. And Liber, O. since 1999 as functionalities of a prototype VLE.
VLE_5 = a learning environment where the student has access to all useful functionalities in structuring, organising, correcting, validating and consolidating knowledge. The students must prove that they can filter and analyse from the different perspectives and also that they can correctly apply the gained knowledge.
OER$_1$ = Open Educational Resources (UNESCO, 2002)
OER_2 = Term used for the first time at the UNESCO Forum, in 2002, as referring to any material taught, learned or resulting from a research process, published in any environment, digital or of a different nature, which has been released to public or under an open licence that allows free of charge access, the possibility for others to adapt and add materials, without restrictions or limitations of any kind.
(https://en.wikipedia.org/wiki/Open_educational_resources)

OER_3 = OECD publishes in 2007 a material that includes the analysis of the results of a research conducted by their team concluding that the term „**open**" in the field of education must be attached to a service or resource that offers the following advantages: „Are sources of services that do not diminish their ability to produce services when enjoyed.", „Provide non-discriminatory access to the resource", „Can be adjusted, amended and shared." (http://www.oecd.org/edu/ceri/38654317.pdf)

MOOC$_1$ = Massive (1) Open (2) Online (3) Courses (4) (2008)

$MOOC_2$ = „The first Massive Open Online Course (MOOCs) was created in 2008 by George Siemens and myself." (Downes, S., 2015)

$MOOC_3$ = „a method of disseminating information and documentation in university educational environments" (Caldera-Serrano, J, León-Moreno, J.-A., 2015)

$MOOC_4$ = „open-licensed courses which are delivered completely online to large cohorts of learners" (Garcia Mendoza, G.A., Jung, I., Kobayashi, S., 2017)

We will present the meanings of each element in the acronym according to different authors (definitions are noted with A) and to our perspective (definitions indicated by B).

1. **Massive:**

A) Some of the versions identified in the articles that we consulted:

a) „attended by a large number of participants" (Politis, T., Koutsakas, P., Karagiannidis, C., 2017),

b) „MOOCs can easily have several thousand students simultaneously engaged in the course" (Masters, K., 2009)

B) We consider that the best meaning attached to this term in the MOOC acronym is: **Unlimited as number of potential users** because it does not contradict the term **Open** associated to these constructions of four terms, MOOC.

2. **Open:**

A) Part of the versions identified in the consulted articles:

a) „no prerequisites other than Internet access and interest, no predefined expectations for participation" (McAuley, A., Stewart, B., Siemens, G., Cormier, D., 2010),

b) No costs (Politis, T., Koutsakas, P., Karagiannidis, C., 2017),

c) Open curriculum. The assessment, if it exists, is open, the information sources are open, the entire software is an open source (Masters, K., 2009).

B) This term is used in several fields: in ICT („open source", „open license"), and in other technical fields („open standards"). In the field of education, the term „open" attached to an educational resource (OER) is used since 2002, its' main meaning being „unconfined", „unlimited", „unrestrained". The research conducted by OECD in 2007 clarified the requests of this term so that it could be used in relation with an educational resource (see **OER**$_3$)

3. **Online:**

A) „The online environment is simply an electronic distribution area" (Masters, K., 2009).

B) The most appropriate meaning for this term is: **Published on the Internet or by other digital or analogical environment of mass media**.

4. **Courses:**

A) On the larousse.fr website (the Romanian language took the meaning of this word from the French language) the meanings of this word are:

a) a professor's lecture that presents a content to be learnt (certain knowledge)
b) teaching that takes place according to a program in the school
c) teaching a lesson in any activity field
d) a set of lessons and lectures in an activity field
e) textbook that refers to a certain subject

f) section that corresponds to a certain level of education
g) name of certain private education institutions.

B) The meanings of this term, as mentioned in the indicated dictionary, refer to delivering certain knowledge from an individual, the one who taught that knowledge, to another individual, who receives the knowledge. We conclude that the term Courses represents in fact **a organised collection of didactic contents used with the purpose of delivering knowledge** from the one who teaches to the one who receives. We consider that some authors' suggestions for associating the term *courses* to certain means or tools used for assessing learning being improper. These tools only measure the level of assimilating knowledge and not the quality of teaching or of the course support as traditionally understood.

CMS_1 = Course Management System (Kats, Y, 2010)
CMS_2 = Content Management System („CMS or a Content Management System is basically designed to support educative or academic courses.” Ninoriya, S., Chawan, P.M., Meshram, B.B., 2011).
CMS_3 = „CWeb-based content management systems (CMS) support all the phases of content management, from creation to delivery” (Ninoriya, S., Chawan, P.M., Meshram, B.B., 2011).
CMS_4 = into the acronym CMS, the letter **C** from „Course” and „Content”, respectively, is used in both situations CMS_1 and CMS_2 but we refer exclusively to the version **Course** Management System that is a **concept used in the field of distance learning**. Content Management System applied in education is actually Course Management System. If it would be applied in other fields (online newspapers, for example) it would be exclusively about the Content Management System – an administration and management system for accessing materials in different forms.
CMS_5= a software application that includes different guiding and access restriction tools for the student according to the results of the students' performances.
LMS_1 = Learning Management System (Ninoriya, S., Chawan, P.M., Meshram, B.B., 2011)
LMS_2 = „LMS were created for tracking registration, attendance class lists, grades, test results, class scheduling, other administrative requirements of schools and instructor-led classes.” (Ninoriya, S., Chawan, P.M., Meshram, B.B., 2011)
LMS_3 = „learning management system – full-scale learning platforms supporting multiple facets of an educational process, from administrative functions to course delivery and assessment.” (Kats, Y., 2010)
LMS_4 = a management system for the entire school itinerary for one or several students, according to the syllabus and to the timetable established by one professor or by a group of professors. It includes educational materials studied in a specific order, with consolidation periods included between the dedicated times for teaching, with support materials for assimilating the critical terms or the new learnt concepts etc. In practice, there are several courses or learning materials selected by a group of professors in order to set certain concepts in students' favourite ways of learning. Learning tasks must be expressed in a correct and complete manner in order to avoid confusion and poor application.

The usage of distance learning in teaching situations

The Massive Open Online Course (MOOC) as cited by Rory McGreal (2012) from Wikipedia „is a course where the participants are distributed and also course materials are dispersed across the web.” His message is a comment to the article of L. Pappano (2012) showing that, due to the open access for reading a presented material in the context of a MOOC, the faculties through their professors cannot offer individual responses to each student. The design of the course and the tools are very important for the students in the same city or in the discussion forums. Thus, it is emphasized that the necessary tools for the team work are not included in a MOOC.

In 2015, Yousef, A.M.F., claimed that, in MOOC, it is difficult to offer individual responses to a high number of students. Yousef (2015) also asserted that, for avoiding the difficulties from this perspective, it would be recommended to apply analytical tools for learning, for monitoring the learning process. Also, he considers it is important to identify the difficulties, schemes for experiential learning and ways for students to be encouraged to express their own ideas about the topic they study. These tools may ensure the management of the teaching process and may allow the student's assistance during the teaching period.

The tools used for analysis, monitoring, discussion, identification and schematization, often approached both by Papano (2012) and Yousef (2015), transformed MOOC in a more complex learning tool than a simple teaching or training system. Although the access to the materials of a MOOC is open, allowing the reading to a large scale, the additional tools may be used only in a one-on-one („face-to-face") relation. It is used by the coordinator (teacher in a methodologically agreed working setup) for guiding the student on a methodologically agreed path.

If a MOOC represents a learning way/framework, the use of additional tools transforms it into an integrated teaching system. A definition for this working model was offered since 1993. Bailey (1993) talks about **integrated learning systems** based on applications installed on the computer (Computer-Based Integrated Learning System or, as named by Bailey, ILS). He claims that the professor's role in an ILS **becomes** that of **organising the learning and assisting time of the students who have difficulties in studying a computer based lesson** while, in a traditional face to face system, the professor may increase the probability that the student learns by indicating the objectives, asking open questions, maintaining a high level of students' attention. Thus, ILS becomes, in Bailey's opinion, a useful system for delivering an organized content to the student, offering a more useful feedback during the teaching phase. Bailey (1993) shows that the professor's roles, although adapted to new demands, remains to identifying adequate contents, organizing the learning time, identifying the unclearness and building tools for clarifying them.

From Bailey's paper we apprehended that, the ILS-based learning process ignores the elements for **maintaining the attention** on the topic to be learnt – important aspect for assimilating information – and the usage of individual adapted strategies for consolidating knowledge, these aspects being the professor's responsibility in the traditional relationship established in a real classroom. As shown by Laura Pappano as well, offering individual feedback to each student becomes a challenge for the professors using an ILS. In 2016, Cucoş C. claimed that „we should not teach only knowledge to a person, but also methodologies for reaching the knowledge, for understanding their meaning and for valorising them in possible contexts". The author draws the attention that the teaching process should associate learning knowledge with building characters, and this is often difficult in online settings. These characters are shaped by the professor during the face to face didactic activities. We must admit that we did not find any study showing that by using an ILS during the learning process could compensate for this advantage of the traditional method and we will assume that this shortfall will be added to the difficulty of maintaining the attention, as indicated by Bailey in 1993.

After studying these terms, we can affirm that an ILS represents:

- an integrated training system;
- that presents the content of a MOOC;
- using a software application that included instruments for offering real-time feedback referring to the aspects that are unclear;
- allows student's coordination for assimilating knowledge and
- allows students' cooperation.

In contrast with CMS, an ILS implies exclusively the monitoring of the path and the results of student's study and it allows them to cooperate for a better apprehension of the new concepts, offering real-time feedback elements. The course management (CMS) also includes methods for assessing and adding new contents, generated by the course participants them self, students or professors, and these new contents must be evaluated and validated by the professor for assuring the scientific originality and quality.

When to an ILS we added tools for subjective assessment and for amending and validating the new contents it becomes a **course management system** (Kats in 2010 named it **Course Management System** or CMS and claimed that it is often confounded with **Learning Management System** or LMS). Ferriman J. (2012) illustrates a difference between the two terms: CMS „is a secure place to store and launch training to a subset of users" of an entire LMS. The difference, in his opinion, is that the Course Management System is a term that expresses the final goal of the process that takes place in a CMS, while LMS offers the general framework for a process in a CMS. This difference is outlined also by the use of two different terms: „learning" and „course". The course is seen as material of the teaching activity. A course is distributed in an open manner and it supplies information to the students. In an organized way, for making the process more efficient, a course is delivered through a computer based system, which allows elements for manipulating/reading/l istening the materials by integrating them in computerised applications.
But learning implies also a process of understanding the context, of settling and consolidating the knowledge. These processes are monitored and mentored by the professor, and cannot be supplied by ILS. The teacher must have access to other tools in order to ensure the flow of the mentoring process while acknowledge that this is difficult to achieved individually (Bailey 1993, Pappano 2012).
A CMS offers additional tools for assessing the understanding and the adequate character for correctly applying the knowledge apprehended by students. These tools must allow the professor to notice if the student is able to express personal competent ideas about the assimilated material and to expose these ideas in a coherent manner. These tools also must allow the teacher to validate the new contents generated by the students. But, as we stated in the beginning of this paper, we talk about learning in the context in which teaching is followed by practice, research, further training. So, we recommend the term LMS to be used only in the context in which learning takes place in an organised context by an education institution, using a set of courses with the purpose of transmitting and consolidating knowledge and following a well-established timetable.
The CMS, along with the ILS for the specific contents to each learning context, form a LMS only when they are accompanied by a syllabus and a well-established timetable. This represents **the management system of the learning process** used in an expertise field and includes the existence of the CMSs and of the ILSs that improve the covering of the specific MOOCs for each of the expertise areas included in the learning program for developing specific competencies and skills.
All these materials and tools that we used for defining the concepts may be applied in distance learning. They are related to designing courses and organising them for achieving a learning or teaching activity. Cucoş C. (2016) mentioned that the „prerogatives of training and the initiatives on the line of teaching are at students' disposal". He identified that, in the theories of learning, the authors talk about intellectual learning or education only in the context of the student's development/learning environment and, respectively, in the context of the teacher's professional and personal evolution. According to Cucoş (2016) „education is a social action that implies multiple interactions among the actors involved." Teaching is one of the interactions that compose the act of learning. The influence of the cyberspace upon the student raises new perspectives regarding the environment of achieving the act of learning.
In 1993, Bailey talked about the new forms of teaching used in education referring to the new electronic educational technologies that gain popularity and become competitors for the professors. In 2013, the authors of the paper *Learning Environment* admitted that the term „educational environment" referred to different physical spaces, educational approaches, contexts and cultures in which students can learn. In 2008, Şoitu L. affirmed that „the new tendencies lead to creating a new Environment for Network Learning Development... in campus/community". He launched the idea that the research in this field must have, also as analysis purpose, the effects of using „the new training-developing-valorising resources" delivered using „the new technologies" and the Internet. Thus, he wanted to emphasize that it is necessary to follow, to research, the effect of

teaching by using the new technologies and that this model of teaching generates modifications of the comprehension and learning capacity.

Cucoş, in 2016, affirmed that a „competence proves it's validity in a specific context, at a specific time" when well applied. Şoitu, in his course of *Adult Education* (2007) claimed that „learning implies the existence of previous processes." We filter everything we try to learn through the filter of our own experience. By learning, we create a new reality that will surround us by integrating in this new reality the new assimilated knowledge as well.

We notice that the majority of the quoted authors refer to learning only in the context of a „learning environment" and they admit that it influences the results of learning that can be represented by the concept Virtual Learning Environment.

The term Virtual Learning Environment (**VLE**) appeared as a result of virtualising the informational environment where we learn. The development of the Internet, of the online mass media, widened the VLE concepts. Van Raaij, in 2006, quoting Martins & Kellermanns, 2004, defined VLE as a communication platform based on web technologies, that allows students to access, without space or time limits, different learning tools such as information about programs, course content, professor's support, discussion webs in electronic forums, systems for delivering the documents and other learning resources.

Chow, S. and Liu, C., in 2005, quoting Wilson, 1996, define the term TVLE (Technology-mediated Virtual Learning Environment) as an open system, computer based as working environment, that allows interactions and knowledge delivery among the participants and between the participants and the trainer and allows the access to a wider area of resources. They claimed that the value of a TVLE is generated by the fact that it allows learning anytime and anywhere. Simultaneously, they admitted that there are feelings that may affect the learning process, caused by the fact that the students do not receive and immediate and effective feedback from a professor.

Chow and Liu concluded in their paper that, due to opening communication paths from a TVLE, the students may articulate and express their own meanings of the materials and that, these expressions lead to a better framing of the knowledge to be assimilated. The same authors claimed that the student's perception is that learning in a TVLE brings more satisfaction, due to a clearer meanings of the learnt material based on articulations achieved during the learning process.

Cucoş, C., 2016, quoted a report of the Commonwealth of Learning, coordinated by Glen M. Farrel (2001) that present the importance of quality of education: „the quality is a dimension that cannot be neglected". The author claimed that, in a virtual learning environment, „the experiences carried by the actors become themselves a value and an important plus of learning".

We presented all these observations with the purpose to emphasize that the „virtual learning environment" is, similar to the „classical" *learning environment,* a favourable environment for learning when this act can be fulfilled considering all the necessary implications for a complete assessment:

- of the learning materials suggested by the professor;
- of covering the bibliography selected by the professor and completed with the bibliography selected by the student;
- of expressing and correcting students' own ideas and understandings regarding the entire material referring to which the student can express his own position.

These interactions in the virtual or traditional environment lead to consolidating the materials and complete the act of learning.

So, the term VLE represents a learning environment achieved through a LMS that allows: interactions and good practice exchanges among the participants; debates among them on the topics taught by the professor; access anytime and anywhere to these debates and to other scientific events and publications that refer to the studied topics.

Correct and incorrect use of the constructs ILS, CMS, LMS, VLE or MOOC

For emphasizing the necessity of this material, we conducted a research on the Internet, using Google or the intern search engine of researchgate.com, using as criteria the acronyms MOOC, CMS and LMS. We ignored the sources presented by the search engine from the list offered by google.com and which not supported in a convincing manner the presented material. Thus, we consulted 15 materials: researchgate.net (8 articles), publications.rwth-aachen.de (1 article), books.google.ro (1 article), whatis.techtarget.com (1 article), oxforddictionaries.com (1 article), wikipedia.org (1 article), centrocp.com (1 article), ncbi.nlm.nih.gov (1 article). We covered the materials presented and in 6 of them we have identified the use of the concepts expressed by the acronyms MOOC, CMS, LMS in their original meanings. In the other 9 articles we have identified changes of the concepts in the direction wanted by the authors, but without consistencies in the use of this new concepts. Thus, instead of some established terms at the date of writing the article, the authors of this studies preferred to use their own terms. Each author modified or created a different term/acronym, ignoring the fact that specific terms established for the different dimensions of distance learning already existed.

Hence, in the specific literature, terms like cMOOC, xMOOC, bMOOC, hMOOC, aMOOC, ahMOOC, LCMS, TVLE appeared defining in facts systems type MOOC, ILS, CMS, LMS or VLE. These five „primordial” key concepts already existed in the literature and the appearance of new ones caused bias.

Let’s use as example the term xMOOC, suggested by S. Downes, defined as a traditional course structure, with a clearly specified programming of the lectures and of the self-testing problems. Nevertheless, Bailey, since 1993, wrote that ILS includes the educational resource, tools for immediate and correct feedback, and the answers to problems (self-assessment). Certain particularities in the description of a xMOOC (Downes, S., 2015) are given by the tools that exist in the definition of the CMS as well: subjective assessment, validation of the new contents by the professor, and other tools for subjective assessment done by the professor.

S. Downes, 2015, also describes the term cMOOC that joins the term „collaborative” to the term MOOC. We find this association described for the first time in Bailey’s book about ILSs. Bailey claims that the collaborative elements are the immediate development for ILSs, studies showing that the inclusion of such instruments in ILS is mandatory. In the same manner, Pappano (2012) and Yousef (2015) talk about MOOC that may include different other tools that should allow cooperation and other actions.

The term hMOOC (hybrid MOOC being described in 2017 as LCMS mixed with social networks and with learning models based on teaching and cooperation, Sein-Echaluce, M.L., Blanco, A.F., García-Peñalvo, F.J., 2017). Still nothing new about the modern learning environment, as Cucoş has wrote one year before (2016). We conclude the hMOOC defines in fact a VLE, that includes all the sources in the school, social and other networks. The academic, formal learning can be done only to the contents that have been verified and organised by a professor or by a group of professors.

The term bMOOC (blended MOOC) is described as a combination among cMOOC, xMOOC and the traditional method, Yousef, A.M.F., 2015: „To fill this gap, hybrid MOOCs bMOOCs have been proposed to combine the advantages of both cMOOCs and xMOOCs.” (Yousef, A.M.F. and others, 2014). But as we have indicated, both cMOOC and xMOOC describe functionalities already included by Bailey (1993) in ILS.

The term aMOOC (adaptive MOOC) offers different learning strategies adapted to learning objectives, different learning profiles and styles of the participants (Sein-Echaluce, M.L., Blanco, A.F., García-Peñalvo, F.J., 2017). The access to OER materials in a MOOC can be done whenever the students want so they are adapting their pace, according to their learning needs. Also, Bailey used this description as one of the features that makes useful the inclusion of a ILS in the didactic act. The three authors are also the ones who include in their paper the term ahMOOC as a MOOC

that combines elements of hMOOC and aMOOC. As already shown, this phenomenon of „combinations of combinations" continues and widens the range of created bias.
The term LCMS, suggested by Ninoriya, S., Chawan, P.M. and Meshram, B.B. in 2011 appears as a hybrid between CMS and LMS. The concept of „learning" in the academic sense cannot be used in the context that lacks materials to study, organized as a „teaching course". The association of the two terms does not lead to a new concept but only to a redundant acronym compared to an already existing construct, the one of LMS. This use of the new acronym can also create biases.
TVLE, introduced by Chow, S. and Liu, C. in 2005 implies the association of two terms: „technology" and „virtual environment" and here we identify a new pleonasm, since the virtual environment is created by technology and depends on it.

Recommendations for using the constructs in distance education
We design, as mathematic equalities, using the acronyms already established for different terms:

1. **OER**=Open Educational Resources
2. **MOOC=**OER+selection, prioritizing and delivering the educational resources.
3. **ILS=**MOOC+tools for analysis, monitoring, self-assessing, discussions, identification and schematization+other tools that accomplish automatic actions using the computer
4. **CMS**=MOOC/ILS+tools for subjective assessment+tools for validating new contents +other tools that imply the subjective analysis of a teacher
5. **LMS=**$(CMS_1+CMS_2+\ldots+CMS_n)+(ILS_1+ILS_2+\ldots+ILS_n)+(MOOC_1+MOOC_2+\ldots+MOOC_n)$+curriculum+timetable+other tools for the management of the teaching/learning process.
6. **VLE=**LMS+debates/conferences for publicly presenting personal opinion+ critique/opinions/reviews+scientific publications accessible without limitations +experiences+other controlled sources of information.

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Toward a Clear Image of Clear Goals in Gamified Environments

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Abstract

The promise of using digital game elements for the goal of learning is that the privileges of games are being utilized in the educational environments. This study aims to assess the impact of clear goals on the learners in a gamified educational environment. This paper deals with five kinds of engagement-oriented features by which the clear goals defined including perfection, precision, presence, and pace. The learners are divided into five groups that to each of which one of the defined clear goals is assigned. To assess the impact of each type of clear goal, the inferential statistical tests on the means of each feature in different groups were done. The results indicate that the pace and perfection features are beneficial for defining clears goals, but three other features could not do the same job so that they seem to be ineffectual. In a further experiment, inferential statistics tests have been done again considering gender factor. The results were same except for the precision and punctuality features which showed to be neutral in the female group. The reason behind being beneficial is that such features are proper to be instructed. In the case of being ineffectual, the nature of the feature is unable to be guided. When a feature is neutral, it means that there is no enough evidence to judge its effectiveness. The results of this paper help researchers profoundly understand the function of clear goals with respect to the way the gamified educational environment is designed.

Keywords: Gamification; Game-based Learning; Clear Goals; Engagement; Inferential Statistics

1 Introduction

Games are designed to attract players and create continued interest for a substantial amount of time (Hamari et al, 2016). This interest can be used to motivate players to do things that they are able to, but not motivated enough to do. Using games for non-entertainment purposes has introduced two new concepts: “serious games” and “gamification”. Serious games are about using full-fledged games for non-entertainment purposes, while gamification is defined as equipping non-game environments with game elements (Susi et al, 2007; Deterding et al, 2011).

“Clear goal” is one of the core game design principles that are being used in gamification as well (Deterding et al, 2011). Clear goals are some accessible objectives which are set for the players and players are aware what to do in order to achieve them. These goals can come in various forms such as badges (achieving badges can be the objective), leveling up, succeeding in competition with others, etc. Almost every game, intentionally or unintentionally, uses clear goals to regulate the players throughout the game and to keep them engaged (Hamari 2013).

Gamified learning environments and educational games are becoming more and more popular as a method to instigate engagement and flow in students and they are proved to be boosting both engagement and learning (Crisp 2014; Sabourin and Lester, 2014). However, although numerous researches have been conducted to study engagement in digital game-based learning, there is not adequate literature exclusively studying the impact of clear goals on user engagement.

This study is intended to use the user engagement features introduced in (Gholizadeh 2017) including "Punctuality", "Presence", "Perfection", "Precision", and "Pace" and define one type of clear goal for each feature. We randomly assign one type of clear goal to each user and then try to use the statistical inference tests to investigate if these clear goals lead to improvements in their respective user engagement feature.

The following section presents the theoretical background about gamification and the clear goal element in gamified environments. In section 3, the research methodology is presented along with a description of the game we implemented. An inferential statistical test and results follow. The last section discusses the practical and theoretical contributions regarding the results and reviews the most important findings then expresses the limitations and future directions of the study.

2 Literature review

Usefulness of serious games and gamification has been proved by many studies in various domains including education, health and wellness, online communities, crowdsourcing and business and customer services (Seaborn and Fels, 2014; Hamari 2015). This is mainly achieved by introducing game elements and game mechanics such as points, badges, leaderboards, levels, time constraints, clear goals, etc. into a non-game system (Deterding et al, 2011).

In the context of education, many studies have confirmed the effectiveness of gamification on both engagement and learning of participants in an e-learning environment and reducing their exam stress (De-Marcos et al, 2014; Domínguez et al, 2013; Ibanez et al, 2014; Cheong et al, 2013).

Games and gamified systems set clear goals for players in order to increase their performance because: (1) it anchors their expectations higher which lead to higher performance; (2) enhances self-efficacy; and (3) the completion of goals leads to increased satisfaction and future performance (Hamari 2013). Proper clear goals are found to make the game more challenging and this is believed to be more effective for players with "thinking" personality type (Sepehr and Head, 2013; Soflano et al, 2015).

Different players have different perception and react differently to the game elements and these difference have been studied from different aspects such as gender, age, and learning styles (McDaniel et al, 2012; Koivisto and Hamari, 2014; Buckley and Doyle, 2017).

3 Methodology

Various elements and mechanics are used to apply in a gamified learning environment. In this research, we focus on the "clear goals" which is used to direct the path of player's progress and learning. This study aims to investigate the effectiveness of clear goals on player's engagement in a gamified learning environment. To this end, a mobile application equipped with game elements was designed by which users learn English vocabulary.

3.1 Defining Clear Goals

Five different types of clear goals were defined in the abovementioned environment each of which relating to a specific feature of user engagement as defined briefly in Table 1. Our intended features are precision, perfection, punctuality, presence, and pace of progress.

Table 8. Features of Engagement

Feature	Description
Precision	The quality of being accurate and careful during the time of playing
Perfection	Passing the chapters completely with most achievable scores
Punctuality	The user's quality of being on time and playing frequently
Presence	The user's amount of time of being present in the application
Pace	The user's speed in completing tasks and going ahead in the game

3.2 The groups of users

Users are randomly placed into five groups. One type of clear goal is assigned to each group. For example, the second type of clear goal is assigned to users of group 2 and their progress will be set up through that goal so that they are instructed and guided to have a specific amount of that feature to reach the goal.

The learning environment is designed to teach 30 lessons. The clear goal shown to the user is divided into 6 smaller sub-goals each containing 5 lessons. After a user reaches a sub-goal, he will be shown the next sub-goal, which relates to the next 5 lessons, to achieve. The purpose of this division is to provide the player with more easy-to-achieve goals.

3.3 Users’ data

To do statistical tests on a practical population, a mobile educational game aimed at learning of English vocabulary was created and has become available on Android markets. The game is placed in the category of memory games, which teaches a total of 500 English vocabularies.

In this game, the mechanisms to measure each of these five features of engagement were improvised in a way that the data concerning the activities of the players and the details of their plays, were sent to the application server on a daily basis to be considered later. Because the application is available on Android markets for people, the demographic factor of its players is entirely various and not limited to a certain age category. Figure 1 includes a sample screenshot of this educational application which holds various game elements.

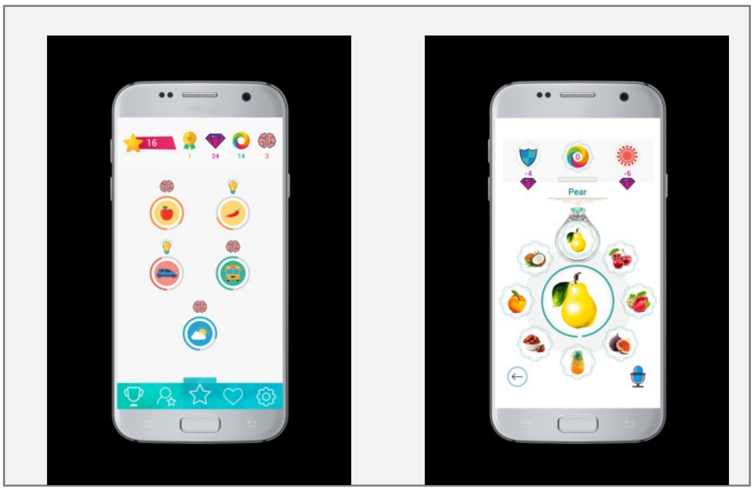

Figure 48. The Screenshot of the Educational Game

4 Results

In order to evaluate the influence of clear goals on users, inferential statistics and t-tests were used. In addition to the t-tests performed for all users, another test was also conducted to investigate if different genders have differences regarding the clear goals. Table 2 summarizes the number of people in the whole population and different genders in each group.

Table 9. The Sample of Population

Groups	All	Male	Female
Precision	110	55	55
Perfection	80	45	35
Punctuality	130	50	80
Presence	60	20	40
Pace	120	50	70
All	500	220	280

Table 3 shows the result of t-tests performed on all users. For each user engagement feature, this table is a comparison of means of each feature between the users whose clear goal is the one derived from that feature, and users having different clear goals. For instance, the first row shows the difference in mean of the precision feature between players for whom we have set a precision-oriented goal and users with different goals. This can help us discover the influence of clear goals regarding various features of user engagement in gamified environments.

Table 10. The Result of the T-test for the whole population

Features	Its group		Other groups		P-Value
	Mean	**SD**	**Mean**	**SD**	
Precision	0.674	0.180	0.737	0.161	0.00134
Perfection	0.604	0.274	0.473	0.296	0.00023
Punctuality	0.498	0.293	0.586	0.315	0.00438
Presence	4347	3358	12582	18979	0.00000
Pace	2.195	4.672	1.007	1.759	0.00740

This table illustrates that users whose clear goals were set for the features “pace of progress” and “perfection” had more speed of progress and perfect scores in lessons. Hence we can conclude that setting clear goals based on these features could be useful and beneficial for a gamified environment. Furthermore, we observed that users had the negative reaction to the other type of clear goals defined based on presence, precision, and punctuality meaning such features are ineffectual to be considered for designing clear goals.

Next, we separated the male and female users into two groups and repeated the above t-tests to investigate how gender can influence the effectiveness of clear goals. The results of experiments on men are shown in Table 4. Results are similar to the previous experiment the gender factor has not been considered. Again perfection and pace of progress were improved due to the utilization of related clear goals and precision, perfection and presence worsened.

Table 11. The result of T-test for the male population

Features	Its group		Other groups		P-Value
	Mean	SD	Mean	SD	
Precision	0.674	0.177	0.875	0.129	< 0.00000
Perfection	0.576	0.206	0.466	0.318	0.00703
Punctuality	0.402	0.254	0.556	0.302	0.00078
Presence	7107	4192	12886	20505	0.00338
Pace	1.666	2.002	0.962	1.834	0.03066

Table 5 displays the results of t-tests on women where some differences were observed comparing to the results of previous experiments. The difference is that the reduction in precision and punctuality is not statistically significant and does not lead to the conclusion that clear goals set for these features can lead to negative effects on learners. However, like the overall and male groups, features of perfection and pace of progress were improved and presence faced decrease. This means that setting clear goals for female users is beneficial if it's targeted to increase perfection and pace of progress, and is ineffective if targeted to increase presence.

Table 12. The result of T-test for the female population

Features	Its group		Other groups		P-Value
	Mean	SD	Mean	SD	
Precision	0.674	0.185	0.702	0.173	0.32467
Perfection	0.640	0.012	0.479	0.342	0.01201
Punctuality	0.557	0.300	0.612	0.325	0.18411
Presence	2968	1624	12329	17674	< 0.00000
Pace	2.574	5.869	1.044	1.699	0.03504

Conclusion

This paper aims to deal with the impacts of clear goals in gamified environments on learners under different circumstances. Conditions are different due to the features by which the clear goals are defined. It is interesting to apprehend how clear goals can show different behavior regarding different feature by which they are defined. The outcome of clear goals could be shown in a beneficial, neutral and ineffective way.

It has been discovered that defining clear goals based on perfection and pace features was worked in a beneficial way, but the presence, precision, and punctuality proved ineffective for the whole population. Given the gender of learners, it was revealed that the effectiveness of precision and punctuality was neutral for female learners, whereas everything else did not change compared to the results of the tests for the whole population.

The reason why some features were beneficial is that when learners are asked to be punctual and accelerated, they would do so due to the fact that these features could be instructed in such gamified environment. But in the case of being ineffective, the learner will not show a proper reaction to the defined goals because such features are unable to be dictated or guided. When a feature is concluded to be neutral, it means that there is no enough evidence to justify its effectiveness.

Conducting such a preliminary research has its own limitations such as the lack of comprehensive data about the learners as well as the conditions they are under. This paper could pave the way for future studies regarding game elements and their impact on learners. It is worth noting that there are many dark aspects in this field that need to be dealt with.

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Designing customized products by combining different pieces from a library

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Abstract

In general, an engineer has to materialise a concept/ idea, a technical drawing, an image, etc. into a physical object with integrated form and functions. For this purpose, he/ she must combine art, science and advanced technology to create useful products, required by different categories of consumers. In a modern society, the consumer is more educated, sophisticated and he/ she is looking for diversified products, specially designed to fulfil his/her needs, but at lower prices (customized products). In the apparel industry, the customized products can be found in all of its branches, even if we refer to personal objects (clothes, shoes, bags, etc.) or big and small home objects (furniture, curtains, carpets, etc.). The patterns of the customized garments must be designed with dedicated CAD software, which has special functions for personalizing this process. The results of this designing process are interactive changeable patterns of the garment parts/ elements, whose shapes and sizes change with the alteration of the values of initially used data in the design scenario. The patterns are saved with coded names correlated with their function and role in the garment. By combining them in different ways, new customized models are created (shirts, skirts, trousers, blouses, etc.). This paper presents the main steps of elaborating such types of new models by taking into account some restrictions: the compatibility between the parts (the size and the geometry of the outlines contour), the garment functionality, the features of the model (structure, silhouette, cut lines), and the technological requirements.

Keywords: customized products, library, models, garment functionality

1 Introduction

In the apparel industry, the fashion trend imposes a quick adaptation of the production (volume and structure) of the companies to the consumers' needs (which are diversified and personalized). At this point, there is a continuous struggle between what the consumers are looking for and what the companies are able to produce in a short time [3, 5,6]. This problem can be solved if the designers understand the market/ consumer's needs and create individualised products for the latter.

In order to manufacture these types of products, the design process must be approached differently, by taking into consideration the consumer's individual requirements. This type of process requires special functions in CAD systems which allow the personalization of the design process. In the market of apparel CAD systems there are several brands (Gemini, Accumark from Gerber, Lectra, Graphis, Optitex, etc.) which have developed special modules for designing the patterns in an interactive manner, These modules allow the automatical reshape and resize of the patterns with the change of the values of the initial data [4].

An useful and appropriate solution by which new models can be created is to combine in different ways the pieces (patterns) of the products, which have been designed in previous collections, by taking into consideration several restrictions:

- The pieces which will be combined to obtain a new model belong to the same type of garment (blouses, shirt, trousers, etc.); it is not recommended to combine pieces from different categories of products;
- The pieces are cut from the same type of materials ;
- The pieces which are combined have the same functions in the structures of the garments they come from;
- The geometries and sizes of the contours on the sewing lines are the same.

This paper presents a solution for creating new models of blouses by combining different pieces from a database or a library.

2 Work method

The patterns of the main elements of the blouse are designed in the Made- To- Measure module from Gemini CAD Systems [8]. This module has the following areas (see figure 1):

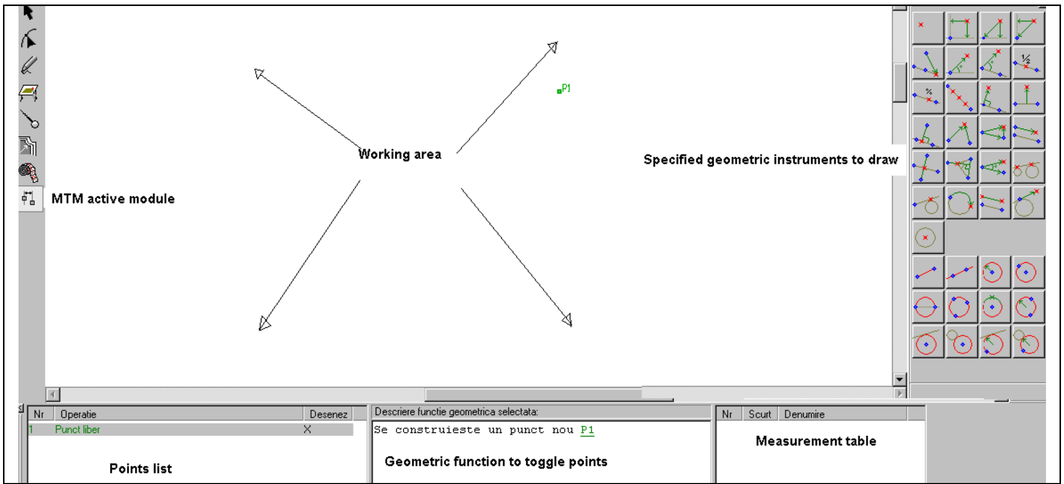


Figure 1 MTM areas

1. work area→ the geometric constructions are displayed here. In this area, one can view a geometric layer or the patterns of the garment pieces;
2. design scenario → contains a table with script functions used for geometric constructions.
3. description area of the used functions → empty fields in which the necessary data is typed after they are selected (numerical values or formulas).
4. a list of initial data → in this area, the user input rates are displayed in the *Edit* window of the working set sizes and measurements from *Table Measurements*.

5. a list of geometric tools used in the designing scenario- it is a list of different geometric functions, which are used to write the design scenario and draw the patterns.

The patterns are designed as follows [2,7,8]:

• introducing all the needed information for designing the patterns (geometric method).

The sizes and the values of the initial data are created in "Edit size set". In this table, it is effortless to add/ eliminate/change sizes, body and product value dimensions (information which is used to write mathematical relations).

• writing mathematical relations for positioning the main points of the base network/ shape of the patterns.

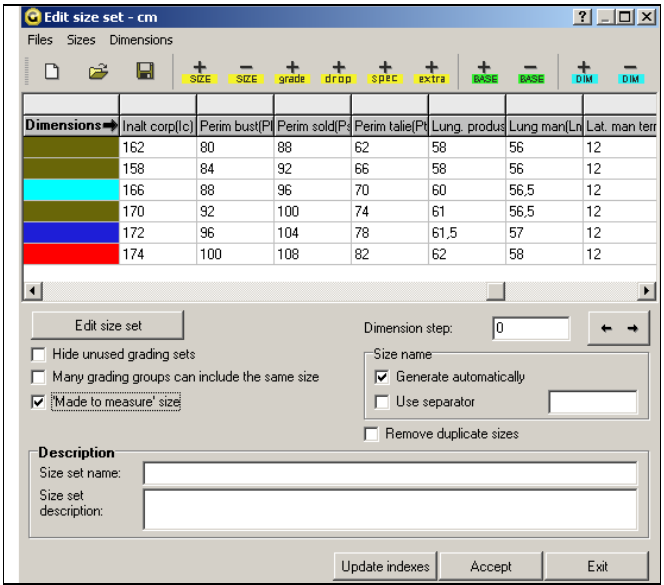


Figure 2. Edit size set information

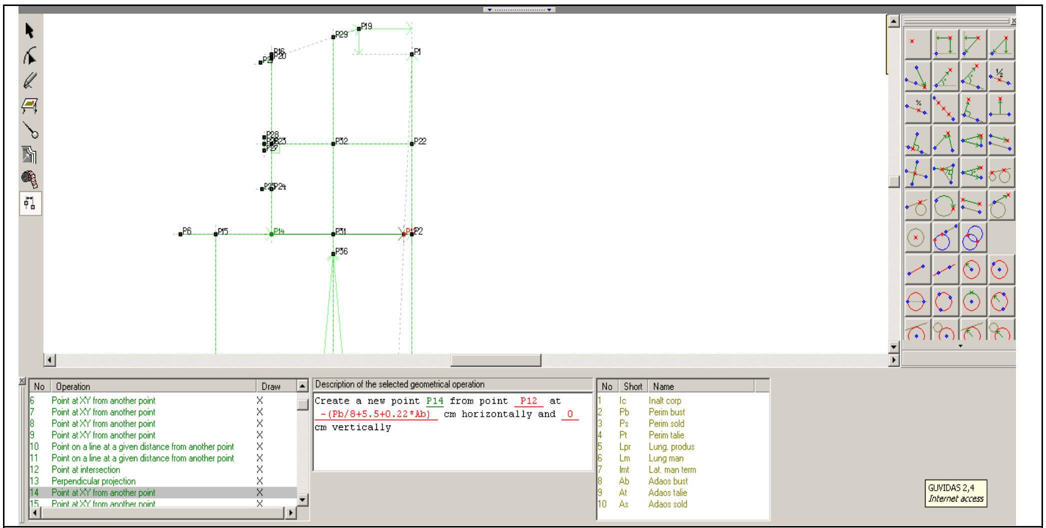


Figure 3. Design scenario

• drawing the shapes of the elements, magnetised with the points positioned in the geometric layer. Afterwards, the form of the main elements is modelled according to the principles of design.

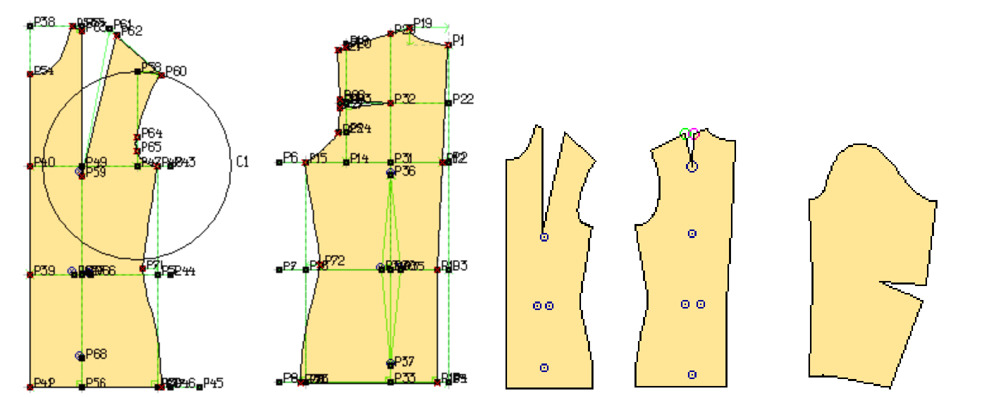
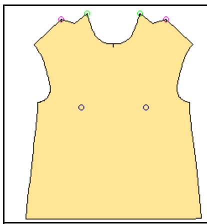
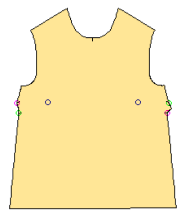
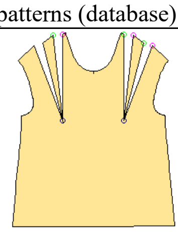
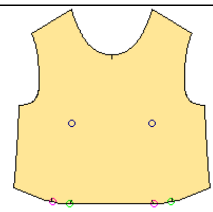
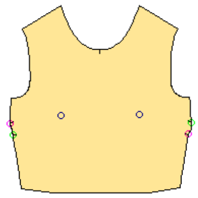
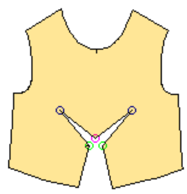
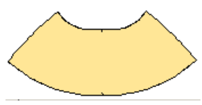
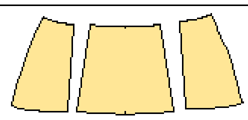
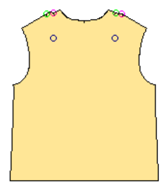


Figure 4. The main patterns (front, back and sleeve)

The patterns which are shown in figure 4 were designed in a customized manner and were used in the past to elaborate different models of blouses. The models are saved in the database. The pieces are named in a suggestive way for an easy identification (F-front, B-back, S-sleeve, 1- piece, 2- piece, 3- piece, D-dart, Y- yoke, C- cuff, L-long, M-medium, S-short, VS- very short, Str- straight, Fl- flare, WC- waist cut line, P-side panel).

Table 1. The shapes of the patterns (database)

			
F1-L-Fl-2D shoulder	F1-L- Fl-2D lateral seam	F1-L-Fl-4D shoulder	F1-WC-2D waist
			
F1-WC-2D Lateral seam	F1-WC-2D middle front	F2-WC	F3-WC-2P
			
FY- Fl large	FY-Fl medium	FY3	B1-L- Fl-2D shoulder

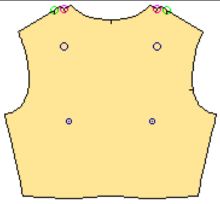
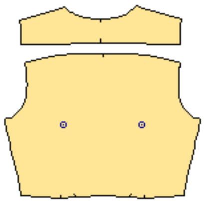
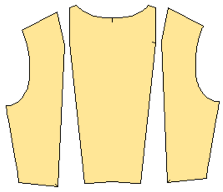
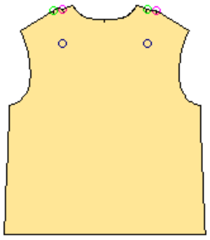
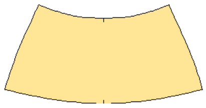
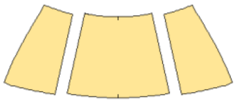
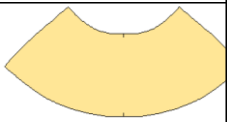
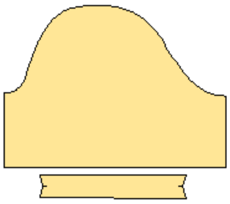
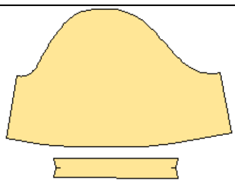
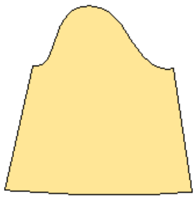
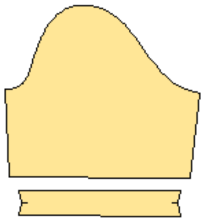
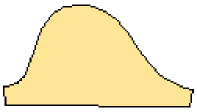
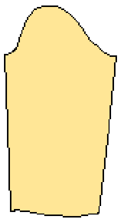
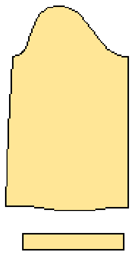
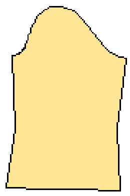
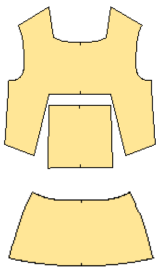
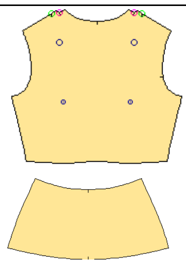
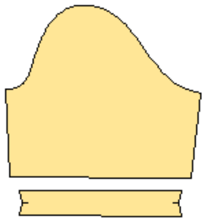
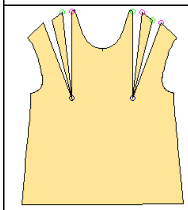
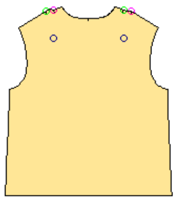
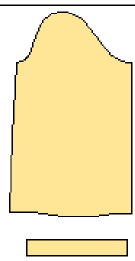
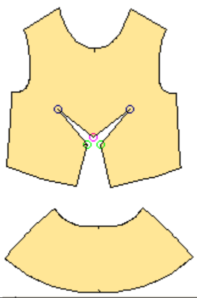
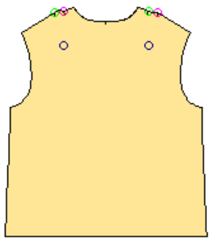
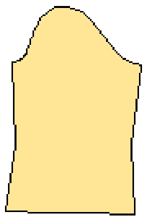
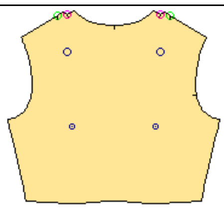
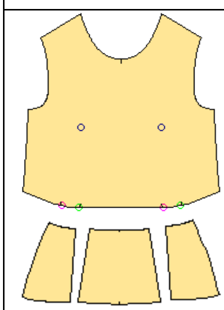
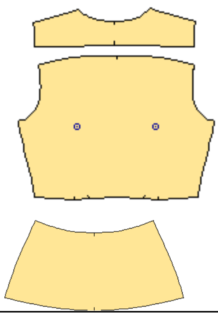
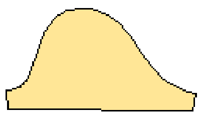
			
B1-WC-2D shoulder	B2-WC-2D waist	B3-2P	B3
			
B1-L-Fl	BY-Fl, medium	BY3	BY- Fl large
			
S-S-Fl-C	S-S-Fl large-C	S-L-Fl	S-S-C
			
S-S	S-L- Str	S-L-Fl-C	S-L-Fl from elbow line

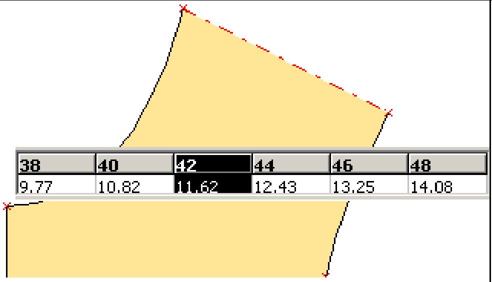
Table 2 presents the newly proposed models as a result of the process of combining pieces from the database.

Table 2. New models

Front (**F**)	Back (**B**)	Sleeve (**S**)	Model Code (**Front**/ **Back**/ **S**leeve)
			**F** 2-WC; FY-Fl medium **B** 1-WC-2D shoulder; BY-Fl, medium **S**-S-C
			**F** 1-L-Fl-4D shoulder **B** 1-L-Fl **S**-L-Fl-C
			**F** 1-WC-2D middle front; FY- Fl large **B** 1-L-Fl **S**-L-Fl from elbow line
		No sleeve	**F** 3-WC-2P **B** 1-WC-2D shoulder
			**F** 1-WC-2D Lateral seam; FY3 **B** 2-WC-2D waist; BY-Fl, medium **S**-S

All the pieces presented in table 1 and the models from table 2 are automatically resized and reshaped according to any modification which is made in the sizing table (the introduction/ elimination of another size causes the alteration of the values of the data used in the script scenario) (see table 3) .

Table 3. Automatically resized patterns

<table>
<tr>
<td>
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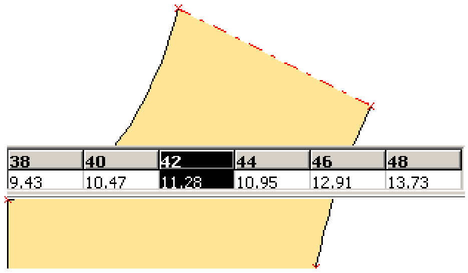
<td>
</td>
</tr>
<tr>
<td>Size 42 is the selected one. This size corresponds to a bust perimeter of 88 cm.</td>
<td>Size 42 is the selected one. For this size the bust perimeter is 86. The bust allowance is 2.5 cm. The pattern is automatically resized.</td>
</tr>
</table>

Conclusions

Clothing pattern designing is a creative activity which requires knowledge of the human body anatomy, garment style, fashion trends, comfort, properties of the materials, patterns making construction, and the manufacturing technology. In this activity, it is important to have imagination, perception and intuition about the possible solutions, by which a sketch or image is transformed into a physical object.

Designing new models by combining pieces saved in a database offers the possibility to explore multiple alternatives for creating new ones. These new models can be produced in small orders and different sizes without additional effort from the designers (time), because the size and the shape of the pieces are automatically generated, according to the alteration of initial data used to design them.

This solution is suitable for those companies which are producing casual garments, the same type (maybe for a period), classic style and simple cut- line.

Acknowledgement

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Determination of geometry influence over the extrusion force using finite element method

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Abstract

When it is calculated the extrusion force it is taken into account only the surfaces of the blank and of the desired extruded geometry. But different geometries with the same areas may have different force values. To prove this supposition there were made simulations using finite element method (FEM) for direct extrusion process. The software used was Deform 3D version 6.1 (service pack 2) and material was selected from the software database (Al 99.8). The thickness of the blank is 5.5 mm and its diameter of 12 mm, resulting an area of 113.04 square mm. After the extrusion will be obtained different geometries with an area of 43.30 square mm. Results an extrusion ratio of 2.61. We have 5 different geometries: a circle with a diameter of 7.4251 mm, a square with sides of 6.5804 mm, a rectangle with 8.66 x 5 mm dimensions, an equilateral triangle with 10 mm side and a hexagon with 4.0825 mm sides. After the results were analyzed there was a difference of 8% between the minimum and maximum forces registered during simulations, that confirmed our supposition. The research will continue with different extrusion ratio and with other materials. After the simulation research using finite element method has been finished, we were able to design dies for these geometries and using a data acquisition system based on National Instruments technologies, we will be able to use the extrusion dies in laboratories experiments together with the students.

Keywords: cold extrusion, simulation, Deform 3D, geometry influence, aluminium

1 Introduction

Extrusion is a method of forming in which metals or plastics are forced through a die or series of dies, resulting in a specific shape of constant cross section.

The cross-sections that can be produced using extrusion process can be either very thick in cross section or very thin. The cross-sections can be either solid or hollow and may vary from regular geometries (solid round, rectangular, hexagon, square, triangle) to L shapes, T shapes, tubes and many other different types. Extrusion is done by squeezing metal in a closed cavity through a tool, known as a die using either a mechanical or hydraulic press. Metal extrusion processes may be performed hot, warm or cold.

Cold extrusion is the process done at room temperature or slightly elevated temperatures. Warm and cold extrusion processes increase the strength and hardness of the finished extrusion, no oxidation takes place during these processes, the pieces have good mechanical as long as the temperatures created are below the re-crystallization temperature, and also can be obtained good surface finish with the use of proper lubricants. Reduced heat also lowers pollution concerns and eliminates costly high temperature tooling.

While virtually all metals may be warm and cold extruded, the most used metals for this type of process are are lead, tin, aluminum alloys, copper.

The three primary methods for warm and cold extrusion are: indirect extrusion, combination extrusion and impact (direct) extrusion.

1.1 Geometries used for direct extrusion simulations

To prove the supposition regarding the influence of geometry ober the extrusion force, there were made simulations using FEM for direct extrusion process. The thickness of the blank is 5.5 mm and its diameter of 12 mm, resulting an area of 113.04 mm^2. After the extrusion will be obtained different geometries with an area of 43.30 mm^2, for an extrusion ratio of 2.61 and an area of 22.62 mm2, for an extrusion ratio of 5. These geometries are graphical represented in the next figures:

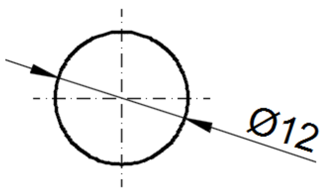

Figure 1. Blank Φ12x5.5 mm

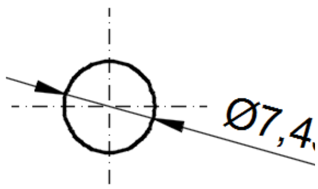

Figure 2. Round r=2.61

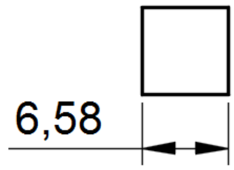

Figure 3. Square r=2.61

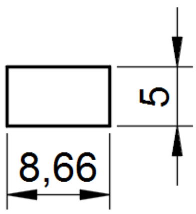

Figure 4. Rectangle r=2.61

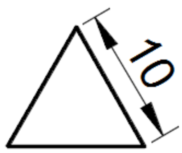

Figure 5. Triangle r=2.61

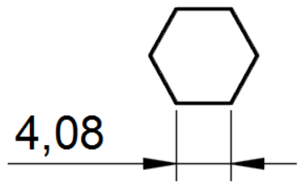

Figure 6. Hexagon r=2.61

For the 5 extrusion ratio we have the following geometries: a circle with a diameter of Φ5.3667 mm, a square with sides of 4.756 mm, a rectangle with 7.5398 x 3 mm dimensions, an equilateral triangle with 7.2276 mm sides and a hexagon with 2.9506 mm sides. These geometries are graphical represented in the following figures:

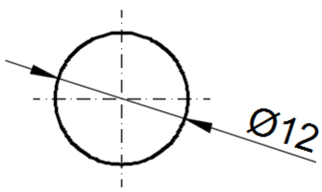

Figure 7. Blank Φ12x5.5 mm

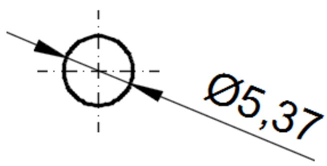

Figure 8. Round r=5

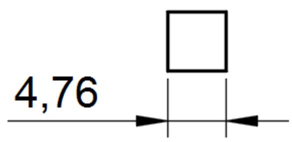

Figure 9. Square r=5

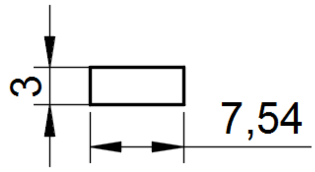

Figure 10. Rectangle r=5

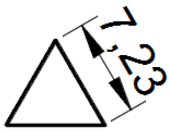

Figure 11. Triangle r=5

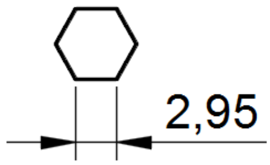

Figure 12. Hexagon r=5

2 Setup

The software used for simulation using finite element method (FEM) is Deform 3D Service Pack 2. This system consists of three major components:

1. A *pre-processor* for creating, assembling or modifying the data required to analyze the simulation and for generating the required database file.

2. A *simulation engine* for performing the numerical calculations required to analyze the process, and writing the results to the database file. The simulation engine reads the database file, performs the actual solution calculation, and appends the appropriate solution data to the database file.

3. A *post-processor* for reading the database file from the simulation engine and displaying the results graphically and for extracting numerical data.

To set up a new simulation must be selected the "New Problem" under the "File" menu. In the wizard window that appears is selected "Deform-3D preprocessor", after that should be chosen the problem location and its name, in the end will be opened the pre-processor window. For extrusion simulation process it is necessary the following objects: workpiece, top die and bottom die. These elements were created in SolidWorks 2010 x64 Edition and were exported to STL format.

The export options for STL format had been: output as ASCII, milimeters as unit, custom resolution with maximum tolarance for deviation and for angle.

2.1 Workpiece

Now it can be created a geometry for workpiece using the "Geo primitive" or it can be imported from the following formats: KEY, DB, STL, GEO, PDS, NAS, UNV and IGS.

To prepare the workpiece for extrusion simulation it is necessary to make some settings. On "General" can be changed the object name and should be selected its type, in our case was choosed the "Plastic" option. Also, the materials used was imported from the library "DIN-Al99.8[70-500F(20-250C)]".

The mesh network was set up to 120000 number of elements and was checked the option "Finer internal mesh" option. After mesh generating process were obtained the following results: 39753 nodes, 194894 elements and 26294 surface polygons. On mesh "Detailed Settings" was selected "System Setup" with "Relative" type, the number of elements remains the same set up before generate the mesh and 1 for "Size Ratio".

For "Remesh Criteria" was selected the "Local Remeshing" type with "Average of Neighbors" for "Size Control" and "Skip Elements With Good Shape" option checked. The object's "Boundary conditions" and "Movement" were kept as default. The "Target Volume" was modified to "Active in FEM + meshing". The billet has 565.48 mm^3.

2.2 Top die

The top die is inserted as rigid object using "Insert object" button.

Considering that the top die is a rigid object, it has not a mesh network and the only settings that were made consist in modifying the movement. For "Translation" was selected the crank type for "Mechanical press" option, that has 2 stroke / sec and 8 mm total stroke. Also, the "Forging stroke" was changed to 8 mm and the direction was choose the "-Y" (depending by the objects positioning).

2.3 Bottom die
Also, the bottom die is inserted as rigid object using “Insert object” button. For the bottom die is not necessary to do any other settings.

2.4 Objects positioning
The objects (workpiece, top die and bottom die) should be put in correct position according with desired assembly design. In “Object Positioning” window there are many methods for moving the objects: drag, drop, offset, interference and rotational. Using the right method and put the correct values for variables (angle; interference; axis: X, Y, Z) the objects are moved to the desired position.

2.5 Inter-Object
In the “Inter-Object” window are registered the relations between objects, are changed the deformation settings and also can be define the thermal, friction and tool wear parameters. The workpiece was setted as “slave” in relation with top die and bottom die (wich are “masters”). For each relation was added the friction values from the “Deformation” tab on the relations edit window. The friction type is shear and the value is constant (0.12), choosed for cold forming (steel dies).

2.6 Simulation controls
On main simulations controls can be introduced the simulation title and operation name, can be selected the operation number, mesh number, simulation mode (in our case deformation and heat transfer), units and type (Lagrangian Incremental). For a new database the starting step number is -1. The number of simulation steps was set to 400 with a step increment to save “1”. The top die is selected as “primary die” and the solution step definition is set to 0.08 mm constant with die displacement. For “Remesh Criteria” was kept the default setting for “Interference Depth” as “Relative” and with 0.7 value. The remeshing method was selected the “Local Remeshing” type with “Average of Neighbors” for “Size Control” and “Skip Elements With Good Shape” option checked. The other simulations controls are let with default data.

2.7 Database generation
Before the database generation should be set the path and the name (also, can be saved over an old database if it is modified). Now, it can be checked and after that will be started the generation process of the database. When the writing of database is done the window should be closed, the job is saved followed by the pre-process closing.

2.8 Simulator
To start the simulation must be clicking on “Run” button. During the process can be checked the progress using simulation graphics, and the simulation engine writes status information, including any error messages, to the message (.MSG) and log (.LOG) files.

3 Results
After the FEM simulations had been finished, were created comparative graphs for extrusion forces variation according with stroke, for all five types of extruded geometries.
To observe the stress-effective variation was choosed to be analized the round geometry.

All information about the simulations can be accessed from post-processor and can be exported for further processing. Also, to easily observe the differences between the forces obtained for each type of geomatry, was made a comparative table and was determined the percentage difference between the maximum and minimum force registered during simulations.

Table 1. Comparison of geometry influence over the extrusion force

Geometry	Force	Extrusion ratio 2.61	Extrusion ratio 5
Hexagon	Maximum force top die	24,018.23	38,279.75
	Maximum force bottom die	23,684.89	37,717.99
Square	Maximum force top die	24,145.45	38,669.49
	Maximum force bottom die	24,054.32	38,323.49
Rectangle	Maximum force top die	25,127.26	40,252.05
	Maximum force bottom die	24,966.14	39,923.14
Round	Maximum force top die	23,473.11	38,021.57
	Maximum force bottom die	23,419.40	37,394.93
Triangle	Maximum force top die	25,454.54	40,072.36
	Maximum force bottom die	24,953.35	39,610.41
Max - min [%]	Maximum force top die	8.44	5.87
	Maximum force bottom die	6.60	6.76

Next, we can see the material deformation for a 2.61 extrusion ratio, round geometry:

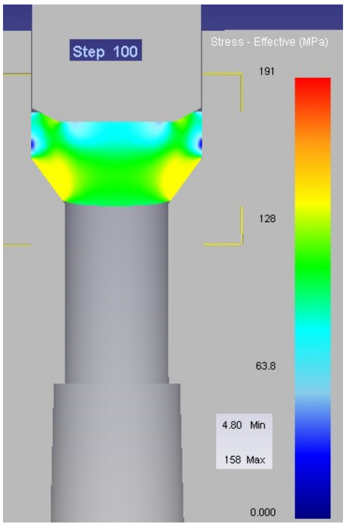

Figure 13. At step 100

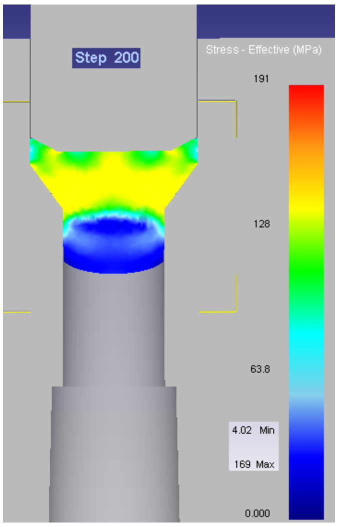

Figure 14. At step 200

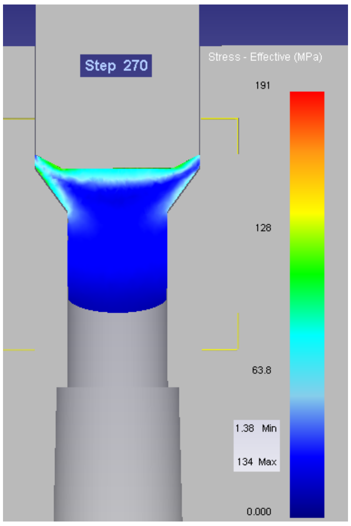

Figure 15. At step 270

For the direct extrusion with a 2.61 ratio, the graph is presented in figure 16.

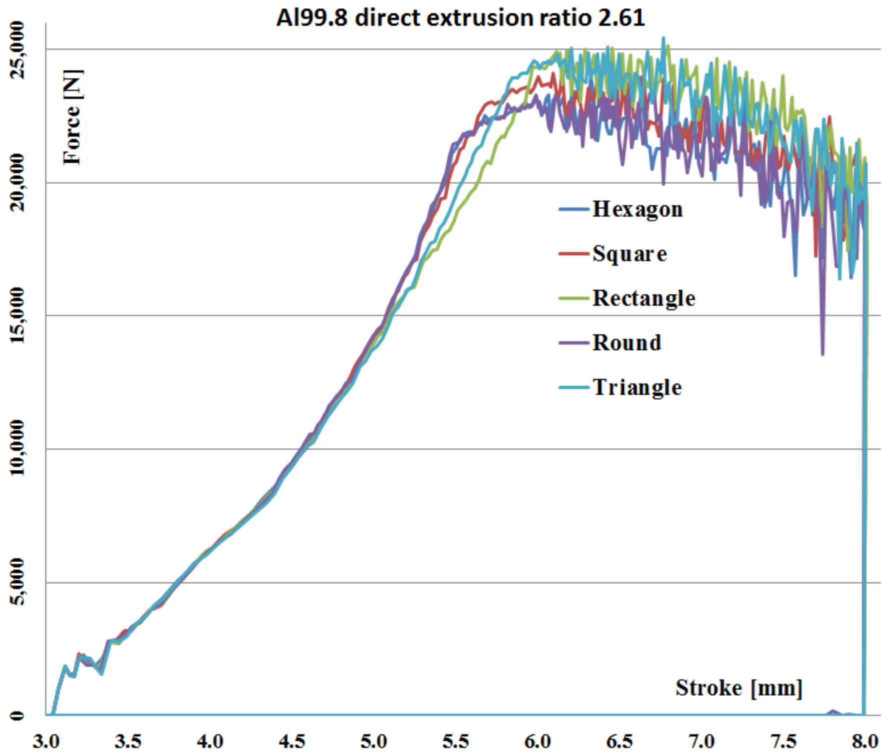

Figure 16. Force variation for direct extrusion with 2.61 ratio

The material deformation for an extrusion with 5 ratio is presented bellow:

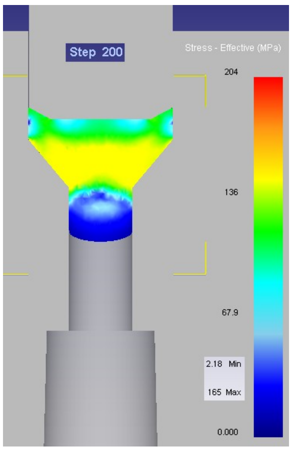

Figure 17. At step 200

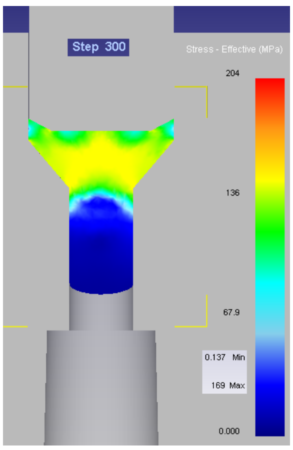

Figure 18. At step 300

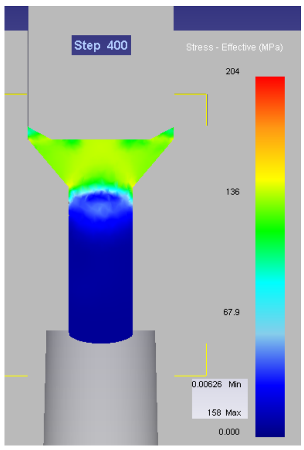

Figure 19. At step 400

For the direct extrusion of Al99.8 with a 5 deformation ratio, the graph is presented in figure 20.

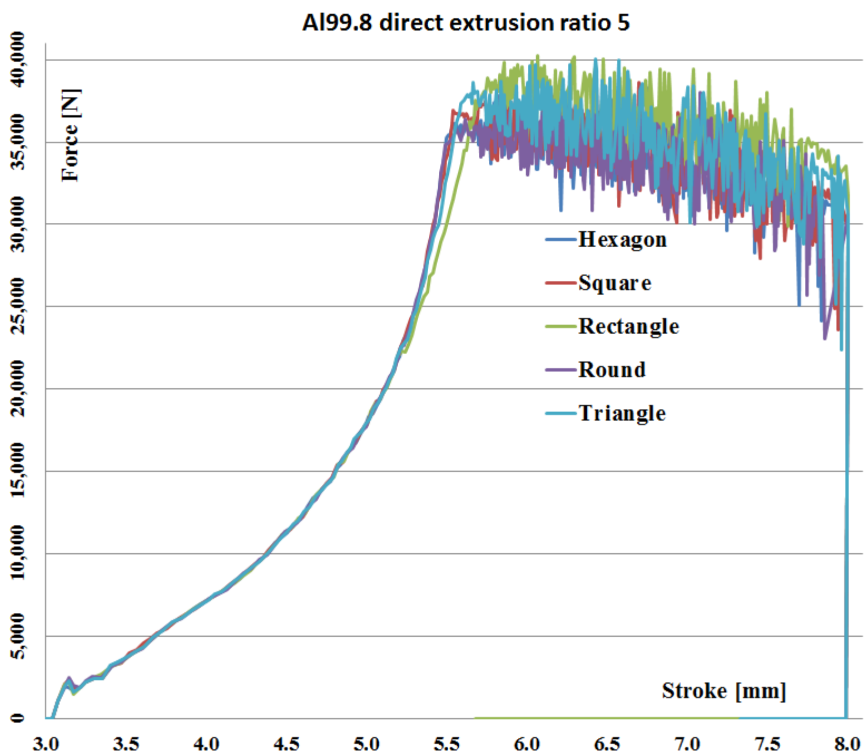

Figure 20. Force variation for direct extrusion with 5 ratio

Conclusions

After the results were analyzed there was a difference over 8% between the minimum and maximum forces registered during simulations, that confirmed our supposition.

The research will continue with different extrusion ratio and with other materials. Also, we will start the simulations for combined extrusion by keeping the bottom dies and only modifing the diameters of top dies.

After the simulation research using finite element method will be finished, we will be able to design dies for these geometries and using a data acquisition system based on National Instruments technologies, will be used the extrusion dies in laboratories experiments together with the students and in this way can be validated the simulation models. The validation process will consists in comparing the results obtained during simulations and experimental tests with calculated values using dedicated formulas.

Finite element modeling and simulation techniques have been necessitated these days for predicting the effect of variable parameters on metal forming process before real production, to reduce the experimental trials because of its cost and time efficiency and also help the students to better understand the these processes.

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Advocating for Bug Fixing. A Case Study

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Abstract

A tester achieves a successful bug reporting when he motivates the reader (i.e., the programmer) to spend his time to fix the issue and he overcomes the reader's objections to not fix the issue. In order to achieve a successful bug report, a six factor approach, named RIMGEN may be followed. The acronym stands for the six activities the reporter is required to perform from the moment he identifies a failure to the moment he sends the bug report. These activities are: Replication, Isolation, Maximization, Generalization, Externalization, and Neutral tone. The paper describes these activities together with a case study on an Apache OpenOffice Writer identified bug.

Keywords: bug, bug reporting, AOO Writer

1 Introduction

Testing is a creative activity that allows exploring various ways to use a software product. When a tester identifies and issue he must possesses skills that will make the investigation and the sent report more attractive to the programmer to allocate time for investigate. Therefore, bug reporting is similar to a sale, where the issue reporter advocates for the item or the bug identified. RIMGEN is very powerful strategy that allows the tester to advocate for the issue investigation.

The rest of the paper is organized as follows: Section 2 reminds the analogy between sales and bug reporting advocacy. Details on the RIMGEN strategy are provided in Section 3. Section 4 consists of a real case study of applying the strategy to a free software product. The analysis of this approach is achieved in Section 5. Finally, Section 6 concludes.

2 Sales and Bug Reporting Advocacy

Sales represent the art of motivating people to buy. *Bug reporting* is an persuasive activity by which the tester encourages the reader to spend time to address the issue. A bug report is a tool used to sell to the programmer the idea that he should spend time to fix the bug.

A sale is successfully accomplished when the salesman achieves the followings:

- he motivates people to buy (i.e., the client believes he needs that product);
- he overcomes the client's objections to buy (i.e., the client needs the product now and this is the best offer for the product);

A tester achieves a successful bug reporting when he achieves the followings:

- he motivates the reader (i.e., the programmer) to spend his time to fix the issue;
- he overcomes the reader's objections to not fix the issue.

The analogy between sales and bug reporting indicates that the salesman is the tester who motivates the programmer (i.e., the buyer) to fix (i.e., to buy) the bug (i.e., the item to be sold). For short, bug reporting is the activity by which the tester sells bugs to the programmer to get them fixed.

3 *RIMGEN* Acronym

In order to achieve effective bug report writing, several activities needs to be performed. They are: ***replication***, ***isolation***, ***maximization***, ***generalization*** and ***neutral tone*** usage in communication. **RIMGEN** (Altom, 2017; BBST, 2017) is the acronym for them.

3.1 Replicate

To replicate a bug means to reproduce the failure.

There are two types of errors: *coding errors* that are essential to replicate and *design errors* that are rarely important to replicate. This is because, usually reports challenges something that everyone agrees is part of the product; the report on a design error should focus on whether the behaviour should be their instated of whether behaviour is there.

Easy to replicate means that the report is written in a way that makes it easy for the reader to follow the instructions in the report and see the failure.

3.2 Isolate

When isolation the bug, the tester finds the shortest sequence of simple actions that demonstrate the problem:

- boiling down the test to the minimum number of steps needed to replicate the failure;
- writing every report so that it covers one and only one failure.

After replicating the bug, the tester has a list of the steps he took to show the failure. By isolating the bug, the tester tries to shorten the list. Aspects to be approached during isolating the bug:

- what the critical conditions are?
- write a report that includes the minimum set of steps needed to replicate the failure;
- include all the steps needed.

3.3 Maximize

In order to achieve the issue maximizing investigation step, the tester tries to see whether the failure is worse than it initially seemed to be.

Follow-up testing to see if one can demonstrate a worse failure than the initial symptom are:

- vary the performed actions, vary the program's settings;
- vary the stored data you give the program, vary the environment.

3.4 Generalize

By generalizing the investigated problem, the tester ensures that the impact of the issue is more general. This means it affects more users and more often.

There several strategies that may be applied in order to generalize a bug:

- after finding an error using extreme-values, the same test with smaller values that are used more often in normal exercised should be run;
- the same error can be reached in several ways; the same misbehaviour might be seen when several features are used, not just one;

Several examples of generalization are:

- testing under conditions that look more like typical customer use (e.g. use less extreme input values);
- retesting on a system that has less memory, older drivers, a slower connection to related applications--changing configurations to see whether the failure will replicate on a broad range of configurations;
- un-cornering the corner cases (show it fails (or doesn't) under less extreme conditions);
- showing it fails (or doesn't) on a broad range of systems;
- checking the bug's age.

3.5 Externalize

When the tester achieves the externalizing investigation step, he looks beyond the program and asking about the impact of the bug.

Examples of generalization are:

- showing historical data on refunds given to customers for previous bugs like this one;
- surveying books and articles written about applications of this kind to gather evidence that proves this failure will be important to a wide range of users.

The best strategy to be applied in order to achieve issue externalization is to switch focus from the program to the stakeholders. Therefore, the following questions on this matter need to be approached:

- What are the consequences of this failure?
- Is comparative data available?
- Is there historical support data for similar bugs?
- Other historical cost data?
- Competitors' problems?
- Have people written about problems like these in this or other products?
- What benefits does this failure interfere with?
- Who would care about this failure and why?
- Get help from stakeholders to understand what this costs them.

3.6 Neutral tone

By using a neutral tone the bug reporter pays attention to the reporting attitude. Issue reports that are annoying are more likely to be rejected. Several aspects to keep in mind when editing a bug report are:

- to make the report easy to understand;
- to keep your tone neutral and non-antagonistic;
- angry, blaming reports discredit the reporter;
- to use common fonts; if you do not have the Times New Roman font, Times regular or an equivalent font close to the printing on this document should be used instead.

4 Performing RIMGEN on Issue Reports

4.1 Case Study

Apache OpenOffice (Apache, 2017) is a free editing and formatting tool. It is the second most used tool from his family, after Microsoft Word. Therefore, the community is willing to keep the quality standards high. One of the activities in the OpenOffice community is fixing bugs reported by different users on the dedicated issue platform.

This section applies RIMGEN to the reported **Issue 120368 - font size with decimal values don't have a consistent** (Bugzilla, 2017) logged on the Open Office bug tracking system.

In the following, the context, settings, and timeline for the studied issue are reminded. Technical aspects of the follow-up testing are presented subsequently.

4.2 Context. Settings. Timeline

Before addressing the **Issue 120368** was previously investigated by:

- first reported: 2012-07-25 by Mohammed Kuranga;
- last modified: 2014-10-08 by Heli Desai.

Issue 120368 was investigated on the following software and hardware configurations:

- Operating System: Windows 10 Home, 64-bit;
- Processor: Intel Core i5, 1.7GHz;
- RAM Memory: 4Gb;
- Open Office 4.1.3.

4.3 Applying RIMGEN

A. Replicate

The follow-up testing will achieve several types of investigation:

- assessing the bug severity with the 4 "vary"-ies: vary the behaviour, vary the options and settings, vary data files, vary the configuration;

- assessing the bug *generality*:
  - failure conditions: extreme-value tests and/or corner case tests;
  - configuration dependence;
  - different ways lead to this bug;
  - the bug age: the bug is new to this version and/or similar failures appear in the database;
  - similar bugs appear in other programs;

- assessing the *context*: the competitor, the product itself, the product owner, and the end user/client/consumer.

In order to replicate the issue the following scenario template (**ScenarioA**) consisting of 6 steps was applied:

1. Start Apache OpenOffice 4.1.3;
2. Create a new Text Document;
3. [optional] Enter text, e.g., "abc"; initial Font Size is set to 12;
4. [optional] Select the entered text;
5. In the main menu, in the Font Size dropdown list enter a new Font Size value, e.g., 14.23;
6. Press Enter to update Font Size value (updated to 14.1 for the above input);

Expected result: Font Size value is updated according to the Specification Document or an error message should appear when attempting to insert a non-numeric value;

Actual result: Font Size value is updated as:

- for input values with decimals the approximation is inconsistently achieved (i.e., it does not follow the mathematical rounding);

- for input values with no decimals the output value equals to the input value;

ScenarioB is a variation of **ScenarioA**, considering the Font menu window to update the Font Size value. **ScenarioB** consists of the following steps:

1. *[optional]* Exit OpenOffice Writer 4.1.3 then start again OpenOffice Writer 4.1.3;
2. *[optional]* Create a new Text Document;
3. Choose Format menu;
4. Choose Character submenu; the Font configuration windows is shown;
5. Type in Font Size dropdown list a new Font Size value, e.g., 14.23;
6. Press Enter to update Font Size value;
   - the Font window is closed now and in the main menu, in the Font Size dropdown list the value is updated to 14.1 (for the above input);
7. Choose Format menu again;
8. Choose Character submenu;
   - the Font window is shown where the Font Size value may be different (14.2 for the above input);

Expected result: Font Size value from the main menu should be updated according to the Specification Document or an error message should appear when attempting to insert a non-numeric value;

Actual result: Font Size value is updated as:

- for input values with decimals the approximation is inconsistently achieved (i.e., it does not follow the mathematical rounding);

- for input values with no decimals the output value equals to the input value;

ScenarioB was run considering the input value 78.23, again. *Figure 49* captures the program state where Font Size value on step 8 in **ScenarioB**, where the behaviour is inconsistent. The font Size attribute was assigned two different values.

The inconsistency persists when the **ScenarioB** is run before **ScenarioA**. *Table 13* shows several runs where **ScenarioA** and **ScenarioB** are executed in different order with different input.

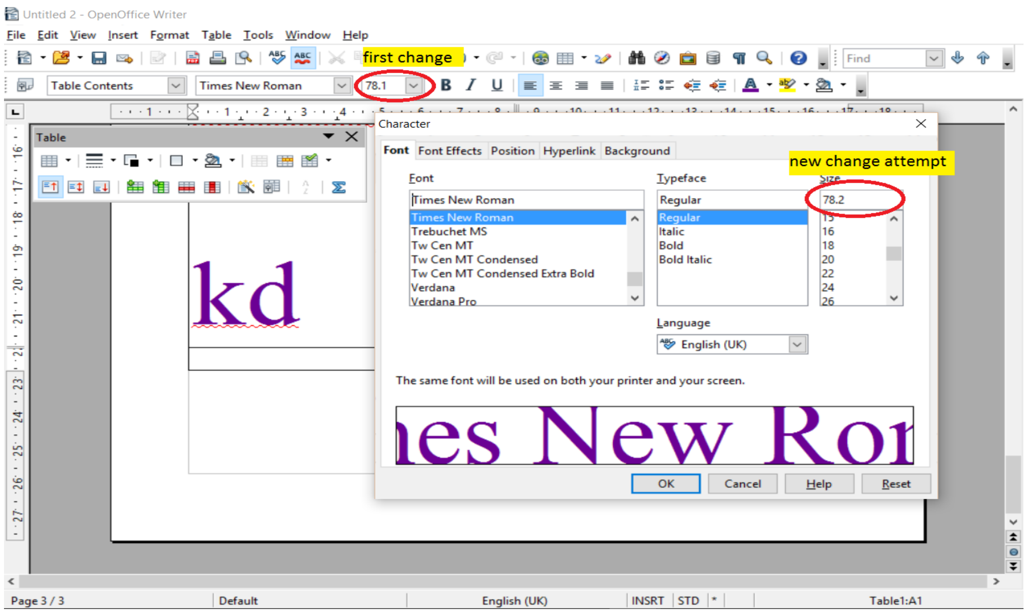

Figure 49 Inconsistency in Font Size values for different application entry points

Table 13 Approximation inconsistencies for different features that use Font Size values

Execution order	Current value	First Scenario		Second Scenario		Notes
		Input	Output	Shown Value	Updated(yes/no)	
1.A, 2.B	100	78.23	78.1	78.2	yes	updated value, correct approximation in B, wrong approximation in A
1.B, 2.A	100	78.23	78.2	78.1	yes	updated value, wrong approximation in A
1.A, 2.B	78.2	100	100	100	yes	updated value, correct approximation
1.B, 2.A	78.2	100	100	100	yes	updated value, correct approximation

The bug severity was studied investigating the Writer’s behaviour where changes or variation on features run, data files, settings, or configuration occurs.

a. vary the behaviour:

- changing the Font Size value from: the Font menu (Format-> Character), the main menu (Font size drop down list), the right click Size menu (not allowed, predefined values to select only);
- changing the Font Size value for text in: document, tables, footnote content;

- changing the Font Size value with a not valid value;

b. vary the options and settings:

- changing the measurement unit (Options -> OpenOffice Writer -> General -> Measurement Unit): from centimetres to inches, from inches to point;
- changing the view (View): from Print Layout to Web Layout, from Web Layout to Print Layout;

c. vary data files:

- changing the dictionary for the spelling options (Tools -> Spelling and Grammar- > Add *standard.dic*);

I have run different the test cases from. No changes on the test results.

- changing the language for all text to Romanian (Tools -> Language - > For all Text -> More… -> Languages -> Local Setting -> choose Romanian); start again OpenOffice Writer.

d. vary the configuration:

- changing the power settings for the computer: from high performance to power saver and from power saver to high performance.

B. Isolate

Test cases presented in *Table 13* indicate an easy way to isolate the bug. **ScenarioA** and **ScenarioB** allow computing an approximation of the Font Size value. They provide a different value which means that (at least) one is faulty. There may be used an Oracle that helps to decide the correct result. In this case, **ScenarioB** returns the right value, while **ScenarioA** constantly provides a bag approximation. Therefore, we have:

- **ScenarioA** that shows the failure of approximation;
- **ScenarioB** that helps to build various scenarios to isolate the bug in **ScenarioA**, but it proves the result is not passed to the main window menu.

ScenarioA and **ScenarioB** transmit one to another the value to be approximated but each of them seem to use a different approximation strategies (i.e., algorithms).

C. Maximize

The worst impact is provided by the inconsistency on the two scenarios discussed above. The error in approximation is considered less important than the fact Font Size value may be assigned to different values at the same time.

D. Generalize

In order to assess the bug generality the following research was performed:

- the analysis on failure conditions indicated by corner case tests;
- the analysis on configuration dependency;
- the analysis on different paths that lead to the same failure;
  - *Table 13* shows there is no sequence dependency on showing the failure;
- the analysis on the bug's age;
- the analysis on similar bugs to appear in other programs;
  - this failure was investigated on the competitor's product (MS Office Word);this failure didn't show u;. the various types of entries (i.e., valid or non-valid, numerical or not) are handled by the competitor's product very strictly:
    - o if the value is not numerical then an error message is shown;
    - o if the value needs approximation to 0.5 then an error message is shown;
    - o if the value exhibits and corner case then an error message is shown;

The failure indicated in the initial report seems to be a small one, an approximation error that affects few people. Few people use the Font Size values having decimals.

E. Externalize

The bug impact may be analysed under different aspects of the end use/client perspective:

- first, the client identifies a problem with approximation, he will be very suspicious on any measurements the product needs to work on or to approximate;
- second, if he realizes that **ScenarioB** offer him the good approximation result will rely on it and his user experience will be affected; he will have to keep in mind always to avoid **ScenarioA** instead of **ScenarioB**.

F. Neutral tone

While editing the issue report, the tester must comply to several aspects related to the communication. He must avoid:

- annoying attitude may cause the bug report to be rejected;
- being aggressive and attacks other persons (developers);
- stating personal opinions on the professional skills of the development team or management team.

5 Results Analysis

There are two main achievements accomplished by applying the RIMGEN strategy to advocate for this bug fixing. First, it allows the issue reported to investigate thoroughly a possible failure. By this, he gains knowledge on the software and the relevance of the problem he intends to report. Second, the tester ensures the provided evidence will make the issue more appealing to the programmer to further investigation.

Conclusions

RIMGEN is a powerful strategy that allows the tester to build its case for a successful bug fixing. The paper presents the way this strategy highlight key aspects of the **Issue 120368** logged for the Apache Open Office Writer. They concern mainly the inconsistency and the bad user experience by forcing him to user the tool in specific way only to achieve the needed result.

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Technical analysis on a modern Virtual Learning Environment

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Abstract

The new recommendations of the High Level Group on the Modernisation of Higher Education (HLG-MHE) included in the report for the European Commission emphasize a zone where the electronic systems in education become vulnerable to virtual attacks or get exposed to risk factors regarding accessibility. This paper offers detailed guidelines elaborated for implementing the modern system Virtual Learning Environment (VLE) type that assures a similar access to the one in the classroom for presenting the materials to a Massive Open Online Course (MOOC) to all people, including the ones with critical immovability without reducing the safety offered by a Learning Management System (LMS).

Keywords: VLE, LMS, MOOC

1 Introduction

Androulla Vassiliou(European Commissioner for Education, Culture, Multilingualism and Youth, in the Report to the European commission on New modes of learning and teaching in higher education, October 2014) had spoke about the enormous potential of new technologies to effect changes in higher education. The modern educational technologies enable universities to meet a broader range of learners' needs adapting and shifting traditional teaching methods and offering a mix of face-to-face and online possibilities that allow learning anywhere, anytime. They also create openings to engage in new kinds of collaboration and offer opportunities to distribute resources more effectively.

2 Literature Review

The recommendations 12, 13, 14 and 15 of HLG-MHE din 2014included in the*Report to the European commission on New modes of learning and teaching in higher education*, in the end of 2014:

- Recommendation 12: „The European Commission and national authorities should encourage and incentivize higher education providers to award and recognize credits under the European Credit Transfer and Accumulation System for all forms of online courses. The current revision of the ECTS Guide should incorporate these principles"
- Recommendation 13: „Governments and higher education institutions should work towards full open access of educational resources. In public tenders open licenses should be a mandatory condition, so that content can be altered, reproduced and used elsewhere. In publicly (co-) funded educational resources, the drive should be to make materials as widely available as possible."
- Recommendation 14: „Member States should ensure that legal frameworks allow higher education institutions to collect and analyze learning data. The full and informed consent of students must be a requirement and the data should only be used for educational purposes."
- Recommendation 15: „Online platforms should inform users about their privacy and data protection policy in a clear and understandable way. Individuals should always have the choice to anonymise their data."

There was a debate back in 2009, at the World Conference on Higher Education, (Paris),about **access, equity and quality** in higher education. Equity must not resume to facilitating access to everybody but it should also aim at offering a safe environment for participation. Higher education should be equipped with specific systems aiming at fulfilling a diversity of individual learning needs and potential while providing high quality education programs.

3 Discussions

We have designed the system together with the colleagues involved in the European project POSDRU/86/1.2/S/64075 *–University for the future in the communication society,* teachers, computer scientists and researchers, considering a sequence of requests that will be presented below as result of the discussions between the partners in the project.

The VLE type system must be represented by an online platform that should allow open access, at any distance, to didactic materials and that should allow the security of the information displayed and validated by teachers. The same instrument should allow the validation of materials by qualified teachers and the cataloguing the published documents. The video materials must also be accessible through common means to as many platforms or video apps as possible or should allow the download of software apps required for visualisation. All these operations must be achieved as transparently as possible.

The VLE type system should be accessible through a web type interface, among the easiest to access currently on any device, intuitive (choosing a standard that should be user friendly), consistent (consequent usage of the chosen standard in all developed apps or modules), flexible (allowing clients to setup different features of the app), convenient (easy to access, enjoyable), concrete (to contain information that is as useful as possible for the users).

The VLE type system must be built on open-source technologies and the content should be processed also under free licence in order to allow open access to any resource for as many users as possible at any distance. All the parts of the system must be tested in similar conditions to the production ones and must respond correctly and in due time to any request.

The VLE type system must be accessible with any browser, platform or working unit connected to the Internet. Also, the implementation and usage costs should be reasonable.

The system should also assure the security for any communication, recording, online broadcasts or other activities that are addressed to the public (entirely or partially). The VLE type system should allow „public” or „private” options for any recording, broadcast or didactic material. The system must be secured so that unauthorized users should be forbidden to modify the resources.

4 Background and framework

In 2009, all participants to the UNESCO World Conference on Higher Education signed the *Communiqué: The New Dynamics of Higher Education and Research for Societal Change and Development*. They made observations regarding the need to include new technologies in the educational field for covering more special needs and for overcoming spatial barriers.

Chihaia and Istrimschi (MEDIAEC Platform. Digital Television for Education and Research, 2010)presenta technical architecture for a VLE video. The authors described a video system capable of broadcasting materials in video format inside and outside the campus of Alexandru Ioan Cuza University of Iasi.

Berechet and Istrimschi(Becoming a modern university. from real approaches to virtual challenges, 2011) cover more aspects regarding the integration of a LMS with video system and creating the premises of the firstmodern VLE – at that time, integrated in the educational services platform for distance learning at Alexandru Ioan Cuza University of Iasi.

Berechet and Istrimschi (Education Reboot: Reinventing the University, 2014) presented a list of arguments forthe implementation of the entire VLE with LMS and video servers in the context of modern higher education.
Berechet and Istrimschi ("Effective information" against "Incomplete information", 2014) conducted a short research at Alexandru Ioan Cuza University of Iasiamong the users of any learning services from three faculties with different curricula. The hypothesis of that research stated that the new students need different and modern methods to interact with the professor and to follow the necessary steps in the learning process. After analysing theobtained answers, the authors had discoveredthat over 70% of the studentswant to review the exact lecture of the professor later in the learning process. This could be possible, from the perspective of the modern VLE, only if there is a video server in addition to a LMS.
Now, with the new developed system in the university campus, we are capable to cover more requests via online and to better secure the entire video servers structure. We also could provide online course materials or presentations and we could speak about the concept of a properly Virtual Learning Environment, containing LMS and video service structures.
The High Level Group for Modernization of Higher Education (Report to the European commission on New modes of learning and teaching in higher education, 2014)had made some recommendations regarding the need of implementation in the educational field of the systems who offer the access to educational act from any distance, in any way. They mention that the access of online learning resources should be almost the same as the traditional "face-to-face" way.

5 Results

Our system was developed on architectural structure presented in figure 1.

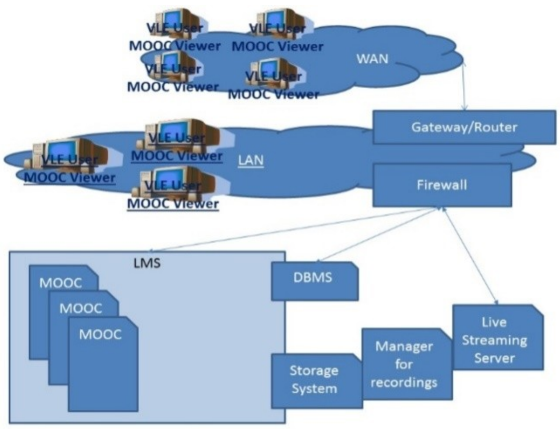

Figure 50. The block scheme for an entire VLE

The security of the entire VLE is the sum of the security of every part in the VLE.
The users of WAN are in the same VLE as the users of LAN and they have similar access to the course materials.
The usage of video servers is accessed in the same way as the LMS itself and could be used independently from or coordinated by LMS. In case a material is private, it could be configured like that, and accessed only through LMS.
The DBMS (Database Management System) could also be used as an independent service or integrated with LMS. In this VLE it is used in the second way, integrated in LMS.

We use Moodle as LMS.
For video live meetings students – professor, we use a dedicated video server called Live Streaming Server.
For recorded video presentations of the course materials we use a video server as manager and presenter of the public recordings and a storage system.
The recorded presentations could be made directly in the classroom with a common videocommunication terminal. The recordings will look as in figure 2.

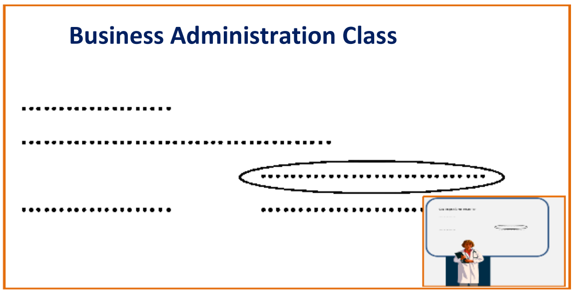

Figure 51.Caption of a recording class

If the professor wants to highlight something, he must execute a circular form on the surface of an “intelligent board” that has a touch sensitive system and the computer attached to that touch sensitive system will record the movement over the presentation of the didactic material as shown in figure 2. On the broadcasted image, the receiver from distance will get an image made of two components. One with the didactic material as presented in the classroom, with the circle mark over the content. And in one corner of the screen there will be an image with the professor in real time making that circle over the material and speaking about the aspect that he intended to emphasize.

Conclusion

Developing the LMS system by using the video component improves the application of instructional methods in the didactic process. This component could be a useful tool along withthe constructivist instruments developed within LMS.

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Intelligent Interfaces for Knowledge Representation and Processing Systems

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Abstract

The usage of markup technologies to specify knowledge to be processed according to a specific field of application is a common technique. This proposal deals with representation techniques based on markup language paradigm to describe various types of knowledge. Details on using Knowledge Representation and Processing Systems in education are presented.

Keywords: KRP systems, Markup technologies, Intelligent interfaces

1 Introduction

By models and markup technologies, in the context of this work, we understand those models and technologies derived from SGML (*Standard Generalized Markup Language*; ISO 8879:1986). SGML is a meta-language, i.e. an artificial language which allow us to describe other languages, in general for the formatting of documents.

Since SGML was used initial by the Association of American Publishers, then it has become a powerful model with applications and multiple influences. For example, (Coleman and Willis, 1997) proposed that SGML to be used in the conservation of the publications of the libraries. In the same year, already appeared HTML (*HyperText Markup Language*, 1990) that languages of the markup for WWW, and *Extensible Markup Language* (XML, 1996) as the language of the description of the structured information. Therefore, SGML is known as being the father of both HTML and XML. However HTML is a court specifies its DTD of SGML (with markers predefined), and XML is a subset of SGML where users can define their own tags and attributes.

An XML document is composed of markers (tags) and data "character" (char, character). A marking is a string of characters bounded by the symbols "<" and ">". An XML file contains three sections: a header (?xml version="1.0" encoding="UTF-8?">), the definition of document type internal or external (example: !DOCTYPE document SYSTEM "external.specifies its DTD">) and the root (XML Information in this part may be set as a tree structure).

A XML schema to describe the set of rules used by Knowledge Representation and Processing (KRP) Systems can be given as below (regula.xsd).

```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
<xs:element name="Regula">
  <xs:complexType>
   <xs:sequence>
     <xs:element name="Eticheta" type="xs:string"/>
     <xs:element name="PStanga" type="xs:string"/>
     <xs:element name="PDreapta" type="xs:string"/>
```

```
    </xs:sequence>
   </xs:complexType>
 </xs:element>
 </xs:schema>
```

XML Processors are used to verify whether the XML documents are well formed or not. To access and editing an XML document, initially is loading the XML document in associated task (example with JavaScript):

```
parser = new DOMParser();
xmlDoc = parser.parseFromString(text,"text/xml");
```

Then extract the elements of the XML document for processing.

In the context of the knowledge representation of the rules used by KRP systems we can consider <Cunoastere> as a root element which may include one or more elements of the rule type. Each item rule has a unique identifier rid. A rule of association (A => B) is formed of "The hypothesis of A" and "B - the inferent part". Therefore, each hypothesis must have one or more items. Each item hypothesis has a name that is represented by a sequence. Describe the this model in table 1.

Table 1. An XML for association rules

XML Document	The DTD of the model
<Cunoastere> <Regula rid=”1”> <Ipoteza> <ItemIpoteza> <Name>A</Name> </itemIpoteza> </Ipoteza> <Consecinta> <ItemConsecinta> <Name>B</Name> </ItemConsecinta> </Consecinta> </Regula> </Cunoastere>	<!ELEMENT Cunoastere (Regula+)> <!ELEMENT Regula (Ipoteza Consecinta)> <!ATTLIST Regula rid CDATA> <!ELEMENT Ipoteza (ItemIpoteza+)> <!ELEMENT ItemIpoteza (Nume)> <!ELEMENT Consecinta (ItemConsecinta+)> <!ELEMENT ItemConsecinta (Nume)> <!ELEMENT Nume (#PCDATA)>

To describe structures useful to outline knowledge in the field of science of the soil for agriculture, (Meenakshi et. al., 2016) have converted XML declarations in a format useful for application, called KBML (*Knowledge Based Markup Language*). All meta-information is stored in a file KBML, while the actual data may be available in any data source (distributed, etc.). However KBML is not a markup language, but merely a XML application.

In the context of modeling and knowledge processing have been developed specialized Markup notations such as: RDF/XML (model supratitles for expressing graphs as RDF documents that XML), CKML (*The Conceptual Knowledge Markup Language*, 2000), OML (*Ontology Markup Language*), DLML *(Logical Description Markup Language*). OML is an extension of the SHOE and supports the lambda expressions. OML and CKML are based on the conceptual graphs introduced by (Sowa, 2008).

The kernel of a RDF model is made up of nodes and pairs of attached attributes/values. A description of the RDF syntax is presented in (Buraga, 2004) and can be understood on the basis of the following example that describes the creator of the file `tey.rdf` located in the folder "`\home\ALI`" on a Windows Server:

```
<rdf:RDF>
  <rdf:Description
    rdf:about="file:///home/ali/tey.rdf">
      <xf:Creator>
        <rdf:Description
          rdf:about="http://www.upit.ro/">
           <xf:Name>A L I</xf:Name>
        </rdf:Description>
      </xf:Creator>
  </rdf:Description>
</rdf:RDF>
```

For RDF diagrams one shall specify the space of rdfs names. The fundamental RDF classes are: `rdfs:Resource` (class resources), `rdf:Property` (describes the properties of the resources) and `rdfs:Class` (for specifying the type or category). To define a new class of RDF diagram, corresponding resource class has the property rdfs:type whose value resource is `rdfs:Class`. The resources which belong to the defined class are called courts. An example that describes a collection of resources is:

```
<rdf:Bag rdf:ID="documente-sustinere">
  <rdf:li
     rdf:resource="file:///lucru/teza.docx" />
  <rdf:li

rdf:resource="https://www.upit.ro/_document/8806/anexa_27_cuantum_
taxe.pdf" />
  <rdf:li
    rdf:resource="
https://www.upit.ro/_document/11836/procedurii_privind_realizarea_
documentelor_in_vederea_sustinerii_publice_a_tezei_de_doctorat_si_
transmiterea_dosarului_la_mencs.pdf" />
</rdf:Bag>
```

New versions CKML have included the ideas and techniques on the informational flow (IF - *Information Flow*) and the design of the logic of the distributed systems. The final version CKML is both a language based on the logic of the information document and a language based on frames. In accordance with (Kent, 2000), "in CKML the specification requires the use of the concept of mathematical latice or the most practical notion of conceptual space", we can infer from here explaining the notion of conceptual latice via "formal concepts that the elements of a laticiale structures of the concepts. The basis of the theoretical portion of the practice based on CKML is CKP Theorem which states the equivalence between data structures of type conceptual latice and formal context (classification).

OML provides three levels of further specify the restrictions: *top* - sequences (corresponding informational flow); *the intermediate pipe* - calculation of binary relations; *Lower logical expressions* (corresponding to concept graphs).

Expressing an ontology is possible using the languages of specification such as: KIF (*Knowledge Interchange Format*), CL (*Common Logic*), OIL, DAML+OIL AND ALLURE.

KIF is based on the logic of the predicates, but provides a LISP oriented syntax for this. From the point of view of the semantic, there are four categories of constant in KIF: constant of type object, constant of function type, constant of relation and logical constant.

OIL (*Ontology Inference Layer*) extends RDF diagram to provide an intuitive syntax and a great power of expression and a semantics more clearly defined with easy to use descriptive logic within the framework of the schemes of reasoning. Such OIL brings together and unifies three directions: descriptive logic, modeling based on frames and modeling RDF/XML.

(DAML DARPA *Agent Markup Language*) + OIL has a syntax diagram type RDF, that inherits the primitives of RDF (subclass, domain, range) and primitive added extras like transitivity, cardinality etc. Schematic DAML+OIL is oriented on the objects in which the concepts are abstracted by grades and roles through the properties of the objects. Thus, the ontological model DAML+OIL is based on a lot of the axioms about the classes and properties, as well as a set of builders very useful from the perspective of the RPC systems: *intersectionOf*; *unionOf*; *complementOf*; *oneOf*; *toClass*; *hasClass*; *hasValue*; *minCardinalityQ*; *maxCardinalityQ*; *cardinalityQ*.

The result of the foregoing the evolutionary process: 1) OIL extends RDF; 2) DAML extend RDF; 3. DAML+OIL DAML integrates and OIL and extends the RDF; 4) ALLURE extends DAML+OIL and RDF.

The final result of the research on ontological modeling using RDF/XML has led to the specification of the ALLURE, in three versions: ALLURE **LITE** (simple hierarchy, hierarchy of classes with simple constraints), ALLURE **DL** (maximum expressiveness) and ALLURE **FULL** (very expressive). For the processing of meta-data described using specific Markup ontologies have been developed a variety of tools for annotation, navigation, utilities (API), edit, view graphics, marking, pan, validation, import, export, compilation, query, search etc. A list of them would be too long. We will be limited to the most important tools, the rest being described in the references indicated: **DUET** (*DAML UML Enhanced Tool*), **UBOT**, The Platform **Protégé**, and **Ontolingua**. Ontolingua Editor allows for the creation of ontologies, exploration and collaborative editing. Using Ontolingua, it is possible to export and import formats like: KIF, DAML + OIL, OKBC, Prologue, the LOOM, Ontolingua and CLIP. Can import data in the protégé format.

2 SCXML and Voice XML

SCXML provides a generic state-machine, an execution environment based on CCXML and Harel State Tables, according to (W3C, 2015). Also in (Kistner & Nuernberger, 2014) it is mentioned that: "using SCXML as the representation of the state machine is seen as a benefit". The mentioned authors found that "large portions of the SCXML standard are not necessary for it to be useful to our customers and us." An example of the SCXML representation is for speech recognition in the natural language. For the implementation of the KRP systems, the role of the SCXML is active in the framework of the failures, through voice and natural language.

According to the above considerations, it was our choise to propose the usage of VXML. VoiceXML (VXML) is a markup language for specifying the vocal dialog between a man and a software application, for example a KRP system. Thus, using VoiceXML 2.0 one can develop KRP applications which provides automatic recognition of speech (ASR - Automated Speech Recognition) and interactive vocal response (IVR - Interactive Voice Response).

The main elements of voiceXML are: <vxml> - start/close any vxml document; <var>, <assign>, <clear> used to declare, assign and delete variables; <grammar> to specify the grammar of the text under recognition; <catch>, <throw>, <error>, <noinput>, <nomatch> to manage exceptions; <menu>, <choice>, <enumerate> to deal with menu; <if>, <else>, <elseif> to deal with conditionalities; <initial>, <form>, <field>, <filled>, <option> to process forms; <prompt>, <reprompt>, <value> for input operations; <prompt>, <audio>, <record>, <reprompt> to deal with multimedia entities; <block> to describe the code to be executed; <disconect>, <exit> for the management of the sessions; <meta>, <metadata> for metadata management; <noinput>, <nomatch>, <help> to manage events and actions; <subdialog>, <goto>, <return>, <linkfor dialog control; <object>, <property>, <param>, <script>, <submit>, <transfer>, <log> for server orienter processing of parameterized queries.

Vxml applications may be of the type uni - or many - document. An application many - document allows us to define a root document which defines all the entities visible in and recovered by the documents son. The example below describes a skeleton query type using the voice. This model can be extended for the implementation of the interfaces based on voice within KRP systems.

3 Markup Technologies

From the point of view of the process of XML tying - JAVA implemented by JAXB, it is noticed the existence of two major components: a generator of diagrams and compiler of diagrams and the process actually involves tying seven actions: *the generation of classes*; *the compilation of classes*; *unmarshal* (XML documents which satisfy the restrictions in the diagram source are processed by the JAXB. Also, JAXB lets you transfer XML data from sources other than the files and XML documents such as the nodes DOM, paintings rows of characters, SAX sources and so on and so forth); *the generation of the shaft into which describes the contents of an XML document*; *validation* (Unmarshal process involves the validation of the source before generating shaft into which describes the contents. Where there is a change in the shaft in the next step can be used the operation JAXB validation to confirm the changes before to transform the contents into a document XML); the client application may change the XML data represented by JAXB shaft using the interfaces generated by the compiler JAXB; *marshal* (the shaft that describes the contents is converted into the XML document. The content can be validated before the conversion. A process called "Marshalling" offers a client applications the ability to convert a Java derived from JAXB in data XML.)

With a force greater than the programming, can be used JAXP technology (Java API for Procesing XML) based on SAX (Simple API for Parsing XML) and DOM (Document Object Model). During the operation of the "parsing" based on SAX it generates events that notify the components identified, and Java application must deal with the events of the callback methods (for the construction of the structure of the database). The operation of parsing DOM build in the memory a representation tree diagram of the data from the XML document. JAXP technology allows the transformation of XML documents using XSLT technology (Extensible Stylesheet Language Transformation).

XMLBeans technology is used to compile the XML layout with obtaining in memory, the classes, and has been developed in the period 2003-2014 by the Apache Software Foundation to enable the processing of large structures.

Therefore, for the processing of databases structured knowledge which comply with a diagram and are stored in XML files may be used JAXB technologies facing on the diagram XML and JAXP facing on the direct rendering of documents XML. JAXP is a good choice for large knowledge database to be processed in terms of low computational capacity.

4 KRP Systems in Education

According to (Sora & Sora, 2012), a KRP system for Artificial Education (AE) should take into consideration four elements. In AE, the first element, "knowledge would include knowledge of pedagogy (teaching practices and beliefs), curriculum, and knowledge regarding the individual student’s needs, assessments, evaluating, and more". The second element is connected to problem solving. In this context, the KRP system should "look at past successful and unsuccessful pedagogies used with individual student, and it would be able to present instructional material to that specific student in a way the benefited him or her individually". The last two elements are connected to developers and administrators, but the mentioned authors did not conclude on smart interfaces for KRP educational systems. However, they emphasize on Intelligent Tutoring Systems (ITS), but ITS are "emphasizing those aspects which have relevance to user support, rather than detailed consideration of the merits of pedagogical or student knowledge modelling strategies" as shown by (Hefley & Murray, 1993).

Following (Horvitz, 1999), an intelligent user interface should consider imprecision and uncertainty aspects during run-time. This is more important in AE, due to the nature of queries formulated by learners. As (Salih D., 2014) mentioned, the Natural User Interfaces (NUI) will be the next generation of user interfaces to improve user experiences. Our proposal is based both on Artificial Intelligence Techniques to deal with imprecision/uncertainty and natural language aspects with speach understanding and knowledge restructuring for fast answering systems.

Therefore, any KRP system for education should consider preliminary requirements to understand the learner's behaviour, markup models and technologies to implement solutions to queries given in "approximate" natural language by learners. One KRP system for education should be able to represent not only pedagogical aspects, but also, different variants of content, and appropriate behaviour according to the learn initiatives.

Conclusions

This work has analyzed the detailed rules for the description of the information structured used in context of KRP systems, using markup languages. The best choice is a model of the XML, and from the point of view of the java technologies for the processing of XML documents deserve to be retained for practical application JAXB (object interrogation, processing in memory) and JAXP (linear, facing processing on the fragments identifying and dealing with events). The effort of JAXB programming is less and is promoted object processing.

In addition, by Voice XML can be describes the smart interfaces of the KRP systems based on voice.

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Involving Students in the Creation of an Intranet Glossary: Outcomes and Challenges

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Abstract

Computers have changed the face of dictionaries, but also the lexicographic landscape, including the way lexicography is taught. Nowadays, it is easier for students to put into practice their theoretical knowledge and take part in the design and construction of new lexicographic tools. The aim of the paper is to present the challenges and associated outcomes for the students involved in the LEXICA-Admin project. On the one hand, we will refer to the result of this lexicographic project, i.e. an intranet Romanian-English glossary of administrative terms from higher education, a necessary tool for university staff dealing with drafting official documents in English or translating them from Romanian into English. On the other hand, we will focus on the construction of the glossary as a teaching instrument, because it involved the participation of master students from our university, and was built on the infrastructure of the existing pilot e-dictionary Lexica (http://lexica.unitbv.ro/).

Keywords: intranet glossary, pilot e-dictionary, dictionary-making, lexicography

1 Introduction

Starting from the premise that “in all stages of making a dictionary the computer plays an important (and in the 21st century an exclusive) part” (Magay, 2000: 449), we intend to focus in this paper on the involvement of students in a lexicographic project which resulted in the creation of the LEXICA-Admin intranet glossary. The latter was built on the infrastructure of an existing pilot e-dictionary, namely *Lexica* bilingual dictionary (http://lexica.unitbv.ro/), available from 2008. As described by Sinu and Micu (2013: 161), *Lexica* “is one of the outcomes of a lexicographic research project, *Competitiveness and Effectiveness in Intercultural Specialised Communication through the Optimization of Online Resources*, funded by the former National University Research Council (CNCSIS) and conducted in 2007 and 2008 by an interdisciplinary team of academics and research students from *Transilvania* University of Braşov. It was originally created as a pilot dictionary for the fields of politics, trade and law on the basis of a corpus made up of texts relating to the European Union”.

This paper aims to highlight the outcomes for the students involved in the lexicographic project LEXICA-Admin, and the challenges they faced while working on it. Thus, we will discuss the project both from the point of view of the resulting glossary and as a multi-stage process conducted with the help of students. The first part of this paper will present the aims of the glossary and its features, with reference to the above mentioned pilot e-dictionary. In the second part we will focus on each of the stages of the project in order to highlight the students’ contributions and gains.

2 LEXICA-Admin: Describing the Instrument

The LEXICA-Admin glossary was initiated within the master programme *Language Studies for Intercultural Communication* (Faculty of Letters), and its lexicographic content was put together by master students enrolled in the programme in the interval 2011-2015, as part of their obligatory research activity. The project afforded students the opportunity to use the *Lexica* experimental dictionary in order to perform lexicographic tasks related to the different stages of dictionary-making, proving that "*Lexica* is a valuable teaching tool as it enables the master students taking the course in *Fundamentals of Bilingual Lexicography* to correlate the metalexicographic input with the lexicographic practice" (Sinu and Micu, 2013: 163).

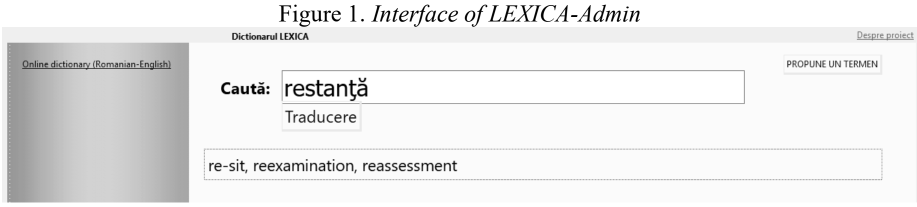
In addition to being a tool for lexicographic training, the glossary was designed as a necessary instrument for our university staff involved in administrative work, especially those who write official documents in English and/or translate documents from Romanian into English, activity which has intensified as a result of the efforts towards internationalization made at university level in the context of globalization.

Globalization has prompted universities to attempt to become more international: "Globalization and internationalization are related but not the same thing. Globalization is the context of economic and academic trends that are part of the reality of the 21st century. Internationalization includes the policies and practices undertaken by academic systems and institutions - and even individuals - to cope with the global academic environment." (Altbach and Knight, 2007: 290). In fact, during the past decades, according to Altbach and Knight (2007: 290), "the international activities of universities dramatically expanded in volume, scope, and complexity". Knight (2003: 2) defines internationalization as "the process of integrating an international, intercultural, or global dimension into the purpose, functions, or delivery of postsecondary education". The internalization strategies of universities from around the world, especially those from countries whose official language is not English, often entail resorting to an international language for communication, which in turn leads to the intensification of the activity (drafting, translating, etc.) in that language at the level of the university administration. This glossary was intended to increase the efficiency of administrative work, especially in the field of drafting documents into English or transferring them into English, by eliminating certain problems which arise in translation. Considering the different educational backgrounds or levels of English language training of administrative staff members, the glossary is meant mainly to ensure consistency and accuracy in the way terms are used.

It is also worth mentioning that the intended usefulness of the glossary was an additional motivation for the students involved, who were aware that they were working to create a lexicographic tool to be used at the level of the university.

Moving on to the features of the glossary, we can notice (see Figure 1 below) that it is a reduced version of *Lexica* which was described in Burada (2009), Sinu and Micu (2013). The reason for simplifying the glossary microstructure and interface was determined by the target users. The glossary is not aimed at language professionals who can be assumed to possess a certain level of proficiency in dictionary use, but at professionals in other fields who are looking for help in the translation process, and whose work might be encumbered by too much linguistic information.

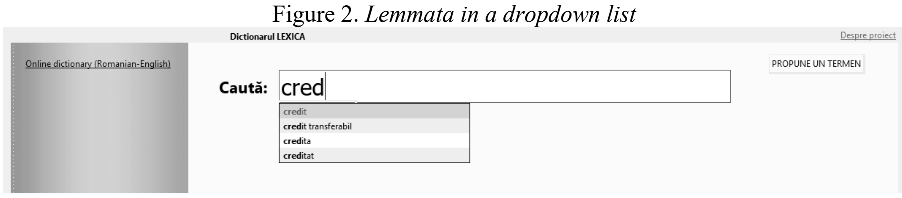
Figure 1. *Interface of LEXICA-Admin*



LEXICA-Admin uses the interface created for the initial project, but it preserves only one option for the user, namely "Traducere" (Eng. Translation), below the search field, unlike Lexica in which the user had access to contexts, paradigm, structures, etc. This means that at the microstructural level the glossary includes only one element, namely the English equivalent or the translation of the Romanian term.

The button "Propune un termen" (Eng. Propose a term) in the upper right-hand corner shows that the glossary was not conceived as a static list of words, but as a dynamic and interactive tool easy to adapt to the users' needs. In fact, the glossary will be updated and corrected with the help of future users who, by means of the above mentioned button, can communicate with the team involved in implementing the project.

Figure 2. *Lemmata in a dropdown list*



In order to assist the users, the dropdown list feature was preserved as we can see in Figure 2 above, making it easier to identify the term of interest and displaying all possible options.

3 LEXICA-Admin: Describing the Process

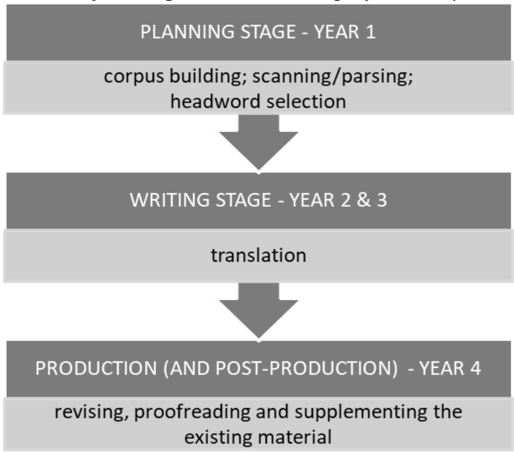
The glossary includes around 3000 terms extracted from about 150 administrative texts in the field of higher education (reports, methodologies, regulations, University Senate decisions, operational plans, strategic plans, etc.), downloaded from the websites of various Romanian universities.

The project was carried out by second year master students as part of their mandatory weekly research activity during the second semester. This was an opportunity for them to apply the theoretical background acquired in the first semester at the module *Fundamentals of bilingual lexicography*. The lexicographic work started in the academic year 2011-2012, and ended in 2015; in November 2015, the glossary became available on the intranet of *Transilvania* University of Brașov.

Working with a different team of master students each year might seem problematic, but we were able to overcome this difficulty because they all had the same theoretical lexicographic input, and by organizing informative meetings and discussions whose purpose was to present the entire workflow of the project to students, in order for them to know each stage of the project they were undertaking, to encourage them to make practical decision based on their theoretical knowledge, to answer any of their project-related questions and offer clarifications, when necessary, concerning the activities they were performing.

The tasks were associated with the three major stages in dictionary-making: planning, writing and production (Landau, 2001:343), which took place over four academic years as illustrated in Figure 3 below. The *planning stage* for students began from a series of given parameters such as the languages involved, the intended target audience, the coverage of the glossary, the types of information to be included in the microstructure.

Figure 3. *Project stages and activities performed by students*



However, the students were involved in corpus building: they gathered texts pertinent for the administrative field from the websites of different Romanian universities; then, they formatted the texts in order to use the text parsing programme developed for *Lexica* to extract words according to their frequency. Next, they selected the terms deemed relevant from the list automatically generated by the parser. The main challenge for students at this stage was to decide on the terms which could be considered useful for the target audience. This entailed becoming familiarized with types of administrative documents available on our university website and learning more about university procedures and regulations. For example, a decision had to be taken whether to include names of study programmes or course titles from the university curricula. After discussions, we agreed not to include such items in the final list of terms because they were viewed as too specific and their translation depended on the options of each department or course convenor, and might vary greatly. Other items eliminated from the list of term in the glossary include specialized terms used in course descriptions, such as “hepatită” (Engl. hepatitis), “inspector de specialitate chimist” (Engl. chemical inspector), “muzeograf” (Engl. museum curator), “proză” (Engl. Prose), “paleografie” (Engl. paleography), “studio (atelier)” (Engl. studio), “solist instrumentist” (Engl. instrumental performer), etc.

In the *writing stage*, each of the Romanian terms selected was paired up with its English equivalent(s). The translation process was supported by general bilingual dictionaries and specialized glossaries, but it also involved checking the way the equivalents were used in administrative documents issued by universities in English-speaking countries. The main difficulty at this stage was caused by the differences between the Romanian university system and the realities in higher education in universities from countries such as the United Kingdom, USA, Australia, etc. These differences were the subject of discussions concerning the way a certain Romanian term could be defined in order for students to be able to understand it and identify an English term referring to a similar or closely related reality. Thus, students had to take into account, for instance, that the Romanian term “bursă” can be translated into English in various ways depending on its type, for instance “bursă contractuală” as “contractual **sponsorhip**”, “bursă de doctorat” as “doctoral **fellowship**”, “bursă de excelenţă” as “excellence **grant**”, “bursă de studiu” as “**scholarship**”. Another example refers to the form “colocviu” which in Romanian covers two distinct meanings, signaled by short explanations accompanying the term, with different English translations, namely “colocviu **(conferinţă)**” translated as “colloquium”, and “colocviu **(formă de examinare)**” translated as “oral examination”.

In some situations, the documentation concerning education available at the level of the European Union proved quite helpful in the terminological research, for example, the terms associated with the Erasmus programme or other European research programmes had readily available translations.

The *production* or *implementation* of the project was carried out by an IT expert, but students were involved in the *post-production* activities, for example, revision, proofreading, identifying logical gaps and filling them.

At each stage, students used their background knowledge in (bilingual) lexicography, e.g. the lexicographic process, principle and rules of definitions, types of equivalents, etc. In addition, in the planning stage, corpus linguistic rules were discussed and applied in order to make sure that the text corpus is reliable and relevant for the purpose; whereas, in the writing stage, students made use of their linguistic skills, and they learnt more about the way universities are organized in Romania and abroad.

Conclusions

In conclusion, we believe LEXICA-Admin reached both of its aims: during its construction it functioned as a learning tool for students, whereas its product represents a reliable terminological resource for administrative staff. Although it is still a work in progress, the glossary can be improved and updated in time so as to better meet the needs of its target users.

As for the students' involvement, we discussed both the challenges they faced and the outcomes of their activity. From the point of view of the challenges for students, the project entailed making lexicographic, terminological and translation decisions concerning the list of Romanian terms and their English equivalents, while taking into consideration the particularities of the Romanian university system and other cultural specificities. As for the outcomes, we feel that students gained practical experience in the field of lexicography, as they took part in the stages of building an electronic reference work by fulfilling various activities. At the same time, they also found out more about their university, especially in contrast with other higher education systems across the world, especially the British and the American one. They were also able to practice their language skills and make informed translation decisions based on thorough documentation.

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Design and Implementation of an Interactive E-Democracy Web Application Based On a Platform for Business Process Management

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Abstract

This paper proposes a solution built on the principles of e-democracy, based on Business Process Management. Its purpose is to reveal the features of this e-activity branch and corroborate them with the specific management processes to create a method for generating e-learning content. The WebRatio platform-based application refers to the democratic process of introducing a law project from its inception until the final approval to the vote. The e-democracy process corresponding to a new law project has four major stages: initiation, planning, execution, completion. The application is designed and deployed to be a strong binder between a democratically elected representative and the corresponding represented community through the active involvement of citizens in the public debate of laws and disclosure of the representative's decisions on law projects proposed to be voted in plenary. The application allows easy, direct and open collaboration, oriented to community consultation, helping the representative to better acknowledge the community needs and desires, through transparent and accurate standardized communication, all these actions being related to debated and voted law drafts. The representative uploads in the application the law draft with the information necessary to disseminate its context and sends it to all community members enrolled in the application. The citizens present their views and communicate them to the representative, which gets all information through the centralized process. Thus, the representative can accomplish informed decision in accordance with the opinions of the citizens. Using the process, the representative shall inform citizens of its vote in plenary and justify it.

Keywords: Business Process Management, Web Application Design, Software Tools, Advanced Web Technologies, Online Management, Virtual Access Systems

1 Introduction

This article proposes a solution built on the principles of e-democracy [1], based on Business Process Management (BPM) [2]. Its purpose is to reveal the features of this type of e-activity and corroborate them with the specific management processes to create a method for generating e-learning content [3].

E-democracy represents all means of information technology used to increase public engagement and key stakeholders in democratic processes. The entire process becomes a transparent decision using a BPM-based platform [4], while Web services [5] provide communication between multiple entities of a BPM solution. Thus, BPM is revealed as modeling, execution, processes and reporting language and, above all, means of analyzing and understanding a business.

2 The Concept of E-democracy

E-democracy represents all the electronic means of information technology used to increase the engagement of citizens and key actors involved in democratic processes [1]. The actors or stakeholders, as they are called, are represented by governments, politicians, mass-media, political organizations and citizens.

The main purpose of this electronic activity support is to increase participation in the democratic and political life of citizens by applying the underlying concepts. It is thus desirable to move from representative democracy, through which citizens are represented at political and decision-making level by their elected representatives at a level closer to that of deliberative democracy, in which decisions are taken by citizens themselves. The previous definitions of e-democracy focused either on the technological side of this concept (on the platform itself) or on the principles and values on which it is based. According to the European Council [6], e-democracy is the use of information technology in the democratic sectors within the political processes of local, regional, state and national communities. The democratic sectors take into account: governments, elected officials, mass-media (including online portals), political parties and interest groups, organizations in civil society, international governmental organizations, and citizens.

By using different forms of transmission of information, such as the Internet or mobile devices, an effective field is created not only to streamline the whole activity, but to organize it in other ways in order to involve those who do not usually participate in decision-making. Thus, through e-democracy, the voice of citizens affected by a series of decisions can be heard in real time, even within the decision making process, thus influencing its purpose. Some researchers [7] support the notion that, de facto, there is no "e-democracy" (electronic democracy) term, as there is no democracy made using the verbal or written message. From their perspective, democracy is a concept, a rule of decision-making and implementation, and so on. Another segment of researchers [7] argues that just adding the "e" prefix contributes to the return of democracy to its original and worthy forms of appreciation.

Beginning with the deliberative democracy applied in ancient space of Athens based on Plato's concepts [8] and continuing with its expansion so as to represent the foundation of governing entire political systems [9], democracy represents a whole segment of the segments. Each of these segments can find their applicability in using different types of electronic support. Among these are: e-voting, e-participation, e-consultation, e-environment, e-legislation, e-parliament, e-justice, e-mediation, e-campaigning, e-petitioning, e-initiatives, and e-polling/e-surveying [10]. Thus, what at first instance may seem to be merely an activity based on the expression of an opinion is rooted in a whole range of independent and autonomous activities from each other.

3 The Concept of Business Process Management

One of the ways in which the entire decision-making process can be transparent is through a computer platform built and based on process management. It opens up the area of flexibility and traceability at decision and procedure level to ensure coherent and consistent information and a clear legislative framework. Such a development platform allows the interaction of decision-makers to clearly define the procedures by which different types of e-democracy can be applied. Being process-oriented, decision-making and consultation management can be perfectly applied to other segments of this context.

Process-based management is a holistic management approach that involves aligning a concept's goals with the functionalities needed to put it into practice. The key benefits of process-based management are: agility, efficiency, continuous improvement and flexibility. From a technical point of view, implementation of BPM (Business Process Management) applications is done with a BPMS (Business Process Management Suite), and Web services are the ones that provide communication between the multiple entities of a BPM solution. It is more than the component of an activity stream or an assignment procedure – it is the equivalent of the basic organic element of the body of activity. Speaking in anatomical associations, it represents the nervous cell that by its connection forms the nervous system, which controls the whole biological ensemble.

A business process is composed of a chain of activities that constitutes its lifecycle, from a defined start, predefined or triggered, to the set end. These tasks can be performed by the personnel involved or automatically by integrated systems (databases, process engines, document management solutions, etc.). Activities are consistently linked and triggered based on events, set times, automated validations, and notifications. To complete the overview, add the reporting part that monitors the activity of the processes, the input-output parameters can provide detailed information and set alerts (see Figure 1).

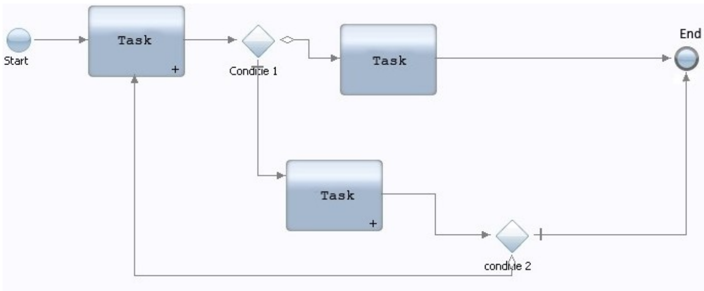

Figure 1. The model of a business process

Thus, BPM is revealed as modeling language (BPMN), execution language (BPEL), process engine, reporting, and first of all, a way of analyzing and understanding a business. From a technical point of view, a BPM application consists of:

- The BPM model – automated workflows through a BPMS (WebRatio): user-assigned tasks, automatic tasks, email notifications, daily procedures, etc.;
- The Database – all information transferred via the workflow will be stored in databases (MySQL) for a functional module of the solution (add container, loan, request, transfer between archives, etc.);
- The Web Services – documents involved in the automated workflow can be transmitted electronically via Web Services to a document management application: it is possible to interconnect with any other application that has Web Services exposed by creating a SOA (Service Oriented Architecture).

4 The BMP-based E-Democracy Application

4.1 The BPM Modeling

In order to implement the management solution for specific archiving activities, we have chosen to use WebRatio BPM [11], a tool used in designing and implementing business processes in a Web environment. The basic concept of the solution presented is BPM, currently materialized in several technologies, the most relevant being: Business Process Analysis (BPA), Complex Event Processing (CEP), BPM Suite (BPMS), Enterprise Application Integration (EAI), and Service-Oriented Architecture (SOA).

To understand what process-based management is, the business process must first be defined. This is the orderly deployment of activities that results in achieving a desired business outcome. BPM is an approach, a concept that allows continuous improvement of an organization's performance. This technological initiative is reflected at the level of IT system architecture and starts from the definition of business components. The technical approach to process management is based on the corresponding BPM notation that has become de facto the standard: Business Process Modeling Notation (BPMN) introduced by the Object Management Group consortium [12]. BPMN is a suite of standard notation graphics similar to those used to illustrate UML (Unified Modeling Language) activity charts [13]. BPMN is used for process design, which will later serve as a starting point for implementing a BPM application. The basic categories of BPMN [14] are (see Figure 2):

- Flow objects (workflow specific tasks) – events, activities, decision blocks;
- Connecting objects – associations, messages, sequences;
- Swimlanes (activity spaces) – departments, roles;
- Artifacts – objects, groups, annotations.

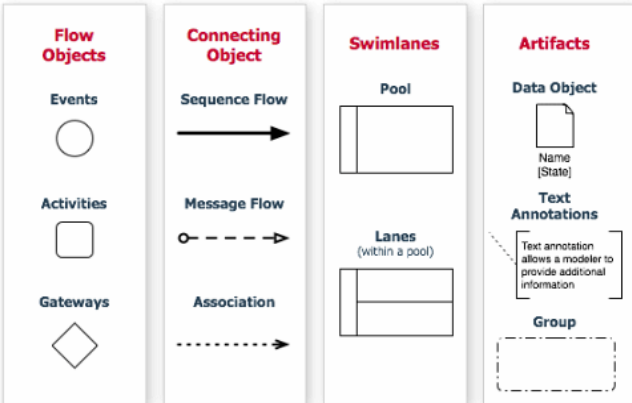

Figure 2. The BPMN elements [14]

The model resulting from the graphical representation of the process through BPMN can usually be exported in a format supported by the BPM solution (XPDL or BPEL). There are a number of vendors specialized only in modeling processes [15] such as IDS Scheer, Proforma, Mega, iGrafx, Telelogic or Casewise.

To achieve performance, implementing a BPM project involves following cyclic steps: design, modeling, execution, monitoring, and optimizing.

Benefits of applying BPM are clear:

1. Run processes and implicitly deliver their results in a shorter time;
2. Reduce the distance between business and IT by merging the two;
3. Delivering a common view on processes, a vision that both businessmen and IT developers understand;
4. Integration of services and applications within the company.

4.2 The WebRatio Platform

WebRatio is a tool that uses the development of Java Web / SOA applications based on concepts such as BPMN and Web Modeling Language (WebML) [16]. WebML is a BPMN-like graphical notation that uses the design of complex Web applications. WebML is represented by four perspectives:

1. Structural model: illustrates site content in terms of entity-relationship, and representation mode is compatible with UML diagrams;
2. Hypertext model: describes what is published on the site and defines hypertext as a site view, which in turn can contain two patterns:

- Composition model: specifies which pages are the ones that compose the hypertext and what notations form a page;
- Navigation model: specifies how links bounded each other the site pages;

3. Presentation model: specifies the graphic composition of the site's page;
4. Personalization model: users and groups are modeled in schemes or structures as pre-defined entities.

WebRatio introduces the concept of process implementation using models. This involves automatic process transformation (BPMN) in Web applications (WebML), the possibility of manual refining the WebML model, automatic generation of executable code and a complete Web application running on the J2EE platform and on an Apache Tomcat server.

4.3 The Design of the Information and Legislative System of the Application

The WebRatio-based application refers to the initiation of a law project from its inception (draft) to the final voting approvals. The e-democracy process of initiating a law goes through four major cyclic stages: inception, planning, execution, and finalizing.

For the entire process of initiating a law, there is a specific documentation for each step that needs to be approved over its course. Thus, the documentation required for these steps will be captured, elaborated and validated within the application.

Deliverables of this stage of initiation are:

1. Analysis of the problem and needs;
2. Analysis of solutions;
3. Elaborating the strategy;
4. Analysis of organizational capacity;
5. Identification of interest and support for the project;
6. Identification of results and impact.

It is intended to identify the working factors of a law and their purposes. The application aims to transfer initiatives to propose laws in the legislative apparatus to local communities, and then to corroborate them as a national decision-maker. It is envisaged as follows:

- involvement of local communities;
- informing citizens about legislative initiatives;
- their contribution to the decision-making level at the local level;
- proposing laws and passing through legal and legislative filters.

A generic scheme of law aims primarily at bringing added comfort and efficiency to social activity. Thus, the generic scheme is represented in Figure 3.

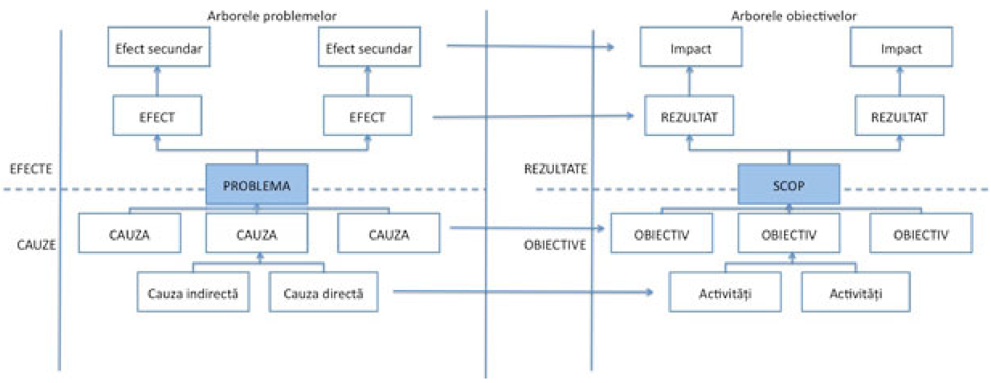

Figure 3. The generic scheme of a law project: causes and effects

4.4 The Use of the E-Democracy Application

The application aims to represent a strong link between the Representative for a specific community (electoral constituency – in the case of Romania, Electoral College, county or local council) through the active involvement of the citizen and the awareness of the decisions taken by the Representative regarding the Law proposed to vote in Plenary / County/Local Council. One of the great disadvantages of representative democracy is the rupture that takes place between the elected person and the community that put him/her in office, immediately or shortly after the election. Thus, willing or forced, the Representative gets to distance himself/herself from the community he/she represents and, most of the time, makes decisions that are not in accordance with its needs.

The application allows Representatives easy, direct and open collaborative cooperation with the community. It is just a community consultation tool and not one that forces the Representative to act in any way. It allows the Representative to know the necessities, wishes and context of the community they actively represent, through transparent, precise communication, and normalized by a process-based system.

Everything relates to the Laws Drafts under discussion and voting. The Representative uploads to the application the Law Draft together with the information necessary to know the context by the community and sends it to all the members of his/her community who are enrolled in the application. They expose their opinions (pros/cons) and communicate them to the Representative who receives them through the Centralized Process.

The representative will be able to take an informed decision in line with the views expressed by the citizens of the corresponding College. Then, through the trial, he/she will inform each one of his/her votes in the Plenum and justify it to them.

As for the context, according to the Romanian Constitution, each law draft must, before entering the vote of the Plenum/County/Local Councils, undergo a public debate. This means both publishing in the Official Gazette of Romania as well as in some media channels. Given the practice of the last years, it is used that the population does not consult the Official Gazette and the media channels used are of the lowest possible coverage. The electorate does not know its rights, which, in conjunction with the authorities' desire to maintain certain passivity from the electorate, leads to the approval of laws that run counter to the interests of most of the voters.

The citizen's rights, according to the Constitution, stipulate:

- Obligation of the Representative to reply to complaints/interpellations from voters;
- The right to information when a law draft is being discussed;
- Obligation of the College's representative to speak in the Plenum and present the wishes and opinions of his/her own Electorate;
- Other: the representative apparatus is meant to express the will of those the citizens.

All can only be used and implemented through coherent information and the standardization of a good practice of expressing opinions. This can be efficiently modeled through processes.

4.5 The Working Procedure in the E-Democracy Application

Students will play the role of both the *Deputy/Representative* and the *Citizen/Voters* in the educational e-democracy application, focusing on specific case studies simulating *Law Drafts*. Steps will be repeated for each of the scenarios.

Deputy/Representative:

D1. Completing Metadata on the Law Draft;
D2. Upload the Document on the Law Draft;
D3. Fill in the Justification and Voting option.
D4. Notification to the Citizen;

Citizen/Voters:

C1. Viewing the Law Draft Document;

C2. Fill in the Comments/Remarks and Suggestions on the Law Draft;
C3. Completion of the Project Personnel Decision;
C4. Sending the Notice to the Representative;
Deputy/Representative:
D5. View Results & Generate Reports (Histogram);
D6. Sending the result of the vote to the Citizens together with the justification;
D7. Answers to Citizens' Notices/Suggestions;
Citizen/Voters:
C5. Consultation of Voting Results/Response to Remarks/Suggestions;
C6. Expression of a new Opinion to the Representative;
Deputy/Representative:
D7. Viewing the Citizen's Opinion;
D8. Answer to this Opinion.

Conclusions

The WebRatio platform-based application refers to the democratic process of introducing a law project from its inception until the final approval to the vote. The e-democracy process corresponding to a new law project has four major stages: initiation, planning, execution and completion. For the whole process of initiation of laws there is a specific documentation to be approved each step along the way. Thus, within the application the required documentation including these steps is captured, developed and validated. The e-democracy educational application is designed and deployed to be a strong binder between a democratically elected representative and the corresponding represented community through the active involvement of citizens in the public debate of normative acts (laws) and disclosure of the representative's decisions on law projects proposed to be voted in plenary. The application allows students easy, direct and open collaboration, oriented to community consultation, helping the representative to better acknowledge the community needs, through transparent and accurate communication, standardized by a process-based (BPM) system, all these actions being related to debated/voted law drafts.

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Online Management of the Virtual Access System to the Activities of Educational and Cultural Institutions

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Abstract

In order to simulate the online management of the real access system in an education and culture institution, a user-friendly web interface was designed using the latest IT technologies. Based on the analysis made in the case study of the Romanian National Museum of Art, the following needs were identified: to create an automated visitors registration system and to implement a management system for events and users. The management system allows the system administrator to add, delete, and edit users or new events via a web interface. HTML5, CSS3, JavaScript and PHP technologies have been used in this project. The application consists of 4 main pages, with HTML structure and dynamic components (Java), and a server-side component (PHP), which makes possible the connection to the MySQL database. The user enters the registration page of an event within the museum website. The signup page is set as the default page for all users accessing the app. Administrator's perspective allows access to the registered users and events management pages. The possibility for registered users to be automatically notified of the data regarding the events was created. Registered users can change/cancel a reservation to a booked-up event, and the administrator can manage users and events in a flexible simple way. The application is built on a modular structure, providing added stability, and the optimal blending of front-end technologies has provided users with a user-friendly and easy-to-use interface. It can be considered as a template for various other types of educational and cultural services.

Keywords: Web Application Design, Software Tools, Advanced Web Technologies, Online Management Applications, Virtual Access Systems

1 Introduction

Online management of the real and virtual access system in educational and cultural institutions is a matter of interest, which calls for the capacity to analyze the activity of the access system and its transposition into a virtual environment [1]. In order to simulate the online management of the real access system in an education and culture institution, a user-friendly web interface was designed, created using the latest IT technologies and software tools [2] ÷ [11].

2 Software Tools and IT Technologies

HTML5 [10] is the latest version of Hyper Text Markup Language. Standard version 2.0 was announced in 1995, and after two years HTML 3.0 was announced, then HTML 4.01, the latter being used at the moment.

CSS3 [11] is the abbreviation of Cascading Style Sheets and represents a styling language used to describe how elements need to be rendered on the screen, on the page, or on other media. CSS3 is a standard for formatting elements in an HTML document.

JavaScript is an object-oriented scripting language with syntax rules close to those of C language. JavaScript commands are included in the Web page, along with the text and bookmarks that make up its content and are interpreted by the browser. JavaScript is based on performing events following a function. Events that can trigger a feature are: pushing a button, loading a page, changing the content of an input, etc.

jQuery [6] is a JavaScript library developed in the idea of writing less code and doing more actions in front-end areas of a web application. Using this library attempts to eliminate common and recurring activities.

Bootstrap [2] is a web-design framework that helps develop responsive web interfaces adapted to any type of device: desktop, tablet, and mobile phones. Built to develop websites and web apps faster, Bootstrap enjoys an increasing popularity, being one of the most popular frameworks for web design. The framework contains HTML, CSS, and JavaScript elements, providing a wide variety of interface components, such as forms, buttons, navigation areas, tables, alerts, and more [9].

PHP [4] is a recursive acronym: Php Hypertext Preprocessor, being considered one of the most important open source, cross-platform and server-side programming languages [7], [8]. PHP is one of the most exciting web site and programming technologies, combining the most complex features and offering simplicity in use.

MySQL [3] is a free distributed database management system based on the SQL standard. SQL is used to create databases, modify database structure, insert and delete data, and control access to information. MySQL is a fast, easy to learn and used management system that supports the connection of several concurrent customers to the server. Its primary role in a web application is to centrally store application data and interface user interactions with database information.

3 Application Description

Based on the analysis made in the case study of the Romanian National Museum of Art, the existing needs for an automated registration system for visitors wishing to participate in the educational and cultural events of the museum could be identified. A system that allows users to record events integrated into the structure of the museum website is very useful and simplifies the work of museum employees.

Based on the same analysis, the need to implement an events and users management system using the registration system has been identified. The recording system is supervised by an administrator and operates independently of museum staff. Thus, the user enters the registration page where he/she can book a number of seats for a certain event. The management system allows the system administrator to add, delete, and edit users or new activities (events) via a web interface.

The application consists of 4 main pages, each page having the .PHP extension. The pages have HTML structure and dynamic components, represented by JavaScript and jQuery library, and a server-side component, represented by PHP, which makes it possible to connect to the MySQL database. Like most web apps, this app has a database to store the information of users who intend to participate in museum events, as well as information about events organized in the museum.

The structure of the database of the application is represented in Figure 1.

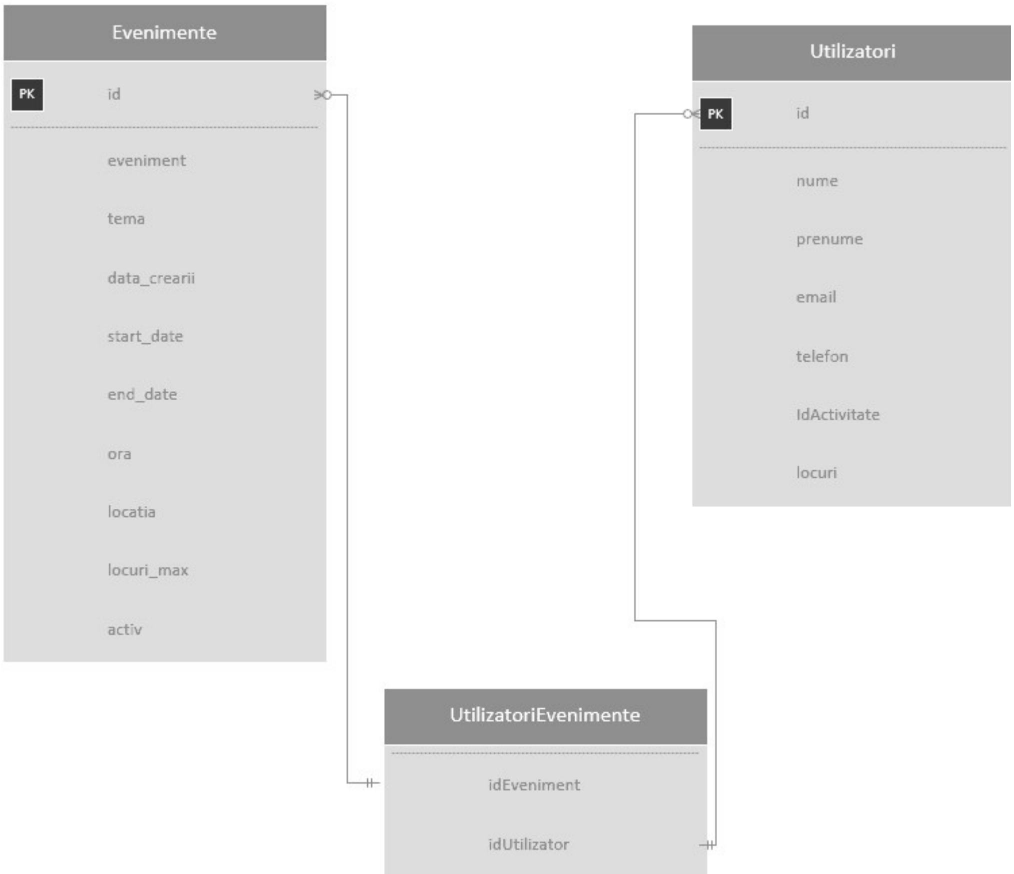

Figure 1. The Structure of the database

The "Event Sign Up" page allows visitors to subscribe to events organized within the educational and cultural activities of the museum, as shown in Figure 2.

The "Cancel/Change Reservation" page allows visitors to cancel or change a subscription to an event organized within the museum's activities, as shown in Figure 3.

The "Manage Users" page gives the administrator the ability to edit or delete visitors who have signed up to participate in various events, as shown in Figure 4.

The "Manage Museum Activities" page allows the administrator to manage events organized within the museum's activities, as shown in Figure 5.

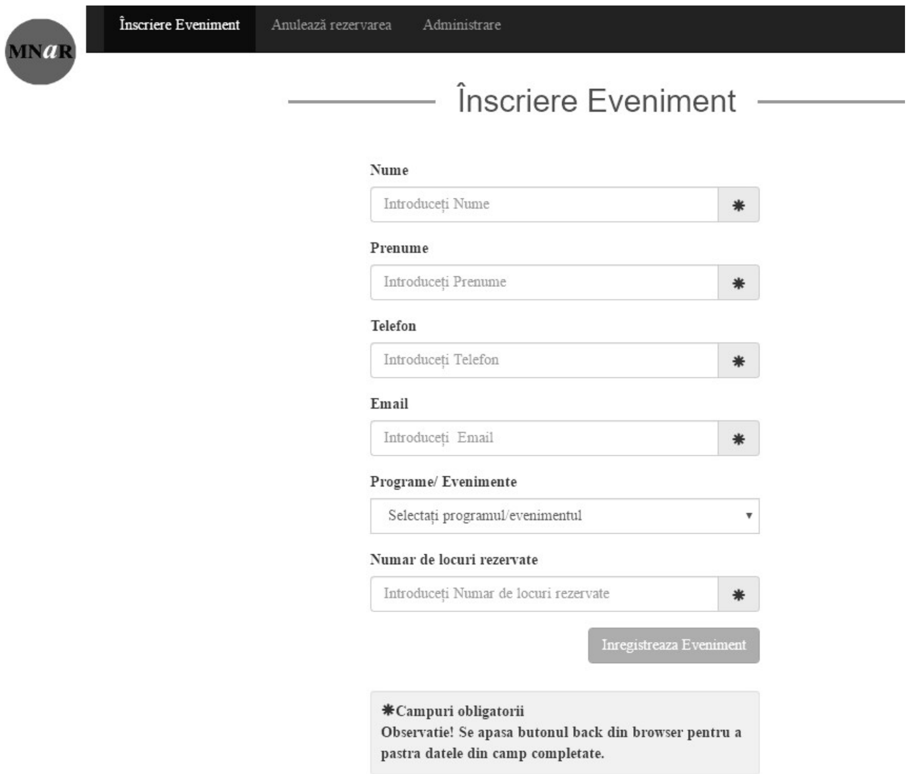

Figure 2. The "Event Sign Up" page

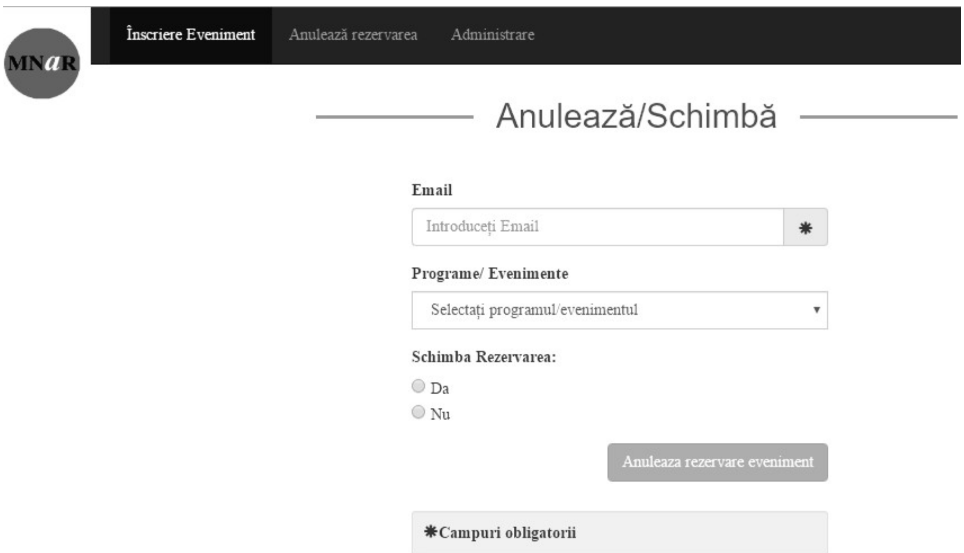

Figure 3. The "Cancel/Change Reservation" page

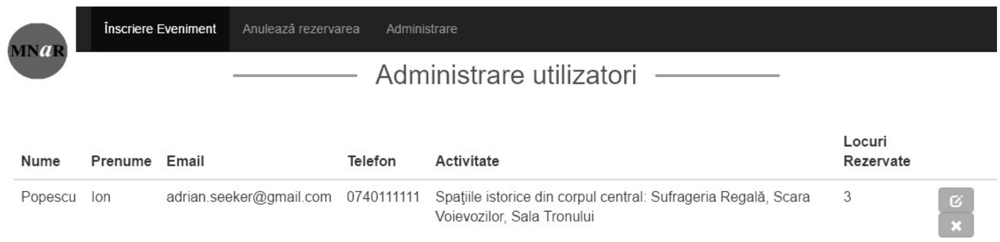

Figure 4. The "Manage Users" page

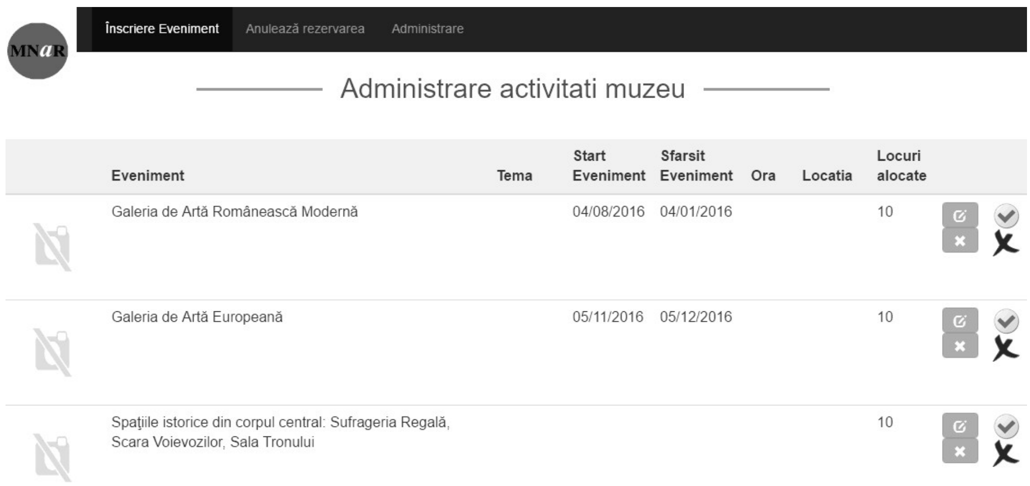

Figure 5. The "Manage Museum Activities" page

4 Application Functioning

4.1 User's Perspective

The first contact of the user with the application is made through the registration page of an event within the museum website. The signup page is set as the default page for all users accessing the application. The user of the application's web interface can view the menu bar to be able to navigate within the application. User perspective allows visitors to view the "Event Sign Up" and "Cancel/Change Reservation" pages (see Figures 2 and 3). These two pages are the pages that any visitor can use.

The registration of the users in the system is done using the form shown in Figure 2. To subscribe to an event, the user must complete the following fields in order to participate in that event: Name, Surname, Email, Phone, Activity Museum (specific event organized within the museum activities), Seats Event, and Number of reserved seats.

The "Event Places" field gives the user information about the number of available seats for an event at the moment of signing up. This field appears dynamically when the user selects an event for registration and it does not appear by default when accessing the "Event Sign Up" page. Figure 6 shows how the "Event Places" field is displayed and populated automatically by the number of seats currently available for the selected event.

Figure 6. Dynamic display of the signup form at an event

The “Number of Reserved Seats” field (see Figure 6) is the field where users can choose to reserve a specific number of seats for the event they wish to attend. Reservation functionality is for individuals or groups up to 4 people. Groups with a larger number of people who want to attend an event within the museum's activities can make reservations by contacting museum’s staff for more details. The recording system has a function to alert users when they fail to enter correct data into the form. These field warnings and checks were deployed to help users enter the correct data into the form but also as a security method, thus restricting users to enter non-specific data into the form.

It is possible for users who signed up for an event to change their minds and not want to participate anymore in that event or want to change the number of places initially booked. Thus, the “Cancel/Change Registration” page (see Figure 3) facilitates the cancellation or modification of a record. A user who for any reason can no longer participate in the event accesses the cancellation form and cancels his reservation.

In order to cancel the booking, the user must fill in all fields of the form in Figure 3, a simple form, consisting of the following fields: User email (unique address), initially booked event, “Modify reservation” option and number of reserved seats. The “Modify reservation” option allows the user to choose one of the displayed options: YES or NO.

If NO is selected, pressing the “Cancel event reservation” button will cancel the user's reservation for that event. If YES is selected, the “Number of reserved seats” field will dynamically appear, which must be filled in with the new desired number of reserved places. This functionality is useful if the user, for various reasons, wants to change the number of reserved places but not to cancel the entire reservation.

The “Event Seats” and “Event Reserved Seats” fields are dynamically populated with the appropriate information in the database so that the user is informed in real-time about the current status of the seats in the system as well as the initial number reserved seats. By clicking the “Cancel” button, a request to change the number of seats for that event is sent to the server. It analyzes the request, and if it fulfills the conditions of validity, the initial registration will be refreshed with the new information.

4.2 Administrator’s Perspective

Administrator's perspective allows access to the registered users and events management pages. Access to these pages is based on the completion of a Login form, where the user name and password are entered. Following successful authentication in the administration area, the pages become accessible to manage users and events within the museum activities.

Managing users who register in the system of booking seats in order to participate in museum events is done by the “Manage Users” page (see Figure 4). The administrator can view all registered users and perform editing and deleting actions.

Managing events within the activities of the National Art Museum of Romania is done from the page “Manage Museum Activities” (see Figure 5). The page provides the administrator with the possibility to view active or inactive events as well as to edit or delete an event. Event viewing is done using a grid structure with a header consisting of the following columns: Event, Theme, Date, Time, Location, Allocated seats. The administrator has the following available actions: edit, delete, enable or disable events.

Similar to user management, the administrator can edit any museum activity (event). After clicking on the Edit button, a pop-up will appear in the interface, providing the administrator with the activity details to be able to modify them, as shown in Figure 7.

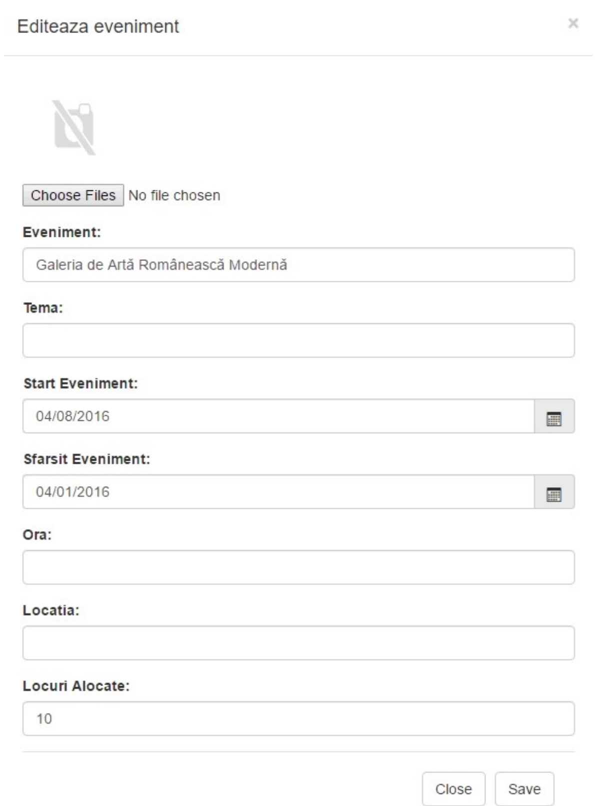

Figure 7. Event edit pop-up page

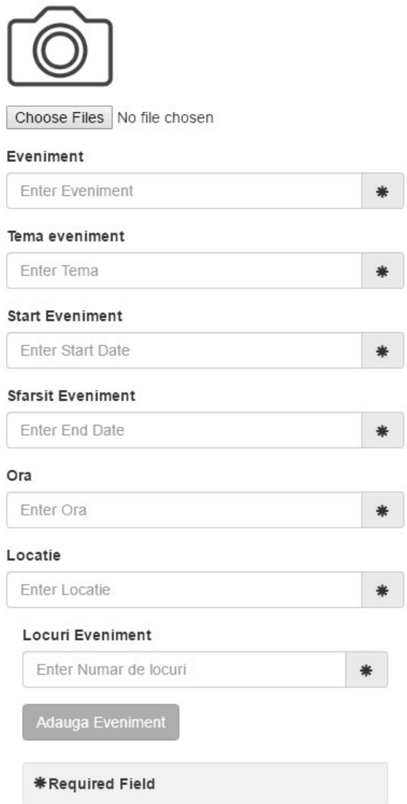

Figure 8. Add new event form

The “Show New Event Form” button displays the form by which the administrator can enter a new event. The form consists of the following fields: Event, Event Theme, Event Start, End Event, Time, Location, Number of Event Places, and event profile photo (see Figure 8). All fields in Figure 8 are required so that the form can be properly processed by the server. The “Add Event” button allows the administrator to enter into the system new events or activities that the museum is about to carry out in the near future.

Based on the analysis conducted with the staff of the museum, it was created the possibility for registered users to be automatically notified by email of the complete data regarding the event to be attended, using PHP Mailer [5], as shown in Figure 9.

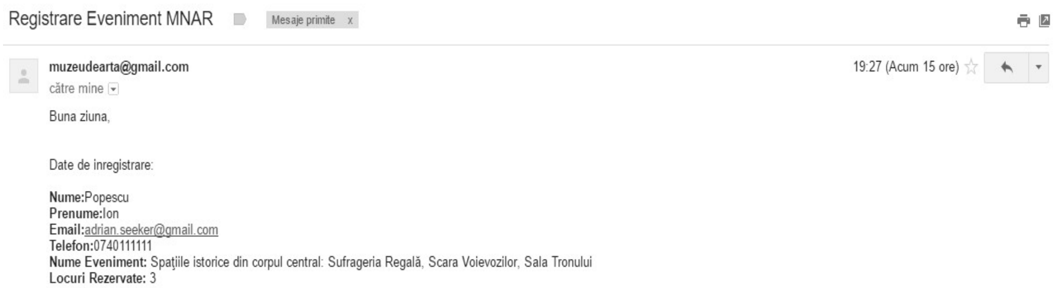

Figure 9. Template for email notification to users

The application is available online for both users and administrator by clicking the Signup Event button on the main page of the National Art Museum of Romania website, at the following address: http://seeker23.0fees.us/MuseumRegistration/Registration.php

Conclusions

The application is built on a modular structure, providing added stability, and the optimal blending of front-end technologies has provided users with a user-friendly, intuitive and easy-to-use interface. Due to the modular architecture of the application, it can be considered as a template for various other types of relationships between users and providers of educational and cultural services, simply by changing the purpose of the application and certain labels corresponding to the chosen goal.

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Role and configuration of digital textbook for musical education from the perspective of initial training for primary school teachers

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Abstract

The authors of present article highlight and analyze some useful aspects of the of digital textbook for musical education's process of developing and implementing on the computer from the perspective of the initial training of the primary school teachers in the university system in the Republic of Moldova.

Keywords: Digital textbook (DT), interactive educational activities, configuration of of DT for musical education

1 Introduction to the DT concept for musical education

One of the basic factors in initial teacher education for primary school teachers is their training in the art of modeling pupils from a multilateral perspective. Among the components of this desideratum are the musical education of young schoolchildren. Pupils' education through mc is a topic of permanent relevance and, in this context, the role and configuration of a digital textbook (DT) for musical education gains importance and arouses a particular interest, being in the list of priorities of teachers Integrated into educational activity at this level of education, software developers, parents and, last but not least, potential users of DT, the pupils.

The didactics of musical education is a compulsory discipline in the initial academic training of primary school teachers, being included in the study programs at all university level institutions accredited in the professional training of this type of specialists. Thus are the faculties of Education and Psychology from different countries of the world, such as: **(1) Norway:** OSLO - Faculty of Educational Sciences, etc.; **(2) Lithuania:** Vilnius - Lithuanian University of Educational Sciences, etc.; **(3) Switzerland:** University of Friborg with its master's programs in the Educational Sciences (EDUCATIONAL SCIENCES) profile, surnamed on the homepage of this institute, EDUCATION, PSYCHOLOGY, PSYCHOLOGY; **(4) Finland:** University of Helsinki - Faculty of Educational Sciences, etc.; **(5) France:** University of Strasbourg - Faculty of Education Studies, etc.; **(6) Canada:** Memorial University of Newfoundland - Faculty of Education, etc.; **(7) Romania:** Cluj-Napoca - Faculty of Psychology and Education Sciences; Sighet - Faculty of Psychology and Education Sciences; Nasaud - Faculty of Psychology and Education Sciences; Târgu-Mureş - Faculty of Psychology and Education Sciences; Sibiu - Faculty of Psychology and Education Sciences, etc.; **(8) Republic of Moldova:** "Ion Creangă" State Pedagogic University of Chisinau - Faculty of Education Science and Informatics and Faculty of Psychology and Special Psychopedagogy; State University of Moldova - Faculty of Psychology and Education Sciences; Free University of Moldova

- Faculty of Psychology, Education and Social Assistance; State University "Alecu Russo" from Balti
- Faculty of Sciences of Education, Psychology and Arts, etc.

2 The role of musical DT into initial university education of primary school's teachers

The curriculum of the Musical Education Didactic / Musical Education Methodology of the majority of the institutions listed above focuses on two main directions. The first refers to basic musical notions such as *sound and its graphic representation, including duration and intensity, range, metric and its elements, sound system, etc. The second main direction of the course focuses on the practice of teaching the subject, beginning with the general notions, on the importance of music and musical education in the development of the child, then going to the applicative part regarding the systematic way of conceiving the lesson, methods and procedures Specific teaching, the specialized exercises imposed by the specifics of the subject matter, the pupil's integration into collective social and musical activities such as the choir and the instrumental ensembles and finally the general and specific assessment methods and strategies* (Margarita Tetelea & Viorica Crişciuc, 2015).

Through this dual structure, both the subject itself and the DT of the given discipline must provide to the students, prospective teachers in primary school, and through their training to the pupils, in addition of the specialist knowledge musical theory about, also the ability to perform various types of musical exercises, such as:

- *Systematic exercises based on framework objectives as well as;*
- *Systematic exercises based on general competences and units of learning;*
- *Various types of musical games with teaching orientation;*
- *Techniques to stimulate imagination, small-school creativity;*
- *Moral and musical education strategies, etc.*

The entire set of teaching activities enumerated above to be incorporated into a program product such as a DT for musical education in turn must be designed not only methodologically, but also informatics and algorithmic for it be able to be implemented on computer in an interactive, flexible, and reliable way.

And the application of the appropriate teaching-learning-assessment methods to the competences acquired by the undergraduate students in the study of the notions related to the primary-school musical education is relevant only taking into account the specificity of the cognitive development of the pupils in the given classes, a fact obligatory to be elaborated and implemented in an informatics algorithm mechanism that is impeccably functional on the level of the didactic scenario of a DT for Musical Education.

3 Configuration aspects of DT for musical education into initial training for primary school teachers

In the Republic of Moldova (RM) in 2015 have been proposed the concept of the digital manual. In the compartment, several objectives have been declared for the purpose of developing and implementing the digital textbooks (DT) of the given document. One of the central ideas in the above-mentioned conception is that the process of developing and implementing of the DT is meant to bring with it "[...] the modernization of the computer tools for pupils and teachers [...]" (Burlacu Natalia & Balmuş Nicolae, 2016), and the move towards a digital information environment is expected to be "... favorable and friendly ..." able to "[...] ensure the delivery of quality education" (Burlacu Natalia & Balmuş Nicolae, 2016).

The commitment to ensure the digital information environment in the educational system in the Republic of Moldova is assumed by the Center for Information and Communication Technologies in Education (CTICE) of the Republic of Moldova, on the official website of which can be downloaded in the format * .pdf, absolutely free any set of school textbooks, for any step and discipline existing in native pre-university education.

The truth, with which we agree, is that both programmers and teachers in the education system from our country and from abroad have the opinion that the scanned manuals in * .pdf are not those digital textbooks about which it are spoken so much, especially that in the fundamental document defining the DT's concept (Burlacu Natalia & Balmuş Nicolae, 2016) reflects the objective which states that: "Another goal of the development and implementation of digital textbooks is to ensure that all actors of the educational system have access to the most extensive volume of modern, interactive digital educational content **presented in various formats**, *professionally developed according* to the didactic, psychological, informatics and design standards; adaptable to the needs of each learner" (Burlacu Natalia & Balmuş Nicolae, 2016).

Program developers and IT specialists understand that an appropriate DT that is consistent with the stated concept is not easy to elaborate at all, and that an scanned ordinary *.pdf will never transform a traditional manual into a digital one.

Thus, this group of authors-developers DT for musical education, has based on the printed manual, has completed the existing learning activities in traditional didactics with multi- and interactive multimedia activities, as envisaged in the draft DT concept issued in Chisinau. The DT version, being designed and developed by us in the Borland Delphi environment, really provides both learners and teachers with a wider variety of interactive educational content. Because, traditionally, in teaching, the schoolmaster resorts to the induction or deductive demonstration and / or argumentation of the lesson's subject, using of didactical means is an imperative of the educational process, in general.

Thus, it is compulsory that DT, which completes and / or accompanies the lesson's approach, is also a provider of educational resources correctly designed from the point of view of modern didactics.

In particular, DT of Musical Education must contain various categories of educational resources (which the authors have included in the beta version of given DT), such as:

- Voice songs for voice assemblies, the interpretation of which is focused only on the melodic virtuosity formula in vocal scores;
- Instrumental parts for instrumental ensembles, the interpretation of which is performed by means of musical instruments;
- The pieces intended for "musical audition", these being a combined model of the first and second musical types;
- Graphic and soundtracks of musical scores containing pieces, sequences of varied origin of musical genres;
- Painting albums able to illustrate / transmit various tangent moods with possible musical works for audience in school;
- Literary texts tangent through its semantic and imaging content with various moods reflected by musical works intended for eventual listening to music lessons and / or outside auditoriums in the discipline concerned;
- Audio-visual means (electronic devices such as computer, laptop, smartphone, tablet, radio, picup, magnetophone, etc.) and / or program products running on the MediaPlayer model, such as: MusicBee, AIMP, MediaMonkey, foobar2000, VLC Media Player, etc.) capable of reproducing the high-quality musical sound and not only;
- Musical instruments represented in different versions of physical and / or digital samples. Here, we also refer to the many classical, ethnic musical instruments from the most widespread, less widespread, rare and very rare that the teacher / student needs to know and the sound to be familiar with. These are: lute, buzuk, harp, blockflote, hand drum, crank, zither, etc.) *(see Table 1, Figures 1.1.-1.2).*

Table 1. Very rare classical and ethnic musical instruments

 *Figure 1.1. The crankcase (musical instrument of Romanian origin)*	 *Figure 1.2. Buzuk (Turkish musical instrument)*

- Very rare **collection instruments** created by more or less famous masters that not every single mortal can have at their disposal, not to mention the school institutions in the world (Stradivarius violins, Soprano accordion, Caparison Angelus electric guitar, Byzantine harmonica Hohner, the Dean ML Black Gold electric guitar, etc.) *(see Table 2, Figures 2.1.-2.4).*

Based on the idea that a DT is a provider of educational resources designed to augment and facilitate the student's ability to assimilate the subject both in qualitative and quantitative terms, speaking about the activities to be implemented in a DT of musical education, in particular, it is worthwhile to value on such a set of didactic activities, as:

Table 2. Rare musical instruments, from collectibles

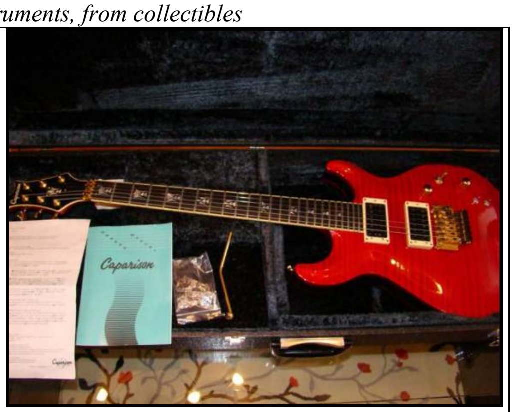
 *Figure 2.1. The Soprani accordion*	 *Figure 2.1. Electric guitar by Caparison Angelus*

Figure 2.3. Byzantine harmonica of Hohner

Figure 2.4. Electric guitar of Dean ML Black Gold

- Music listening exercises - these activities include the listening of different musical ensembles’ interpretation, these in turn being of only three types: *the voice ensemble; the instrumental ensemble; vocal-instrumental ensemble.*
- Diving into the concert atmosphere for listening musical works in the interpretation of more or less famous musical groups - classical or ethnic musical orchestras; cor, etc. (Balmuş N., Borş Al., Burlacu N. & Chirilov V., 2016) *(see Figure 3).*
- Exercises for writing sequences of musical compositions or musical dictations (Balmuş N., Borş Al., Burlacu N. & Chirilov V., 2016).
- Following the conductor's activity in various types of musical-instrumental groups - classical music orchestras; folk music bands; chorus, etc. *(See Figure 4).*

Figure 3. Diving into the concert atmosphere of the Benia blockflote festival included in DT of musical education, developed by this group of authors. Video sequence source: https://goo.gl/CZZ1vt

- Solfeggio exercises, executed without words, designed to form musical hearing and ability to read the musical notes.
- Exercises for writing sequences of musical compositions or musical dictations (Balmuş N., Borş Al., Burlacu N. & Chirilov V., 2016).

Taking into account the fact that in the correct methodological selection of the musical pieces (vocal, instrumental and audio) for musical education there are several criteria, which are obligatory to be respected, a DT can be conceived, programmed and assembled according to the requirements that meet the criteria data.

Figure 4. Activity of Master Horia Andreescu at the Philharmonic desk George Enescu. Image source: https://goo.gl/PnLM7L

Thus, the DT of musical education developed and implemented by the representatives of the current group of authors from Chisinau, Republic of Moldova, teaches the future primary school teachers to take advantage of various methodologies previously elaborated by authors such as: Ana Motora-Ionescu, 1978; Ion Şerfezi, 1968, didactics as: Aurel Ivaşcanu, Ligia Toma-Zoicaş and Pavel Delion (Iaşi), who have continuously indicated for criteria for the selection of "songs for school", the following items:

A. Criteria for selecting the vocal parts necessary for vocal musical activities

1. It's depending from programs' contents of curricular cycles;
2. It has based on the framework objectives and / or general competences including the instructive and attitudinal component (aesthetic attitude, educational value);
3. Depending on pupils' ability to learn the sounds (Avram Florea, 2007).

B. Criteria for selecting the vocal repertoire according with framework objectives or general competences implies that the teacher will have to choose musical pieces that are:

1. Provided in the curriculum of each level of study;
2. A part of the songs must have vocal qualities which can be interpreted in the both mode - vocally and instrumentally, keeping one basic tone / popular way, able to fuse in a native way the instrumental and the vocal musical sheets;
3. It is possible to interpret in an accessible way by the students after their listening the models of the great vocal performers;
4. Musical parts with a compulsory didactic character, which contain in the essence, but at least 3 positions, samples and / or exercises able to exemplify necessary to be taught;

5. It imposes the need to call for solfeggio and demonstration exercises, but only in situations where the vocal piece does not meet the qualities of inductive, deductive or analogue / comparative argumentation;

6. Through its morphology and musical syntax, the literary text allows a certain flexibility to be interpreted by the pupil's personal self and / or to represent a problem piece for its constitution in a "case study", etc.

C. Selection of the vocal repertoire on the basis of the right intonation capacity is one of the problems that has not been fully solved, so the teacher should consider the following:

1. The pupil's voice diapason must coincide with the ambit of the song, which is means, the soundtrack sounded by a pupil from the worst sound to the most acute, must be the same as the track that the song contains, from the worst to the most acute sound. This correspondence is a mandatory condition for a song to be accessible;

2. The songs must also be selected according to the life offer of the class's and school's pupils, because their voice are change its diapason, the musical timbre from one school year to another;

3. The song repertoire have to be sorted taking into account the seasons and the cultural calendar of the school and / or the community to which the student belongs, etc.

Because the didactic design is in itself recommended to be oriented towards the personalization of the teaching-learning-evaluation activity, the teacher, in the case when these complex criteria previously reviewed are not found in the generous offer of the traditional and / or alternative textbooks, DT has the possibility to include during the academic year musical pieces selected by each individual didactic framework after the prototype of a portfolio either in personal interpretation or one performed by a musician, professional interpreter, master in music, etc..

Conclusions

It is obvious the children's attraction for music from the early years of childhood. Music, being an integral part of children's lives and preoccupations, is endowed with multiple cognitive, emotional and volitional valences, enriches the soul of children, shaping them for life. At both preschool and small school level, musical education is performed by teaching staff formed in a separate, organized way, with means and procedures specific to each educational cycle, a scenario fully implemented in the DT of musical education described in given article. Such a digital product also presents itself as an active formative component of the initial teacher education process of teachers in the primary school of tomorrow.

In our opinion, the teaching-learning-evaluation and self-evaluation activities made available to the end-users of a competitive and performing DT, regardless of the subject of the study for which it is being developed, must include various types of interactive activities such as: animation; simulations; educational games; galleries of multimedia clips with video and audio tracks of musical works to be studied; complex evaluation and / or self-evaluation activities, etc.

The whole set of didactic implementations previously enumerated and integrated into a DT for musical education are called upon both to enhance the quality of the educational process developed within that school discipline and to increase the students' interest in the studied content at the lessons of musical education and to capitalize, on the whole, the entire musical treasure recommended by the school curriculum and provided by our DT.

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Software application for the assessment of hydrophilicity of textile materials

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Abstract

Because textiles can be assimilated with more or less homogeneous capillaria, hydrophilicity can be determined under laboratory conditions, through different and specific assessing methods and indicators, based on the principle of capillarity. In order to avoid inducing errors in the appreciation of the hydrophilicity, we recommend using in parallel multiple methods and comparing the results. This approach requires a large amount of time and work that can be simplified by the use of a software application presented in this paper. Application implies the creation of a platform that enables the user to select the desired method for the determination of hydrophilicity and the introduction of the experimental values specific to this method. The calculated values of the indicators specific to the selected method as well as the related graphs keep on being generated. After finishing the methods selected by the user, the application allows to compare the results obtained for the reaction to water of the tested textiles by using the key COMPARISON. The software application can be used both as a teaching material for students as well as a working instrument for master students and PhD students and/or specialists in the field of textiles.

Keywords: software application, hydrophilicity, textile materials, capillarity

1 Introduction

Under intense effort when the human body sweats intensely, the humidity in the space between the skin and clothes reach a liquid state and it may create a continuous film on the skin, influencing the exchange of heat and mass through clothing and also the thermo and sensory comfort of the individual.

Therefore, it is necessary for the fabrics of the clothes used as a first layer to be hydrophilic. Textile materials are capillary-porous bodies (pore and capillary with different lengths and diameters) whose hydrophilicity can be determined in the laboratory by various methods based on the principle of capillary.

2. Theoretical aspects

Hydrophilicity can be evaluated by certain evaluation indicators, specific to each used method. In order to avoid errors in the assessment of hydrophilicity, it is recommended to use several methods simultaneously and compare the results.

The most commonly used method for the determination of the hydrophilicity are: the "fuse" method, the capillary tube method, the "immersion" method, the dripping method.

2.1 "Fuse" method

This method consists of tracking the rise of water in the sample of textile material partially immersed in water [1]. The rise of water in the tubes must be monitored every 10 minutes, up to 30 minutes, for the height h [mm] of the water rising through capillaries. Determinations are done both on the direction of the warp (the wale), of the weft (mesh row) and on radial directions.

The hydrophilicity of the tested materials is assessed as follows: the best hydrophilicity will appear in the material with the highest values of the water rising height h [mm] and the rising speed v [mm/min], and the weakest hydrophilicity will belong to the material with the lowest values of the water rising height h [mm] and rising speed, v [mm/min].

For a comparative assessment of the textile materials tested by this method, histograms or diagrams can be drawn showing the variation of the water rising speed v [mm/min] and of the rising height h [mm] in the form h, v = f (t).

2.2 Capillary tube method

This method requires a capillary glass tube with small diameter corresponding to the average pore size of the textile materials. Measure the time τ [s] necessary for the absorption of the water column with height h [cm] from the tube and calculate the apparent absorption power N[erg/s] with the relationship 1.

$$[1] \quad N = \frac{\left(\pi r^2 \cdot h^2 \cdot \rho g\right)}{\tau}\left[erg / s\right]$$

where:

- r- radius of the capillary tube, (r = 0.03 cm or 0.025 cm);
- ρ – water density [0.997 g/cm^3];
- g - gravitational acceleration [981 cm/s^2];
- h - the height of the water column balanced in the tube (cm);
- τ - the time of absorption of the water column (s).

By this method hydrophilicity is assessed as follows: very poor or poor if N < 4 erg/s, and the stain has an irregular outline; good or very good if N > 5 erg/s, and the moisture stain has a regular contour.

2.3 "Immersion" method

The method consists in determining the time t[s] required for the immersion of the fabric in a container with water. Determine the time t [min, s] necessary to replace the air in the pores of the fabric with the water from the container, as the sample continues to float on water. Hydrophilicity is considered to be good or very good when the immersion time is lower and low and very low when the immersion time is higher. Comparative analyses can be performed related to the peculiarities of the structure, of the finishing treatments, the fiber composition, fineness etc. based on histograms.

2.4. Dripping method

The rapid dripping tests rely on the dripping of certain amounts of water on the surface of the test material. Hydrophilicity is assessed through specific measurement values of each method, such as:

a. The absorption time ta [min;s] of a quantity of water dripped from a certain height on a textile surface, the drying time tusc [min], the diameters of the wet spots on the direction of the warp (row) $D_{U(Ş)}$[mm] and the direction of the weft (row) $D_{B\,(R)}$[mm], diameter ratio R_D=D_U/D_B.

The material with the shortest moistening time is considered to be hydrophilic. If the diameter ratio is around 1, hydrophilicity is deemed compatible on both nominal directions of the material. When the value of the ratio is less than 0.9 or greater than 1.1 it means that the material has in its structure, on the two nominal directions, yarns with different compositions and different affinities towards water.

b. For double-layer materials, the area of the moisture spots on the inside layer S_{int} [cm^2] and the outside layer S_{ext} [^{2}], the ratio R_S=S_{int}/S_{ex} to transfer water from one side of the fabric to the other. Assessment of hydrophilicity is made according to the ratio R_S: R_S = 1; satisfactory water buffering; R_S< 1; very good or good buffering; R_S> 1; non satisfactory buffering.

3. Software application

Starting from the theoretical considerations mentioned above, a software application was created in order to reduce the time for processing the experimental data concerning the hydrophilicity of fabrics. The application can be used as an e-learning tool and by specialists in the field for processing a high volume of experimental values (figure 1).

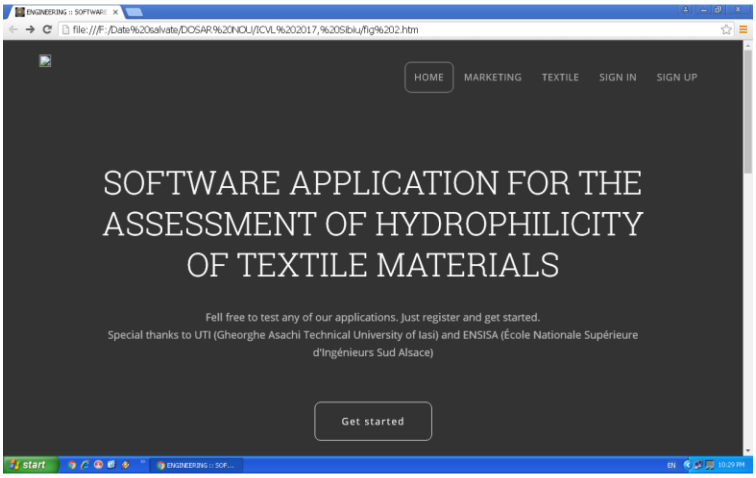


Figure 1 Open the application

The application implies the creation of a platform. When you open the application specific methods are displayed for the determination of hydrophilicity (figura 2). An example for the use of the software is presented in figure 2, for capillary tube method.

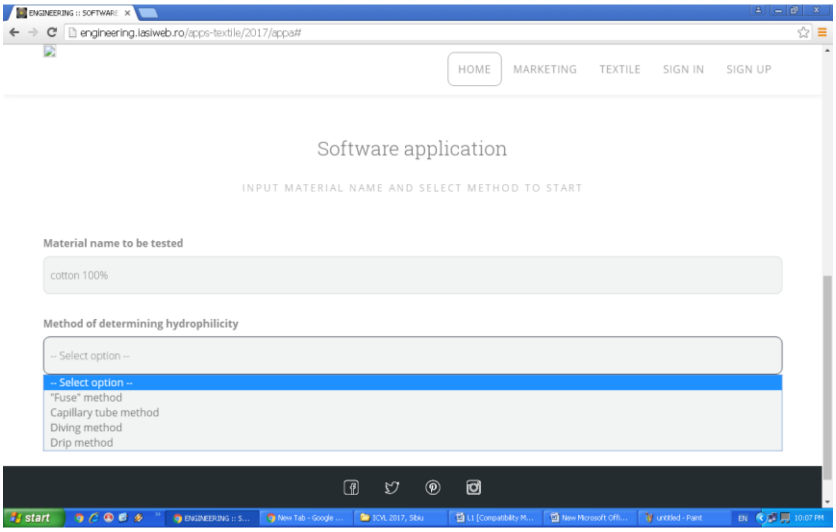


Figura 2 Input data

The user selects the method by which to assess the hydrophilicity, thus opening a window where you will enter the input data (experimental values) that are specific to the selected method. (figura 3). The data input are: the name of the material tested, the capillary radius r[cm]; water density ρ[g/cm^3]; gravitational acceleration g [cm/s^2]; height h [cm] of the water in balance in the capillary tube; time τ [s] of the absorbtion of the water column

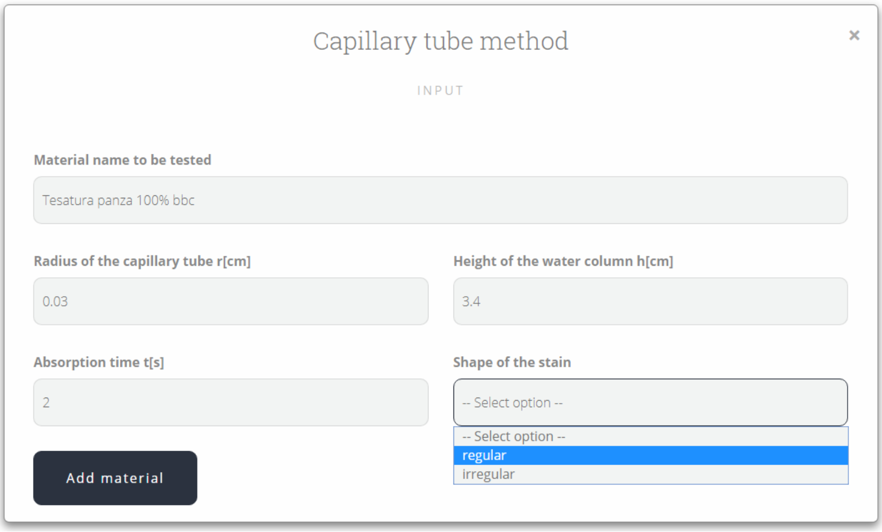


Figure 3 Selected method

A new command will create the opportunity to obtain the values for the output variables (figure 4). Output data (figure 4) are as follows: the apparent power absorption values N[erg/s], the information about the hydrophilicity of the tested material (low, good, very good), histograms (if the user requests them and if more textiles are analyzed).

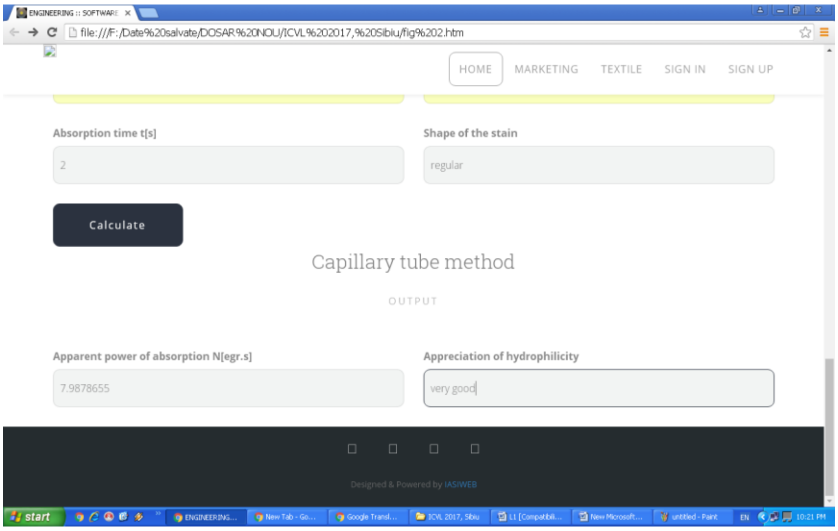


Figure 4 Values for the output variables

From the figure 4 it is seen as the value for hydrophilicity is > 5 erg/s and the moisture stain has a regular contour, so hydrophilicity is very good . Software application has the possibility processing data for multiple textile materials (figure 5).

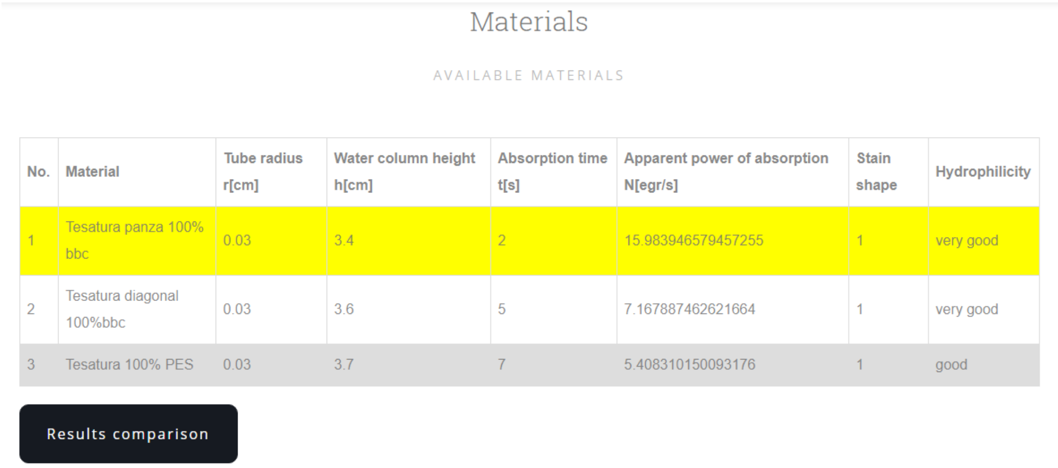
Materials

AVAILABLE MATERIALS

No.	Material	Tube radius r[cm]	Water column height h[cm]	Absorption time t[s]	Apparent power of absorption N[egr/s]	Stain shape	Hydrophilicity
1	Tesatura panza 100% bbc	0.03	3.4	2	15.983946579457255	1	very good
2	Tesatura diagonal 100%bbc	0.03	3.6	5	7.167887462621664	1	very good
3	Tesatura 100% PES	0.03	3.7	7	5.408310150093176	1	good

Figure 5 Available materials

By pressing the COMPARISON key the application offer the possibility of comparing the results obtained from various experimental methods applied to the same material (figure 6) by marking the best textile from the point of view of hydrophilicity or by histograms (figure 7).


Materials

AVAILABLE MATERIALS

No.	Material	Tube radius r[cm]	Water column height h[cm]	Absorption time t[s]	Apparent power of absorption N[egr/s]	Stain shape	Hydrophilicity
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2	Tesatura diagonal 100%bbc	0.03	3.6	5	7.167887462621664	1	very good
3	Tesatura 100% PES	0.03	3.7	7	5.408310150093176	1	good

Results comparison

Figure 6 Comparing the results

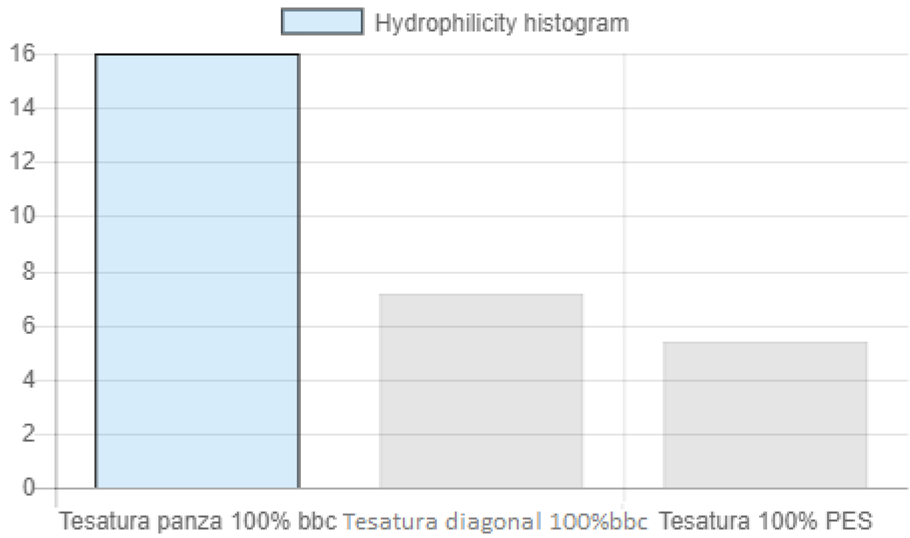

Figure 7 Histograms

The program also has the option of processing the input and output values (mean, coefficient of variation Cv [%], etc.). For the purpose of the comparative analysis of the output variable values, variation diagrams and histograms can be drawn in according with these.

Conclusions

The software application is designed as a tool of e-learning for students and professionals in the field.

The software application can be accessed to address http://engineering.iasiwe b.ro/apps-textile/2017/appa.

It is easy to use and it offers in a short time the processing of the experimental values regarding the ability of textile materials to absorb water.

There is also the possibility of comparing the results obtained from various experimental methods applied to the same material, by pressing the COMPARISON key.

The use of this application allows the processing of large amounts of experimental data, ensuring the accuracy of results and conclusions.

References

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Software application for the assessment of the fabric behavior in wet environments

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Abstract

The hygroscopicity of textile fabric is determined by the nature of the raw material, the parameters of the technological processes for processing and finishing of yarns and textile surfaces, by the relative humidity of the outside environment, the permanence in a wet environment, the speed of air currents, the ambient air temperature, the condition of the dressed body. The software application, using the experimental values as the input data (the area of the test samples, the relative humidity of the environment, the permanence time of the test samples with fabric in the wet environment, the mass of the conditioned test samples, the mass of the test samples after being maintained in the environment with a certain relative humidity. Output data are: values of hygroscopicity obtained after certain periods of permanence in a wet environment, values of the hygroscopicity index corresponding to the same time intervals. There is a possibility of generating the hysteresis curves for each analyzed fabric, displaying the variation graph and histograms. The software application reduces the time and workload required for the input data processing, and it can be used both in research activities and in the teaching activities.

Keywords: software application, fabric, hygroscopicity, hysteresis

1 Introduction

While wearing the clothes, when the individual sweats moderately, the microclimate under the clothes must be maintained as dry as possible, in order to have a state of comfort. The ability of a fabric to absorb or transfer or even to retain water vapors is called hygroscopicity. Hygroscopicity is a natural quality of fabrics, it being determined by their fibres, but that can be influenced also by the parameters of the technological processes for the machining and finishing of yarns and textile areas. During clothes wearing, hygroscopicity is influenced also by the wearing conditions: the relative humidity of the outside environment, the permanence in humid air currents, speed of the air currents, ambient air temperature, the condition of the dressed body (resting or activity with different effort).

To ensure the conditions of hygiene and thermo-physiological comfort during clothes wearing, textiles (mainly the ones intended for the first layer) must have a minimum of moisture content of 6% under the standard atmospheric conditions.

2. Theoretical aspects

An evaluation of hygroscopicity of a/some material/s is done using specific laboratory methods that allow the collection of a data set with which you can calculate a series of indicators for assessing the hygroscopicity of a fabric.

The tubes for the clothes, conditioned in advance, are kept for a time (τ) in a moist environment tightly closed (desiccator). The influence of the relative humidity of the environment is revealed through the conditioning of the textile samples in relative humidity φ = 0% and then by keeping them in environments with different relative humidity (e.g.: φ=35%; φ=65%; φ=100%) crossing these environments first in the upward direction of the relative humidity and then in the downward direction. This will lead to obtaining data required for drawing up the absorption and desorption curves of the tested textile materials.

For the analysis of the influence of the duration of the maintenance in humid environment, samples are previously conditioned to a relative humidity φ = 65% and then kept in the environment with the relative humidity φ = 100%, being weighted at specific intervals.

2.1 Relative indicators for assessing hygroscopicity

An indicator for assessing hygroscopicity H[%] expresses the weight of the absorbed vapor mass (given away or detained) in the total mass of the test tube (relation 1).

[1] $H=[(M_{ud}-M_{u}s)/M_{us}]100$ *[%]*

where:

M_{us} [g]– the mass of the conditioned test-tube;

M_{ud} [g]– the mass of the test-tube after it has been kept in an environment with a certain relative humidity.

Because the hygroscopicity of materials is influenced by the surface exposed to the environment, as well as the duration of keeping the sample in such environment, it can be ascertained through an indicator that reports the amount of vapor (mass difference) to the area and time unit. This is how an absolute indicator of hygroscopicity is calculated i_H [g/m^{2}h] (relation 2).

[2] $i_H=(M_{ud}-M_{us})/S\ t$ *[g/m^{2}h]*

where:

S[m^2]– represents the area of the test-tube;

t[h] – the duration of permanence of the test-tube in the wet environment

3. Software application

In order to reduce the time for processing a large volume of experimental values obtained by applying specific laboratory methods for the determination of hygroscopicity, a software application is proposed (figure 1).

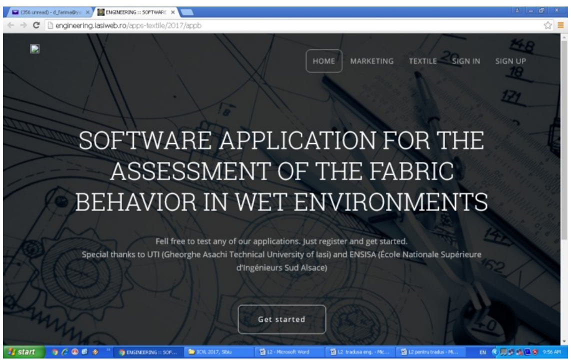


Figure 1 Print screen for started page

The application consists in creating a platform in which the input data are: the dimensions of test-tubes S[cm^2], the relative environmental humidity φ[%], the time t[min] to keep the test-tubes with the fabrics in the wet environment, the mass of the conditioned test-tube $M_{initiala}$[g] in an environment with φ[%] relative humidity, the mass of the test-tube $M_{ud.i}$ [g] determined at certain time intervals "i" for keeping them in an environment with a certain relative humidity (figure 2).

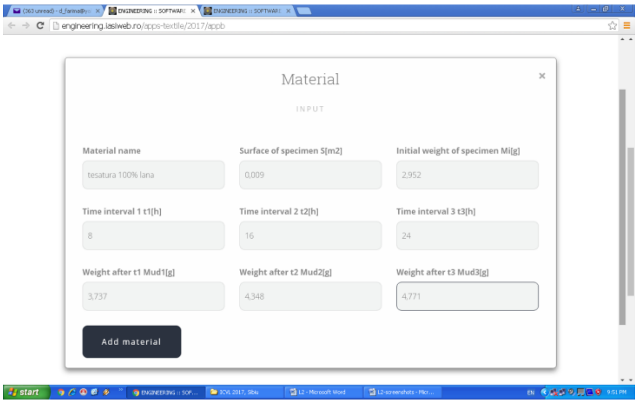
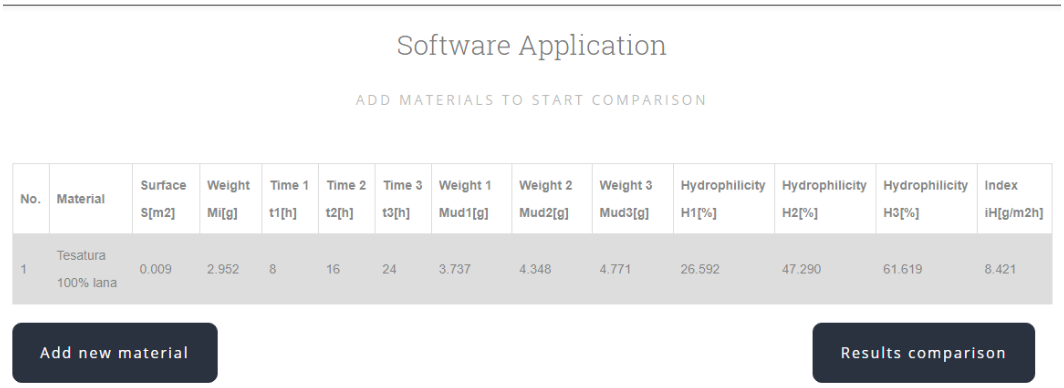


Figure 2 Input data of application

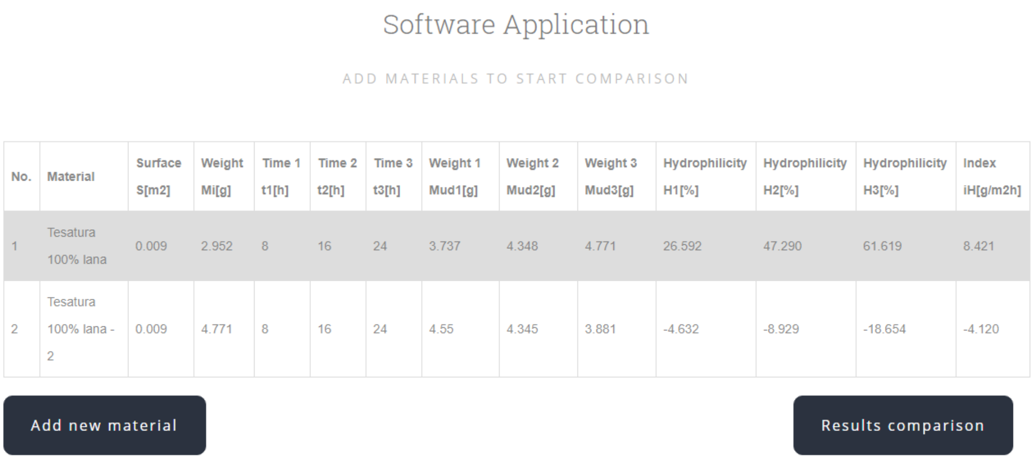
Output data of the application (figure 3) are: H_i [%] hygroscopicity values obtained after certain periods of time "i" of keeping in humid environment, the hygroscopicity values H_i [%] obtained after a time t [min] of permanence in humid environments with relative humidity φi [%], the values of the hygroscopicity i_{Hi} [g/m^2h] corresponding to the same conditions mentioned above [1].



No.	Material	Surface S[m2]	Weight Mi[g]	Time 1 t1[h]	Time 2 t2[h]	Time 3 t3[h]	Weight 1 Mud1[g]	Weight 2 Mud2[g]	Weight 3 Mud3[g]	Hydrophilicity H1[%]	Hydrophilicity H2[%]	Hydrophilicity H3[%]	Index iH[g/m2h]
1	Tesatura 100% lana	0.009	2.952	8	16	24	3.737	4.348	4.771	26.592	47.290	61.619	8.421

Figure 3 Output data of the application

If the user wants, it is possible to generate the hysteresis curves for each analyzed fabric as well as showing the variation charts H=f(t), i_H=f(t) sau i_H=f(S). For the purpose of the comparative analysis of the behavior of fabrics in wet environments histograms can be generated. If several textile materials are taken to be analyzed, the application allows the generation of sorption - desorption diagrams on the same system of axes (H, t) for the purpose of comparing their behavior in wet conditions.


Software Application

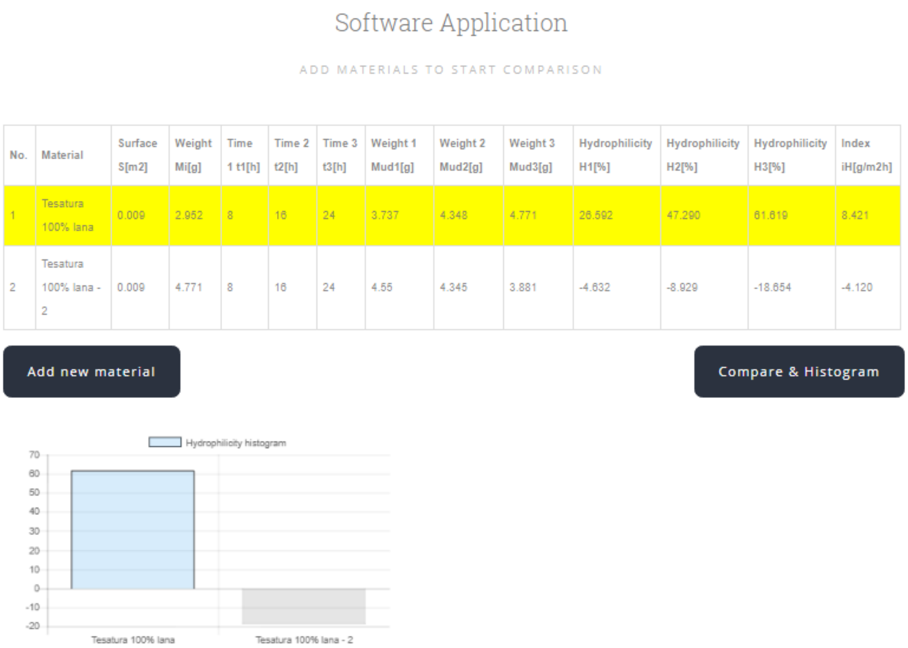
ADD MATERIALS TO START COMPARISON

No.	Material	Surface S[m2]	Weight Mi[g]	Time 1 t1[h]	Time 2 t2[h]	Time 3 t3[h]	Weight 1 Mud1[g]	Weight 2 Mud2[g]	Weight 3 Mud3[g]	Hydrophilicity H1[%]	Hydrophilicity H2[%]	Hydrophilicity H3[%]	Index iH[g/m2h]
1	Tesatura 100% lana	0.009	2.952	8	16	24	3.737	4.348	4.771	26.592	47.290	61.619	8.421
2	Tesatura 100% lana - 2	0.009	4.771	8	16	24	4.55	4.345	3.881	-4.632	-8.929	-18.654	-4.120

Add new material | Results comparison

Figure 4 Software applications for 2 textile materials from wool 100%

For the purposes of the comparative analysis there is the possibility of generating histograms (figure 5). In figure 5 is presented an example for two textile materials from wool 100%, for absorption and desorption case.


Software Application

ADD MATERIALS TO START COMPARISON

No.	Material	Surface S[m2]	Weight Mi[g]	Time 1 t1[h]	Time 2 t2[h]	Time 3 t3[h]	Weight 1 Mud1[g]	Weight 2 Mud2[g]	Weight 3 Mud3[g]	Hydrophilicity H1[%]	Hydrophilicity H2[%]	Hydrophilicity H3[%]	Index iH[g/m2h]
1	Tesatura 100% lana	0.009	2.952	8	16	24	3.737	4.348	4.771	26.592	47.290	61.619	8.421
2	Tesatura 100% lana - 2	0.009	4.771	8	16	24	4.55	4.345	3.881	-4.632	-8.929	-18.654	-4.120

Add new material | Compare & Histogram

Figure 5 Histogram of higroscopicity values

In figure 5 are analyzed two textile materials.

Conclusions

The paper, by the way it was conceived and presented, has a high originality level. The software application has been designed as an e-learning tool in order to facilitate the solving of the algorithm for determining the indicators for the assessment of the hygroscopicity of fabrics. This application also facilitates the improvement of the analysis of the hygroscopicity indicators by generating graphical representations (sorption-desorption curves, histograms).The users of this application can be both students and teachers, or specialists in the textile field. The address for this application is http://engineering. iasiweb.ro/apps-textile/2017/appb.

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[1] D. Farima, "*Confortul si finctiile produselor textile si din piele",* Ed. Performantica, 2010, ISSN 978-973-730-724-8

Software application for the calculation of the moisture permeability index

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Abstract

The index of moisture permeability is a criterion of comparison of thermo physiological quality of textile material, as a size that does not depend on the thickness. This software application is meant to create a platform, which includes as input data the thickness of the textile material, the coefficient of thermal conductivity and the vaporization coefficient values, and as output values, the application generates values for the heat resistance, and the moisture resistance of the fabric, as well as values for the moisture permeability index. The application contains ranges of values for the moisture permeability index for different purposes with the possibility of classifying the generated values with experimental data in one of these categories. Thus, knowing the moisture permeability index the researcher will know how to direct the fabric to the most appropriate area of use thereof in terms of thermo physiological comfort. The use of this software application reduces the time and workload for the solving of the calculation algorithms for the moisture permeability index. This application can be used both by students and PhD students or specialists in the field, interested by the approach of this aspect regarding the behavior of the fabrics with moisture permeability.

Keywords: fabric, thermal resistance, resistance to moisture permeability, moisture permeability index

1.Introduction

Regardless of the destination of a garment, simultaneously with the transfer of a thermal flow (heat) from the body to the environment, a vapor flow (mass) also occurs.

The heat and mass transfer depends on the conditions of the human body and the environmental conditions in which it operates.

To compare the fabrics in terms of thermo physiology, considering both the heat and vapor transfer, we introduced the index for the passing of humidity i_{mt}, the value of which reflects the comfort while wearing a garment under different climatic conditions and different conditions of the wearer (relationship 1).

$$[1] \quad i_{mt} = S \frac{R_{ct}}{R_{et}}$$

where:
R_{ct} - the resistance to the heat flow [m²K /W] ;
R_{et} - the resistance to the humidity flow [m²mbar/W].
S=0.6 [mbar/K]

Since both the resistance to the heat flow R_{ct} [m²K/W] or [m^2h^0C/Kcal] ,and the resistance to the vapor flow R_{et} [m²mbar/W] or [mm m^2h/Kcal] of a fabric are influenced by thickness δ[mm], there is the need of introducing the humidity flow index i_{mt} as a value that does not depend on thickness. The humidity flow index value i_{mt} allows the comparison of the ratio between the resistance to the heat flow and the humidity flow resistance for a fabric, with the ratio of the same resistances of an air layer with the same thickness as the one of the fabric (hence the quasi-constant S = 0.6 [mbar / K] in the usual temperatures for clothing).

2. Software application

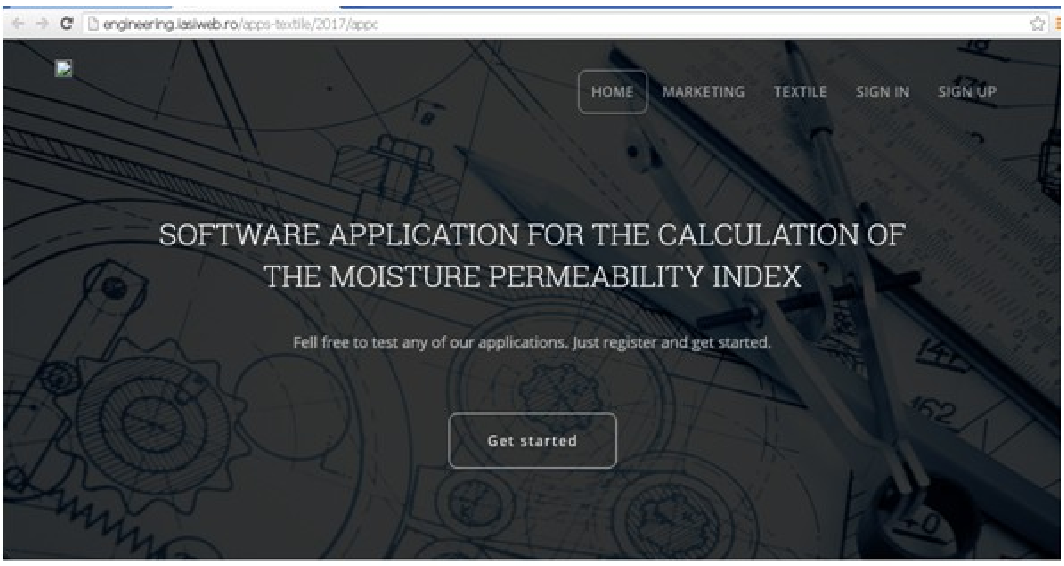
This software application aims at creating a platform that includes, as input values, the thickness of the fabric δ[mm], the coefficient of thermal conductivity λ[W/mK], the vaporization coefficient μ[g/m^2 h], the constant S = 0.6 [mbar/K] and as output values, the application generates values for the resistance of the fabric to the heat flow R_{ct} [m²K /W], and the resistance of the fabric to the passage of humidity R_{et} [m²mbar/W], and the values obtained for the humidity flow index i_{mt}.

The index for the humidity flow i_{mt} can receive only dimensionless values between 0 and 1.

The i_{mt} =0 value could be reached when the resistance of the fabric to the vapor flow would be infinitely large and the i_{mt} =*1* value would be true for a fabric that would have the two resistance values equal to the ones of the air. In reality, even waterproof materials, have high resistance to the humidity flow, but not infinite [1]. On the other hand it is known that the resistance of the fabric to the humidity flow is greater than the resistance of the fabric to the air flow with the same thickness as the one of the fabric. In this context, the thermal resistance of a fabric is less than the thermal resistance of an air layer with the same thickness as the one of the fabric.

Therefore the actual limits of variation of this index range between 0.15÷0.90. Depending on their destination, fabrics are classified according to the values of the humidity flow index i_{mt}.

The application (figure 1) is able to automatically classify the fabrics in the corresponding category of the value obtained for the humidity flow index.



Software Application

Figure 1 Print screen for started page

Thus, knowing the value of the index of the humidity *flow* i_{mt}, the user will know how to direct the fabric to the most appropriate field of use from the point of view of the thermal comfort (table 1).

In the structure of a clothing assembly it is recommended that the fabric with the highest value of the humidity flow index i_{mt} should be the closest to the skin and the fabrics with small values of this index should be far from the body.

Table 1 Destination classes of the values of the humidity flow index i_{mt}

Categories of fabric use	Fabric for:	Humidity flow index: i_{mt}
I	Suits and gowns	0,15÷ 0,35
II	Shirts	0,20 ÷0,45
II	Underwear	0,25 ÷0,50
IV	Sportswear	0,25 ÷0,50
V	Therapeutic segments	0,30 ÷0,60
VI	Thermo insulation layers	0.45.0.70
VII	Duvets, sleeping bags, sportswear for cold environment	0,50 ÷0,90

The figure 2 shows an example of using the software application for a knitted fabric made of 67% cotton / 33% polyester, with the following values of the input quantities: (δ= 1,39 mm, λ=0,0366 $Kcal/mh^0C$, μ= 29,57g/m^2h).

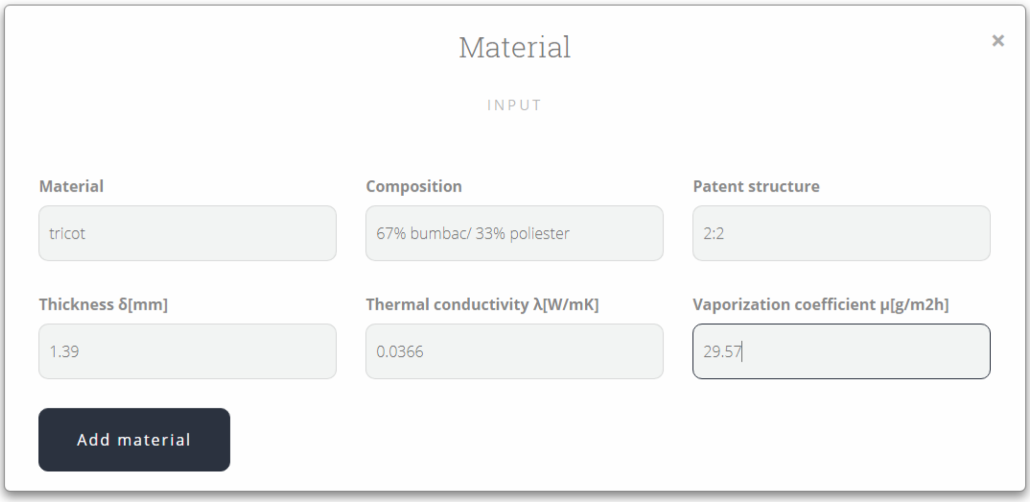


Figure 2 Input data

After entering the input values the application will generate the output values (figure 3): the heat glow resistance of the fabric R_{ct} =0, 0379 [$m^2h^0C/Kcal$], the resistance to the humidity flow R_{et} =0,047 [mm m^2h/g], and the value of the humidity flow index i_{mt} =0,483.

Software Application

ADD MATERIALS TO START WORKING

No.	Material	Composition	Patent structure	Thickness δ[mm]	Thermal conductivity λ[W/mK]	Vaporization coefficient μ[g/m2h]	Resistance to heat transfer Rct[m2K/W]	Resistance to moisture migration Ret[m2mbar/W]	Humidity passage index imt	Material class	Material usage
1	tricot	67% bumbac/ 33% poliester	2:2	1.39	0.0366	29.57	0.0380	0.0470	0.4851	Class III.Class IV.	Lingerie.Sportswear.

Add new material

Compare & Histogram

Figure 3 Output data

The value of the humidity flow index i_{mt} =0,483 is classified automatically by the application in class II - underwear (figure 3).

If several fabrics are analyzed from the point of view of wet heat flow for the same purpose (for example, sportswear, class III), a comparative assessment reveals that the most advantageous from the point of view of comfort is the one with the i_{mt} close to 1. Thus the application has the option of memorizing the values of i_m and using the COMPARISON command, the histogram of these values is displayed (figure 4).

No.	Material	Composition	Patent structure	Thickness δ[mm]	Thermal conductivity λ[W/mK]	Vaporization coefficient μ[g/m2h]	Resistance to heat transfer Rct[m2K/W]	Resistance to moisture migration Ret[m2mbar/W]	Humidity passage index imt	Material class	Material usage
1	tricot	67% bumbac/ 33% poliester	2:2	1.39	0.0366	29.57	0.0380	0.0470	0.4851	Class III.Class IV.	Lingerie.Sportswear.
2	tricot 2	40% bumbac/ 60% poliester	2:2	1.33	0.0333	23.33	0.0399	0.0570	0.4200	Class II.	Shirts.
3	tricot 3	30% bumbac/ 70% poliester	2:2	0.99	0.0256	16.83	0.0387	0.0588	0.3949	Class II.	Shirts.

Add new material

Compare & Histogram

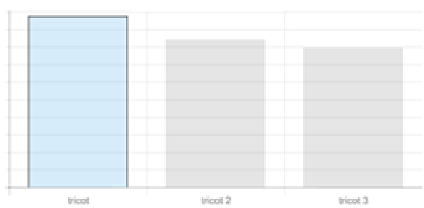


Figure 4 Comparison

From Figure 4 we can conclude that from the 3 analyzed fabrics, from the point of view of the wet heat flow, the *tricot 3* fabric with $i_m = 0.4851$ provide the wearer with the best comfort in the field of destination.

Conclusions

In the example shown above the input data belong to polyester and cotton knit which is suitable for making underwear. If the value of the humidity flow index i_{mt} was framed in another destination category and the user had in mind another destination, it means that the garment obtained would not provide the thermo comfort of the wearer.

The application allowed the rapid settlement of an important aspect regarding the purpose for which a fabric is designed (from fiber, yarn, textile area, finishing treatment), namely the proper destination in terms of ensuring the thermo comfort of the wearer.

The application can be used both in teaching activities but especially by manufacturers of textiles and clothing products.

The application was created for the aim of easing the processing of large volume of experimental data to obtain the value of the humidity flow index i_{mt}, and to reduce the process time.

Because *imt,* much depends on the existence of pores in the fabric, they cannot be compared to each other if they are not similar. Therefore, we resorted to sorting the materials in categories according to their destination and we set the i_{mt} values for each category.

The software application can be accessed to address http://engineering.iasiw eb.ro/apps-textile/2017/appc.

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Interactive development of web-based applications containing decision-makers

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Abstract

Web applications that contain personalized offers involve an interaction between client and supplier. The supplier faces the difficulty of building a wide range of offers, which ultimately come to be personalized, and the customer is confronted with defining its requirements. An example might be a web application that offers houses with modular structure. The application can offer several types of homes, in which case it will only satisfy a small number of customers or can provide solutions for each client. Providing customized solutions to each customer can be accomplished through direct communication with the design expert, but this involves high costs or a small expert system that assists the customer in building the offer. This last solution implies a step-by-step development so that the expert system meets customer requirements in identifying supply data. A construction of customer demand details can become difficult and the client should learn to use the specialized software for house design, which would reduce the number of clients. The paper aims to present an approach that minimizes the costs of developing and operating such a software application.

Keywords: software design, web applications

Introduction

Agile methodology [2] can be used successfully for small or medium applications where it is not very clear how the final application should look like. It is now examined the case of a provider that offers prefabricated steel structure. The expert must decide what elements are needed by the client and the price în order to make them an offer.

Initially, the system will be based on human expert work, but the number of initial customers may be small. For example, some types of houses can be offered initially, the client modifying only the dimensions of the rooms. For each dimension, the expert will need to calculate the material requirements. This human expert work can be used to build a small expert system. Depending on the development of the activity, three stages of architecture development can be established:

- Minimal arhitecture - the client chooses a template project and on this basis he discusses with the expert the necessary materials and the price;
- Intermediate arhitecture - the expert is helped by a small decision system to determine the cost of the project;
- Complete arhitecture - the user designs the house using a dedicated application and uses the decision-making system to determine the price.

Minimal Software Architecture

This architecture involves an human expert interaction with each client, the entire offer is personalized. To build this architecture, modules are required:

- image based presentation module;

- module for public communication between human expert and client based only on name and email address;
- module for private communication between human expert and client based on name, email address and other contact data (figure 1).

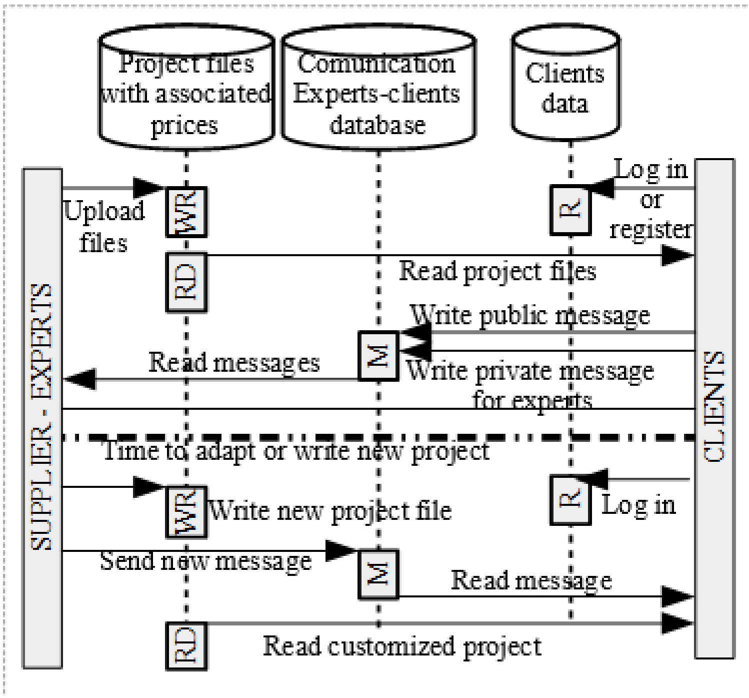

Figure 1. Sequence diagram for minimal software arhitecture

Minimal architecture involves high costs for human experts, the application only performs the communication function between them and clients and the function of displaying the template projects.

Intermediar Software Architecture
This architecture has, in addition to the minimal architecture, a decision-making module on project costs. This module assumes the components of the project, their positioning and returns the cost of the project. The module can be constituted by classification input data and establishing price-building rules. To build this architecture we have the modules;

- image presentation module, based on images;
- public expert-client communication module based on a name and email;
- expert-client private communication module based on name, email address and other contact data;
- the project pricing module will include:
  - input data classified module;
  - rule editing module;
  - module for data inference.

In this case there is a waiting period for the client due to the processing of the customization request for the project (figure 2).

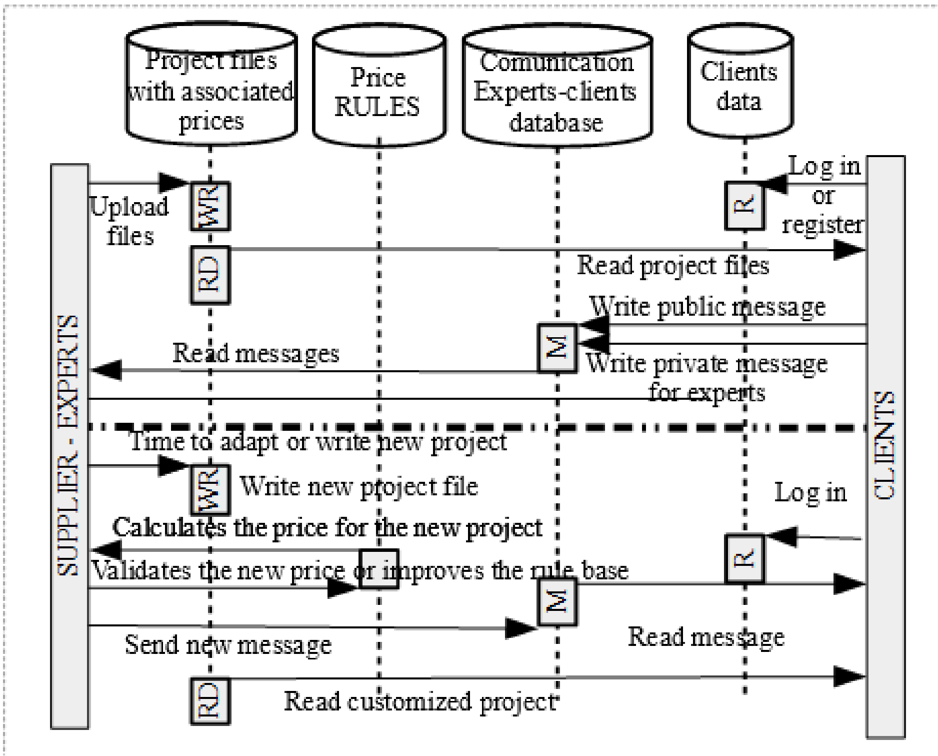

Figure 2. Sequence diagram for intermediar software arhitecture

It is also necessary to have a validation function for the rules introduced by the expert; so as to ensure their uniqueness, otherwise the price obtained may be uncertain.

Complete Software Architecture

The complete architecture also includes a module for building a project from a template project. This module communicates with the pricing module. In this way, the human expert will only supervise the activity and adapt the rules for pricing.

The construction module of the project will have a database of components and a database of connection types, elements that will be inputs into the price calculation module (figure 5).

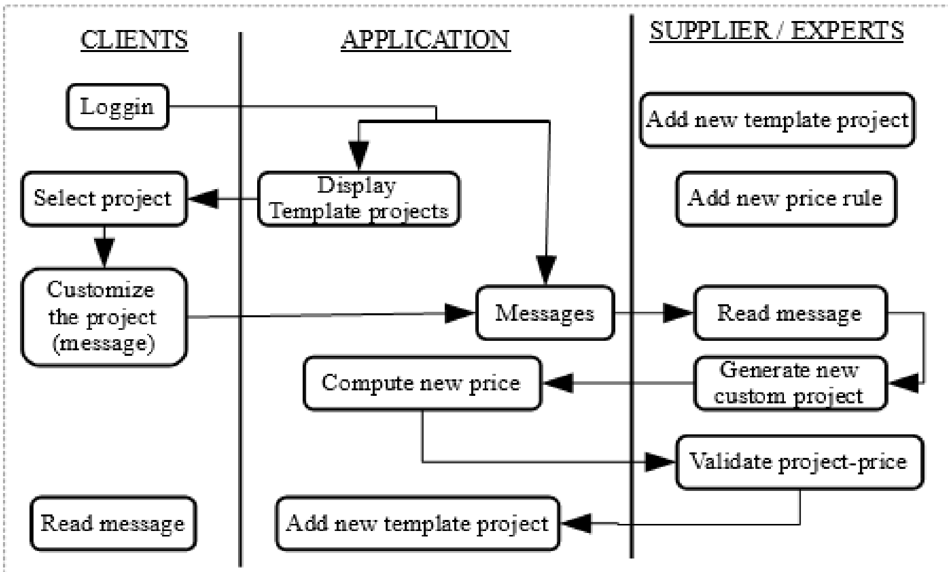

Figure 3. Activity diagram for intermediar software arhitecture

The module for building a new project, starting from a template project and the price generation module, can be the core of a small expert system.

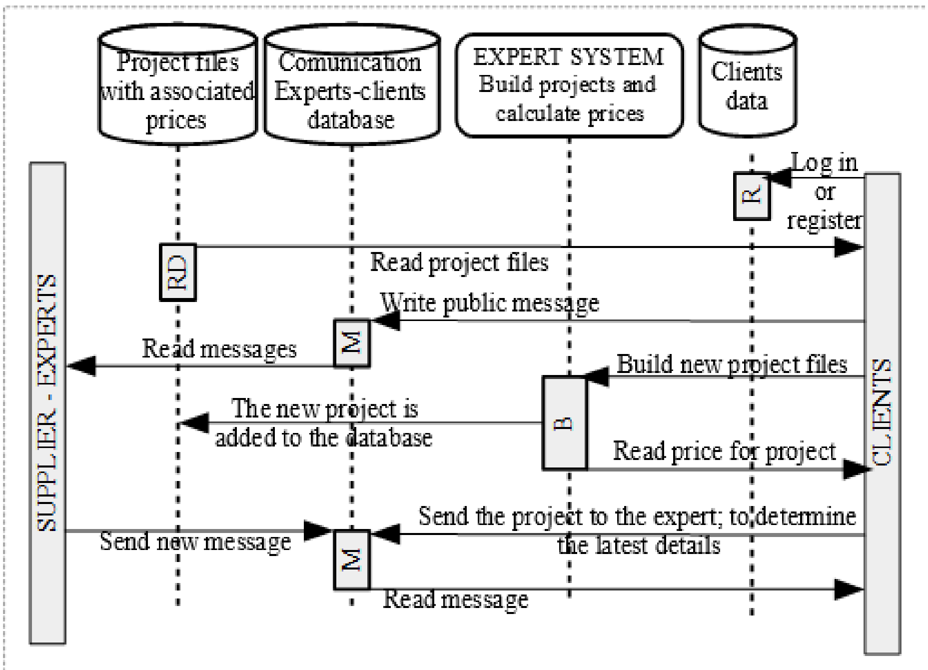

Figure 4. Sequence diagram for complete software arhitecture

There may be rules for the price calculation module that is also reflected in the module for building design.

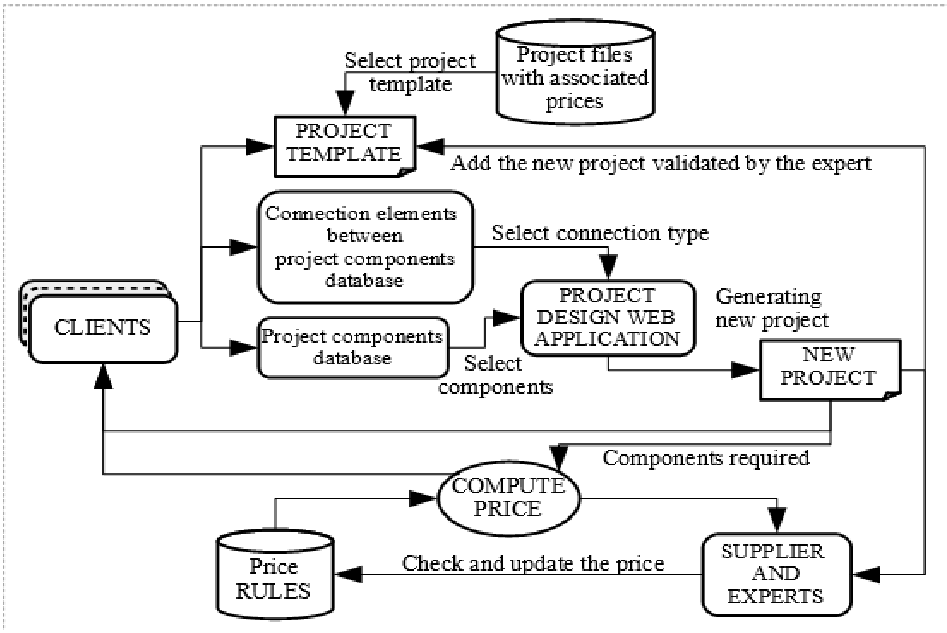

Figure 5. Data flow diagram for complete software arhitecture

Conclusion

The solution chosen is the gradual development of the application. The transition to the next stage of development is achieved only in the conditions of the demand of the customers. In this way, the exploitation costs of the application and the development of the application are minimal.

Table 1. Comparison between the three architectures

Parameter	Minimal arhitecture	Intermediate arhitecture	Complete arhitecture
Optimal for	Few clients	Moderate	Many clients
Time taking - experts	high occupancy time	occupancy time - moderate	low occupancy time
Time taking - clients	low	low	hight
Possible clients	Many clients-limited by human experts' time	Many clients-limited by human experts' time	Moderate -limited by the clients ability to use 3D design products.
Operating costs	hight	moderate	low

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Designing software applications for production lines that require critical space resources

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Abstract

There are industrial processes in development that use critical space resources to store the resulting elements in different production stages. Also, a difficult allocation of space resources leads to an increase in time resources due to fragmentation of space resources by increasing repositioning time. Reaching critical situations resource allocation of space, it may be due to evolutionary order size and type these commands. Reaching critical space allocation space situations may be due to both the evolution of the size of orders from suppliers and their types. An example of this is the line of sheet metal processing. In this case there are parts that are stackable and are parts that require a separate storage. This requires the use of the dynamic allocation of storage sites according to the other available resources and existing planning. The paper aims to present a way of solving the design of a software application for controlling a production line that involves the dynamic allocation of space resources.

Keywords: software design, space management

1 Introduction

Space resources may be sufficient initially, but over time there may be situations where they are no longer sufficient. For example if a sheet processing lines for ordering parts that vary over time, we have benchmarks that can be stacked board and others that can not be stacked.

In such an activity we must take into account:

- the dynamics of customer orders - terms, quantities, typologies, orders (dimensions, the possibility of stacking in various stages of manufacturing, shape factor)
- existing space resources;
- the production capacities of existing equipment and associated human resources;
- transport capacities between locations;
- for some processes, machine tools require a series of time-consuming adjustments, so these operations need to be grouped;
- the ability to receive parts and deliver the manufactured parts.

In the following is presented the architecture of a software application that offers a design solution for a sheet processing line where the locations are dynamically allocated according to the parameters mentioned above.

2 Software Architecture

The architecture of the software system is given by:

- a DBMS containing information about orders, supplies, supplies, machine tool capability, item / component stats, locations, operators etc.;
- a desktop interface for editing and reports;
- a mobile interface that allows quick selection status and location of an item/part (figure 1).

The status of an item / component consists of its processing state (the processing step it has passed). This status will always be accompanied by location information.

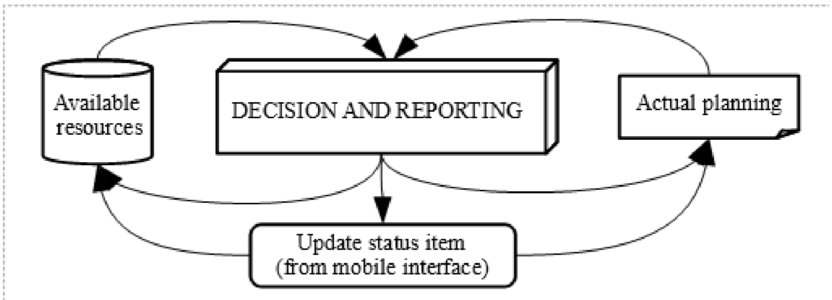

Figure 1. General data flow

Manually updating the status of items, including manually reallocating them to other locations, should not disturb existing planning, otherwise the application will have to warn the operator about this.

2.1 Order Management Module
The process starts with customer orders, depending on which raw material orders are made to suppliers.

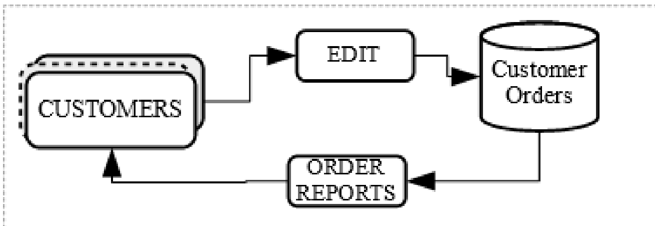

Figure 2. Order management data flow

2.2 Module for Managing Production Capacities
Each machine tool is serviced by some operators. Before starting the machining, items must occupy pre-established locations. For some processes, machine tools require a series of time-consuming adjustments, so these operations need to be grouped but this complicates the allocation of items to locations.

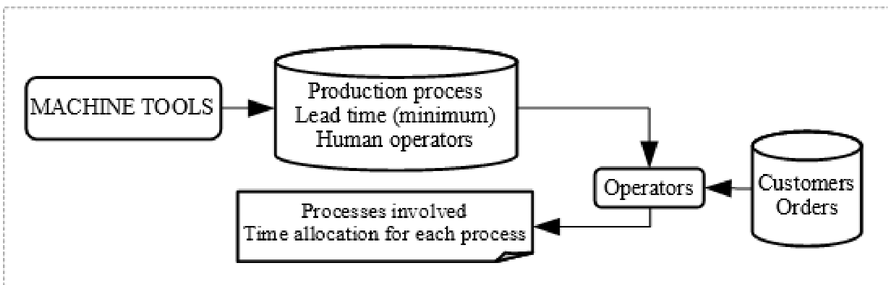

Figure 3. Managing production capacities data flow

2.3 Module for Managing Locations and Transport Capacity between Locations

To relocate an item to a new location, consumed time consists of:

- the time of effective movement between the two locations:
- the loading time of the item on the old location;
- the time of placing the item in the new location.

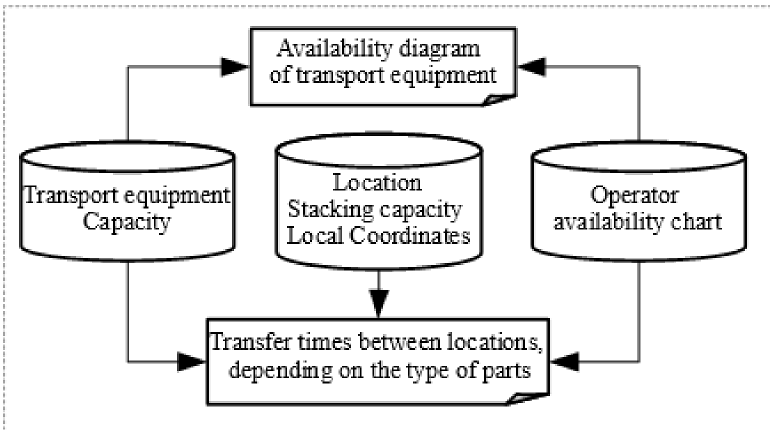

Figure 4. Managing locations and transport capacity data flow

It is also necessary to have the availability of operators and transport equipment.

2.4 Reception Module for the Management of Raw Materials

In order to control the flow, it is also necessary to integrate the supply of raw materials. Discharge of raw materials requires the availability of operators and transport equipment,

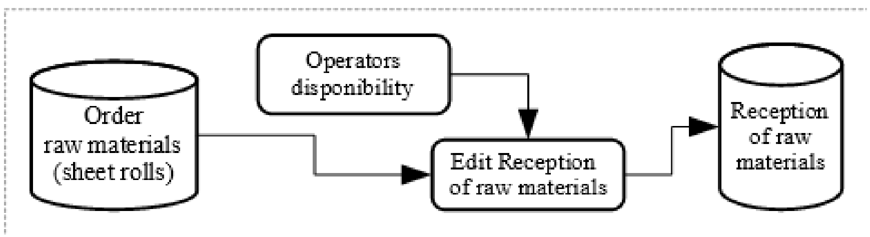

Figure 5. Reception module data flow

2.5 Module for Managing the Delivery of Items

The delivery of items will take into account first of all delivery times in customer orders. Delivery also involves the availability of operators and transport equipment.

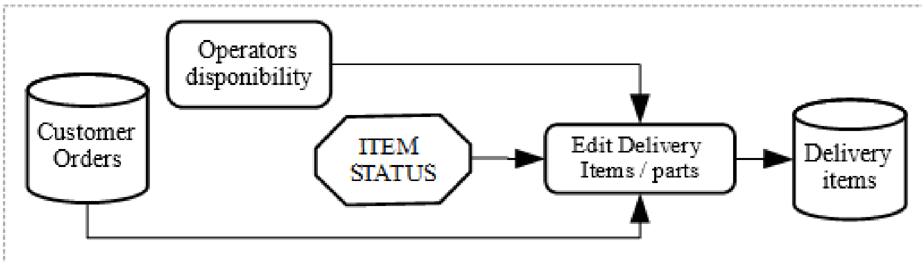

Figure 6. Delivery module data flow

2.6 Module for Editing Item Status

Following the introduction of resources and orders, the application can generate a plan of activities. Operators on production lines have access to planing with mobile devices. The interface must provide quick access to items entering production. The operator will perform the following operations:

- Selects the item and the associated processing process code - the item goes into processing state;
- Select the item and a location (the application will suggest a location) - the application verifies whether this disrupts the planing, in which case it issues a warning;
- Validates the item location after the item has been assigned to a new location.

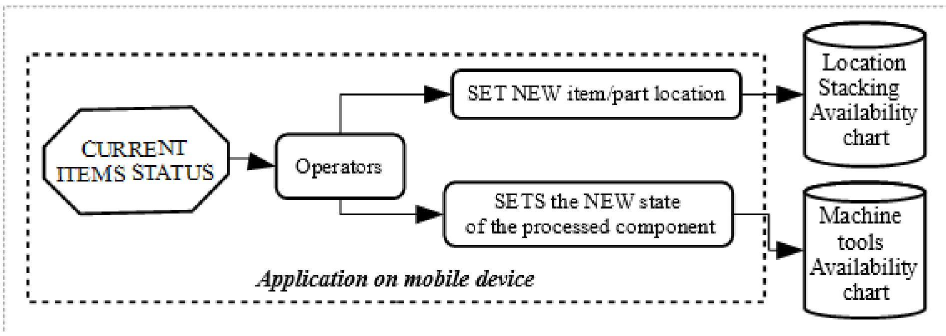

Figure 7. Editing items status data flow

New status and new location for items will be found in the database. The information gathered at this stage can be based on reports on manufacturing costs.

2.7 Decision and reporting module

The decision system can be a classic one based on fuzzy techniques. In this respect, it is necessary to classify the resources that come into the system. It is also necessary to classify the periods in the planning. The time interval class will be given by the shortest production or displacement operation.

The decision to allocate resources refers to the construction of a planing which involves:

- grouping items by process, at the level of machine tools;
- optimal allocation: item - tool machine - operator - time intervals;
- finding a location for the item so as to require a minimum time for taking, moving (before and after processing) and after processing.

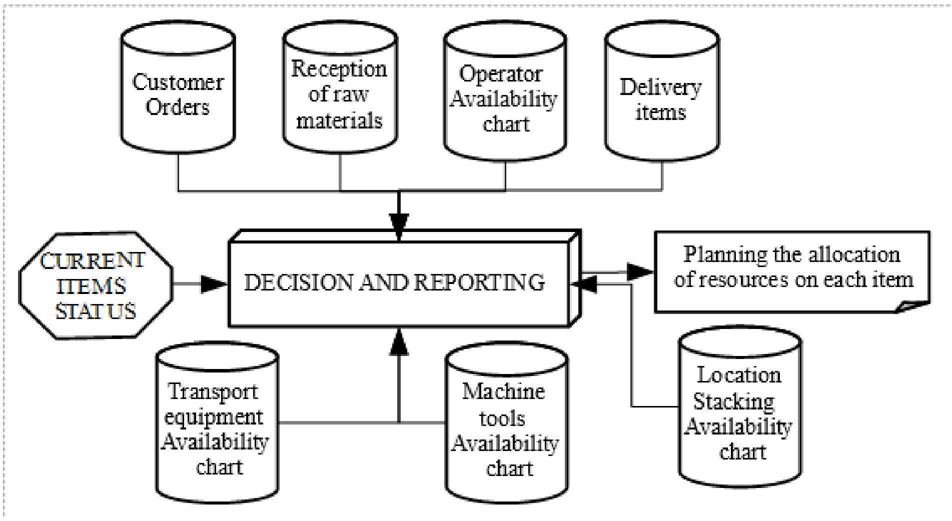

Figure 8. Decision and reporting data flow

Conclusion

An item is tracked from receipt (as raw material) to delivery. In the field of machining of metal profiles, the same piece of piece is placed on the entire processing chain.

The main elements of planning are: times, machine tools, operators, locations. Location assignment depends both on the vertical stacking capacity and the shape characteristics of the item being processed. Sometimes the appreciation of the possibility of stacking is not possible in advance and therefore the application must offer the possibility of reallocation. Also, the handling times can vary quite a lot, and then it is necessary for the operator to check on the application on the mobile device when it is on location and to select the location.

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A DBMS architecture in the field of physics that allows variable data structures over time

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Abstract

The complexity of data structure grow in time. Meny technics are developed in order to control data's complexity. Data structures are dynamic, there are changed in time. A solution would have been the initial representation of data in specific structures of NoSQL databases, but this would involve periodic conversions between different data structures. The means are done by data's relations. Many physics data stored in the DBMS can be represented by the relationships between them. Translating problems from the formalism of representation through fixed structures in the formalism of representation through relationships can lead to increased scalability of the system. A variant of representation of these data consists of external JSON/XML files, or JSON/XML data that are part of DBMS. The paper aims to outline solutions for data representation having a structure that can evolve over time.

Keywords: DBMS Design; XML Data; Variabile Data Type Structure

1 Introduction

In physics, data can represent relationships without the need for complex transformations. For example, instead of having a table with columns with the value of a parameter, we can have a relation between a domain and the respective parameter, the relationship having assigned the equals attribute. For representing data whose structure varies in time, classical representation methods are ineffective, these methods which are based on sequential files representing text/binary or in DBMS. The most common type of database is based on the concept of entity-relationship, in this case the data is stored in logical tables. Besides tables, a relational database may contain: indexes, stored procedures, sequences, users and groups of users, types of data, security mechanisms and management of transactions and so on. The objectual databases are being used increasing frequently. Their use involves the possibility of defining new types of user data [3]. When defining a new data type is required SQL operator overloading, which are used to work with that kind of date, inclusively indexing operators. DBMS's have data types such as XML and JSON, also have associated functions for working with them. Using XML or JSON data type have the advantage of a possible structure variables. Taking an XML or JSON data type involves and validation, which consists of checking that validation -XML or JSON format.

Use of information whose structure varies over time may be covered by an object representation of the data. For example, we have started a field containing an integer information - the year and then use the same format for the calendar date information entity. In this case different methods are needed that treats information, depending on the types of information with which it interfaces.

Another way to format data representation method for time varying emphasis on interlinked entities rather than on the information itself.

2 A Dynamic Storage Data with XML Type Structure

A time-varying structure involves a flexible user interface (Figure 1). The management interface is achieved through a class that stores the links between controls and data via a mapping table stored on the server.

Informational Flow.This approach is based on the CIDOC - Conceptual Reference Module [1]. This data time changing its structure, so it can be stored in simple tables (relational DBMS). This data structure involves a series of relationships between them. Both entities are stored (object_) and the links between them (relation_).

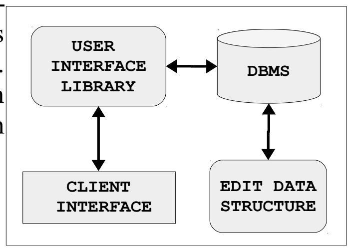

Figure 52

A minimal architecture should include:

- A table "resorce_" that contains the actual data in XML format
- A table "object_" containing data on external resources such as files or web pages;
- A table "relation_" which contains links between resources or between resources and objects:
- A table "logentry_" containing the editing their events.The structure of these tables is given in Figure 2.

Table's structure. The tables involved had the following structure:

relation_

- *id* (uuid) - the ID of relationship;
- *type* (uuid) - type of Relationship identifier;
- *idLeft* (uuid) - relationship identifier left [res-ID, obj-ID];
- *typeRelLeft* (varchar) - the nature of relationship left (resource, object);
- *idRight* (uuid) – the identifier on the right relationship [res-ID, obj-ID];
- *typeRelRight* (varchar) - the nature of the right relationship (resource, object);
- *status* (integer) - relationship status - Internal variable, dependent on the application code;
- *notes* (xml) – description;
- *canceled* (boolean) – activ;

object_

- id (uuid) - object id;
- *filename* (varchar) - file wherein there is stored object;
- *type* (varchar) - type of object;
- *status* (varchar) - internal variable;
- *folder* (varchar) - the path for file;
- *notes* (varchar) – description;
- *item_id_ref* (uuid) - id of resource referred to by the object;
- *canceled* (boolean) – activ;

logentry_

- *id* (uuid) - registration identifier
- *item_ref* (uuid) - the entity identifier affected [Resid, rel_ID, obj_ID]
- *dateTime* (timestamp with time zone) - time for action
- *action* (varchar) - the action (creation, deletion, insertion, modification, validation, disabling object)
- *xpath* (varchar) - locating element inside the XML structure
- *element* (xml) - item deleted or replaced
- *editor* (uuid)- ID of the person who executed the action
- *notes* (xml) – description;

resource_

- *id* (uuid) - resource identifier;
- *type* (uuid) - type resource identifier;
- *schema* (uuid) - XSD schema identifier corresponding XML data
- *xmldocument* (xml) - XML document that describes / represents the resource;
- *notes* (xml) - description;
- *CreationDateTime* (timestamp with time zone) - moment of the creation of the resource;
- *status* (varchar) - internal variable;
- *canceled* (boolean) - activ;

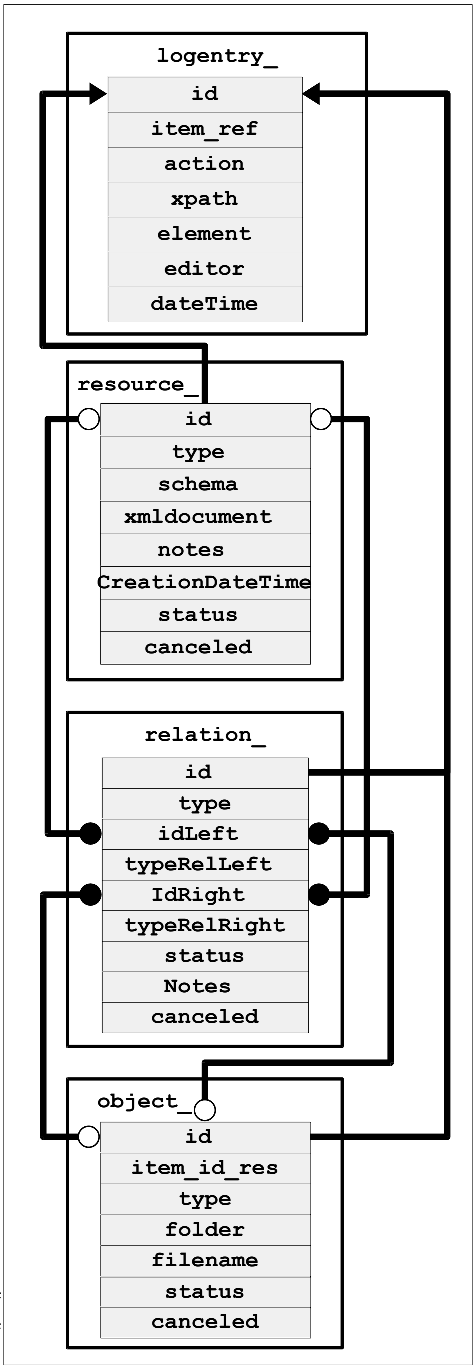

Figure 53

All resources have one unique identifier type UUID / GUID (128 bits) and one field for the resource designation for the cancellation. Information is stored in XML format.

Relations type left / right allow for the construction of oriental relations. Status field can be used to store some classifications of resources or links between them.

3 Management of Access RightsIt is difficult to apply access restrictions to data contained in the XML structures that are interconnected. In this case each SQL statement requires a filtering component which will add access restrictions specific to each group of users. Access restrictions at the links are grouped restrictions restrictions reading and writing.
It is difficult to apply access restrictions to data contained in the XML structures that are interconnected. In this case each SQL statement requires a filtering component which will add access restrictions specific to each group of users. Access restrictions at the links are grouped restrictions restrictions reading and writing.

When access to the database, restrictions may be the result of applying server-level functions, functions that take as a parameter access group (figure 3).

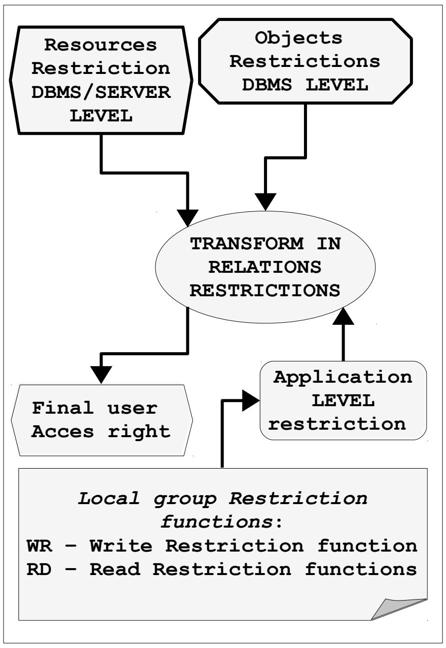

Figure 54

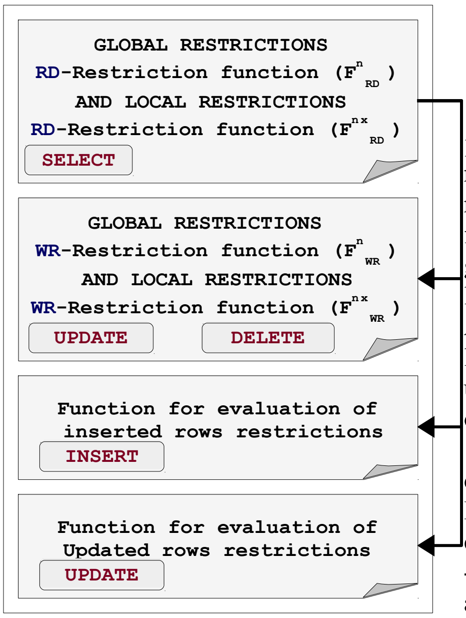

Figure 55

Acces system Setting access passwords at the application levelFigure 4 shows detailed restrictions for each type of operation. Each restriction is formed by a group of general restrictions, implemented globally and a specific group of restrictions given by the lowest level of restrictions (local level).
Access to the DBMS can be field-level and application-level access can be any condition that is transpunsa a filter using SQL commands. This may be the selection / reading or writing.

Depending on the type of the SQL filter can be built dynamically on the server side
Implementation can be achieved by using object-oriented concepts. In this case we have two choices:
- Object-oriented representation centered on resources and objects;
- Object-oriented representation centered on relationships between objects / resources.

Object-oriented representation centered on resources and objects enable a rapid expansion of resources and detrimental to items in their relationship.
Object-oriented representation centered on relationships between objects / resources take difficult new resources, objects but allows easy expansion of links between them.
Both representations can be implemented in DBMS using user data types. The relationships between entities can be implemented by server-side functions. The DBMS-specific functions can be used for working with XML data.

Restriction systemImplementation of restrictionsFor operations "INSERT" and "UPDATE" is required prior to their simulation to verify data affected. Otherwise it would be possible for a user to add data, the editing (without making a selection), which does not have access.

4 Conclusions

An immediate application of these techniques is the nomenclature for the management of electronic equipment. Usually, a nomenclature contains: Reference technical, commercial reference, description, supplier etc. Codifications can change frequently without any significant changes in equipment, and a subsequent search will not allow aggregation of similar equipment depending on the technical characteristics. In this case the type definitions are necessary concepts and terms, the concept being given the overall functionality of the equipment. The components of these devices can be interchanged which requires defining the relationships between the components compatible equipment.
In the following table some features are compared. The adopted method offers flexibility especially in terms of expanding the structure of the database system.

Table 1. Compare Techniques

Criterion	This methode (with relational DBMS)	NoSQL	Classic Relational DBMS
Flexible Data Model	higher	higher	lower
The design time for the SGBD	Long for short term Short for long term	Short for short term Short for long term	Short for short term Long for long term
Scalabilty	higher	higher	lower
Decoupling components that make data access	higher	medium	lower
Data integration processes	higher	medium	lower

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S e c t i o n

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The Study of The Uniform Circular Motion Using the Accelerometer of a Smartphone

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Abstract

Smartphones can nowadays be used as educational instruments in the Physics class due to their integrated sensors. Using the accelerometer of a smartphone the students can study the uniform circular motion and determine the physical quantities associated with it. In this study we performed a series of experiments aimed at determining the medium values of the Cartesian components associated with the centripetal acceleration of a smartphone placed on a horizontal platform which performs a circular motion. Based on these determinations, we calculated the values of the other physical quantities associated with the uniform circular motion, such as the centripetal acceleration, the rotation period and frequency, the angular speed and the centrifugal force. We performed these experiments using three measurement methods of the centripetal acceleration: 1) on a small scale with a rotating disc; 2) on a medium scale, using a bicycle wheel; 3) on a large scale, using a merry-go-round from a park. The Cartesian components of the centripetal acceleration which the mobile phone was subjected to were observed in real time and recorded using the application Linear Accelerometer.

Keywords: Smartphone, Accelerometer, Circular Motion, Centripetal acceleration, Frequency

1 Introduction

The sensors present in nowadays modern smartphones can be employed in most Physics experiments. The accelerometer in particular is a sensor which can be successfully used in a wide range Mechanics experiments (Castro-Palacio, J. C. *et al*, 2014; Viridi, 2013; Vogt and Kuhn, 2013; Resta and Trzmiel, 2014).

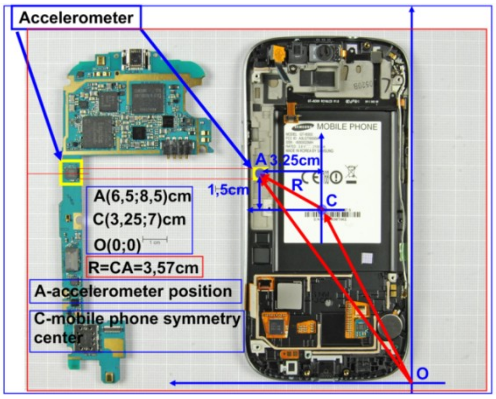
In this paper we intend to illustrate a modern teaching method based on the integration of the smartphone in the study of the uniform circular motion in order to determine the physical quantities associated with this motion. For this purpose, we developed experiments aimed at determining the average values of the Cartesian components a_x and a_y of the centripetal acceleration a_{cp} of a smartphone placed on a horizontal platform performing a circular motion. With the help of these determinations, we calculated the values of the following physical quantities: centripetal acceleration a_{cp}, rotation period T, frequency ν, tangential speed v, angular speed ω, centrifugal force F_{cf}. We performed the measurements using three experimental methods, which are illustrated in the following section of the paper.

2 Measurements performed using a rotating disc. The study of the dependence of the centripetal acceleration on the radius of the trajectory.

We placed the smartphone on a disc performing an uniform circular motion. In order to set up this rotational device, we employed an electric motor of a computer fan. On its axis we placed consecutively a CD, a vinyl disc with a diameter of $30cm$ and some millimetric paper. The experimental setup was powered electrically from a stabilised power supply having a voltage of $12V$. From the menu of the *Physics Toolbox* suite installed on the smartphone we selected the application *Linear Accelerometer* in order to record the data.

The next stage of the experimental setup consisted in placing the phone on a disc in different positions along a diameter containing tags which marked the distance of the mobile device from the center of the disc. A very important step consisted in correctly establishing the position of the acceleration sensor on the motherboard of the smartphone. In order to do that we placed the phone in the central area of the disc and gently moved it in its plane, until we identified the point where the measured values of the accelerations a_x and a_y were almost null. We have to take into account the fact that a_z, the projection on the axis Oz of the centripetal acceleration vector, equals zero, because the movement of the smartphone is performed in the xOy plane.

The point determined using this method was correspondent to the position of the accelerometer on the motherboard of the mobile device. The accelerometer of the smartphone used in the experiment was located in the immediate vicinity of the lateral edge of the motherboard, in a point A which had the coordinates $A(3,25;1,5)cm$ relative to the symmetry center of the device, being situated at the distance $R = 3,57cm$ from this center (Figure 1 - left). Once we established the position of the acceleration sensor inside of phone, we performed recordings of the acceleration components by moving the smartphone in several points situated along the marked diameter of the disc (Figure 1 - right).



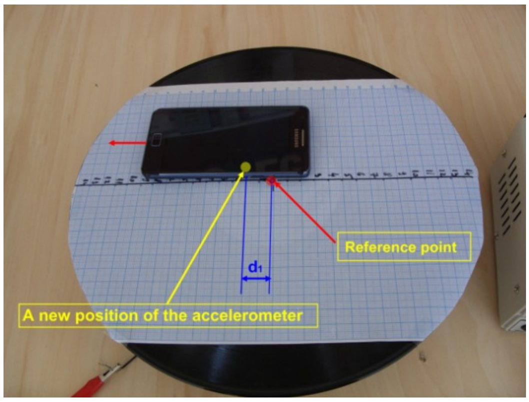


Figure 1. Location of the accelerometer (left); Radial displacement smartphone (right)

The data recorded by the accelerometer was stored in .csv files (comma separated values) and exported in Excel for analysis. We provide an example on how to analyse and work with the data obtained from one of the performed recordings. We chose a recording with the duration $\Delta t = 30s$ (Figure 2).

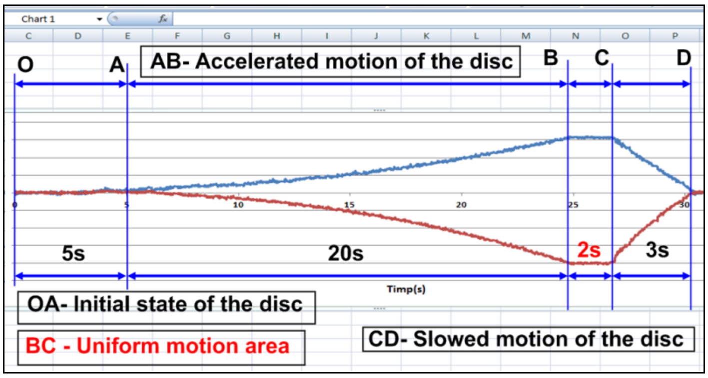


Figure 2. Recording of the circular motion of the disc

The BC segment of the graph corresponds to the constant rotation speed of the disc. In the time interval associated with this segment, the rotation motion of the disc was uniform. The transition zones AB and CD correspond to the time intervals in which the disc is accelerated (the starting phase of the electric motor) and slowed down (the stopping phase of the electric motor) relative to the uniform circular motion regime.

From the analysis of the BC segment of the graphic we calculated the average values of the accelerations: $a_x = 1,57 \frac{m}{s^2}$ and $a_y = -2 \frac{m}{s^2}$ .This way we calculated the centripetal acceleration $a_{cp} = \sqrt{a_x^2 + a_y^2} = 2,54 \frac{m}{s^2}$. Using the value of the centripetal acceleration a_{cp} we determined the values of the angular speed ω and of the period T and frequency ν of the rotation. We performed additional measurements along the diameter of the disc and the values obtained are illustrated in Table 1.

Table 1. Measurements performed using a rotating disc

$r(m)$ (measured)	$a_{cp}(\frac{m}{s^2})$ (measured)	$\omega(\frac{rad}{s})$ (calculated)	$T(s)$ (calculated)	$\nu(Hz)$ (calculated)
0.02	2.54	11.269	0.557	1.795
0.03	3.75	11.180	0.561	1.780
0.04	4.92	11.090	0.566	1.766
0.05	6.03	10.981	0.571	1.748
0.06	7.01	10.808	0.581	1.721

Using the *Tracker* desktop application for the analysis of the video recordings showing the smartphone rotating on the support disc, we identified the number of rotations N performed by it in the time intervals Δt associated with the uniform circular motion regime.

Based on the relation $T = \frac{\Delta t}{N}$, we determined the values of the rotation period for the five cases and we compared them to the ones calculated and displayed in the table above (Table 1). Moreover, using the relation $a_{cp} = \omega^2 r = \frac{4\pi^2 r}{T^2}$, we calculated the values of the centripetal acceleration and compared them with the ones measured using the accelerometer. The results are illustrated in the table below (Table 2).

Table 2. Values of centripetal acceleration ($a_{cp}^{smartphone}$ vs. $a_{cp}^{Tracker}$)

$r(m)$	$T_{measured}(s)$ $T = \frac{\Delta t}{N}(s)$ *Tracker	$T_{calculated}$ (s) *Smart-phone	$a_{measured}$ $(\frac{m}{s^2})$ *Smart-phone	$a_{calculated}(\frac{m}{s^2})$ $a_{cp} = \frac{4\pi^2 r}{T^2}(\frac{m}{s^2})$ *Tracker	$\varepsilon = \left\lvert 1 - \frac{a_{cp}^{Tracker}}{a_{cp}^{smartphone}} \right\rvert$	$\varepsilon_{average}$ (%)
0.02	0.567	0.557	2.54	2.45	0.035	4.7
0.03	0.572	0.561	3.75	3.62	0.035	
0.04	0.579	0.566	4.92	4.71	0.043	
0.05	0.589	0.571	6.03	5.69	0.056	
0.06	0.601	0.581	7.01	6.54	0.067	

The graphic representation of the two types of acceleration values can be observed in Figure 3.

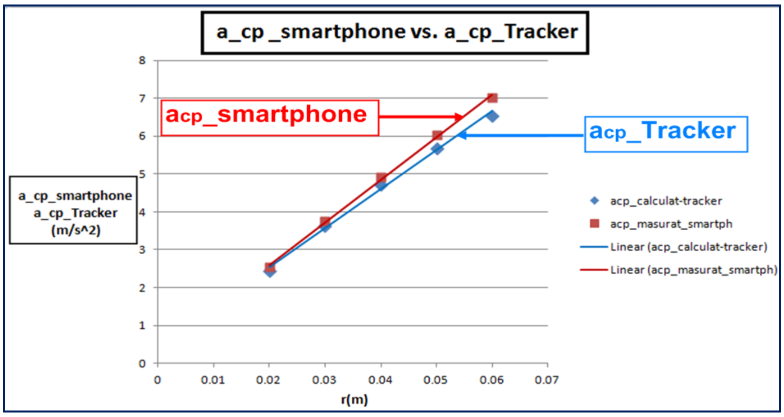


Figure 3. Centripetal accelerations - comparative graphs

From Table 3 we can notice an average value shift of $4,7\%$, an aspect which confirms the accuracy of the experimental data obtained with the accelerometer of the smartphone.

3 Measurements using a bicycle wheel. Determining the radius of the trajectory by measuring the centripetal acceleration.

In order to overcome the limitations imposed by the small radius of the disc used previously we decided to extend the experimental fields to higher values of r, using a rotational support surface with a constant distribution of the mechanical resistance factor to external pressure.

Therefore, we selected as a support for the mobile phone a bicycle wheel with the diameter of $60cm$. The phone was placed at the distance r, the wheel was quickly set into motion and then it was left to spin freely.

Analysing the recorded graphic performed at a distance $r_1 = 8cm$ relative to the rotational axis, we selected the time interval $3s$ associated to a uniform motion of the wheel, followed by an interval of almost $20s$ of motion slowed down until it stopped (Figure 4 - right). We calculated the average values of the accelerations: $a_x = -4,86\frac{m}{s^2}$ and $a_y = -2,40\frac{m}{s^2}$ and we obtained the value of the total acceleration: $a_{cp} = 5,41\frac{m}{s^2}$. From the analysis of the video recording of the experiments, with the help of the *Tracker* application, we deducted the number of rotations performed by the phone in the time interval $\Delta t = 3s$ associated with a uniform circular motion: $N = 4$ (Figure 4 - left).

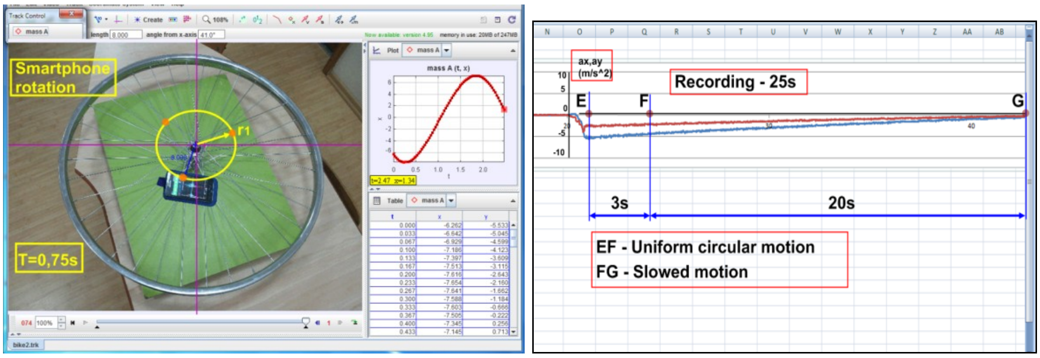


Figure 4. Smartphone placement on the bicycle wheel (left);
Graphs of recorded a_{cp} components (right)

Using the value calculated for the motion period T we calculated the angular speed ω and we deducted that $r = \frac{a_{cp}}{\omega^2} = 7,7cm$. We compared this value with the one determined through direct measurements ($r_1 = 8cm$) and we noticed a slight value shift of $3,75\%$, a value which indicates a fairly accurate precision of the determination performed using the accelerometer.

We proceeded to compare the calculated values of the distance r (using the recordings of the centripetal acceleration a_{cp}) and the ones measured directly by placing the phone in four additional points r_2, r_3, r_4 and r_5 on the diameter of the wheel.

The deducted values of the accelerations and the calculated values of the uniform rotation periods, based on the graphical recordings, are illustrated in Table 3.

Table 3. Measurements using a bicycle wheel

$a_{cp}(\frac{m}{s^2})$ (measured) *Smartphone	$T(s)$ (calculated) *Tracker	$\omega(\frac{rad}{s})$ (calculated)	$r(m)$ (calculated)	$r(m)$ (measured)	Relative error $\left\lvert 1-\frac{r_{calculated}}{r_{measured}} \right\rvert (\%)$
5.41	0.750	8.37	0.077	0.080	3.74
7.92	0.761	8.25	0.116	0.120	
10.34	0.770	8.16	0.155	0.160	
12.48	0.781	8.04	0.193	0.200	
14.25	0.795	7.90	0.228	0.240	

4 Measurement of the uniform circular motion parameters using a rotating platform

The next stage of our experiments occurred on a larger measurement scale. We performed determinations of the centripetal acceleration using a rotating platform from a children's park (merry-go-round). We placed three mobile phones on the platform at different distances from the spinning axis and we studied the dependency of the centripetal acceleration a_{cp}, of the tangential speed v and of the centrifugal force F_{cf} on the circular radius trajectories. The selected distances were adapted to the dimensions of the platform and had the values $r_1 = 55cm$, $r_2 = 60cm$ and $r_3 = 65cm$ (Figure 5 - left). The graph illustrated in Figure 5 (right) shows the recording performed at the distance $r_1 = 55cm$.

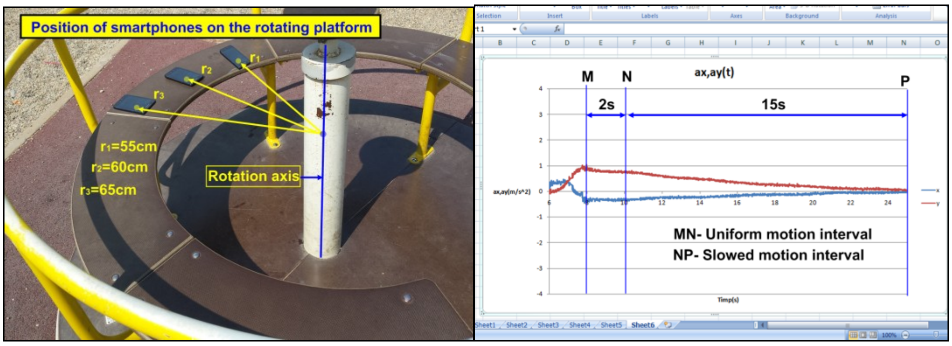


Figure 5. Position of the smartphone on the rotating platform (left)
Graphs of the recorded acceleration components (right)

The average values of the measured components of a_{cp} in the time interval associated with a uniform circular motion ($8 \div 10s$) were: $a_x = -0,334\frac{m}{s^2}$ and $a_y = 0,785\frac{m}{s^2}$, therefore the calculated acceleration was: $a_{cp} = \sqrt{a_x^2 + a_y^2} = 0,853\frac{m}{s^2}$.

The recording performed simultaneously by the three mobile devices can be seen in the table below (Table 4). This table illustrates the measured and the calculated values of the physical quantities specific for the circular motion $a_{cp}, T, \nu, v, \omega, F_{cf}$.

Table 4. Measurements using a rotating platform

$r(m)$	$a_{cp}(\frac{m}{s^2})$	$T(s)$ (calculated)	$\nu(Hz)$ (calculated)	$\omega(\frac{rad}{s})$ (calculated)	$v(\frac{m}{s})$ (calculated)	$F_{cf}(N)$ (calculated)
0.55	0.853	5.042	0.198	1.245	0.684	0.127
0.60	0.946	5.003	0.199	1.255	0.753	0.141
0.65	1.048	4.868	0.205	1.269	0.824	0.157

Using the data from Table 4 and drawing the associated graph, we can notice the linear dependency of the acceleration a_{cp}, of the angular speed ω and of the centrifugal force F_{cf} on the increase in the distance r relative to the rotation centre. This aspect is a consequence of a good rotational inertial stabilization that the rotational platform has.

Conclusions

The integration of the smartphones in the Mechanics experiments had a positive effect on the overall performance of the students in the Physics class, as our previous studies have shown (Oprea and Miron, 2014; Oprea, 2017). Their motivation and involvement reached a new level, qualitatively superior to the one they manifested previously. The use of the smartphone in the study of the circular motion is in line with a learning method which is more accessible, faster and more precise than the classical one, which relies solely on the standard laboratory equipment. This approach develops the students` research abilities, which are reflected in their capacity to acquire, process and interpret experimental data.

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The Study of The Free And Damped Harmonic OscillationS Using The Accelerometer of a Smartphone

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Abstract

The study of the free and damped harmonic oscillations can be performed during Physics classes using the accelerometer of a smartphone. The oscillating body suspended by a spring is the smartphone itself. Using the free app Linear Accelerometer from Google Play Store we can visualize in real time the Cartesian components of the acceleration vector associated with the movement of the mobile phone. In this study we analyzed a one-dimension oscillatory motion of a smartphone and we performed a phenomenological study of a time-domain graph associated with the recording of the system's acceleration, in order to calculate the defining parameters of the oscillatory motion. We focused both on the free harmonic oscillations regime and on the damped oscillations regime, using various springs with specific elastic constants.

Keywords: Smartphone, Accelerometer, Free harmonic oscillation, Damped harmonic oscillation

1 Introduction

Smartphones have nowadays become widely accessible pedagogical tools, particularly in the STEM field, a term that refers to the academic disciplines of Science, Technology, Engineering and Mathematics (Khatri *et al*, 2017; Hora and Oleson, 2017). "Mobile learning" or "M-learning" has begun to play a major role in teaching and learning, as more and more educators make use of it in order to provide the students with a better understanding of scientific concepts (Lu, 2012; Desmond, 2005; Oprea and Miron, 2014). In the Physics class, in particular, smartphones can be successfully used in various experiments due to their integrated sensors (Attewell and Savill-Smith, 2004; Goad, 2012; Monsoriu *et al*, 2014). This study illustrates the way in which the acceleration sensor of a smartphone can be used to study the harmonic oscillation motion and on the damped oscillation motion, as very few studies have tackled this topic so far (Castro-Palacio *et al*, 2016).

Based on these considerations, we analysed the one-dimensional oscillation motion of a smartphone vertically suspended from a fixed point by a spring. We performed a phenomenological study on a time-domain graph associated with a recording of the acceleration of the system. We used the free app *Linear Accelerometer* in order to visualize in real time and record the variations of the Cartesian components of the acceleration vector associated with an oscillatory motion.

The analysis of the graph led to the delimitation of two time intervals. The first interval, situated at the beginning of the graph, having constant amplitude oscillations, was associated with the harmonic oscillation regime. The second interval, extended until the end of the motion, was associated with the damped oscillation regime.

From the analysis of the interval associated with a harmonic oscillation regime we deducted the maximum value of acceleration, the period, the frequency and the pulsation of the oscillator. Based on these measurements, we calculated the values of the motion amplitude, the elastic constant of the spring, the maximum speed and the maximum kinetic energy of the suspended body. We also provided the equations which show how the elongation, the speed, the acceleration and the kinetic energy of the oscillator are time-dependent.

From the study of the area associated with the damped oscillation regime we deducted, aside from the values of the physical quantities that we mentioned earlier, the values of the motion damping coefficient, the relaxation time and the quality factor of the oscillating system. The analysis of the damped harmonic oscillation and the calculus of its parameters were performed for springs with a low elastic constant, as well as for springs with a high elastic constant.

2 Experimental setup

The experimental device used was made up of a smartphone (placed in a protection case) which was vertically suspended with an elastic spring from a point situated on the symmetry axis of a tripod (Figure 1 - left).

Using the app *Linear Accelerometer* from the *Physics Toolbox* suite, we recorded the acceleration of the oscillator both in harmonic regime and in damped regime. The movement of the suspended body occurred in one direction, therefore the acceleration component which had the most significant contribution to the value of the total acceleration $a(a_x, a_y, a_z)$ was a_y, while the other two components a_x and a_z had an insignificant contribution.

3 The study of harmonic oscillations

The spring was initially in an undeformed state and, when we suspended the phone on its free terminal, it went through a deformation process through extension (Figure 1 - right).

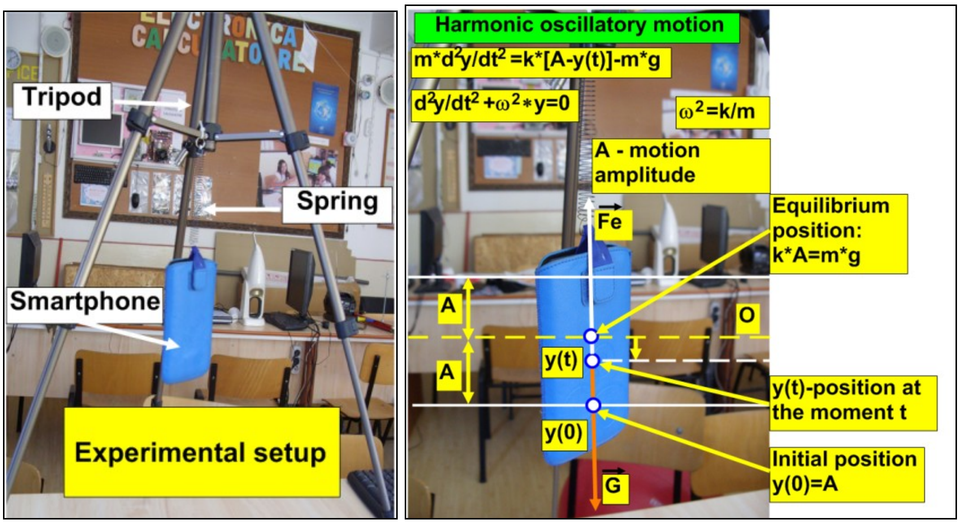

Figure 1. Experimental setup (left); Parameters of the harmonic oscillatory motion (right)

Under the action of a short-term external disturbance force F_{def} the body will oscillate harmonically with the elongation

[1] $$y(t) = A \cdot \sin(\omega \cdot t + \varphi_0),$$

where the terms A, ω and φ_0 represent the amplitude, the pulsation and the initial phase of the oscillating motion.

The quantitative aspects of our experimental study included, first of all, the determination of the elastic constant k of the spring we used. Afterwards, we determined the amplitude, the maximum speed and the maximum acceleration of the body in motion. With the help of these values we calculated the total energy of the harmonic oscillator.

In usual experimental conditions, the harmonic oscillation regime is harder to obtain for an extended period of time. For this reason we selected an interval which corresponds to the harmonic oscillation regime from the graph showing the variation in time of the body acceleration (Figure 2).

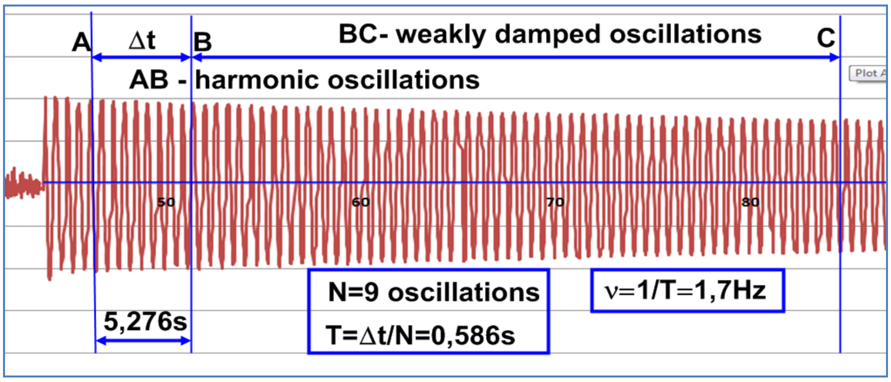

Figure 2. Oscillatory motion recording

As one can notice, the number of oscillations present in the selected interval $\Delta t = 5,276s$ is $N = 9$. Therefore we calculated the oscillation period $T_0 = \dfrac{\Delta t}{N} = \dfrac{5,276}{9}s = 0,586s$.

Knowing the oscillation period T_0, we deducted the value ω_0 of the pulsation of the body: $\omega_0 = 10,71s^{-1}$ and the frequency: $\nu_0 = 1,7Hz$. Knowing the value of the pulsation ω_0 and of the mass of the system $m = 160g$, we were able to calculate the elastic constant of the spring: $k = m \cdot \omega_0^2 = 0,183\dfrac{N}{cm}$.

This value of k was compared to the one deducted from static determinations: $k = \dfrac{m \cdot g}{\Delta L} = 0,189\dfrac{N}{cm}$, thus obtaining a small relative error: $\varepsilon = 1 - \dfrac{0,183}{0,189} = 3,17\%$.

The value of $1,79\dfrac{m}{s^2}$, taken from the graph, associated with the maximum acceleration of the body suspended from the spring, enabled us to calculate the amplitude of the oscillation:

$$A(t=0) = A_0 = \frac{a(t=0)}{\omega_0^{\,2}} = \frac{a_{\max}}{\omega_0^2} = 1,56cm$$

Once again the value deducted was compared to the value of the maximum elongation of the spring $A = \Delta l = 1,5cm$, produced by the deformation force F_{def}. The relative discrepancy between the two values is very small $\left|1 - \frac{1,5}{1,56}\right| = 4\%$, a fact which proves the accuracy of the data provided by the smartphone accelerometer during the recording.

This relative variation of the amplitude deducted from the graph relative to the amplitude determined experimentally is caused by slight geometrical alignment fluctuations of the oscillating system during the motion.

The maximum speed of the body, when it has gone through the equilibrium position, was $v_{\max} = \omega_0 \cdot A = 0,167\frac{m}{s}$.

The associated maximum kinetic energy had the value:

$$E_{c\max} = \frac{m \cdot v_{\max}^2}{2} = k \cdot \frac{A^2}{2} = 0,00222J = 2,22mJ = E_{total}$$

4 The study of damped oscillations

During the oscillatory motion experiments, the maximum contribution was brought by the recordings associated with the damped oscillatory regime. This type of movement is characterized by the drop of the amplitude and of the total energy of the oscillator in time.

We proceed to highlight some of the theoretical aspects of the damped oscillatory motion. The presence of a damping force $F_f = -\gamma \cdot v$, proportional to the speed of the oscillator, leads to the following solution of the differential equation of the damped oscillator

[2] $$y(t) = A(t)\sin(\omega \cdot t + \varphi_0),$$

where $A(t)$ represents the amplitude of the damped oscillation:

[3] $$A(t) = A_0 \cdot e^{-\delta \cdot t}.$$

One needs to mention the fact that A_0 and φ_0 are determined from the initial conditions.

The previous theoretical analysis will be completed with a short quantitative analysis on the evolution of the damped oscillation amplitude (recorded for the purpose of this experiment), determining its damping coefficient δ, the period of the movement T, its pulsation ω, the elastic constant of the spring k and the relaxation time τ of the oscillatory motion.

In the graph below (Figure 3) we can study the complete recordings showing the evolution in time of the acceleration component a_y of the suspended body used in the previous experiment.

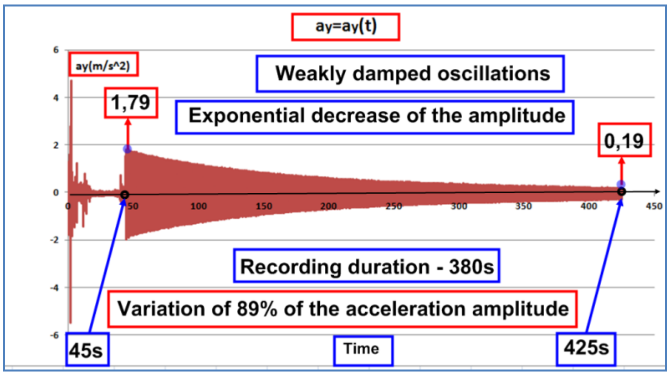

Figure 3. Damped oscillations recording

The lack of homogeneity in the physical structure of the spring and the friction forces present at the contact points caused a slow exponential drop of the acceleration amplitude of the motion in time (under-damped oscillations), according to the relation:

[4] $$a(t) = a_{\max} \cdot e^{-\delta \cdot t},$$

where δ represents the damping coefficient.

From the graph we can notice the fact that the maximum acceleration value was $a_{\max} = 1,79\frac{m}{s^2}$, while towards the end of the experiment, it became $a_{\min} = 0,19\frac{m}{s^2}$.
The determination of δ was made by applying a logarithm on the expression of acceleration dependency on time, obtaining:

$$\delta = -\frac{1}{380s} \cdot \ln(\frac{0,19}{1,79}) = 0,0059s^{-1}$$

This small value of the damping coefficient is characteristic for weakly damped oscillations. The time of relaxation, that is the time in which the amplitude of the oscillation dropped by $e = 2,718$ times was: $\tau = \frac{1}{\delta} = \frac{1}{0,0059s^{-1}} = 169,5s$.

For determining the pulsation ω of the damped oscillations we used the value of period T_0 of the free oscillations ($T_0 = 0,586s$) previously calculated for the sample of oscillations situated at the beginning of the graph, where their amplitude was nearly constant.
Knowing the pulsation of the free oscillations $\omega_0 = \frac{2\pi}{T_0}$, we determined the damped oscillation pulsation ω, which was: $\omega = \sqrt{\omega_0^2 - \delta^2} = 10,70s^{-1}$

We noticed a negative variation, below 1%, of the pulsation ω_0, a fact which further highlights the characteristics of weakly damped oscillations. In our case, the quality factor had the value: $Q = \omega_0 \tau = 10,71s^{-1} \cdot 169,5s \approx 1815$.

We noticed that the energy of the oscillator drops exponentially with time:

[5] $$E(t)=\frac{1}{2}\cdot k\cdot A(t)^2=\frac{1}{2}\cdot k\cdot A_0^2 e^{-2\cdot\delta\cdot t}.$$

At the initial moment its value was $E(0)=E_0=\frac{1}{2}\cdot k\cdot A_0^2=0,002233J$, but after a period T of the movement, it dropped to the value: $E(T)=2,217\cdot 10^{-3}J$, that means there was a drop of $0,7\%$ per period.

At the end of the experimental study interval (after $380s$) the energy of the oscillator became:

$$E(t=380)=\frac{1}{2}\cdot 18,352\frac{N}{m}\cdot(0,0156m)^2\cdot e^{-2\cdot 0,0059s^{-1}\cdot 380s}=2,555\cdot 10^{-5}J$$

We noticed a drop in the initial energy of the oscillator of about 87 times.

For a better quantitative distinction of the determined parameters of the oscillating motion we replaced the previous spring with one having a higher elastic constant. The graph showing the evolution of the recorded values of acceleration for this spring can be seen below (Figure 4).

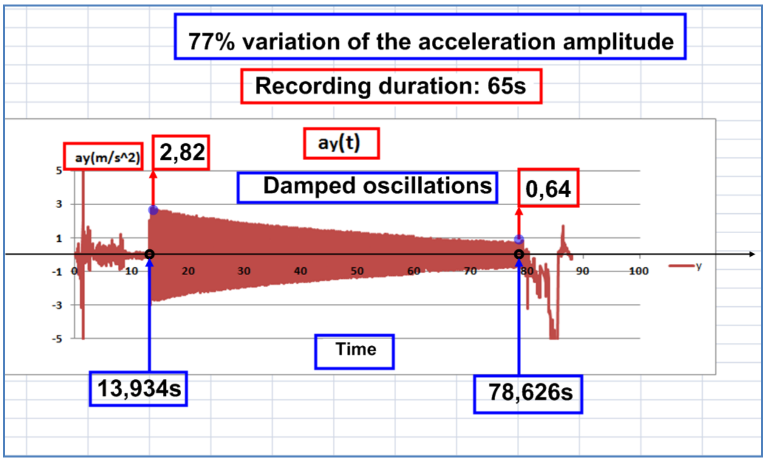

Figure 4. Damped oscillation recording (new spring)

The damping coefficient δ was estimated at the value of $\delta\cong 0,023s^{-1}$, while the relaxation time was: $\tau\cong 44s$

The determined values can be found in Table 1 below.

Table 14. Experimental measurements

Physical quantity	δ (s-1)	τ (s)	T_0 (s)	ω_0 (s-1)	ω (s-1)	k (N/m)	Q	E_0 (mJ)	E_{fin} (mJ)
Value	0.023	44	0.375	16.747	16.746	44.87	736.87	2.243	0.113

From Table 1 we can notice the fact that the quality factor Q of the oscillating system had the value of approximately 737 units. Moreover, during the recording interval, the energy of the oscillator dropped by nearly 20 times.

Conclusions

The study of the harmonic oscillations and of the damped oscillations using the accelerometer of a smartphone enables the calculus of the main parameters of this type of movement: the period, the frequency the pulsation, the amplitude, elongation, the speed, the energy, the relaxation time, the damping coefficient, the quality factor etc. This method is qualitatively superior to the classical method based on using conventional instruments, such as stopwatch and a tape measure. The precision of the results using the acceleration graph analysis is remarkable for Physics education activities. All in all, this study proves that smartphones are reliable teaching tools and that Physics teachers can use them to enrich their students' learning experiences.

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The free fall in gravitational field treated analytically and numerically with Excel spreadsheets

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Abstract

This paper describes an Excel didactic tool for the study of the free fall in Earth's gravitational field. The results are obtained in the spreadsheet both analytically and numerically. We considered a spherical body and the drag force quadratic in velocity. The analytical solution uses the explicit form of the solutions for the equation of motion. The numerical solution is based on an iterative process of generating the results under a tabular form exploring the equation of motion. With the help of a specific search function in the spreadsheet we can find the numerical values for the ground velocity and the fall time. The tool presented allows the comparative analysis for the free fall of a body in air and in vacuum. Moreover, it can also test in which conditions the motion in air can be approximated with the motion in vacuum. The tool can be created in the classroom, together with the students, under an analytic or a numerical form, according to their level of knowledge at a given moment. By using this tool we can check the equivalence between the results obtained through the analytical method and the results obtained through the numerical method.

Keywords: Spreadsheets, free fall, terminal velocity, drag force, didactic tools, Physics Education.

1 Introduction

The study of the free fall in Earth's gravitational field is of particular importance due to the analyses of the physical patterns used to describe the motion of a body in a field of forces. For example, in a first approximation, the body is assumed to be punctiform and the motion is considered to be in vacuum. A closer to reality model should take into account the presence of air, but also the shape and dimensions of the body. Each model has its own applicability limits but can be used successfully under certain well-specified conditions. Consequently, the literature offers a variety of topics related to the motion in the gravitational field, and further we will give some examples.

The one-dimensional and two-dimensional motion in the gravitational field with drag force quadratic in velocity has been discussed for spherical bodies of different masses. The experimental data provided by the video analysis with Videopoint have been in good agreement with the chosen theoretical model (Pagonis et al, 1997). For a linear and quadratic in velocity drag force, the equations of motion at ascent-descent in gravitational field were solved analytically and the results discussed with examples from everyday life (Timmerman and van der Weele, 1999). One of the methods for determining the gravitational acceleration is based on the measurement of the descent time of a body from a given height. We calculated the error resulting for the gravitational acceleration considering the motion of the body in vacuum, and we showed under what conditions the presence of air can be neglected (Benacka and Stubna, 2005).

Several articles deal analytically or numerically with the motion of the projectile in the gravitational field using Excel spreadsheets. Thus, for a drag force quadratic in velocity, the trajectory of the body was graphically rendered, comparatively in vacuum and air numerically solving of the equation of motion (Benacka, 2009). The vertical throw in the air was treated with spreadsheets to highlight the asymmetry of the law of motion at ascent/descent. It has been shown that this asymmetry increases with the launching speed of the body and the maximum height was graphically rendered against the initial velocity, comparatively in vacuum and in air (Grigore and Barna, 2015). Spreadsheets have also helped describe a tool to study the free descent of a parallelepiped body on an inclined plane with sliding friction and in the presence of a resistive medium (Grigore et al, 2015a). The two-dimensional motion of the projectile in the gravitational field was approached analytically with spreadsheets when the resistive force is linear in velocity (Grigore et al, 2017).

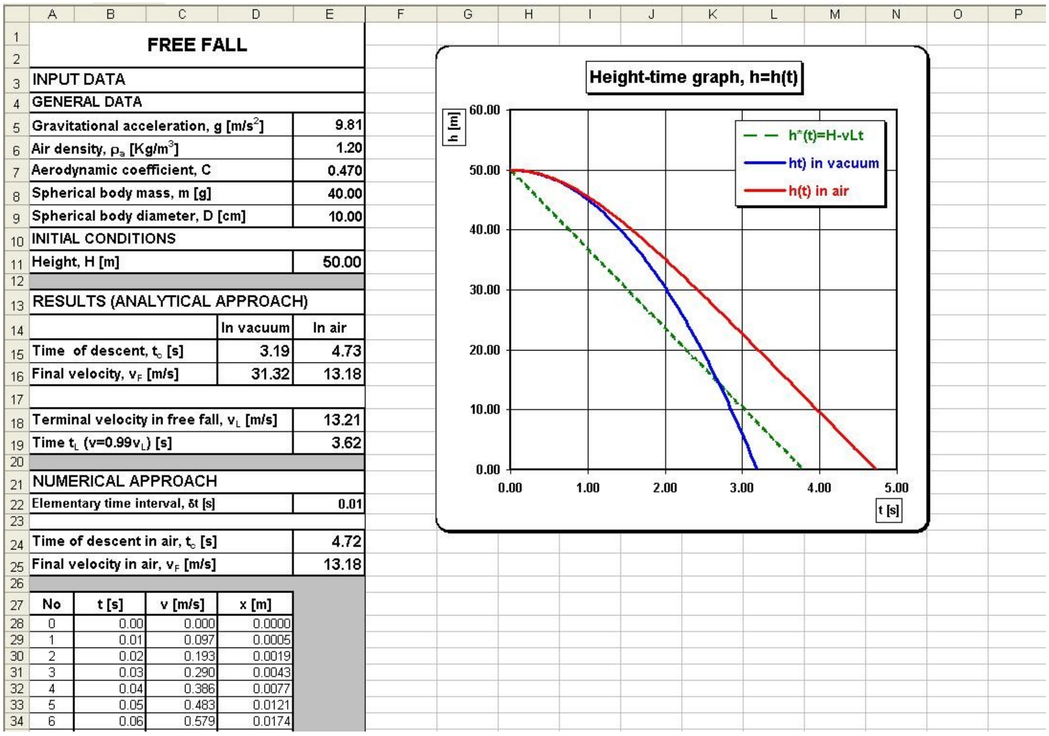
This paper describes an Excel didactic tool for the study of free fall in the gravitational field with results obtained both analytically and numerically. Depending on the input data, the final ground velocity and the fall time are calculated by considering the body spherical and the drag force quadratic in velocity. Both numerically and graphically, the results are presented comparatively for the motion in vacuum and for the motion in air. To explore examples from everyday reality, in a special spreadsheet, the free fall from the same height of three different balls has been analyzed.

The analytical approach is based on the calculation relations for the fall time and ground velocity established after the equation of motion has been solved. The numerical approach is based on an iterative process of exploring the equation of motion generating the results in tabular form. It is demonstrated that the spreadsheet allows the application of both analytical and numerical methods for the study of the free fall in gravitational field.

2 Organization of spreadsheets

The tool presented consists of several interactive spreadsheets. Figure 1 shows the main spreadsheet with the Input Data and Results sections. As the problem of freefall is solved both analytically and numerically, the Results section is divided in two distinct subsections: the subsection "Analytical Approach" and the subsection "Numerical Approach".

The section Input Data contains two subsections, General Data and Initial Conditions. In the General Data subsection the following measures are introduced: gravitational acceleration, g, in cell E5, air density, ρ_a, in cell E6, aerodynamic coefficient, C, in cell E7, body mass, m, in cell E8, and body diameter, D, in cell E9. In the subsection Initial Conditions, we enter the fall height, h, in cell E11.



FREE FALL		
INPUT DATA		
GENERAL DATA		
Gravitational acceleration, g [m/s^2]		9.81
Air density, ρ_a [Kg/m^3]		1.20
Aerodynamic coefficient, C		0.470
Spherical body mass, m [g]		40.00
Spherical body diameter, D [cm]		10.00
INITIAL CONDITIONS		
Height, H [m]		50.00
RESULTS (ANALYTICAL APPROACH)		
	In vacuum	In air
Time of descent, t_c [s]	3.19	4.73
Final velocity, v_F [m/s]	31.32	13.18
Terminal velocity in free fall, v_L [m/s]		13.21
Time t_L ($v=0.99v_L$) [s]		3.62
NUMERICAL APPROACH		
Elementary time interval, δt [s]		0.01
Time of descent in air, t_c [s]		4.72
Final velocity in air, v_F [m/s]		13.18

No	t [s]	v [m/s]	x [m]
0	0.00	0.000	0.0000
1	0.01	0.097	0.0005
2	0.02	0.193	0.0019
3	0.03	0.290	0.0043
4	0.04	0.386	0.0077
5	0.05	0.483	0.0121
6	0.06	0.579	0.0174

Figure 1. The main spreadsheet of the tool with the height-time graph

In the Results section, we calculate the time of fall, t_c, and final velocity, v_F, in cells E15 and E16, through the analytical method, and in cells E24 and E25, through the numerical method. The same measures are calculated analytically for the free fall in vacuum in cells D15 and D16. As a complement, in cells E18 and E19, the terminal velocity at free fall in air is calculated, respectively the time after which the body velocity becomes 99% of the limit velocity.

To obtain the results both analytically and numerically, we start from the differential equation of motion of the body in free fall (Newman, 2008):

$$[1] \qquad m\frac{dv}{dt} = mg^* - \frac{1}{2}C\rho_a S v^2$$

The first term in the right side of equation [1] is the apparent weight, which includes the effect of the buoyant force, while the second term the drag force quadratic in velocity.

Equation [1] can be brought to the following simpler form:

$$[2] \qquad \frac{dv}{dt} = g^* - kv^2$$

where g* represents the effective gravitational acceleration and k a constant:

$$[3] \qquad g^* = g\left(1 - \frac{\rho_a}{\rho}\right) \qquad\qquad k = \frac{1}{2}\frac{C\rho_a S}{m}$$

In the previous relations we used the notations: m - body mass, v - body velocity at the time moment t, ρ - body density, ρ_a air density, C aerodynamic coefficient, S cross-sectional area.

Equation [2] is solved analytically by the method of separating the variables. With the initial conditions, i.e., at t=0 we have v=0, x=0, resulting the velocity and coordinate time dependencies:

[4] $v_{(t)} = v_L th\left(\frac{g^* t}{v_L}\right)$ $x_{(t)} = \frac{v_L^2}{g^*}\ln\left[ch\left(\frac{g^* t}{v_L}\right)\right]$

In relations [4], v_L is the terminal velocity at free fall in air and it is obtained by equating the apparent weight with the drag force:

[5] $v_L^2 = \frac{mg^*}{(1/2)C\rho_a S}$

By processing equations [4], with the condition x=h, where h is the fall height, we obtain the expressions for the fall time, t_c, and the final velocity at ground, v_F:

[6] $t_c = \frac{v_L}{g^*}arcch\left(e^{\frac{g^* h}{v_L^2}}\right)$ $v_F = v_L\sqrt{1-e^{-2g^* h/v_L^2}}$

Relations [6] have been adapted in Excel in cells E15, respectively E16, as follows:

"=(Velocity_L/Acceleration_GE)*ACOSH(EXP((Acceleration_GE*Height_H)/Velocity_L^2))"

"=Velocity_L*SQRT(1-EXP(-2*Acceleration_GE*Height_H/(Velocity_L^2)))".

To easily operate with the absolute references in the spreadsheets, cell names have been used. The effective gravitational acceleration, g*, and the terminal velocity, v_L, were calculated in an appendix sheet according to relations [3] and [5] and the cells with the respective values were entitled Velocity_L and Acceleration_GE, respectively.

Solving equation [2] through the numerical method involves establishing certain recurrence relations to obtain the velocity and coordinate values according to time in the form of a data table. Thus, establishing an elementary time interval δt, we obtain the recurrence relation between the velocity v_i at the moment t_i and the velocity v_{i+1} at the moment $t_{i+1}=t_i+\delta t$:

[7] $v_{i+1} = v_i + dv = v_i + \left(g^* - kv_i^2\right)\delta t$

To obtain the recurrence relation between the coordinate x_i at the moment t_i and the coordinate x_{i+1} at the moment t_{i+1}, the motion of the body in the elementary time interval $[t_i, t_{i+1}]$ is approximated as a uniform motion. We have considered that the velocity of the body in the time interval $[t_i, t_{i+1}]$ is given by the arithmetic average of the values v_i and v_{i+1}:

[8] $x_{i+1} = x_i + \frac{1}{2}(v_i + v_{i+1})\delta t$

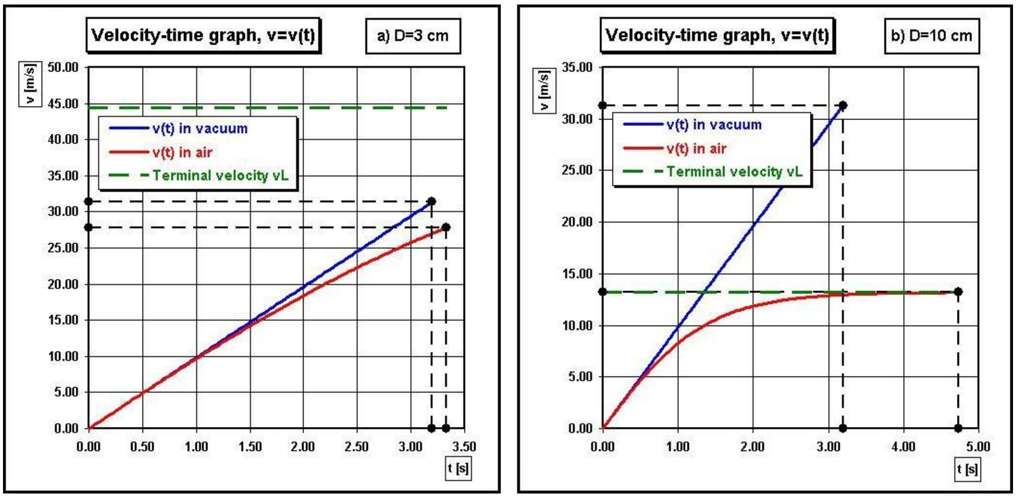


Figure 2. The velocity according to time stating the fall time for two spherical bodies of different diameters

To explore the recurrence relationships [7] and [8] in the spreadsheet we first chose an elementary time interval, δt, in cell E22, which we entitled Delta_T. After that, we built the table with the order number in column A, the time moments in column B, and the values of the velocity and of the coordinate at each time moment in columns C and D. As shown in Figure 1, this table runs from line 27 of the spreadsheet downwards. Taking into account that at the initial moment $t_0=0$ the velocity and the coordinate are null, the zero value was written in cells B28, C28 and D28. In cell B29 we have written the formula "=A29*Delta_T" to generate the time moment $t_1=t_0+\delta t$. In cells C29 and D29 we have transcribed in Excel the relations [7] and [8] to generate the values v_1 and, respectively, x_1, corresponding to the time moment t_1:

C29: "=C28+(Acceleration_GE-Coefficient_K*C28^2)*Delta_T";

D29: "=D28+(1/2)*(C28+C29)*Delta_T".

The formulas written in cells B29, C29 and D29 have been propagated along the three columns up to the last line of the data table. The number of table lines has been chosen so as the value of x from column D from the last line is at least equal to the fall height from the input data. Coefficient_K represents the title of the cell where we calculate the constant k, in conformity with the second relation from the group of relations [3]. This coefficient is calculated in an appendix spreadsheet, after previously calculating the cross-sectional area, S, according to the diameter of the spherical body.

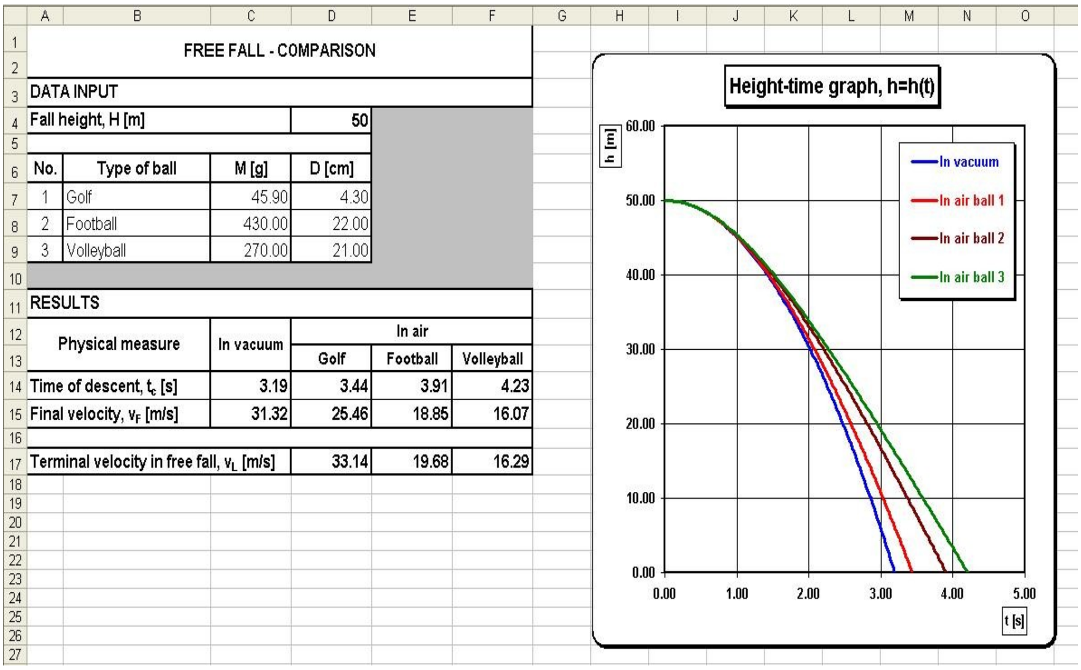


Figure 3. The spreadsheet that comparatively analyzes the free fall of three different balls

To determine the fall time and final ground velocity from the above table data, we have used the vertical search function VLOOKUP in the spreadsheet. This function provides a value from a specified column, corresponding to a given value from the first column of a table. Taking into account the VLOOKUP search mode, we have inserted a new spreadsheet where we reversed the order of the columns so that the values of the x coordinate are placed in the first column. We have thus operated with the VLOOKUP function in this new spreadsheet, entitled Source_CN, and have chosen the TRUE value for the search-type argument to specify an approximate search. As a result, we have written the following Excel formulas in cells E24 and E25 of the main spreadsheet:

E24: "=VLOOKUP(Height_H;Source_CN!A5:C879;2;TRUE)";

E25: "=VLOOKUP(Height_H; Source_CN!A5:C879;3;TRUE)".

According to the previous Excel formulas, in cell E24 we search for the value of the time moment in the 2nd column of the domain A5:C879 for which the value of the coordinate in the first column is equal to the fall height entered in the input data. Similarly, in cell E25 the value of the final speed is searched.

It is noted that the results obtained by the analytical method coincide with the results obtained by the numerical method. If differences occur between results, they may be reduced and eventually eliminated by changing the time quantum in cell E22 and, accordingly, the number of lines of the table for the numerical method.

Figure 1 graphically renders the height according to time: the blue curve for the free fall in vacuum and the red curve for the free fall in air. There was graphically represented with a green dotted line the height-time dependence of a body in a uniform motion at a velocity equal to the terminal velocity of fall in air. It is noted that with increasing values of the fall time, the height-time graph for the motion in air tends to become parallel to the height-time graph corresponding to the uniform motion with terminal velocity. This is the consequence of the fact that the velocity of the body in free fall tends towards the terminal velocity when time tends to infinity. For small values of the fall time, the red graph corresponding to the motion in air overlaps the blue graph corresponding to the motion in vacuum. In the overlapping area of the two graphs, the motion in air can be approximated by the motion in vacuum.

Figure 2 renders the velocity-time graph for two spherical bodies of different diameters. The other input data remained unchanged at the values shown in Figure 1. The red curve represents the velocity-time graph for the motion in air, while the blue straight line is the velocity-time graph for the motion in vacuum. The green dotted line highlights the terminal velocity of the fall in air. To highlight the values for the fall time in vacuum and in air, along with the corresponding velocity values, black dotted lines were used. The source tables of the two graphs, height-time and velocity-time respectively, explore relations [4] in Excel and have been done in separate spreadsheets.

Figure 3 renders the spreadsheet for the analysis of the free fall of three different balls from the same height fixed in the input data in cell D4. An example is provided for golf, football and volleyball balls. The mass and diameter for each ball are entered in cells C7, C8, C9 and D7, D8, D9, respectively. The analytical and graphical results, along with the input data, highlight the different values for the fall time and ground velocity for the three balls. If the motion took place in vacuum, the balls would simultaneously reach the ground, the height-time graph being rendered in this case by the blue curve.

Conclusions

With the help of the tool described in this paper we can analyze the free fall of a body comparatively in air and vacuum. With rapid feedback, we can observe the influence of input data on the final ground velocity and time of motion. The graphical representations, height-time, respectively velocity-time allow us to specify under what conditions the motion in air can be approximated with the motion in vacuum. Also, through the graphic representation, the terminal velocity has been highlighted not only in the velocity-time graph, but also in the height-time graph, which contributes to a clearer understanding of this concept.

The Excel tool presented can be created in the classroom with the students, in analytical or numerical form, depending on their level of knowledge at a given time. For example, in a first stage, the numerical method can be applied, and after the students have learnt to operate with certain mathematical functions such as logarithm, exponential or hyperbolic functions, the analytical method can also be applied. Using the tool, it is easy to verify that both methods lead to the same results.

Excel spreadsheets can be used as an alternative means of interactive physics learning to increase school performance by building a beneficial connection between Physics, Mathematics and Informatics lessons (Grigore et al, 2013; Grigore et al, 2015b; Grigore et al, 2016).

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Bringing the scientists' perspective on Science in the classrooms

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Abstract

How is science produced? Do students need to understand how science is achieved? How can we reduce the gap between what students learn in the schools and what researchers find in their huge labs, using their huge computers? In this paper we will discuss how global society responds to the challenges of reducing the gap between the rapid advancement of Science and the slower evolution of the educational systems. We will present three directions in which important steps are taken: teachers' training to integrate into their lessons the recent results of scientific research, facilitating dialogue between students and scientists and involving students in research activities.

Keywords: Interdisciplinary teaching, Physics education, Coriolis force, Foucault pendulum, GeoGebra modelling

1 Introduction

In the last decade, there is a significant shortage of highly qualified people in the fields of STEM (Science, Technology, Engineering and Mathematics). The number of graduates in STEM fields is declining, most young people preferring to choose careers in different fields that they consider more attractive or accessible. An ample process for identifying and applying measures to reduce this undesirable gap is taking place in the world. The following three directions are pursued with priority:

1. teacher training, to bring the recent results of scientific research into the classrooms, and to familiarize their students with the latest research methods;
2. involving scientists in developing educational content for students, to popularize the recent scientific results and the process of achieving these results;
3. involving students in research activity, so that they become more confident in their ability to face the rigors of research work.

In this paper we will present three projects oriented on these three directions, in which we had the opportunity to take part. Finally, we will describe an interdisciplinary application at the high-school level, developed by the authors consequent to their involvement in these projects, aiming at understanding the Coriolis force from the perspective of three different school subjects: Mathematics, Physics and Geosciences.

2 Preparing teachers to bring the latest scientific knowledge into classrooms

An effective initiative, bringing together teachers from around the world to get in touch with the latest results of research in Geosciences, is represented by GIFT (*Geosciences Information for*

Teachers) workshops. The April 2017 edition, which we had the opportunity to participate in, had as the general theme the *Mediterranean*. The specialists in Geosciences presented here, in their close interdependence, the various processes characteristic of the Mediterranean area: the dynamics of the tectonic puzzle, seismicity, volcanoes, climate change and sea level change, pollution and its impacts on biodiversity.

Researchers from ESA (European Space Agency) presented results of monitoring the dynamics of various parameters by ESA satellites, from the atmospheric concentration of different elements to vegetation evolution, from water temperature to morphology of the seabed, from vertical displacements of the crust of the Earth to its' horizontal displacements. Participating teachers have been engaged in practical activities, which they can later achieve with their own students, to help them better understand, at a smaller scale, physical phenomena that, at a larger scale, shape the environment in which we live. Teachers were invited to present their own contributions in a poster session called "Science in tomorrows' classroom."

The workshop took place at Austria Center Vienna, within the General Assembly of EGU (*European Geoscience Union*), attended by over 14,000 researchers from around the world. The attending teachers have benefited from various opportunities: visiting the Mineralogy Exhibition, participating in Google's presentation about the capabilities of the Google Earth engine, watching documentaries in the Geo-cinema room, and visiting different poster sessions about the results of recent research in Geosciences.

Presentations given by specialists at the GIFT workshop were posted in a special section of the EGU site, creating the opportunity for more teachers to have access to information and to use them in their lessons. Presentations include animations, documentaries, different maps and useful links for STEM teachers interested in interdisciplinary topics related to Geosciences.

3 Bringing renowned scientists in the classrooms

Within the ERIS project (*Exploitation of Research results In School practice*), researchers from three countries (France, Romania and Poland) develop educational content to be used by Mathematics and Science teachers in their lessons. We had the opportunity to participate with our students at five webinars with scientists from the University of Bucharest to test the educational content developed by them. The topics of these webinars were: *Elementary particles and fundamental forces, Wind and waves, Interchanging Data and locating earthquakes, Weather - a game between pressure and temperature, Geographic coordinates and digital maps* (Figure 1).

The students were really interested in all these topics. The researchers explained them how the *GPS* system works, how an earthquake is located, how the CERN (*European Organization for Nuclear Research*) particle accelerators are used, how waves in the sea are formed and how they depend on the intensity and direction of the wind. The webinars captured the students' attention, interactivity being provided by quizzes on the *kahoot* platform. The students responded to the questions, by connecting to the *kahoot* platform with their own smartphones. The scientists presented students various resources available on-line, containing data collected from scientific research, which can be used by students themselves. The problems proposed to students at webinars were appropriate to their level of understanding. The problems were of various types, including open problems, which could constitute future research topics for students: for example, tracing the histogram of spreading angles of a beam of projectiles on the objects of different shapes.

Figure 1. Participating with students at one of the ERIS project webinars

4 Involving students in research

By engaging students in research, they will experience the dealing with inherent difficulties; they will understand the effort required to find solutions, what it means to work in a team and what communication of scientific research results means. Within the international project *Math. en. Jeans* (Duchet, 1997; Dubois, 2012), we were the coordinating teachers for ten students from the "Mihai Eminescu" National College of Satu Mare, grouped in four teams. Mathematical research workshops organized in this project give to students from all over the world the opportunity to study different applied mathematics topics, and develop their skills in research work. In every year, within *Math en Jeans* project, there are several international congresses where students can present to other participants their results. The teams we coordinated attended the *Math en Jeans Congress* organized in Cluj-Napoca, where almost 200 pupils from 14 high schools from Romania, France and Italy presented their research results. The research topics of our students referred to the determination of the quickest paths, the calculation of some probabilities and the mathematical modelling of various physical phenomena. Students have learned how to use some software applications to achieve computer simulations. Two of the teams used the *GeoGebra* software to perform the simulations, and the other two used the C++ programming language for the alternative calculation of some probabilities.

The students had presentations both in the plenary session and in an interactive session where they exposed posters, models, computer simulations and other materials they created. Students have sustained presentations in English, improving their communication skills. Each student team has produced a paper, also in English, containing the results of their research, to be published in the Proceedings of the Congress. In the Opening and in the Closing Session of the *Math en Jeans Congress* in Cluj-Napoca, researchers from *Babeş-Bolyai University* presented some research topics at a level accessible to students, to inspire the students in their future research activity. The school year 2016-2017 meant for us the first participation in this project and this experience encourages us to participate in the next editions. The slogan of the Math en Jeans project - *Ne subissez pas les maths, vivez-les!* - Do not undergo math, live it!- was followed by the participating students, who appreciated the opportunities offered by the project.

5 Enrichment of educational content through teachers' contributions

One of the webinars we attended with the students in the ERIS project, presented above, dealt with explaining the formation of winds. The researchers presented, among others, the role played in this process by the Coriolis force (Figure 2). Because the Physics curriculum at high-school levels does not include this topic, the authors of this paper have developed several tools to help students understand the Coriolis Effect (Marciuc and Solschi, 2017).

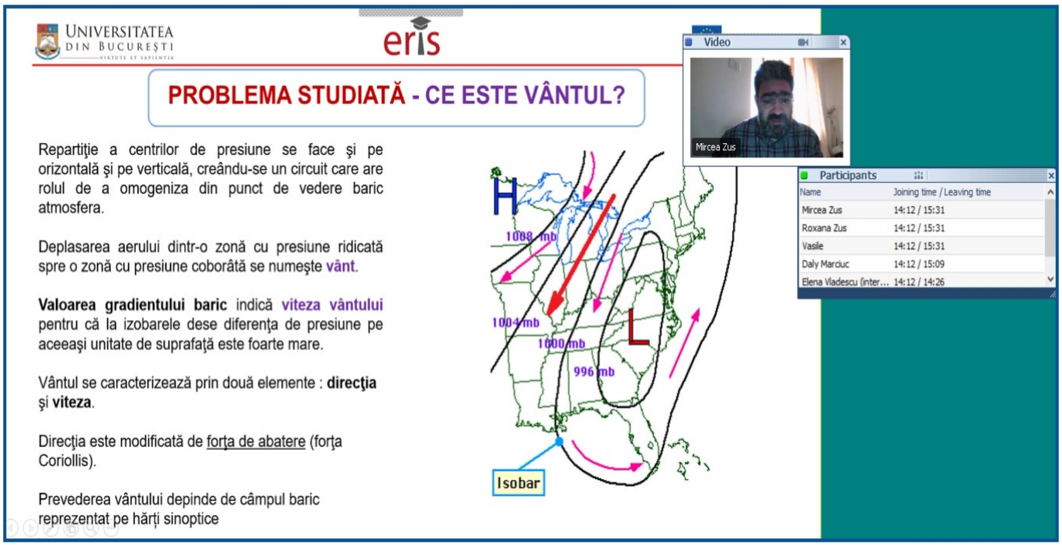

Figure 2. Coriolis force and wind formation - image from an ERIS webinar

The problem was first approached from a mathematical point of view, and then we demonstrated it experimentally with a Foucault pendulum installed in the classroom. Finally, the students watched videos describing the role played by Coriolis force in the movement of air masses or in the formation of ocean currents. We present in the next section the instruments we created to explain the Coriolis Effect.

5.1 The Coriolis Effect as a mathematical problem

In the beginning, we have proposed to students the following problem:

*A circular platform of radius **r** rotates at angular velocity **ω**. A body moves in straight line above the platform, along a diameter, with constant speed **v**. Each time when the body reaches the edge of the platform, the direction of velocity is reversed. What is the path described by the body relative to the rotating platform?*

The construction of a mathematical model to obtain a visualization of the body trajectory, combining the two kinds of motion, starts from the observation that the elapsed time for crossing a whole diameter of the platform is $t_m=2r/v$. Then we can determine the algebraic distance s from the body to the centre of the platform at a moment t by the following relations: b = floor (t/t_m) modulo 2, $a = (-1)^b$, $s=a*r-a*v*(t \text{ modulo } t_m)$. Consequently, the coordinates of the body at time t, in a reference system solidary to the platform, are $M = (s\cos(\Theta),\ s\sin(\Theta))$, where $\Theta = \omega t$. In order to obtain a closed path we imposed the condition $n\, t_m = m\, 2\pi/\omega$, where n and m are integers. In the time $t_f = n\, t_m$, the body crosses the platform n times and its angular coordinate reaches m times the value 0.

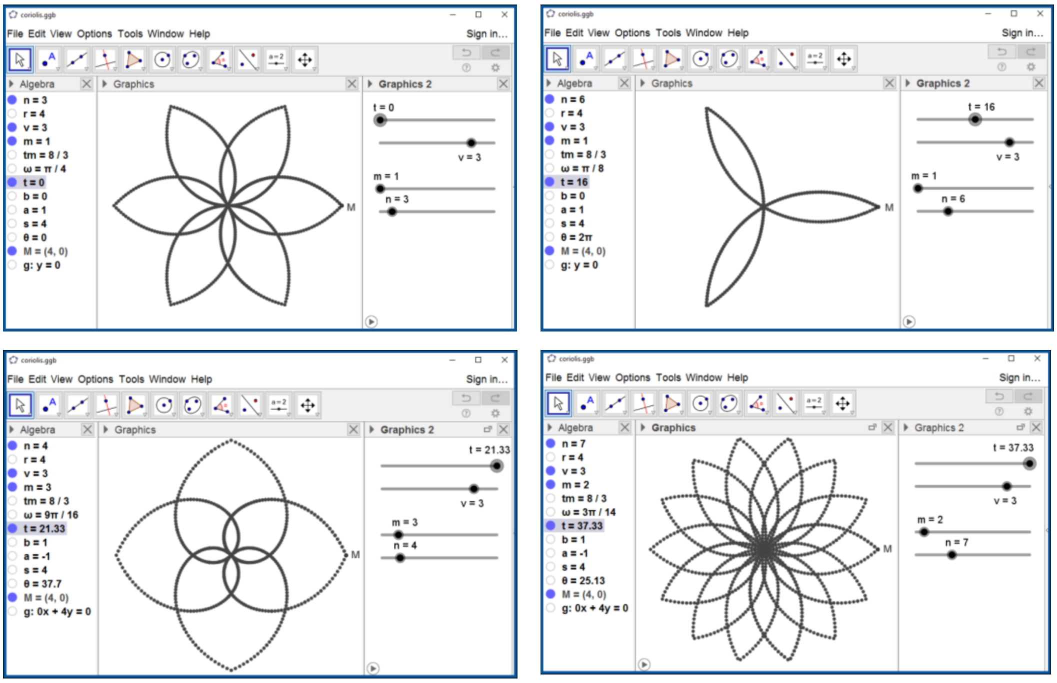

Figure 3. Composing with GeoGebra two types of motion

Based on the obtained mathematical model we have built a simulation of the movement of the body relative to the rotating platform. To achieve this simulation we used the *GeoGebra* software, a dynamic geometry software that provides tools for easily simulating of various physical phenomena (Marciuc and Miron, 2014; Marciuc et al, 2016). The images in figure 3 show the body trajectories relative to the platform, obtained by our simulation, for different values of the system parameters.

5.2 The Foucault Pendulum in our classroom

To prove experimentally the Coriolis Effect we installed in a classroom in our school a Foucault pendulum. The length of the pendulum is 4.5 m and the mass of the ball is about 4 kg (Fig. 4, center). The hanging device is presented in the figure 4 (left). We put under the pendulum a disc divided into 32 equal sectors printed in different colours (Fig. 4, right). At the latitude of Satu Mare city, the deviation of oscillation plane is approximately 360°/32 in an hour. The movement of the pendulum is damped in more than 2 hours, so we can observe clearly the Coriolis Effect.

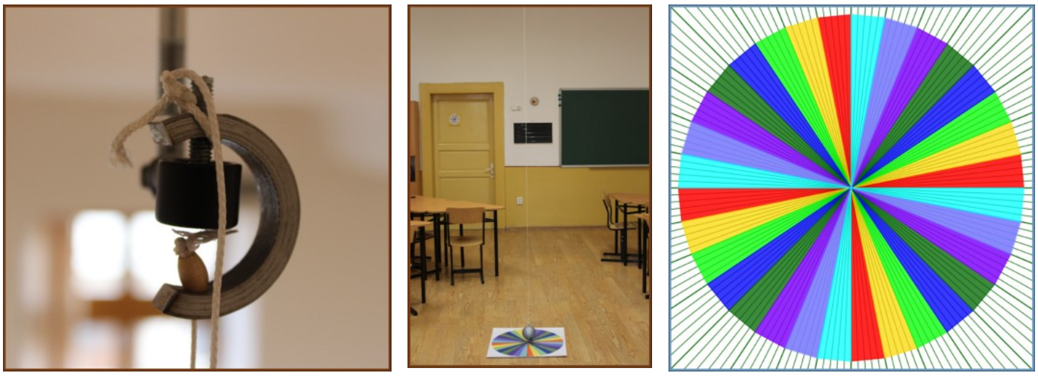

Figure 4. Foucault pendulum installed in the classroom

Table 1. GeoGebra commands to simulate the movement of a Foucault pendulum

Commands	**Results**
ω1=1; r=4	The pulsation and amplitude of pendulum
m=1; n=1440; ω=m/n * ω1	The angular speed of Earth rotation related to pendulum pulsation
t=0	Initialisation of time variable
Θ = ω*t; s = r*sin (ω1*t)	The pendulum coordinates in a reference system related to Earth
M=(s*cos(Θ), s*sin(Θ))	Representing the position of pendulum at time *t*

Using the software *GeoGebra* we made a simulation of the movement of the Foucault pendulum at the South Pole. The animation shows the trajectory of a pendulum with the oscillation period equal to one minute (figure 5 - left). Table 1 lists the *GeoGebra* commands used to achieve the simulation. By changing the values of the variables ***m*** and ***n***, the pendulum motion is simulated, for different values of the ratio between the period of pendulum oscillation and the period of the planet rotation. In figure 5 (right) you can see the result of simulation, when this ratio is 66: 1.

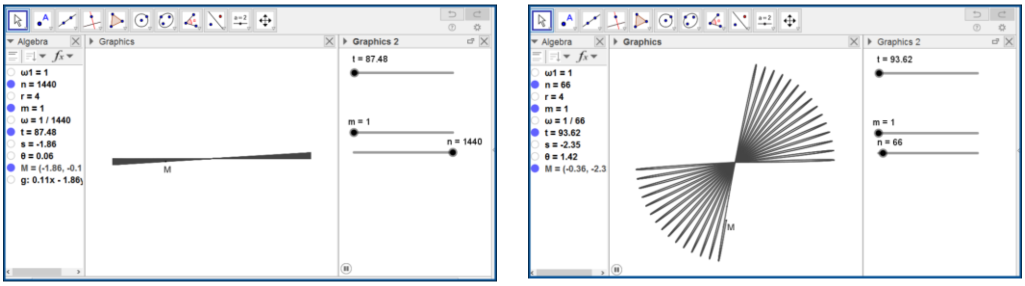

Figure 5. A GeoGebra simulation for the Foucault pendulum

Explaining and proving Coriolis Effect with the tools of Mathematics and Physics enables understanding of some complex natural phenomena, such as the movement of air masses and ocean currents. To understand these consequences the students watched the videos that we indicate in the References section.

6. Conclusion

Mathematics and Science teachers have an important role to play in reducing the shortage of highly qualified staff in the STEM fields. They can identify students able to pursue a career in the STEM fields and can support them in developing their skills, encouraging them to pursue university studies in these areas.

By engaging in research, high school students can form necessary skills in scientific work and can form an identity of future scientists. Some gifted high-school students do not think of pursuing a career in science because they have no idea what working in research means. By participating in congresses as budding researchers, in university centres where they have the opportunity to meet real scientists, students gain new perspectives. Initiating students in the use of computational technologies is a key element, given that today's and tomorrow's research cannot be carried out without these tools.

Preparing teachers to support students in choosing STEM careers is essential. Providing better working conditions, classes with fewer students, endowing classrooms with advanced technologies are also key elements. Public policies must consistently provide support to teachers, for their professional development in pace with the science and technology advancement. Last but not least, through the benefits offered to teachers in the STEM fields, including better salaries, gifted young people can be attracted to work as teachers after graduating universities. Actions such as those exemplified in this paper are intended to help avoid wasting valuable human resources for the STEM domains.

Aknowledgement

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Developing students’ creativity by Physics lessons

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Abstract

Is creativity a skill learnable in Physics lessons? In this paper we will justify that the answer is affirmative, if the students appropriately use the tools of information technologies. Using the GeoGebra software or the VPython programming language, classical Physics themes for high school gain new valences. The examples that we will present refer to the construction of interactive simulations of some optical phenomena, as well as to simulating the movements of the electric charge beams under the action of a uniform magnetic field.

Keywords: Physics education, GeoGebra, VPython, computational modelling, geometric optics, magnetic field

1 Introduction

Traditionally, Physics learning focuses on understanding the connections between theory and experiment, each of which helps to clarify the meaning of the other. Expanding the use of computational technologies has led to a change in the methodology of conducting scientific research. Computation has now become the third pillar of Physics, along with theory and experiment.

To keep pace with the evolution of scientific investigation methods, it has become necessary to restructure the curricula so as to integrate the objective of developing students' skills to use computational technology tools. A curriculum developed to meet this need has been used for more than a decade in many universities (Chabay, 2015). The tool used by the promoters of this initiative is the *VPython* programming language, resulted by completing the widely used *Python* language with a special module called *Visual*. The *VPython* programming language makes it easy to get navigable three-dimensional graphical representations and the use of power of mathematics, including vector operations (Chabay and Sherwood, 2008).

Familiarization with computational technologies to model physical phenomena has become possible since high school due to the development of technological tools accessible to students. The *GeoGebra* software (Hohenwarter and Fuchs, 2004) can be used to initiate students in building simulations of various physical phenomena (Marciuc et al 2015, Marciuc et al 2016a, 2016b). The students who possess basic programming skills can also use the *VPython* programming language in order to create a wider range of simulations for a better understanding of the phenomena (Marciuc and Miron, 2017).

2 Using GeoGebra to simulate the reflection phenomenon

In the study of the optics, complex topics can be approached, even at high school level. After explaining how images are formed in a plane mirror, a deeper study of the multiple reflections in two mirrors can be carried out.

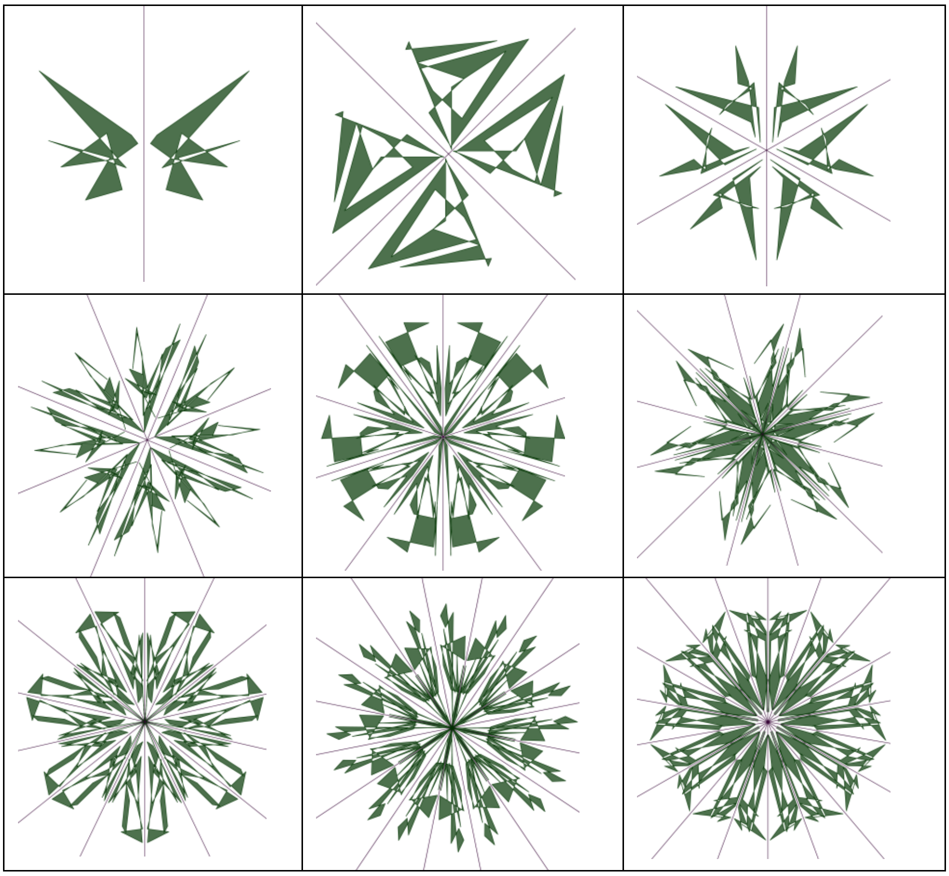

Figure 1. Figures with multiple axis of symmetry generated with GeoGebra

The students begin with the investigation of the positioning of multiple images of a point object in two plane mirrors forming an arbitrary angle u. Using the *GeoGebra* models, students can prove that the multiple images are obtained by applying rotations with angles multiples of $2u$, on the source object and its primary image in one of the two mirrors. Based on this observation, they created the applet that generates images with n axes of symmetry, as shown in Figure 1. The number of symmetry axes, n, can be changed using the displayed slider. The value of the variable *np*, representing the number of vertexes of the initial polygonal surface, can also be modified with a slider. Table 1 contains the commands used to achieve this applet.

Table 1. GeoGebra commands for generating images with multiple symmetry axes

GeoGebra Commands	Results
n=10; points= Sequence[(r *cos(π / (2n) + i π / n), r *sin(π / (2n) + i π / n)), i, 0, 2n - 1]; mirrors= Sequence[Ray[(0, 0), Element[points, i]], i, 1, 2n]	Representing the axes of symmetry

na=20; np=15;
argm=Sequence[(-u) / 2 + i u / (na + 1), i, 1, na];
radial=Sequence[RandomBetween[1, 500] / 100, i, 1, np];
vertices=Sequence[(Element[radial, i] *cos(Element[argm, RandomBetween[1, na]]), Element[radial, i]*sin(Element [argm, RandomBetween[1, na]])), i, 1, np];
poly=Polygon[vertices]
	Random generating of the polygon with *np* vertexes to be reflected in the constructed axes

Sequence[Rotate[poly, 2i u, A], i, 1, n - 1]; poly1 = Reflect[poly, Element [mirrors, 1]]; Sequence[Rotate[poly1, -2i u, A], i, 1, n - 1]	Construction of the symmetrices of the initial polygon

The *GeoGebra* software can also be used successfully to explain the formation of images in a spherical mirror. Using their geometry knowledge, students can prove the formula of the spherical mirror, for a concave or convex mirror, supported by the dynamic representation made with *GeoGebra*. Figure 2 shows two hypostases captured in the dynamic applet made for this purpose. For each situation it is outlined the justification of the spherical mirror formula, based on the law of reflection. The students applied the theorem of the external angle of a triangle and the arithmetic progressions properties. Also, the definition of the tangent of an angle was used as well as the approximation, for small angles, of the tangent of the angle by the angle value. The dynamic representations achieved with *GeoGebra* allow discussion of the meaning of the sign convention in expressing the spherical mirror formula. For example, for the concave mirror represented in figure 2 we notice that in the case $x_1 = PV > R$, we have $x_2 = PV' > 0$, and in the case $x_1 = PV < R/2$, we have $x_2 = -PV' < 0$. The applet allows to change the mirror curve radius R and also to move the object P and the incidence point D of the ray.

Students can visualize and explain using *GeoGebra* the phenomenon of spherical aberration and the significance of Gaussian approximation. Table 2 contains the commands introduced to create the applet showing this phenomenon, and Figure 2 captures two instances within the resulted applet. It can be seen that when the angular opening of the incident beam is high, the intersection points between the reflected rays and the axis of the mirror are spread, whereas when the angular beam angle is small, the reflected rays converge at a single point on the axis.

A very interesting illustration of the generality and transferability of the models is given by the analogy between the reflected ray and the path of a particle that collides against a surface. *GeoGebra* offers all the tools necessary to easily draw the histogram of the scattering angles of a beam of projectiles that collide against a surface.

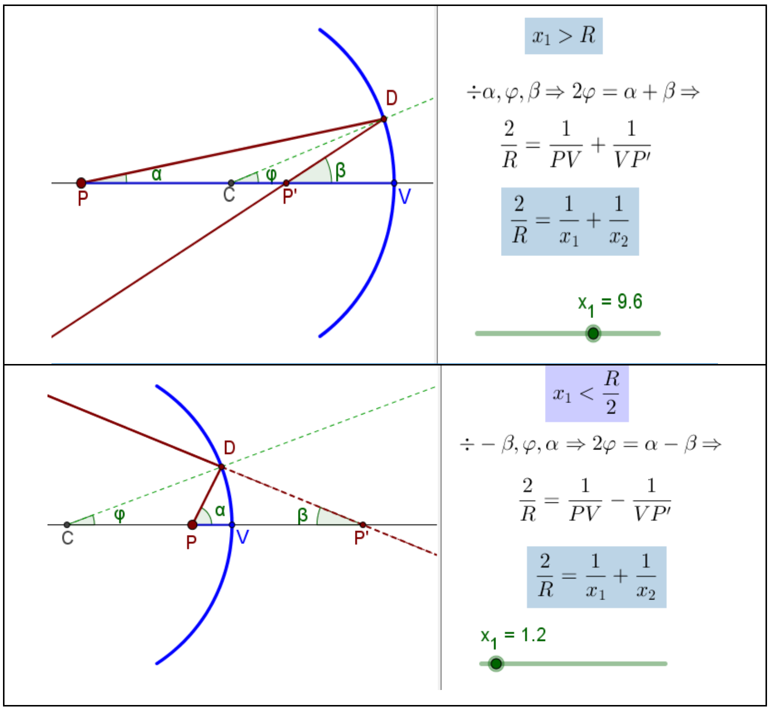

Figure 2. A proof of the spherical mirror formula in a GeoGebra simulation

Table 2. GeoGebra commands for simulating the spferical aberration

GeoGebra Commands	Results
R=5; t=-25°; A=(-R, 0) + (R cos(t), R sin(t)); B= (-R, 0) + (R cos(-t), R sin(-t)); C= (-R, 0); V=(0,0); c= CircumcircularArc[B, V, A]; a=Line[C,V]; P=Point[a]; n=12	Representing the concave spherical mirror and object *P* and defining the number *n* of rays
points= Sequence[C + (R cos(-t + 2i t / n), R sin(-t + 2i t / n)), i, 1, n - 1]	Defining the points of incidence on the mirror
incident= Sequence[Segment[P, Element[points, i]], i, 1, n - 1]	Representing incident rays
normals= Sequence[Segment[C, Element [points, i]], i, 1, n - 1]	Representating the normals at the surface of the mirror
simpoints= Sequence[Reflect[P, Element[normals, i]], i, 1, n - 1]; refl= Sequence[Ray[Element[points, i], Element[simpoints, i]], i, 1, n - 1]; int= Sequence[Intersect[Element[refl, i], a], i, 1, n - 1]	Representing the reflected rays and their intersections with the axis of the mirror

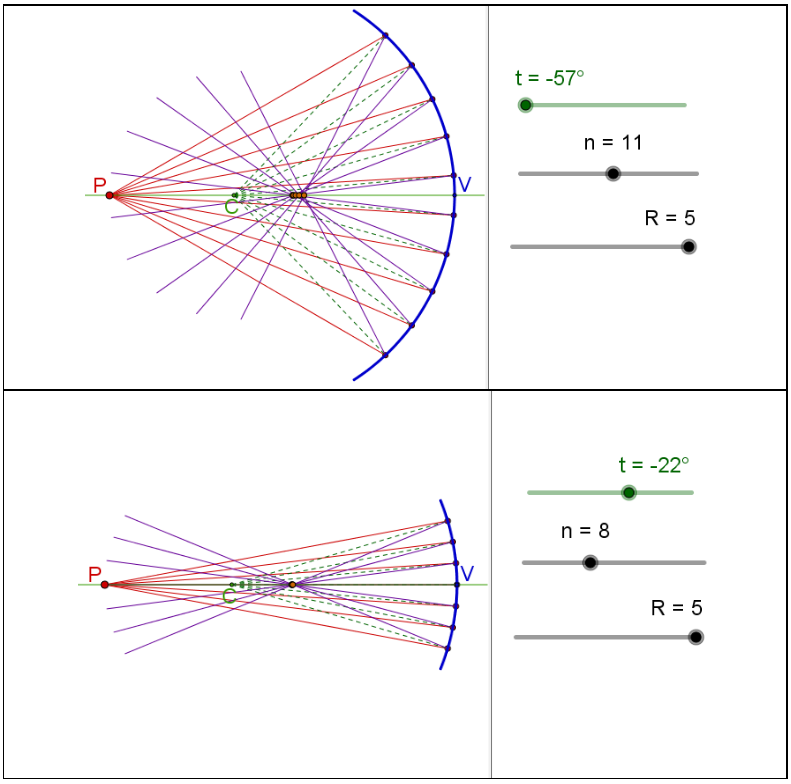

Figure 3. GeoGebra simulation of the phenomenon of spherical aberration

This problem was proposed to our students in the *ERIS* project (*Exploitation of Research results In School practice*), developed by the University of Bucharest, within the webinar "*Elementary Particles and Fundamental Forces*". Discussing experiments at CERN, researchers at the University of Bucharest presented some techniques for collecting and processing information, including the study of particle beam scattering angles.

3 Modeling of electric charge movements in a uniform magnetic field

Programming in *VPython* allows us to easily create three-dimensional animations. This capability is very useful for simulating the motion of electrically charged particles in a uniform magnetic field. Magnetic force acting on the particle, expressed as a vector product between particle velocity ***v*** and magnetic field ***B***, has the direction perpendicular to the plane of these two vectors. Students can simulate the movement of an electric charge in different situations:

- if the initial velocity is in the same direction as the magnetic field ***B***, then the magnetic force is null and the particle will move uniformly;
- if the initial velocity is perpendicular to ***B***, then the particle will move uniformly on a circular path, the magnetic force acting as a centripetal force, perpendicular to the direction of motion;
- in other cases, the velocity will be decomposed on the direction of the magnetic field and a direction perpendicular to it, and consequently the movement will represent the composition of the two types o movement, rectilinear and circular, resulting in a helicoidal trajectory.

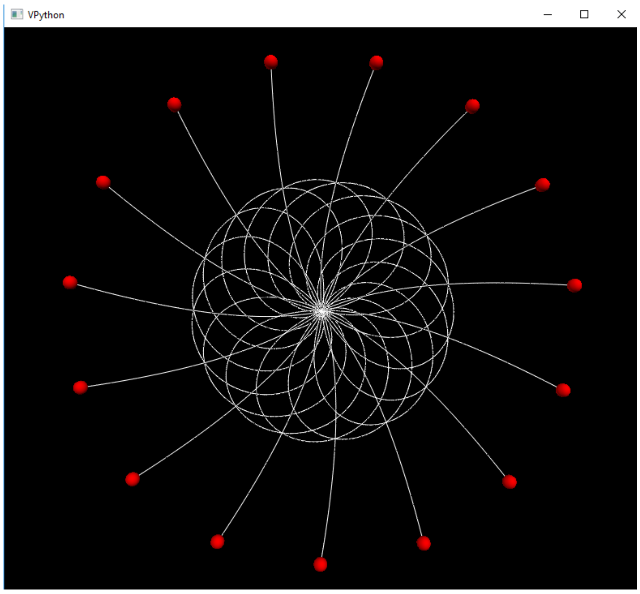

Figure 4. Simulation of charges moving in a uniform magnetic field

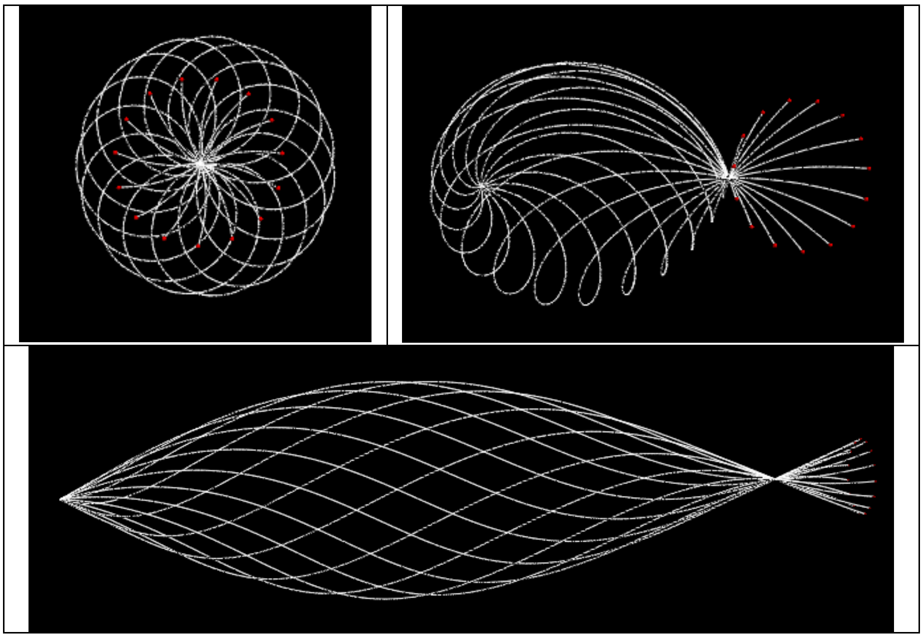

Figure 5. Viewing from different angles the particles' trajectories

An interesting problem for students is to simulate the movement of several electrical charges in a uniform magnetic field, so that their speeds are equal, and their velocities form the same angle with the magnetic field, but being oriented in different directions. The helical trajectories of these particles are shown in Figure 4. Table 3 lists the *VPython* commands used to perform this simulation. Figure 5 shows the trajectories obtained in simulation, viewed from different angles.

Table 3. VPython program to simulate the movement of an electric beam into a uniform magnetic field

```
from visual import *
dt = 0.001; g=9.8; pi=3.14; n=15; v0=3; teta=25.0*pi/180; q = -3; m=100; F=[];
B=vector(0,0,-25); v=[];balls=[];trails=[];l=2*pi*m*v0*cos(teta)/(-q*mag(B));
scene=display(x = 60, y = 30 , width=800, height=800,center=(0,0,l/2+0.8),
        background=(0,0,0))
for i in range (n):
   v.append(vector(v0*sin(teta)*cos(2.0*pi*i/n),v0*sin(teta)*sin(2.0*pi*i/n),
              v0*cos(teta)));
   balls.append(sphere(pos=(0,0,0),color=color.red,radius=0.03));
   F.append(q*cross(v[i],B)); trails.append(curve())
while(balls[1].pos.z<l/cos(teta)):
   rate(10000);
   for i in range (n):
      balls[i].pos = balls[i].pos+v[i]*dt; F[i]=q*cross(v[i],B);
      v[i] = v[i]+F[i]*dt/m; trails[i].append(pos=balls[i].pos)
```

Conclusions

The main objectives pursued by the Physics lessons are the conceptual understanding of the fundamental principles and phenomena and the development of the solving problem skills. The use of computational technologies favors the achievement of both objectives and empowers students with indispensable tools in today's scientific research.

By using appropriate computational tools, students are able to create simulations of the various phenomena, based on the known physical principles. By engaging in these activities, students have the opportunity to connect the different representations of a phenomenon: the algebraic equations, the computer instructions resulted from the mathematical model and the graphical representations on the computer, dynamic and animated. Even if the use of the simulations made by others can be useful for understanding complex phenomena, engaging students in the construction of simulations fosters a deeper understanding of the underlying concepts.

Involving students in building computer simulations encourages students to manifest their creativity in a different way than when they only receive traditional tasks. With the help of simulations, students can study the problem for different initial conditions, beyond the requirements of the proposed problem. Students can make changes in the programs so they can get unexpected general results. One of the examples presented in this paper describes the shift from the study of the images of a point-shaped object in two plane mirrors to the study of images obtained by the multiple reflection of randomly generated polygonal shapes, reaching the amazing point where Physics meet Art.

The study of the motion of an electric charge in a uniform magnetic field can be widened, simulating the movement of several electric particles with the initial velocities oriented in different directions. The three-dimensional geometric forms given by the trajectories of these particles are also amazing. The *VPython* programming language allows us to simulate these movements in a three-dimensional and navigable view of the trajectories: the angle at which the movement is viewed can be easily modified using the mouse, and the scale of the images can be changed.

The integration into the Physics lessons of computer simulation activities contributes to creating a working environment where accuracy and creativity are intertwined. On the one hand, for the correct realization of simulations, the physical principles that govern the phenomena must be rigorously applied, on the other hand, by formulating some new problems, drawn from the old ones, students' creativity is developed. Given that many of the routine activities will be taken over by robots and computers in the future, the focus on student creativity development is the next requirement of education.

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Arduino Yun photovoltaic system for solar energy study in school

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Abstract

In this paper we present a photovoltaic system consisting of three photovoltaic modules: one of the fixed, one mounted on a tracker with one axis of rotation and another mounted on a two-axis tracker. A comparative study between the performances of these three photovoltaic modules will be done. This system allows the Internet to monitor the parameters, but also to write them in a text file for the purpose of making a photovoltaic school teaching based on practical results. Acquisition, processing, storing or transmitting data over the Internet on a web page is made with the Arduino Yun development board.

Keywords: Physics education, Photovoltaic system, Tracker solar, Arduino Yun

1 Introduction

The sun is undoubtedly a vast source of energy. The solar energy that reaches the Earth's surface in one hour, meets the energy needs of all the inhabitants of Earth for a year. It is estimated that in about two decades the electricity produced by the sun will compete with conventional electric energy produced from fossil fuels (Lucian, 2014). Solar energy is the main renewable energy that has captured and captures the attention of specialists around the world, emphasizing the importance of education in this area (Korganci et al., 2015).

This paper highlights the attractiveness of photovoltaic technology in order to motivate students to learn fundamental physics concepts and data analysis. The didactic activities were designed to involve students in exploring the scientific methodology of formulating results, designing and running experiments, and then recording, analyzing and interpreting experimental data to draw scientific conclusions.

The leap that society is going to make in developing the use of renewable energies depends on the quality of the preparation of future generations (Dina et al, 2012), building an education based on the social and economic situation in our country (MEN, 1998).

The current state of the technology, namely internet communication devices, allows quick and easy access to existing information on different servers or more tempting at different workstations where the user can experiment or access real-time data (Ma and Nickerson , 2006). So, meeting the students and providing them information but also access to the laboratories when they feel appropriate is a fairly important challenge.

The direct conversion of solar energy into electricity is achieved by photovoltaic modules, which represent the main element of a photovoltaic system. In order to analyze and evaluate the performance of photovoltaic systems it is necessary to know the components and their function, to know the operating parameters of the photovoltaic modules and their characteristic curve (Iftimie et al, 2014). For this, we started to develop a photovoltaic system to present these elements, also to retain the parameters, meaning data acquisition, for their interpretation. Soon these requirements are met by Arduino development plates. So, for our system, the Arduino Yun model was chosen to connect to the Internet, build a website, but also process and store data on an SD card.

The photovoltaic system provides for users real-time viewing of the parameters of three photovoltaic modules: a fixed one, one with a rotating axis and one with two rotating axes. The data acquisition system records text data from a current sensor, battery temperature and voltage, allows file access and downloading to analyze module parameters to increase system performance and efficiently manage the produced power, considering that there are a lot of factors that influence the final results.

2 The photovoltaic system

The main objective of the photovoltaic system is to provide for the students a teaching tool for studying the performance of photovoltaic cells by monitoring the maximum power produced by each photovoltaic module according to orientation, every day of the year. For this the system includes three photovoltaic modules, a parallel voltage regulator, battery, consumers and a data acquisition facility, figure 1.

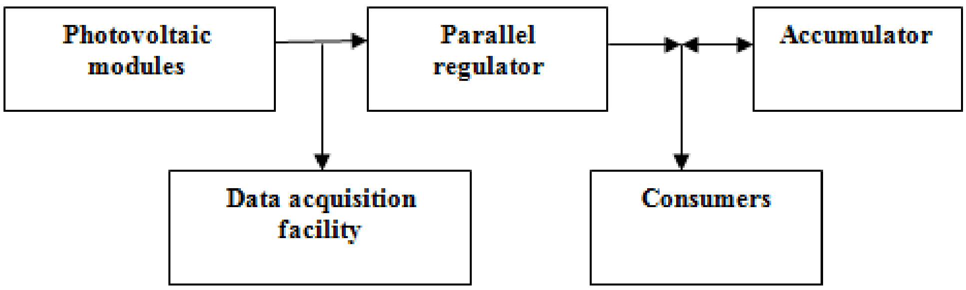

Figure 1. Components of the photovoltaic system

The three photovoltaic modules were positioned so that one was fixed, oriented to the south and inclined to 45^0, the second was mounted on a solar tracker with a rotation axis that allows it to track the sun's trajectory at the spring or autumn equinox, and the third module was mounted on a solar tracker with two axes of rotation that allow it to be steadily oriented so that the solar radiation is perpendicular to it, figure 2.

Figure 2. Photovoltaic modules

The photovoltaic system studied in this paper is located in Olt County, Drăgăneşti-Olt area and has the following characteristics:

- Location: latitude: 44.03, longitude: 24.64
- Altitude: 84 m
- Maximum photovoltaic power: 150 W (3 x 50 W)
- Module short circuit current: 2.81 A
- Open circuit voltage: 22.5 V
- Critical point current: 2.69 A
- Critical point voltage: 18.6 V

The parameters correspond to the standard conditions at a solar cell surface area of 1000W / m^2, the cell temperature of 25^{0}C, and the conventional air mass, AM = 1.5.

3 Hardware & Software

Due to researches in the domain, the efficiency of photovoltaic cells has increased considerably in recent years, but a significant increase in the performance of a photovoltaic module is achieved through the use of a solar tracking system. Using solar trackers helps the module to capture the maximum solar energy at that location, so increasing conversion efficiency up to 50% (Visa and Comsit, 2004).

In order for the intensity to be permanently maximum in the circuit, it was chosen to use a parallel voltage regulator. The parallel voltage regulator is characterized by a constant voltage maintained at its terminals regardless of the intensity value passing through it. This module's working area allows us to determine the maximum power, with sufficient precision for the purpose of our work.

As the intensity varies widely, it has been chosen to measure it by a current sensor for each panel, figure 3.

The current sensor is ACS712-05B based on the Hall effect, which allows measurements at 1.5% accuracy, it powers to a voltage of 5 Vcc and outputs in the absence of a measuring current, the voltage V/2 having a response of 185 mV/A up or down depending on the current to be measured.

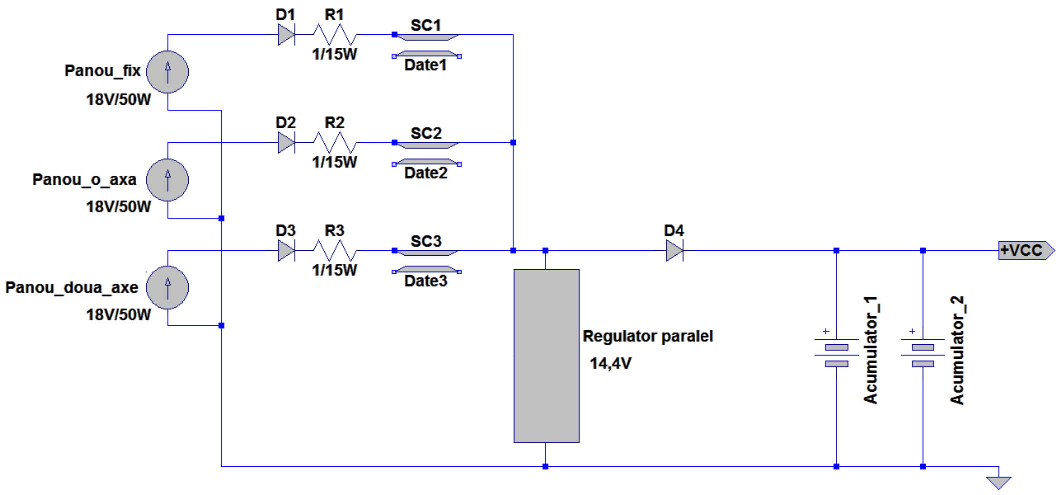

Figure 3. Photovoltaic system operation scheme

Each module contributes to the total current with the same current it would contribute if it were alone in the circuit. The current on each branch is measured by a current sensor. The current sensor is connected to an Arduino Yun plate which calculates the power of the panel, the resulting values being stored at a 10 minute interval in text files on a memory card.

To keep each panel at the maximum power point when the batteries are charged and requires no charging current, and consumers do not require current, we needed a linear regulator that would not introduce peak currents in the circuit, sometimes readable peaks. Since we have not identified a linear regulator on the market, we have made one that has the main control element the operational amplifier 741 which compares the voltage of 14.4 V through a resistive voltage divider that falls on a zener diode. At the output of the amplifier, a power stage is built to dissipate the entire heat energy on the power resistors and transistor, which is the case where neither the external consumers nor the battery requires current. The controller resists a maximum current of approximately 10A, which characteristic is shown in figure 4.

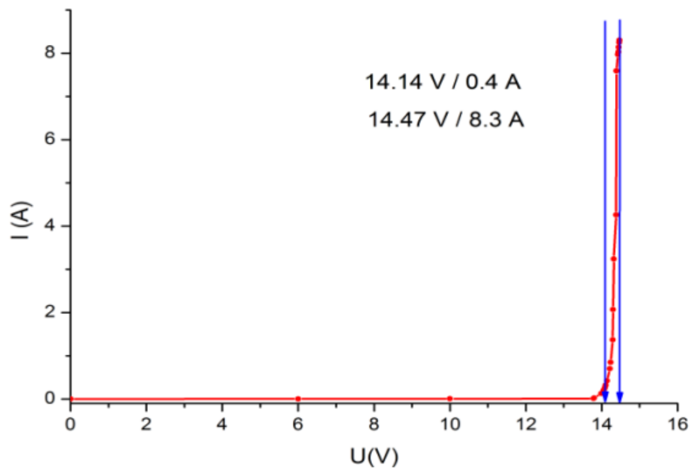

Figure 4. Current-voltage characteristic for the parallel regulator

To measure the voltages offered by the current and temperature sensors, was chosen a computing unit Arduino system based on an ATmega32u4 processor running a program written in C. Considering that we want to display the measured value in a WEB page, Arduino Yun was selected from several Arduino plates, which contains a second Atheros AR9331 processor on the motherboard that runs a Linux OS that provides Ethernet via an RJ45 as well as a WI-FI connection through the wireless module it contains, Figure 5. So SO Linux provides a web page located on an SD card that attaches to Arduino Yun in the appropriate port (https://www.arduino.cc).

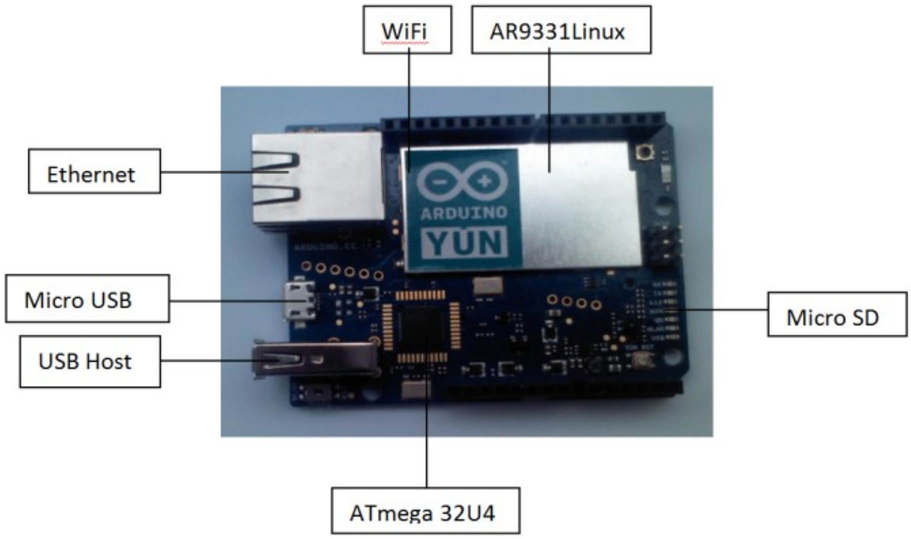

Figure 5. Arduino Yun

The Arduino Yun development board is relatively easy to program by writing a code to C, which makes the entire calibration process of the sensors switch from electrical or mechanical adjustments to changing the C code. So for calibrating the current, temperature and voltage sensors was written an initial code in C that displays the raw values read by Arduino, and on the outside with several high-performance tools (ammeter, voltmeter, thermometer) more values were read. The data was represented in Origin and their fitting allowed the determination of the formulas that were written in the final C code.

4 Results

We wanted and we achieved a photovoltaic system for students to know the parts, how they work, which are the parameters, to observe and analyze the performance of a photovoltaic system. The pupils' response was positive, the system offering them data in real time, easy and interesting to use. They were able to access the data multiple times and to compare the results for a better understanding of the basic concepts.

We asked the ATmega32u4 processor to create a file on the SD card in which to write the six sensors read values at 10 minutes. The experimental data are presented in Table 1:

Data (yymmddHHmmss)	Fixed photovoltaic module power (W)	A axis photovoltaic module power (W)	Two axes photovoltaic module power (W)	Panel temperature (^{0}C)	Environment temperature (^{0}C)	Storage battery voltage (V)
170520144124	45.00	46.57	47.77	44.15	26.05	13.22
170520145124	42.87	44.24	45.41	46.28	26.57	13.23
170520151124	37.55	40.99	42.35	47.04	27.42	13.22

Table 1. Recorded data on SD card

Recorded data can be downloaded to be analyzed and interpreted using data and graphics analysis programs, figure 6.

Between the two development board processors there is a "data bridge" that allows bidirectional data and command transfer in different formats, a bridge that allows real-time data and requests to be transmitted between the WEB page containing a JavaScript code and the ATmega32u4 processor. Thus, the access to the SD card can be done by both the ATmega32u4 processor and the Atheros AR9331 processor.

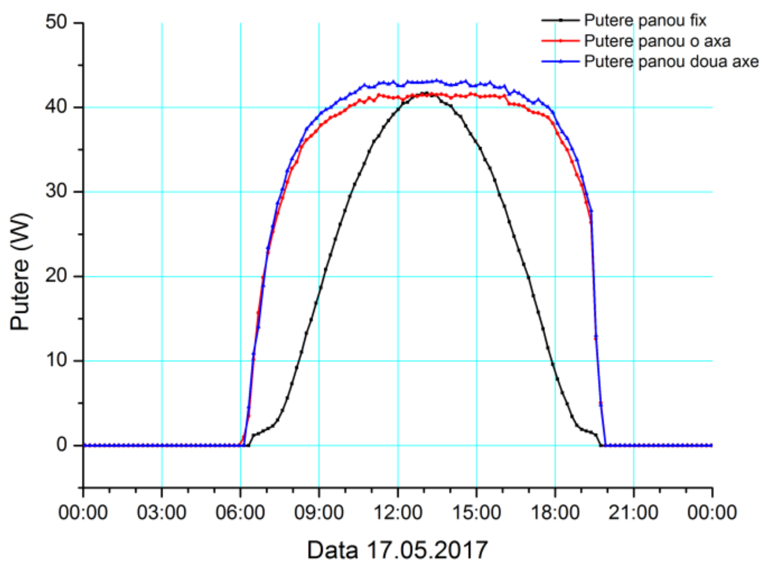

Figure 6. Power of photovoltaic panels on a sunny spring day

In this way, each pin real-time data or different statuses of the digital pins can be displayed, or commands can be given and answers can be offered about different existing states, figure 7 or http://fotovoltaic3.ddns.net:12380/sd/index.html.

Figure 7. Instant data. Parameters of the photovoltaic system

Conclusions

In this paper was presented a photovoltaic system based on Arduino Yun for remote monitoring of the parameters of a photovoltaic system consisting of three modules mounted on a tracker with two axes, with a fixed axis, respectively fixed, the parameters that are used for the study of the electric energy products of each module depending on positioning, season and weather conditions.

Remote monitoring has been possible thanks to new Arduino Yun-based technologies that allow both data acquisition and live broadcast over the Internet. Data stored by Arduino on the SD card can be downloaded and interpreted by any user.

Being successful in remote monitoring and accessing, this photovoltaic system can be a start for making other remote applications of different laboratories that enable students to improve knowledge and increase motivation for knowledge.

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Threats that may arise in teachers' training for improving their digital skills

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Abstract

The aims of this paper are to present the risks that may arise in teachers' training for improving their digital skills. The research is part of a DECODE project. The instruments of research are focus-groups and interviews. In the paper are presented the results of the research about the risks in implementation of ICT tools in schools. The threats in developing teachers' skills can be: creating of the digital educational content in a bad manner; implementing of the school management applications; misuse managing thr educational content. In terms of innovation in teaching, it isn't a balance between the didactic work and time; it depends on how much time is necessary to project the didactic act, because the teachers have to work at home, at school, beyond the norm of teaching. For a teacher, there are many teaching tasks, countless bureaucratic tasks and there is not enough time for the actual preparation of the didactic act. In fact, each course is an innovation adapted to the class; the teacher has to demonstrate creativity, empathy and adaptability. Also, it can be notated that, given the pace of development in this area, training should be very frequent, because changes sometimes occur faster than 2 years. The lack of a satisfactory number of school licenses is acutely felt. The threats revealed into interviews are: the new school curricula is misunderstood by the teachers; prejudices from previous teachers' experiences; some teachers believe that what they know at the moment is enough; ICT tools, both software and hardware, have the accelerated obsolescence.

Keywords: ICT tools, risks, threats, ICT skills, educational content, teaching tasks

1 Introduction

The natural consequence of the development of new technologies is their proliferation among young people, with all the risks that arise: online games, social networks, socializing with strangers, cyber-attacks. ICT integration and using the Internet in teaching activities also create the need to provide protection and prevention mechanisms for students due to inappropriate content that can be found on-line. To reduce the risk of using these, the growth of empathy between teachers and pupils is needed, as well as greater openness to discussions about Internet activities and on-line pupils' lives.

As risks, we can notice the loss of traditional work skills and reduction in the need for memorize information. If the computer system will collapse, the teacher, the school and, implicitly, the society will paralyze. There is a risk that the use of ICT in particular will lead to the diminution of practical skills, the loss of the sense of reality, the "moving" of the children from the real space into digital space, the loss of the sense of reality.

Teachers need to integrate short, simple and attractive exercises in their teaching activities, to help students internalize the concepts of online safety and responsible behavior that a digital citizen has to understand.

According to the research by the Save the Children Organization in 2012 (Consorţiul Sigur.Info, 2014), the vast majority of the Romanian children access the internet daily or almost daily (86% of them). About 90% of the children say they use at least one social network, most of them (87%) being Facebook users.

Two out of three children have seen or received messages with obscene or aggressive content in various forms via the Internet. The children's activity on the Internet, their permanent connection through mobile devices, the many social functions of applications, programs and sites accessed by children are all a reality and one of the ways in which technology transforms the society and our daily life.

The need to link the development of the means of communication and their use by children with the school, family and social environment in which they live becomes evident. As many studies have shown, digital environments continue to produce major changes in people's everyday lives, both socially and culturally, and psycho-cognitively (Sigur.Info, 2013).

ICT has made the world more interdependent on digital means, facilitating the free movement of its products, money and information. These transformations are not only positive. For example, the access to information has created new forms of exclusion, poverty and deprivation of rights (the so-called digital divide), which emphasizes old inequalities. There has also be an excess of information that people are less and less able to process and verify. Virtual forms of socialization and communication have exacerbated certain social issues such as lack of privacy, self-isolation or harassment on different forms. It can be seen that virtual socialization results in human isolation. For children, these challenges are matched by lack of experience and age-specific social intelligence. A lack of experience in this area is also experienced by adults, parents and educators and long-term consequences can not be noticed. Being able to quickly gather information, children are quickly adopting these forms of communication, but they rarely have protection or caution against online dangers.

Knowing the risks in the online environment is the most important step in avoiding and counteracting them.

New technologies have irreparably changed people's daily lives, communication, ability to understand things, opportunities for development and expression. There is an acute need for the society to adapt to new technologies, to try to understand and use it intelligently in order to make the most of this extraordinary resource. Caution must also be taken when a profile is created in the virtual environment and it is important to be aware of the long term effects, the reputation that the cyberspace can have apon the individual in real life. Parents need to be as aware and responsible for the online activity of children as they are for their activities in real life. However, the Internet can be more of a basic friend than a fearful foe if it is used responsibly, and this is largely left in the task of the teachers and school.

2 Methodology

"DECODE, "DEvelop COmpetences in Digital Era", is an action research project which aims are to create the best conditions of exchange the best practices in teaching digital skills. The project aims are to share best practices in using of information and communication technology (ICT) in the teaching process. At the same time, it is desired to identify possible problems that may arise in the integration of ICT in the didactic process. The integration of ICT in teaching practices and teachers' digital competences could be strategic in didactical field and are need to will fill a void of information on real teaching practices. (DECODE, Home)

To the research participated a lot of 27 Romanian schools.

3 Results and Discussions

3.1 Threats gained in Focus-Group research

As limits of the use of ICT in education, the participants mentioned:

- reduction of verbal expression capacity, loss of the habit of discussion, of the argumentation;
- high costs for acquiring software licenses;
- rapid moral wear of IT systems;
- lack of funding leads to a time lag between software supply and integration into the teaching process;
- lack of funding leads to non-concordation between apparition of new version IT applications and teachers’ training;
- decrease of attention and concentration capacity in case of preponderant use of ICT.

3.1.1 The innovation vision at school level

As threats, it can be notated that, given the pace of development in this area, training should be very frequent, because changes sometimes occur faster than 2 years. The lack of a satisfactory number of school licenses it is acutely felt.

It is suggested that each school to have a system engineer with following duties: to keep the computers' system in optimal functional parameters; to have the program of the teachers' activity; to help the teacher during the class.

In terms of innovation in teaching, it isn't a balance between didactic work and time; this fact depends on how much time is necessary to project didactic act, because the teachers have to work at home, at school, beyond the norm of teaching.

For a teacher, there are many teaching tasks, countless bureaucratic tasks and there is not enough time for the actual preparation of the didactic act. In fact, each class course is an innovation adapted to the student class; the teacher has to demonstrate creativity, empathy and adaptability.

3.1.2. Key competences and best practices

Using the socialization platforms through which teachers and pupils interact can has unfortunately, this practice also has drawbacks. Use of digital skills depends on human quality, specialized knowledge and the distributive attention of the teacher, empathy, the adaptive and re-adaptation power to the pupils, their age, students' understanding and knowledge of capture techniques, maintaining and gaining students' attention.

Dual education depends on the economic agents and the financial strength of the school. Bureaucracy greatly restricts the acquisition and use of these skills.

It is necessary to allocate a fund to each school for its own research on the needs of students, parents, local community. In these funds, financial resources should be provided for experimental work. We rely too much on volunteer work. There is a big problem with regard to classroom formation, regardless of intellectual possibilities. From the practice at the chair it is observed that the mixing of the students does not work, it gives more efficiency to the differentiated education by classes, by level. A limitation factor is the blackmail to bureaucratic level, such that the student that represent in competitions to belong of certain schools.

Another factor of constraint is the lack of respect of the teaching staff promoted by the current society. It would be useful for the didactic norm to be composed of the actual teaching norm, the norm for study for didactic training, the norm of collaboration with the parents and the civil society in the area and the norm for assuring the assistance - the additional training of the pupils.

The representatives from the Pedagogical High School "Vasile Lupu" consider that it is a great problem to correctly understand the status of Information and Communication Technology in the educational instructive process. In the activity of each school, the goal is not to be integrated but should be understood as an educational instructive.

3.1.3. Professional development

All teachers have training on AEL platform, but use of AEL system is difficult, not all of computers can be synchronized and isn't functioning properly.

It is necessary to train teachers of other disciplines in using ICT techniques and developing digital competences. Threats - lack of schools' equipment, the acquisition of material resources (tablets, laptops and video projectors, digital board - for class.

"We want educational software; we want quality, modern means and computer science laboratories."

The methodical skills needed to integrate ICT into lessons can be developed through teacher training courses. As a good practice is mentioned the training course: "Intel Teach - Learning in the Knowledge Society" - in which the teachers have built the lesson project. Practical courses are useful if a teacher is put in the position of doing things, doing a project, making software, and holding a lesson to real pupils in which they integrate a lesson.

The training course does not have any effect, finality, if the content is just a theory, but without a practical end. Teachers want to learn, but they do not want to attend to a lot of theory, they want to learn applicative things that are useful to the class.

3.2 Threats gained in Interviews research

- The new school curricula are misunderstand by the teachers, as consequence it isn't optimal apply
- Prejudices from previous experiences tend to teach teachers to think that the elements required for school competition are in the curriculum, which is not true; it belongs to the Center of Excellence.
- Some teachers believe that what they know at the moment is enough, it is also untrue, it requires a continuous improvement as ICT tools and both software and hardware meet the accelerated obsolescence.

3.2.1 Problems in implementation process

In context of the curricular changes that have begun in 2017 and are now in the process of being implemented, the introducing Computer Science and ICT subject at Gymnasium, it is the possibility that some of teachers will not understand the new curriculum program. They could have prejudices from previous experiences and to be tempted to think that the elements required for school competitions are in the school curriculum, which is not true; this belongs to the Center of Excellence.

Many also consider that what they know at this moment is sufficient, and that is also untrue, each teacher has to learn, to develop both scientifically and didactically - it is known that the dynamics in this field is particularly large. The Curricular Program for Gymnasium is an initiation in the application of current ICT tools, respectively their smart use.

Conclusions

It have been highlighted the conclusions on the risks that can be born of using ICT in school from the point of view of innovation at school level, to key competences, good practice, and teacher development. At the same time, there were mentioned some problems that can occur in the process of implementing the new technologies - the possibility that some of teachers will not understand the new curriculum program.

The possible threats to developing of teacher' skills have been exemplified: creating digital educational content in a bad manner; implementing school management applications; misuse managing educational content.

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Opportunities in the teachers' training for the enhancement of their digital skills

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Abstract

Aims of this paper are to present the opportunities in the teacher training for the enhancement of their digital skills. The results of research are based on focus groups and interview tools. Opportunities are external factors that could have a positive impact on the enhancement of digital skills. Transforming computer on a way of communication, work, learning and instruction guide through a computerized environment, driven by the science of automatic data processing, and mediates the widespread using of the multimedia means. The collaborative skills are essential in the teaching practice, for the improvement of the didactic act and the professional evolution. At the same time, there is the opportunity for all teachers to develop basic skills in mathematics and science, which are essential in practicing this profession in the modern age which we are crossing. As conclussions, when talking about the opportunity to develop ICT skills, we mainly refer to: editing and storing documents (eg using GoogleDrive / Dropbox); creating and editing presentation materials and videos; working with tables; html programming; searching for information on the Internet; e-learning. Also, opportunities created by the on-line communication are a reality: communication is both horizontal between schools and vertical between the Ministry of Education, County School Inspectorates and schools. Video conferencing improves the communication and understanding of the transmitted message, it can interrelate better. There is a well-established communication system from hierarchical point of view, Ministry of National Education - County School Inspectorates - Schools and vice versa.

Keywords: Teaching Design, on-line platform, lesson plan, unit of learnning

1 Introduction

Opportunities are external factors that could have a positive impact on the enhancement of digital skills. Transforming computer to a way of communication, work, learning, assessment and instruction guide through a computerized environment, drive to the science of automatic data processing, and mediates the widespread using of the multimedia means. It is time to include in the educational activity of the schools, the programs, software, presentations and useful resources on the Internet that make interactive and pleasant hours for students. Using of the ICT resources in education improve the management of school, communication between all actors of education: police makers, decision factors, teachers, students, parents and society. Opportunities offered to the educational system by means of ICT are in terms of time gained, high content of information in various forms and the adapting to different types of learning.

The Ministry of Education is becoming increasingly visible in the fact that before adopting a law it puts it in public debate. Thus, any of the educational actors has the opportunity to improve the content of the respective bill. We can speak of a more direct communication between decision-makers and beneficiaries.

2 Methodology

The research is based to 3 focus groups and 8 interviews. Participants on research are teachers, heads of the methodical commissions at school level, principals, and decision staff at county level. Personel from 27 schools attended to this research.

3 Results and Discussions

3.1 Opportunities gained in Focus-Group research

The opportunities found in the responses of the teachers involved in the focus group refer to the innovation vision of schools, developing of key competences and best practices, and professional development. Opportunities offered to the educational system by means of ICT are in terms of time gained, high content of information in various forms and adapted to different types of learning.

3.1.1 The innovation vision at school level

The school innovation is a challenge for teachers and students. Innovation must ensure sustainable development. The school can and must combine applied sciences and classical theory of mechanics, electronics, electro-technics, and ICT with what is newer. This have as results in innovations on the field of mechatronics / robotics. In every area of life, the digital technique has penetrated everywhere. Learning through the game plays a very important role, applications in the field of mechatronics from kindergartens through platforms developed by LEGO - it imposes technical problems and thinking. The design of a device starts from the mechanical part, from what it is expected to execute, and then proceeds to the programming. It is proposed to introduce in the curriculum some applications that foresee the application of mechatronics in which to develop integrated, technical skills, both manual and digital, sciences and technologies; if the students click on it, then they would be clicking efficiently.

The innovation, in vision of schools in opportunities terms suppose: the correct and efficient use of the technology; access of the disadvantaged children to technology; digital literacy of society; access to new technologies and the transfer to the student, which involve ethical and moral aspects; digitization of the didactic process; introducing IT technology into administrative work; equipping schools with modern technology; removing teachers’ reluctance towards the acquiring new skills.

The innovation vision of schools means not cap to professional developping of teacher, wanting more for self and pupils. It means use the ICT games in seriously manner. Stimulate students to create games that include definitions from the subject matter they teach. It means stimulating creativity. To be creative you have to want more from you. ICTs stimulate students in learning activities. Of great importance is the openness to innovation. Experienced colleagues may be open, and young colleagues may be reluctant. In school there are children with special educational needs; for them have taken into account didactic methods adapted from non-formal education.

3.1.2 Key competences and best practices

The digital revolution and the challenges of artificial intelligence change learning and practices, foster exchange of experiences with teachers from other European countries who want to implement new teaching and learning strategies with tablets, Android systems and smartphone applications. For example, the main objective of the "High School, High Tech - School of the Future" project is the formation of a teaching staff with digital competences in line with the

European e-skills requirements for the 21st century, able to implement modern teaching methods and strategies The help of which will be the student-centered education by introducing the tablets at the class hours.

Based on their own experiences, the participants mentioned that in a modern society of the 21st century, multicultural, it is necessary to develop the competencies like: communication - modern language learning; digital communication; information management; compliance with ethical and legal norms in digital space; creating digital content needed in the knowledge society; implementing management applications across all domains; managing information content; Internet browsing; adaptation to various facilities offered to the modern society: on-line purchase, filling in online forms

The main skills that teachers need to have are: creating digital educational content; implementing school management applications; managing educational content.

Very important for successful educations are: the pleasure of teaching, of being a teacher; motivation; scientific knowledge; spirit of research; appropriate payment.

As a pedagogical aspect of ICT integration in school practice, it is relevant:

- use of tablets, iPad, free apps, Android operating systems;
- advantages and disadvantages of use the tablet in didactic activities compared to other ICT devices
- a wide range of free applications that teachers, regardless of the subject they teach, can use in teaching-learning-evaluation-self-evaluation activities: presentation and processing of digital photos, audio and video documents, linguistic games, etc.
- using the didactic strategies of tablet integration in the educational act
- creating lesson plans using your tablet and mobile phone for each discipline
- selecting information available in electronic format for various didactic and extra-curricular activities (competitions, competitions, etc.)
- remote communication between teacher-student using tablet, smartphone applications, accessing home learning resources to facilitate access to education for students with disabilities.

"The best practice is not to use software within one hour, but to integrate lesson moments in which are used a certain digital application. ICT must be integrated in a clear moment of lesson, a limited time, with immediate feedback; otherwise I lost the students' attention. It's like letting the students one hour to play on the computer. ICT tools can be used in specific lesson moments, to be integrated into a traditional lesson." (teachers' oppinion)

It is risks which include use methodological competencies. One of the focus group participants pointed out the difficulty they encountered when they wanted to integrate into his lesson a software created by him. "I have had problems rethinking my lesson to integrate the software in specific moments of lesson. A lesson in which you integrate software should be prepared in advance, from checking your tools, checking if the software works on those tools, if those students understand the scientifically content and can capitalize the experience acquired in the lesson. Otherwise, students just play on the computer." (teachers' oppinion)

3.1.3 Professional development

In order to keep abreast of the educational advances specific to the dynamic society in which we live, resources such as the Internet, interaction with friends of the teachers, the purchase of specialized software, knowledge of free applications, training courses are used.

It is recommended to set up a ministry store to facilitate the purchase of ICT educational products.

National education policies support the development of pedagogical and methodological innovation through ICT through programs such as Teacher Training in the Knowledge Society: DeCeE; The Internet in your school - that is a national project, or the INSAM (Digital

Improvement Quality Assessment in Pre-University Education) that aimed at developing and implementing digital tools and mechanisms.

The project "At a click of modern and efficient education" was an ample European project run by the County School Inspectorate (ISJ) Iasi, in partnership with ISJ Tulcea, Iasi Teaching Staff House and SIVECO Romania, and was ended in 2013. The training courses of the first two series (a total of 12 groups with about 300 teachers) were completed. Graduates of the first training series were evaluated between March 24th and March 25th (the first six groups), followed by the other six groups in the first series and the graduates of the second series being evaluated in April 2013.

Teachers attended the training courses like: "ICT Training for Primary Teachers" - offered by Babeş-Bolyai University, or courses offered by SIVECO, training / qualification courses in database management.

3.2 Opportunities gained in Interviews research

The opportunities found in the responses of the teachers involved in the focus group refer to the digital challenges for national education system, national policies for ICT and innovating education, European recommendations and current national policies, problems in implementation process and the national specificity that is considered useful to enhance.

3.2.1 Digital challenges for national education system

The opportunities in digital challenges for national education system imply:

- developing of strategies for allocating sufficient funds for the development and purchase of software for school institutions;
- promoting the ICT, technology, mathematics, informatics, engineering within a Center for Excellence for Educational Robotics;
- accessing European funds for training of teachers in ICT fields.

The personal participation of the teachers, those participated in the present research, to national policies in the context of European/ national projects or the curricular changes offers the opportunity to work in teams of professionals, have the opportunity to promote their ideas and examples of good practice. This has resulted in a great deal of information, and has outlined a new vision of ICT and computer science in gymnasium. A new vision on IT and ICT has emerged in the gymnasium. It must be taken into account that any educational event influences not only the educator's future but also that of the whole society. The spirit of the curricular program has to be very well understood and key actors (policy makers, decision makers and institutional representatives) must have the availability of on the part to develop resources, platforms, training, with support from all the institutions that can contribute to the development of students. ICT technologies are useful not only for real disciplines but also for the social or humanistic field. The use of ICT has made changes in each of us in all respects, especially in terms of distance communication, both with family and socially or professionally. The didactic film, communication with students and colleagues contribute to personal and professional development. The key elements are access to information (I can search for materials and adapt them), access to methods and communication with others.

The challenge for teachers is to learn to use modern means and learn to transfer what they have learned. Our education and career systems need deep changes to prepare teachers for digital globalization.

3.2.2 National policies for ICT and innovating education

Government regulations for ICT integration in the education system and teaching practices such as the National Education Law in 2011 and the curriculum changes that have begun in recent years and are now in the process of being implemented, the introducing Computer Science and ICT subject at Gymnasium are also new opportunities for modernizing Romanian education. The revolutionary measure is the achievement of the current gymnasium program, which is absolutely innovative and will be starting to apply beginning the school year 2017-2018.

Other two governmental initiatives worth mentioning as opportunities with large-scale application of digitization of school institutions and didactic process are: digital textbooks for primary education and the introduction of professional standards / teacher evaluation sheet, which foresee the use of new technologies in teaching.

One of the intervention areas understands of school curricula.

Training courses, platforms, and educational resources are required because these programs are designed for school students to use the resources they have, programs that can be free or purchased.

Free educational resources must be provided on a timely basis by experts to teachers, because selection work requires work of research. Emphasis should be placed on didactic aspects and teaching methods. Educational policies should focus on how to implement this school curriculum in all schools in Romania.

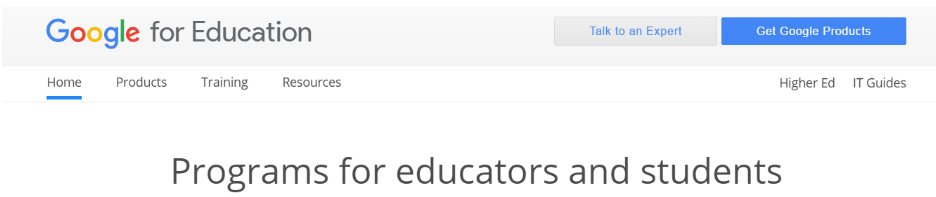
Are proposed the opportunity for a computerized platform which to measure the frequency of pupils at school and the results of their assessments. In terms of frequency, if a student is missing from school, when the teacher records the absence, the family to be immediately notified.

The Hour Code had over 400,000 participants in Romania with impressive feedback from students, students, teachers and parents, https://ro.code.org/. The program' vision of The Hour of Code Program is that every student in each school should have the opportunity to learn because computer technology and programming should be part of the core curriculum in education along with other science, engineering and mathematics courses (STEM) such as biology, physics, chemistry and algebra. The event coordinator for Romania is ADFABER - Technlology for Social Change.

3.2.3 European recommendations and current national policies

The opportunity terms, in accord with European recommendations, to develop teacher competences in ICT, implies: adaptability to modern technique; preoccupation for learning and continuing professional performance; communicating on the principle to know, to know to do and know to do with others; be able to creatively use the scientific content at the class and boost creativity among students; has correctly knowledge by point of view scientifically; being able to teach the children to learn in the team; being able to make students learn and participate with pleasure in school activities; to Know how to handle the information; to be able to communicate in digital format; to be able to create educational content in digital format; to manage the administrative system in digital content; to manage systems on educational content; to use digital equipment in education; to obey the ethical and legal norms imposed by digital deontology.

The integration of ICT activities into the curriculum has also been integrated with projects such as the Scientix, the Open to the Universe, the Eramus+ or Google for Education Program (https://edu.google.com/resources/programs/), which offers the opportunity for schools, teachers and students to benefit from the latest knowledge and applications.



3.2.4 National specificity that is considered useful to enhance

Thus, the INSAM project (Digital Instrument for Improving the Quality of Evaluation in Pre-university Education https://insam.softwin.ro/) aimed at developing and implementing digital tools and mechanisms to improve the evaluation and self-assessment / self-evaluation processes of students in high school education. Exist the opportunity of creation of a database platform with assessment items. More than, development of digital skills at curriculum level have promoted IT and ICT across all disciplines.

The INSAM project envisages the following target group: directors of the education units - deputy directors; personnel with management, monitoring, evaluation and control functions from the school inspectorates, central and local structures of the MECT; staff from the national system of examination, assessment and curriculum in pre-university education; students (pre-university education). The proposed project aims to address problematic issues by providing an evaluation system accessible to all participants in the education process (student, teacher) and stimulating them in the process of education adapted to the needs of the labor market and the knowledge society.

Conclusions

One of the conclusions drawn from interview research is to improve the access and participation of teachers in pre-university education to initial and continuing vocational training opportunities by developing the capacity to use interactive teaching and learning methods using ICT. Also, on creates the opportunity to develop a quality education through innovative multi-regional training programs, based on priority areas in education and digital resources. Teachers have had the opportunity to participate in projects with multi-regional implementation with a transnational approach, and the territorial dimension has covered both urban and rural areas.

Romanian Ministry of Education creates the opportunity for teachers to improve digital skills and communication skills, both in mother tongue and in a foreign language, especially in English from training courses.

Collaborative skills are essential in teaching practice for improvement didactic act and professional evolution. At the same time, there is the opportunity for all teachers to develop basic skills in mathematics and science, which are essential in practicing this profession in the modern age we are crossing.

When talking about the opportunity to develop ICT skills, we mainly refer to a) editing and storing documents (eg using GoogleDrive / Dropbox), b) creating and editing presentation materials and videos, c) working with tables (eg Microsoft Excel), d) html programming, e) search for information on the Internet. All this should be included in a training course on ICT for Teachers.

Last but not least, there is a need for a partnership with pupils in articulating the didactic process.

Opportunities created by on-line communication are a reality: communication is both horizontal between schools and vertically between the Ministry of Education, County School Inspectorates and schools. Video conferencing improves the communication and understanding of the transmitted message, it can interrelate better. There is a well-established communication system from hierarchical point of view, Ministry of National Education - County School Inspectorates - Schools and vice versa.

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The advantages of using sensors in Project-Based Learning of sciences

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Abstract

The use of sensors in science projects increases interest in the study of physics, the motivation for learning through the project. It is possible to consolidate the knowledge gained in the class. It can be done as homework for teamwork or individual projects. These projects can aim at measuring and interpreting the various parameters characteristic of essential physical phenomena: magnetism, especially terrestrial, production and propagation of sounds, emission and absorption of light, etc. Interdisciplinary science competitions are a good opportunity for these projects to find another utility. Earth's magnetic field is a priority in geophysical investigations, it is essential in telecommunication, adaptation of species, in bird migration, an "umbrella" in the way of cosmic radiation.The paper presents a study of the Earth's magnetic field through the magnetometer sensor.

Keywords: Science education, interdisciplinary teaching methodology, magnetometer

1. Introduction

In the modern education, marked by the contrast of the strong communication development and information technology and the low interest in the study, the approach of project-based learning in teaching science is one of the newest and most interesting.

The foundation of project-based learning (or PBL) is to address an open question and a complex problem to a group of students and to determine them to find the best solution.

PBL is a constructivist learning strategy; the proposed problems are part of reality. The students are encouraged to find a solution based on their own understanding of the world and of the problem.

Teachers should first conceptualize the issue or the project, which is often more complex than it seems. What essentially defines project-based learning is authenticity, along with student drafting and their autonomy, the optimal challenge, and the ongoing and persevering research. (http://www.gettingsmart.com)

Students are fascinated and interested by modern technologies; are exploring smartphone facilities without having any idea of the underlying physical phenomenon. For a science teacher this interest can become a hopeful ally.

Research on preferred methods of teaching in science highlights the fact that computer-assisted training, virtual modeling of experiments hold an important place. (Maftei et al, 2013).

New project-based teaching methods (PBL) by using GoogleApps are valuable resources in physics, not just in traditional education but especially in "in-formal" learning, "distance learning" and "long-life learning ". These strategies are important for all levels of education.

The teacher should focus in particular on didactic aspects related to the transfer of skills and abilities. The impact of these materials and strategies for the development of physical education must be carefully monitored.

The implementation of new educational technologies based on these applications can radically transform learning as an active process into the informal part in the first phase because not all students have the possibility to use dedicated sensors.

Defining the theme and the question is a challenge for both the teacher and the student.

The advantages of this educational approach can be highlighted (Holm, 2011):

- increased motivation and curiosity for interdisciplinary and transdisciplinary themes;
-consolidates knowledge and skills and facilitates the acquisition of new ones;
-knowledge lasts for a long period of time;
-adaptation of the didactic approach to the students' learning styles, this one is effective for the dominant visual and kinesthetic style. (Chilom and Stanescu, 2017);
-the learning objectives are quickly achieved.

The PBL approach exploits age-specific curiosity with interest in new generation software and IT equipment. Perhaps this manner of teaching and learning is insufficiently known and exploited by the lack of necessary equipment: specific sensors and software. (Stanescu, 2012)

We have designed in the last few years many didactic strategies using PBL-Project-based Learning with various themes. One of the notable results was the increase in number of participants and prizes at symposiums and scientific sessions or experimental techniques competitions.

Lately, a number of applications (https://play.google.com/store) that can be included in PBL didactic scenarios have been designed and developed.

The teacher must have the necessary skills to identify the relevant issues to a particular phenomenon, application and to choose, where it's appropriate, the group of students to work on the required solution.

Not all students have the necessary knowledge about how sensors can be used in measurements.The student team discovers and selects the appropriate investigative method to formulate the best response to the project requirements.

Planning PBL activities requires the teacher to design evaluation tools that do not lead to predictable responses. Evaluating these activities is a feed-back that can trigger an in-depth research of multiple topics relevant to the students.

The use of new computer technologies in science lessons involves identifying the objectives and competences set out in the curriculum, choosing the right didactic software and obviously providing the necessary hardware. One choice from the perspective of implementing the interdisciplinary study of terrestrial magnetism is the use of educational application package (www.vieyrasoftware.net).

With this software you can link mathematical concepts (functions, numerical methods, graphical representations, etc.) with the description and recording of bio-electromagnetic phenomena (Figure 1).

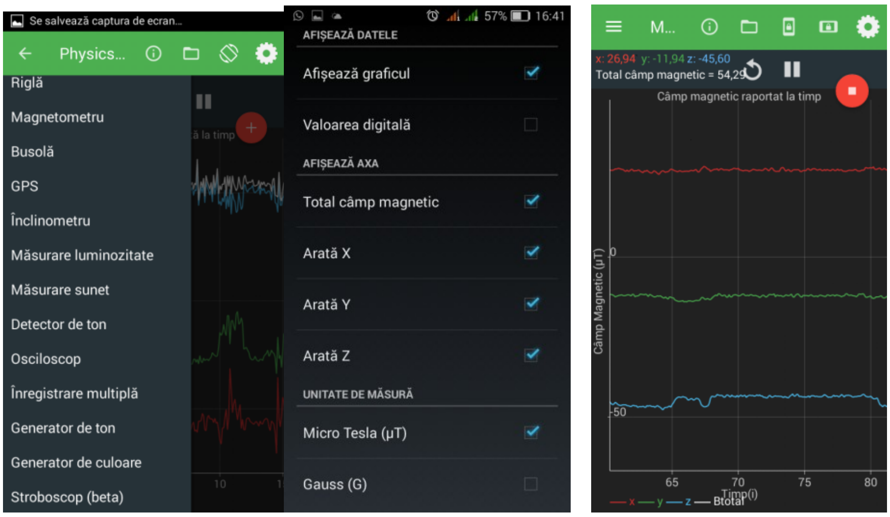

Figure 1. Screenshots Of Toolbox, Settings And Magnetometer

Several published studies (Vogt, 2012; Dinescu et al, 2013; Oprea et al., 2014) show that various experimental data can be acquired through sensors. These can be processed using specific applications. Students can be initiated in the processing of information using Excel. The role and the advantage of Excel in learning physics had been highlighted in many cases. (Miron, Grigore et al., 2015; Miron, Grigore et al.,2017).

Theses studies highlight the motivating role of the formal and non-formal learning experiences that integrate mobile phone sensors.

The following is an example of PBL experience built on the interdisciplinary theme of the origin and influence of Earth's magnetism. (http://www.science-on-stage.eu/images/download/iStage_2_The_Earths_Magnetic_Field_IMP.pdf). This was approached by a group of students as the theme within the scientific assembly.

2. A Case-Study

The project started from a curiosity about Android or IOS sensor systems followed by a lot of surmounting problems.

Questions on which the project was built:

- Is the magnetometer sensor suitable to study the behavior of the local Earth's magnetic field? What are the limitations imposed by this tool?
-Are the terrestrial magnetic field values different in various buildings we live in? Is this belief a myth or a reality?

3. Methodology

An investigation has been carried out to support the idea that smartphone applications, such as magnetometer sensors, are suitable for studying the characteristic parameters of different physical phenomena.

In the present case, the Earth's magnetic field values for different locations and influences of other field sources.

These recordings are particularly useful for deducting some correlations between these sources and the type of construction and their age. Furthermore, we can design ways to study the possible effects that these artificial magnetic fields can have on living organisms.

Using educational software (www.vieyrasoftware.net), the students had to design a scenario for determining and interpreting magnetic field values in several locations over several days in situations of external magnetic charge and different disturbances. Following a documentary process guided by the physics teacher, the students identified the following issues that needed clarification:
-how the magnetometer sensor works;
-how the sensor should be correctly positioned to measure the value of the total magnetic field;
-where to record the signal and how long;
-how data is processed in Excel and how it can be interpreted.

For the project, two schools were chosen, located in areas with different external electromagnetic influences. The measurements were made after classes. It started from the assumption that the chosen classrooms would have, on average, the same electromagnetic influences from other sources. The data were recorded under the same conditions (position, height etc.).

The school A is located in the center, in the area of shops, blocks and offices and the C-school, located in the city park area, surrounded by a lot of free space. The buildings of the two schools have different number of levels.

The average level measured for the Earth's total magnetic field was about 48-50μT.

Several sets of data have been collected, processed in Excel and compared to those provided by the latest World Magnetic Model (WMM). (https://www.ngdc.noaa.go v/geomag-web/#igrfwmm)

The on-line calculator provides an easy way to get results in HTML, XML or CSV (API) format. Global positions have been determined with Google Earth applications, as well as the altitude of different measurement locations.

4. Results

The magnetic field dependence of altitude was recorded, as shown in Tables 1 and 2. The values were again calculated using the WMM- universal magnetic model. B_i represents values in different days.

Level	B 1(μT)	WMM (μT)	B2 (μT)	WMM (μT)	B3 (μT)	WMM (μT)
Ground-floor	44,62710	48,18653	44,62710	48,18632	42,4054	48,18652
1	63,18020	48,18652	45,06210	48,18632	72,0160	48,18652
2	52,93670	48,18651	38,88390	48,18631	49,1420	48,18651
3	41,94740	48,18650	40,76820	48,18630	44,3846	48,18650

Table 1. School A, Built 40 Years Ago

Level	B (μT)	WMM (μT)
Ground-floor	46,1277	48,1656
1	34,3109	48,1655
2	42,2723	48,1657
3	44,1543	48,1657

Table 2. School C, Built 40 Years Ago

The same day values were also compared in two schools (Tables 3 and 4).

level	B (μT)	WMM (μT)
Ground-floor	48,0740	48,1656
1	57,4310	48,1655

Table 3. C1 School Unit, Built 85 Years Ago

level	B (μT)	WMM (μT)
Ground-floor	69,9516	48,1656
1	43,3010	48,1655

Table 4.C2 School Unit, Built 40 Years Ago

Students have found that the value of the Earth's total magnetic field is broadly around the WMM value of about 48-50 microTesla. The average values obtained (44-48 microTesla) correspond to our research purposes.(Table 1 and 2)

The deviations are relatively small, so the sensor's efficiency is good for the proposed problem. The value of the total magnetic field may depend on the building type, the floors’ height (Table 3 and 4); the possible cause of this dependency is the theme of a new project.

Conclusions

The method designed and used by the students was appropriate for the proposed project determinations. The students processed and interpreted the raw signal. A rigorous scientific investigation required the smoothening of the signal with special software, like MATLAB. This would outweigh by far our teaching goals and school curriculum.

It turns out that the magnetometer sensor is a tool with good precision and also an aid in scientific research, even at the level of “beginner scientist”.

The new technology included in teaching can stimulate motivation to study science, significantly reducing measurement time and opening new horizons of knowledge and experimentation.

The advantage of using sensors is that it expands learning beyond the physical lab and creates it where it’s missing. The operating principles of smartphone sensors may be the study subjects for leisure time or competitions.

Through quick access to web educational resources and mobile or fixed devices as well as fast data transfer, smartphones are considered digital mobile platforms with valuable educational implications. (Oprea et al., 2014).

There is, instead, a limitation for educational use imposed by legislation. In some educational systems, mobile phones are not allowed in schools.

The role of these devices in education is obviously an important one; their status in the classroom has been controversial for the past years.

Since introducing smartphone applications into science education is a recent field, additional research will be needed to improve the pedagogical usefulness of this approach.

Thanks to the more efficient and easier to use versions, signal processing sequences can be introduced even at high school level, at least for the students in computer classes or those in the performance circles. This approach would complement the programming and operating knowledge acquired through the curriculum.

It is a way of stimulating motivation for the study of science and it can open new opportunities for capitalizing on students’ capacities and abilities.

The project, through its implementation and its conclusions, strengthens and develops new communication skills. It is also a starting point for new scientific projects completed with the participation in competitions or only with pleasant experiences, reinforced by co-operation among colleagues.

Project-based learning experiences remain in the memory of students for years (http://www.gettingsm art.com). People share these memories with friends and family. In the classroom or lab, knowledge and complicated solved issues are easy to forget.

But scientific investigations, experiments, contests of any kind remain with us forever and help us in defining and shaping our personality.

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The development of the linguistic levels of preschoolers through the didactic game

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Abstract

Our paper starts from the idea that the acquisition of language is not a unitary phenomenon. The curriculum for kindergarten education proposes a series of objectives that target the development of some linguistic aspects. We have concentrated this input into five levels of language which are constantly aimed at throughout a school year for each study level in kindergarten, 3-5 years, 5-6 years. Practice in kindergarten has shown that the didactic game is the main activity for this level of age, favouring both the informative as well as the formative aspects of the learning process. By means of the game the children are spontaneous, sincere, show their tendencies, interests, and abilities. The communication function of the language is efficiently developed through the didactic game as it contributes to a great extent to the formation and development of all aspects of language: phonetic, lexical, morphological, syntactic and stylistic. Our focus is on the degree of development of these linguistic levels achieved through the use of the didactic game in the language education activities. The research offers data on language development for each level of kindergarten age so that teachers and other practitioners should make the best decisions to improve preschoolers' communication skills.

Keywords: Didactic game, Language education, Linguistic levels, Communication

1. Introduction

Children develop quickly in the early years of life and as such kindergartens aim to provide the necessary support to enable each child to fulfil their potential through a series of objectives which ensure children's learning and harmonious development. Thus, kindergartens ensure small children a broad range of knowledge and skills that provide the right foundation for good future progress in school and life. One of the prime areas of learning and development that form the educational programmes in the early years is the communication and language area. The educational activities included in this area give children opportunities to develop communication skills through experiencing a rich language environment, through expressing themselves, through speaking and listening in a range of situations. The diversified input contained in the mandatory objectives from the curriculum for kindergarten education could be easily concentrated into five aspects of language constantly pursued throughout all early years of education programmes: phonetic, lexical, morphological, syntactic and stylistic.

Research has shown that the acquisition of language is not a unitary phenomenon. Lenneberg (1984) states that there are multiple critical periods for the acquisition of language aspects. Thus, phoneme acquisition starts in the first year of life and ends around five or six years old. During this period, the sounds of the words undergo different changes: the speech tempo, the intonation etc. are often subjected to child's moods. Teachers and other providers must take reasonable steps to provide opportunities for children to develop and use correctly the phonetic aspects of language.

Children acquire the vocabulary of a language in different stages. The first stage is passive: children learn words and their meanings, but they do not produce them. The second stage is productive: children utter words, but these ones have different phonetic and prosodic characteristics from the adults' words (Enachi-Vasluianu, 2010). In the following stages words are proper used even if not always. At the age of 4-5 years old, the words are not used echoic anymore; the children can define them spontaneously. The rate of vocabulary growth increases in a significant way and it reaches its peak when the child goes to school (5-6 years). The acquisition of vocabulary continues through life, although slowing down with age. Mention must be made that vocabulary development is not an isolated act, but it is sensitive to phonological and morphosyntactic knowledge.

From a morphological point of view children starting from 3-4 years old, acquire consciously rules for expressing the number and gender of nouns, the gender and number agreement between noun and adjective, the tenses of the verbs, the pronouns, the adverbs, the correct use of the articles, overuse of interjections (to express personal feelings) etc. By the end of 5, children have adult-like knowledge of grammar of the language (Avram, 2002). From a syntactic point of view, they can use and understand complex sentences; they can use and understand passives, conditionals, relative clauses, sentences with multiple embeddings etc.

From a stylistic point of view, at the age of 5-6, children can deal with disambiguation, metaphors, jokes, or metalinguistic negation (they can deal with those phenomena which require an interpretative use of the language). Experiments (Hatch, Brown, 1995) have shown that they understand metaphorical relationships and when they learn new words, they already extend their meanings to new semantic fields. Children produce metaphors spontaneously when describing things, but they can not always provide explanations for the metaphor proposed (Enachi-Vasluianu, 2009).

The didactic game is organised in a relaxed atmosphere according to a certain structure, governed by certain rules in accordance to specific educational objectives. It is centred upon learning through discovery, through children's active involvement in the process of acquisition. Playing is essential for children's development, building their confidence as they learn to explore, to think about problems and to relate to others. Specialised literature classifies the didactic game in the language education activities according to the linguistic criteria into phonetic, lexical, morphological, syntactic and stylistic didactic games (Hobjilă, 2008). All the games in this classification aim at developing child's linguistic skills, speaking, listening and understanding. As such, when speaking they distinguish the sounds that make up the words, they pronounce the words correctly, they use correct grammatical forms, they express personal opinions, develop their own narratives and explanations by making use of figurative speech. At the same time, children learn to listen attentively in a range of situations. They learn to respond to what they hear with relevant comments, questions or actions. They show awareness of listener's needs.

2. Presentation of research

The objectives of our study are: a) to identify the linguistic aspects according to the mandatory objectives of the communication and language area contained in the curriculum for early education; b) to determine the degree of development for each linguistic aspect through the didactic game for the three levels of age, 3-4 years old, 4-5 years old and 5-6 years old.

The research instrument was a questionnaire analysing the opinions of the teachers in kindergarten regarding the development of each linguistic aspect through the didactic game. The respondents were asked to choose one of the following 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, thus showing the degree of development for each linguistic aspect.

We used a sample of 150 kindergarten teachers from Vrancea County, Romania. The participants (all women) were 47 teachers with 10 to 20 years of experience in the educational system, 54 teachers with 20 to 30 years of experience and 49 teachers with 30 to 35 years of experience. The experiment lasted for one school year, 2016-2017. During this time teachers used mainly the didactic game in the language education activities. Mention must be made that in the Romanian educational system kindergarten period is structured into three groups of age: 3-4 years, 1st year of study, otherwise known as small children's group; 4-5, 2nd year of study, medium-aged children's group; 5-6, 3rd year of study, big children's group. The analyses of the linguistic development were made on levels of age, as previously described.

In order to analyse the data collected we used the SPSS program, the t-test for the independent samples and Levene test. Descriptive statistics of the scores obtained are presented in Table 1.

Table 1.Means and standard deviation of linguistic aspects developed through the didactic game

Items of linguistic aspects developed through the didactic game	1st year Mean (std. dev.)	2nd year Mean (std. dev.)	3rd year Mean (std. dev.)
phonetics	4.82 (0.438)	4.78 (0.418)	4.12 (0.940)
lexis	4.60 (0.756)	4.68 (0.514)	4.42 (0.785)
morphology	4.24 (0.981)	4.18 (0.661)	4.52 (0.820)
syntax	4.16 (0.842)	4.22 (1.008)	4.38 (0.667)
stylistics	4.00 (0.746)	4.04 (0.925)	4.20 (0.670)

We used the means from Table 1 to make a classification of the linguistic aspects developed through the didactic game in the three kindergarten levels, as presented in Table 2. Thus, the first rank is considered the highest degree of linguistic development, whereas the fifth rank shows the lowest degree of linguistic development.

Table 2.Descriptive of classification of the linguistic aspects developed through the didactic game

Rank	1st year of study	2nd year	3rd year
1.	phonetics	phonetics	morphology
2.	lexis	lexical	lexical
3.	morphology	syntax	syntax
4.	syntax	morphology	stylistics
5.	stylistics	stylistics	phonetics

As Table 1 shows, all means are above 4, which demonstrates the consistence of the evolutions registered by preschoolers for all five linguistic aspects studied. The highest means were recorded for phonetics at the first year of study (m = 4.82) and the second year of study (m = 4.78) and for morphology at the third year of study (m = 4.52). So, teachers appreciated the phonetic aspect registered the greatest progress at 3-4 level of age and at 4-5 level of age, whereas the highest progress is registered for morphology at 5-6 level of age. The development of the lexical aspect ranks two for all groups of age, but the highest mean is recorded for the second year of study (m=4.68). This shows that, in teachers' opinions, preschoolers acquire at a fast, constant pace elements of vocabulary through the didactic game (many new words, phrases each year). The lowest means were recorded for stylistics at the first year of study (m=4.00) and second level of age (m = 4.04), and for phonetics at the third level of age (m = 4.12). Although stylistics rated the fifth in the hierarchy, means above 4 underline the idea supported by the specialists in age psychology, linguistic psychology according to which language develops at a spectacular pace during the early age education (Crețu, 2005; Zlate, Șchiopu, 1997; Slama-Cazacu, 1973; Avram, 2002). Although these observations are of general nature, our study particularizes and exemplifies these qualitative and quantitative linguistic boosts through the intensive use of the didactic game in the context of well-structured educational programmes.

We applied the T test for the independent groups in order to determine the differences among the linguistic aspects developed through the didactic game at the three kindergarten levels. So the analyses are realised between the first year and the second year of study, the first year and the third year of study, the second year and the third year of study. The significance level was set at 0.05. Starting from the significant differences from a statistical point of view among the appreciations of the teachers from the three kindergarten levels we can state the relevance of the linguistic aspects developed through the didactic game.

Analysing the items on levels of age, according to the criterion of statistically significant differences, we noticed that there were such differences between the medium-aged children's group and the big children's group for two items, phonetics and lexis ($p < 0.05$). For the phonetic level the highest mean is rated for the medium aged children's group meaning that teachers consider that at this level of age the phonetic acquisitions are the most consistent. The high means for the lexical aspect at the medium-aged children group show that teachers consider that at this level of age the vocabulary acquisitions are the most consistent.

The analysis between the first year of study and the third year of study shows that there are statistically significant differences for only one item, phonetics. As the highest mean is registered for the first year of study this means the greatest phonetic progress is made by children at this level of age. There were no statistically significant differences between the first and the second year of study, which demonstrates convergence of opinions between the groups investigated.

Conclusions

To sum up, the process of language acquisition develops at an amazing rate in kindergarten. The dissociation among the linguistic areas, phonetic, lexical, morphological, syntactic and stylistic, is meant to be in support of our study, as language acquisition includes all aspects simultaneously, but at different rates of development. As for the activity in kindergarten, the didactic game offers a stimulating context for linguistic development in which the children acquire information in a relaxed, entertaining, less formal environment. Taking these into consideration we believe that choosing the didactic game as a form of realization of language education activities was helpful for the achievement of the objectives proposed by our study. In support of our observations teachers involved in the study stated that their experience in the educational system showed that the best results in the development of language were obtained when an activity was projected as a didactic game. The study could be completed with a comparative analysis of linguistic development through various form of realization of the language education activities, such as memorization, image reading, conversation, storytelling etc.

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Nonverbal and paraverbal aspects in teacher's communication perceived as hostile by students

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Abstract

According to various definitions a hostile environment can be an unfriendly, tense context in which one can not have natural, relaxed manifestations. In school the hostile environment is usually associated to the authoritarian teacher. This teaching style can become repressive, discouraging intercommunication, the formation of autonomous, independent personality in students. Research has shown that a hostile atmosphere can induce in students a sense of helplessness, of dependence and estrangement from the subject studied. As a rule, in a hostile climate, students are afraid to talk, to express their opinions, thus leading to lack of self confidence and pessimism. Students have the tendency to give up when confronted to a new task. Our paper limits the research to the nonverbal and paraverbal aspects in teacher's communication perceived as hostile by students. The sample involved in the research is made of students from gymnasium and high school. The data gathered offer teachers information on students' perspectives regarding a relevant range of nonverbal and paraverbal elements that determine a hostile communicational environment. Acknowledging these elements is important if we are to take into account that the climate in the classroom determines students' active participation in the communication and the learning process. Ignoring them would mean developing a barrier between teacher and students with repercussions on school performance.

Keywords: Hostile environment, Nonverbal and paraverbal communication, Communicational climate

1. Introduction

Hostility in communication is usually associated to a large range of characteristics such as distant relationship between partners, inflexibility, lack of active listening, judgemental attitude, excessive criticism, domination, authoritarian control, pressure, abuse of power, refusal of negotiation etc. Such a hostile communicational environment causes repression, helplessness, dependence of a probable authority, lack of trust, lack of initiative, pessimism, disruption in communication, disharmonious formation of personality. In school, the hostile communication environment is usually related to an authoritarian leading style. This kind of style is exercised by the authoritarian teacher who requires severe discipline and expects to be obeyed unconditionally as s/he considers being the only one apt to make decisions. The students know that the teacher must not be interrupted, that s/he discourages discussions, negotiations and controversies. As a consequence, they lack the opportunity to develop communication skills through exercise. On the other hand, even if this leading style is blamed in the present educational context, some scientists claim that such a style is necessary for an efficient evolution of the student. Lucien Laberthoniere (apud Stan, 2006) states that teacher's authority is the help the child expects and requires to evolve harmoniously. This authority cannot be efficient unless it maintains its dominative character. So teachers must command, must enforce their will to ensure an efficient development of the student.

The hostile communication environment in school caused by teacher's authority is characterised through verbal, nonverbal and paraverbal aspects. The current study limits the research to the last two aspects from the previous enumeration: nonverbal and paraverbal aspects in teacher's communication perceived as hostile by students. Nonverbal communication is a form of interhuman communication in which the information is encoded and transmitted through a diversity of signals related to posture, movements, gestures, facial expressions, placement in the classroom (Cosmovici, Iacob, 2008). Gestures represent a synthetic code of useful information as their role is to establish equilibrium with the exterior environment. Communication through gestures can replace verbal communication, but most of the times it completes, emphasizes, contradicts or adjusts. Gestures in the educational process are classified into two categories (Grant, Hennings, 1977): personal or adjustment gestures specific to each teacher (spectacles adjustment, un/buttoning the coat, tracing the hand through the hair etc.) and instructional gestures as inherent parts of the educational process (pointing to the blackboard, nodding or shaking the head, movements that seem to serve as added punctuation or emphases such as pointing with the hand or with the turn of the head etc.). Students also use instructional movements such as raising the hand, wrinkling the forehead when failing to understand, gestures of disapproval when other peers do not pay attention to the lesson etc.

In the classroom there are perceived as hostile rapid gestures which denote irritability and emotional tension, gestures such as vertical movements of the hand that mark the importance of some elements of the language, gestures that indicate directions (to stand up or to go to the blackboard), rhythmic movements that impose cadence of actions (circular movements of the hand which indicate the student to speak faster or move on) (Ekman, Friesen, 1969; Mehrabian, 1972). As for teachers' gestures, students perceive as hostile the slow removal of the spectacles in order to gaze at the student, shaking the head when a student speaks, rhythmic nervous leg and foot movement, sudden turnaround, rhythmic finger movement to the head indicating student's intellectual inability, arranging sheets of paper while the student talks, balance of the foot etc. Specialized literature mentions that rigid posture, with hands behind the back also indicate hostile, unfriendly attitude.

There are several facial expressions psychologists recommend to avoid, especially in the educational activity: the maintenance of a wry, fixed physiognomy, raising the brows, compressing the lips, gazing at the student when the teacher is discontent etc. H. Ruckle (2001) states that staring into the interlocutor's eyes can express, in some contexts, hostility, domination, arrogance, pride or contempt. Looking from the top down is intended to minimize the interlocutor, whereas eyes' moving slowly from bottom up is considered a sign of aggression. Short, discontinuous, intermittent eye contact indicates lack of interest or unfriendly attitude. In the classroom students perceive all these characteristics of eye contact as hostile, and have a negative impact on them. There are contexts when even smiling is considered hostile if it is derogatory, ironic.

Teacher's placement in the classroom has an important role in the nonverbal communication, offering tips on the type of relationship a person wants to establish with his/her interlocutor (Amado, Guittet, 2007). Teacher's complete immobility, standing with his/her back facing the students, looking at something else rather than the student delivering a speech, backing-off from a student speaking suggest lack or loss of interest for the speech delivered and consequently can block intercommunication.

Paraverbal communication ensures the personalized dimension of the communication act. It is realized through elements that accompany the word, consisting of loudness of the voice, speech melody, speaking tempo, pitch of the tone and emphasis of different words in the sentence, use of pauses, quality and rhythm of the speech.

In school, teacher's loud volume transmits the student a subliminal aggressive message that gives negative connotation to their relationship. The high pitched tone is associated to dissatisfaction, irritation. The pauses during the speech can be as suggestive as the words, representing ways of controlling the receiver. Long pauses accompanied by a fixed stare indicate hostility, unfriendly communication environment. The emphasis on certain words, group of words or syllables in the sentence draws attention on some information, but can also intimidate the student, suggesting teacher's domination over the communication.

2. Research design

The current study includes two objectives: a) to identify a series of nonverbal and paraverbal elements perceived as hostile in teacher's communication based on specific literature and data provided by students in focus groups; b) to realize descriptive analyses of the these elements in order to establish the relevance for two school levels: gymnasium and high school.

Our study included 100 participants, 50 gymnasium students and 50 high school students from Vrancea County, Romania with ages ranged from 11 to 19. The selection of the participants was based on volunteering.

The instrument of research was a questionnaire which provided the opinions of the students. It was conceived using information from specific literature and from discussions in focus groups with students in the two school levels. The data collected ensured the identification of a series of nonverbal and paraverbal elements perceived as hostile in teacher's communication:

- gestures
- movements
- posture
- facial expression
- teacher's placement
- pitch of tone
- emphasis
- loudness of voice
- pauses in speech.

While applying the questionnaire, the respondents were asked to choose one of the 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. Each choice is meant to show the impact of teacher's nonverbal and paraverbal elements on shaping a hostile communication environment.

3. Results and discussions

Table 1.Means and standard deviation of nonverbal and paraverbal elements perceived as hostile in teacher's communication

Items o of teacher's hostile communication	Gymnasium Mean (std. dev.)	High school Mean (std. dev.)
Gestures	4.68 (0.614)	4.54 (0.646)
Movements	4.64 (0.942)	4.52 (0.789)
Posture	3.86 (0.756)	3.50 (0.678)
Facial expressions	4.78 (0.418)	4.70 (0.642)
Teacher's placement	4.32 (0.892)	3.40 (1.309)
Pitch of tone	4.58 (0.538)	4.64 (0.563)
Emphasis	3.68 (0.513)	4.42 (0.850)
Loudness of voice	4.60 (0.638)	4.62 (0.733)
Pauses in speech	4.14 (1.010)	4.24 (0.960)

According to Table 1 the highest means were recorded at gymnasium (m = 4.78) and at high school (m = 4.70) for facial expressions. This shows that, in both groups' opinions the facial expression is the indicator with the greatest impact in shaping a hostile communication environment. Thus, students pay much attention to what teacher' face and eyes express, as they declared in focus groups. The lowest means were registered for emphasis at gymnasium (m = 3.68) and for teacher's placement (m = 3.40) at high school. With the other items the hierarchic order varies as shown in Table 2.

These means allowed the realisation of a hierarchy of the items above, in which the 1st rank is considered to have the greatest impact on students, whereas the 8th rank is appreciated with a very low impact in shaping the hostile communication environment.

Table 2.Descriptive of hierarchy of nonverbal and paraverbal elements perceived as hostile in teacher's communication for the two school level

Rank	Gymnasium	High school
1.	Facial expression	Facial expression
2.	Gestures	Pitch of tone
3.	Movements	Loudness of voice
4.	Loudness of voice	Gestures
5.	Pitch of tone	Movements
6.	Teacher's placement	Emphasis
7.	Pauses in speech	Pauses in speech
8.	Posture	Posture
9.	Emphasis	Teacher's placement

The hierarchy established based on the means in Table 1 reveals the existence of three items which ranked the same place for both school groups investigated: facial expression ranked first, pauses ranked seventh, and posture ranked eighth.

In order to determine the differences regarding the nonverbal and paraverbal elements which are perceived as hostile in teacher's communication we applied the t-test and Levene test for the independent groups, in our case gymnasium students and high school students. The significance level was set at 0.05.

Analysing the appreciations of the two groups of respondents we identified significant differences for three items: posture, teacher's placement, emphasis. The first two items registered higher means at gymnasium rather than high school. This means that posture and teacher's placement have a greater impact as elements of hostile communicational environment for the gymnasium students. For the last item in the enumeration, emphasis on certain words or group of words, the higher mean is registered at high school. The rest of the items do not register significant differences in scores, which demonstrates that there is convergence of opinions between the groups investigated.

Conclusions

Far from being a mere theoretical element, hostility in the educational environment is a reality which inhibits the educational act. The students included in the focus groups were responsive to the theme we proposed and provided various information and examples, drawing attention upon on the negative aspects the hostile environment has on the learning process: intimidation, passivity, communication block, fear of teacher, distancing from the subject of study, negative perspective on the school experience.

In order to eliminate the possible tensions, teachers must pay attention to their personal style of expression and behaviour, to their facial expression, gestures and posture. They should also take into consideration students' emotional states, attitudes and reactions to what and how they communicate in the didactic process. They should also be able to correctly decode the verbal and nonverbal messages transmitted by the students so that the communication relationship can continue efficiently. The results of the study could constitute generous information with practical formative value for teachers, especially since it is based on students' perspectives upon the hostile communication environment. The research could be completed with further studies on the verbal aspects of hostile communication in school.

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Digital Resources and Heritage Education in Romanian Rural Schools

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Abstract

This paper offers a brief analysis of the potential impact of digital resources and of activities dedicated to the arts, culture and heritage for increasing the attractiveness of school in rural areas. Considering the current educational aims regarding the development of the digital and cultural awareness and expression key competences, it is obvious that these components are not sufficiently explored in schools. In the Romanian K-12 education, there are some procedures that could support the integration of digital, artistic, cultural and heritage resources as learning opportunities in regular school activities, which could be used to develop long-term educational projects. We highlight good practices for improving the quality of education in rural areas, especially the eTwinning project, as well as the school-based curriculum. The results of our analysis support the idea that the integrated development of educational resources for heritage and digital resources may provide students with a more motivating learning context, focused on exploration, interaction and debate. In addition, digital resources could facilitate student access to information and collaboration networks, being able to support distance learning in rural schools.

Keywords: education in rural areas, digital resources, heritage education, eTwinning, school-based curriculum

1 Introduction

Many rural schools think they have a lack of access to various educational activities because of scarce local economic resources. Under these conditions, the ability of these institutions to provide quality education may be significantly affected, and students' equality of opportunities with regard to education may be far from being ensured. There are many school subjects that, in teachers' view, would need material and financial resources for optimal delivery. Both the fields of new technologies and the fields of arts and culture in a heritage context are seen as being highly dependent on such resources. Despite the financial difficulties existing in rural areas, there are still possibilities to bring the arts, culture and heritage in schools with the help of digital resources. In this article, we intend to **1.** Conduct a brief analysis of the actual use of digital resources in rural schools in relation to current educational challenges, **2.** Review the existing procedures which schools may use in order to put in place a programme for increasing the attractiveness of school through arts, culture and heritage, and **3.** Present a few examples of good practices, which may be used to bring the arts, culture and heritage in schools with the help of digital resources.

2 The use of digital resources in rural areas

The continuous interest of European policies in the use of digital resources is present at all levels of intervention, be it social, civic, educational, cultural etc., since they provide for the equality of opportunities, access to resources and better quality of life. In the Romanian education system, there is an increased access to the internet and cultural activities, which "creates some real contexts for the population to acquire new skills and competences, impacting on the interest in learning and in-service training throughout life" (Institutul de Științe ale Educației 2015, p.57). It is necessary to further promote and integrate the ICT tools with a variety of classroom activities, and also to recognise the learning outcomes in informal and non-formal contexts. The 2011 Law of National Education (LEN) generated a change of the curriculum framework and the subject curricula for the integration of competences, in primary education and lower secondary education so far. At the end of compulsory education, students should have developed the eight European key competences, which include the digital skills (LEN 2011; European Parliament 2006). For example, in the development profile of the student who completes lower secondary education, two of the three descriptors of digital skills involve the "use of digital devices and applications for searching and selecting digital information and educational resources which are relevant to learning" and the "development of multi-media digital contents in the context of learning activities" (OMENCS 3590/05.04.2016). Currently, special school time is allocated to computer science and ICT. This opportunity is useful, but it is not enough, because practices in Romanian education show that appropriate endowment in this area does not necessarily mean that resources are used in educational activities in other school subjects than those of the Technologies curricular area.

The Report on the Evaluation of the Quality of Education in Rural Schools (ARACIP 2015) shows that "the use of ICT in teaching for less than 25% of the planned hours and the insufficient endowment of the school have a negative influence on the capacity of teachers to attain the expected outcomes with their students" (p.8). The Report recommends an analysis of how teachers "use the existing endowment in student activities and for communication purposes" and the "intensifying the endowment efforts and improving the use of ICT in communication and teaching, especially for teachers in areas with access difficulties" (p.12). Concretely, according to the ARACIP Report, even if schools have computers, the computers are used in student activities only for a third of the allocated school time. The underuse of the existing resources can also be seen in how school premises and additional premises are integrated to serve instruction. We can also notice that the dropout rate is two thirds, and the results at national evaluations and examinations are worse compared to urban schools. The analysis of the quality of education in rural schools reveals that "the main managerial concern is the organisation and functioning of the school, institutional development being a secondary concern" (p.10).

For this specific field, we can see that the use of digital resources is an explicit subject matter for analysis as well in the documents, reports or studies concerned with artistic, cultural and heritage education (e.g. NACCCE 1999, UNESCO 2006a, Council of Europe 2005, EACEA 2009). The study of arts and culture in European schools (EACEA, 2009) offers an overview of the programmes and practices promoted by educational, cultural or social institutions. The analysis takes into consideration the information regarding the national bodies and networks that promote artistic education and the procedures used for collaboration between schools and the artistic and cultural world; the practices in the organisation of extracurricular artistic and cultural activities; and the use of ICT. The research conclusions show that, in Romania, references of the use of ICT can be found in secondary education, for the specialisations of architecture, ambient art and design, and they relate to digital image manipulation. Also, in almost two thirds of the European countries, including Romania, the use of digital resources in educational activities in connection with the arts, culture and heritage depends on teachers' choice and is different from one school to another.

Since 2013, recommendations for the use of digital resources have been included in the subject curricula for primary and lower secondary education in connection with competences, learning activities, contents or methodological suggestions (the design of the curricula was completed at the beginning of the year, and they will become effective as of the 2017/2018 school year).

With regard to the procedures used for the development of artistic and cultural activities, the national programme “Școala altfel” (A Different Kind of School) initiated in 2010, gives schools one week during which they can conduct educational activities which are of interest to their students, in or out of school. The evaluation of the programme impact (Velea & Mănțăluță 2013) reveals that all schools throughout the country organise, to a large extent, cultural and sports activities (more than 60%). Among these, the sports activities are more frequent in rural areas, while the cultural ones, in urban areas. These options may be explained both by the economical context, which is unfavourable in rural areas, and the opportunities for participation in artistic and cultural activities in a heritage context, which are more abundant in urban areas, mainly in large towns.

3 Procedures and programmes available to schools for developing integrated programmes

As we can see in the analysis above, the good endowment of schools does not necessarily mean more diverse opportunities for developing competences through activities, programmes and educational projects with the use of digital resources. We can also see that there is no national programme dedicated to artistic and cultural education in a heritage context available to Romanian schools. However, at national level, schools may create various learning contexts for an integrated development of students' competences through: the application of the curriculum in the classroom (for the subjects of the core curriculum); the provision of school-based curriculum; extracurricular activities (e.g. the annual timetable of educational activities approved and funded by the Ministry of Education); the national programme “Școala altfel”; national and European projects (e.g. Erasmus+). We should also mention the opportunity created in lower secondary education to allocate one hour/week to the integrated curriculum (OMENCS 3590/05.04.2016), which involves an educational offer integrating several curricular areas determined at school level (for example, the integration of a foreign language with computer science and ICT).

Schools may materialize their educational interests with the provision of the school-based curriculum, where options are made following the consultation of parents and students. Generally, parents' interest goes towards fields which are covered by the national evaluations and examinations (mathematics, Romanian language, foreign languages) and computer science. We need to point out that the evaluation of the quality of education provided by schools takes into account some indicators which refer to the development of the offer of school-based curriculum and of extracurricular activities. The report on the quality of education in rural schools reveals a positive aspect in teachers' interest in the development of these educational segments (ARACIP 2015).

Research carried out in this area (Mândruț 2010) shows that although the procedure of the school-based curriculum has been promoted as an opportunity for educational innovation in schools ever since 1998, the provision proposed by teachers has not generated many significant methodological changes. The analysis of this provision (Iacob & Mihăilescu 2016) reveals that there are no curricula dedicated exclusively to arts, culture or heritage education in which digital resources play a central role, with one exception, in primary education: “Playing the Architecture”.

Regarding the educational activities dedicated to the arts, culture and heritage, an exploratory research study of procedures and practices facilitating students'access to cultural resources highlights that “the students in rural schools are more attracted to music than their peers in urban areas, whose preferences go towards several fields, as suggested by the general trend. Theatre arts and visual arts are almost inexistent among students' preferences in rural schools, most likely because there is no access to the forms of manifestation of these fields. In rural areas, the results of the enquiry are influenced not only by the lack of cultural institutions, but also by the lack of artistic activities organised with/by artists in schools” (Iacob & Mihăilescu 2016, p.59). If parents from urban areas may ensure the participation of their children in at least one cultural event every year, the lack of economic resources, and also of cultural offers, makes the cultural education of rural students difficult to be provided by families.

If research in this area shows a tendency to diversify the experiences of schools regarding the integration of artistic and cultural activities (Iacob & Mihăilescu 2016), in everyday practice, the approach of heritage in education seems to know no clearly shaped representation, as viewed by teachers and students, compared to artistic and cultural activities. We keep in view that the awareness of the importance of local or national heritage assets assumes the knowledge of this heritage and taking on responsible actions in order to protect and preserve it.

4 Opportunities for bringing the arts, culture and heritage in schools with the help of digital resources

One of the procedures used for supporting the diversity of learning activities and school innovation available to teachers in K-12 education has been, since 2005, the eTwinning programme which was promoted by the European Commission as part of the Lifelong Learning Programme, now named Erasmus+ (the European Union programme for education, training, youth and sport). In Romania, the eTwinning programme has been implemented since 2007 and is coordinated by the Centre for Development and Innovation – TEHNE and the Institute of Educational Sciences, being considered a successful project (Istrate 2013). The programme was initiated in order to offer European schools an opportunity to carry out educational projects in a partnership, with the use of digital resources (www.etwinning.net; www.etwinning.ro; iteach.ro). Its goal is to facilitate communication and intercultural cooperation in schools from 36 European countries through an e-learning platform. The projects developed in a partnership involve carrying out joint educational activities in a work context appealing to students and teachers, and developing learning experiences through the integration of new technologies. The programme is accessed by schools from all the regions of the country, but we can see that the number of implemented projects is lower in less economically developed areas.

The methods used by teachers of various subjects to apply the activities contribute to the integrated development of all European key competences (assumed as well by Romanian K-12 education). Teachers proved to be motivated by the opportunity to propose learning projects which can be shared in an international professional group and offer visibility to their teaching activity and official recognition of the innovative practices they used (e.g. national and European quality certificates for the best projects). The topics approached by the Romanian teachers suggest interdisciplinary connections (between areas such as mathematics, physics, chemistry, foreign languages, mother tongues, history, arts education, musical education, geography, sports) and are developed through activities which are connected to the competences and learning contents of the school curriculum. Among the projects that received a quality certificate, notable proposals include: MART – Mathematics and Arts beyond Word and Chalk; Art Inspired by Mathematics; *Let's admire the Universe together; Traveling through Europe on our own e-learning highway; A European Story; Generations@schools Forum; Bon.plannet; Reporting without Borders; Intercultural Dialogue through Fairy Tales; Drama and Art; Schoolvision; Hopscotch with Animals; George on Tour; Wedding Traditions; European Cities; Let's create a Story; The meaning of Colours; We know each other through our Folktales; A Rainbow over Europe: Culture, Education, Traditions, Art, History, Influence of WW2 on our families etc. (Istrate 2013). In the examples above, the projects use the artistic and cultural field in learning activities and consider the support of digital resources for documentation, processing information, making project materials, communication between the project partners. Involving art in order to make it easier to understand some contents which are considered less accessible to students is due to a belief that art has "tools" near at hand that can express some concepts unrelated to art in a different way. This can also be a way to foster creativity and the expression of one's ideas, can put learning in the students' sociocultural context and can make the most of the intergenerational potential, structuring the heritage assets at local, national and international level.

Generally, in order to motivate students, the methodology of the eTwinning projects appeals to students' learning experiences out of school, as well as to age specific preferences and cultural interests (Cuciureanu 2017; Căpiță 2011). It is important to mention an aspect which is relevant to our subject matter: bringing together digital resources and the use of elements belonging to artistic, cultural and heritage education contributes to increasing the attractiveness of school. The attractive school must meet the students' educational, emotional and social needs, and the arts make a contribution to increased attractiveness (Bamford & Wimmer 2012). Educational activities that envisage the field of arts, culture and heritage reveal a positive impact on students' motivation for learning, and the school climate (Bozec, Barrère & Montoya 2013). Thus, these activities generate interest in participating in cultural events, a change of perspective with regard to the importance of heritage, and willingness to get involved in its preservation. The cultural projects which were carried out in rural areas aimed to reduce absenteeism and increase students' interest in learning, given that the dropout rate is high.

Alongside the eTwinning programme, there are other digital resources which are very useful for bringing the arts, culture and heritage in rural schools. We highlight the UNESCO world heritage education project, which is intended to create a network for collaboration and exchange of experiences for all the schools in the world. The project is targeted at students in secondary education. The participating schools aim to develop world heritage education in the classroom through the UNESCO network of associated schools – reSEAU (for Romania, information is available at www.cnr-unesco.ro/structuri-asociate/scoli-asociate-2). The goal of the network is to promote the humanistic, cultural and international dimensions of education (UNESCO 2006b) through pilot projects conducted with the support of the UNESCO World Heritage Centre. The form of collaboration and exchange of experience consists in using digital resources, and this ensures a regular mean of communication for the students and teachers involved in the projects, which does not require considerable financial resources difficult to obtain. Students are therefore encouraged to learn to use digital resources to research the world heritage and solve specific problems, to participate in exchanges of information together with other partners and to enter an intercultural dialogue. The UNESCO website has information resources which can be accessed, and the World Heritage Information Network (WHIN) is an advanced search tool which can provide information about the conservation of world cultural and natural heritage.

In the curriculum provided to schools by "Playing the Architecture", constant exploration of digital resources throughout the student activity plays, from a methodological perspective, an equally important role as activities of exploration of the surroundings through expeditions and to practical activities of ambient design and building of models of architectural sites. The opinions of the teachers and volunteer architects who participated in the delivery of this curriculum indicate the instructive impact of digital resources, in the assembly of learning activities that were conducted, both for the presentation of new notions or information and during the workshops (documentation, design, building the models) (Iacob & Mihăilescu 2016). Activities with interactive presentations are systematically used: slide shows with images, exhibitions of students' photographs, video watching. The "Playing the Architecture" Association makes this school programmes accessible both in urban and in rural areas through the opportunities to collaborate through co-teaching (both teachers and volunteer architects) offered by the platform (www.de-a-arhitectura.ro)

Besides the UNESCO resources which may be used to develop education for preservation of heritage assets (we recall the short films with the adventures of Patrimonito - whc.unesco.org/en/patri monito/), there is the online information about the cultural heritage of national or international museums. They make available for the students everywhere databases with images and cultural information or educational resources, and also the possibility of a virtual visit.

Considering these project-based learning experiences and, especially, the ongoing and diverse use of digital resources in carrying out the activities, the quality of education could be improved in rural areas through a more specific project focus on the dimension of heritage, brought to school with the help of digital resources.

Conclusions

National reports and research in the field revealed that digital resources were used 25% of the cases, which is much below their possibilities to support the current challenges related to the quality of education in the Romanian rural schools. The lack of equipment in schools, as well as the lack of resources in the local communities are seen by teachers as being a major disadvantage in an educational perspective not only for the organisation of activities which use the ICT resources in learning, but also for activities related to arts, culture and heritage. However, this situation could be improved if rural schools would pay more attention to the definition of a coherent educational programme of the school which makes the most of the existing opportunities. In the Romanian education system, there are several procedures available at national level which could support the initiatives of schools (the school-based curriculum, the national programme dedicated to educational activities "Şcoala altfel"). For an integrated development of the digital competence and the competence of cultural awareness and expression, schools may use the eTwinning platform, which has been active in the last 10 years across Romania. For the field of heritage, the reSEAU platform offers as well resources for the development of international projects in a partnership, which may also be accessed by rural schools. Digital resources could significantly support distance learning because, given the lack of financial resources, the museums and cultural sites which are relevant to national and international heritage can be brought to the classroom by accessing the stock of documents or with virtual tours on their websites.

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