The 15th International Conference on Virtual Learning
VIRTUAL LEARNING – VIRTUAL REALITY

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

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ICVL 2020 dedicated to Dr. **Ștefan Odobleja**, forerunner of Generalized Cybernetics and Artificial Intelligence:
Cybernetics was born in Romania

ICVL 2020 - 15 years anniversary

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

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Proceedings of the 15th International Conference On Virtual Learning

OCTOBER 31, 2020, UNIVERSITY OF BUCHAREST

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

ICVL 2010-2030
INTERNATIONAL CONFERENCE ON VIRTUAL LEARNING

editura universității din bucurești, 2020

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

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MOTTO

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

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

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

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

"Learning is evolution of knowledge over time"

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

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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

October 31, 2020 – BUCHAREST, EUROPE-ROMANIA

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

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

Participate

The Conference is structured such that it will:

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

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

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

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- Technical Programme Chair **Dr. Grigore Albeanu**, Professor of Computer Science, Spiru Haret University, Research Center for Mathematics and Informatics (Romania)

- Associate General Chair **Dr. Dorin Mircea Popovici**, Professor of Computer Science, Ovidius University of Constanta (Romania), CERV- European Center for Virtual Reality (France)

- Associate General Chair **Prof. Radu Jugureanu**, eContent Department Manager, eLearning and eTraining Senior Consultant, Bucharest, Romania

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- Associate General Chair **Dr. Olimpius Istrate**, Prof. at University of Bucharest, Faculty of Psychology and Educational Sciences, Romania

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

Research papers – Major Topics

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

Thematic Areas / Sections

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

Objectives

2010 – Towards a Learning and Knowledge Society – 2030

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

Relevant topics include but are not restricted to:

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

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

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

General Objectives

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

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

Particular objectives

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

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

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

Thematic Areas/Sections

Models & Methodologies (M&M):

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

Technologies & Virtual Laboratory (TECH):

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

Software Solutions (SOFT):

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

Innovation in education and research (IntelEDU):

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

Topics of interest include but are not limited to:

Virtual Environments for Learning (VEL):

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

Virtual Reality (VR):

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

Knowledge Processing (KP):

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

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

S e c t i o n

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

Priorities in Cybernetics, Computer Science and Artificial Intelligence About the beginnings of world and Romanian Informatics

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Abstract

Following studies and research within the ROINFO 2018-2020 project (Romanian Informatics) conclusions have been reached that must be known by the world scientific world. These conclusions refer to the emergence and development of Informatics in the world and in Romania. The role of some nations in the emergence and development of Informatics worldwide are highlighted,through the joint efforts of scientists - pioneers of Computing (Computer Science and Computer)s: mathematicians, physicists, engineers, cyberneticists, economists, psychologists, etc.From the conclusions of the ROINFO project, some facts unknown until today in the history of world informatics have been reached.For example, Romania can be proud of a "Romanian Informatics" because through the scientists from 1953-1970 it contributedto the development of researches regarding the construction of the modern computer, managing to build their own Romanian computers.Between 1953-1954, Romania ranks third in the world, after the USA and USSR, in the research activity on Theory of switching circuits - according to the number of articles (Grigore C. Moisil). Romania was the eighth country in the world designing and building an electronic computer (1957) and the 11th country in the world, which built an electronic computer with transistors. (1963). Therefore, comparing the scientific results and the contributions of scientists in the development of Informatics and computers,it can highlight the priorities of some researchers and scientists, worldwide or nationally. These priorities refer to Cybernetics - the science of systems, without which Informatics and the construction of computers would not have been possible.There is also evidence and results on some concepts and aspects regarding the vision of some scientists for the emergence and development of Artificial Intelligence - complex fieldfor building intelligent machines and systems that simulate intelligent human behavior in solving complex decision-making problems.

Keywords: Cybernetics, Computer Science, Artificial Intelligence, Informatics

MOTTO: "*All what is correct thinking is either mathematics or feasible to be transposed in a mathematical model*." Grigore C. Moisil(1906-1973)

"*The value of a scientific work is judged by the influence it exerts on the evolution of science. There are also clogged roads in science, rivers that instead of flowing into rivers and thus into seas and oceans, fail in a small lake or simply in a puddle*" Solomon Marcus (1925-2016)

1 Introduction

A science develops through the set of research, concepts, theories, methods and techniques that become valid and contribute to the study and solution of complex problems of science. Sometimes, over time, some of the theories, methods or techniques become obsolete and, through the appearance of more efficient and effective ones, disappear or are updated. Such examples are in mathematics, computer science, biology, medicineetc. The role of scientists is to contribute to these efforts to develop science. Globally, every nation has some fundamental contributions in the development of a science, at various times when, scientists, researchers, engineers, etc. are inventors or have priorities in developing theories, methods or techniques. In this sense, Romania can also be proud of such people, even if in some situations the international recognition came later or maybe with great difficulties. Thus, a conclusive example is the case of Dr. *Ștefan Odobleja* (1902-1978), a forerunner of Generalized Cybernetics, who, only in 1978, at the Fourth Congress of the World Organization for General Systems and Cybernetics in Amsterdam, was recognized for its primacy (1938-1939) to the mathematician *Norbert Wiener* (1894-1964), who founded cybernetics (1948). For this reason, *Norbert Wiener* could no longer be awarded the Nobel Prize. The president of the congress, *J. Rose*, decided to award the gold medal "*Norbert Wiener*" - 30 years of cybernetics to *Nicolae Ceaușescu*, the leader of Romania.

About the beginnings and development of world and Romanian informatics

- **Year 1938**: *Inventive machine* - "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." Dr. Ștefan Odobleja, "Consonant Psychology", Paris
- **Year 1973**: *Informatics* - "The Informatics/Computer Science restores not only the unity between the pure and the applied mathematical sciences, the concrete technique and the abstract 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.." acad. Grigore C. Moisil
- Year 2015: *Computational models*- „All important computational models came from simulating the activity of the nervous system. The automata models of the 1940s, the Turing machine of the 1930s, and the electronic computer produced by John von Neumann and his team in 1948 focused on the upper nervous system. In my 1964 book Finite grammars and automata there is a large chapter on the neural system, as modeled by finite automata and regular grammars by S.C. Kleene" acad. Solomon Marcus, 2015
- Year 2017: *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." PhD Marius Buliga

In 1978, as a student at the Faculty of Mathematics in Bucharest, Department of Informatics, I participated in the conference held by professors *Solomon Marcus*, *Cristian Calude*-fresh assistant and *Ionel Țevi*-researcher at the Institute of Mathematics with the topic "Gabriel Sudan - The first example of position recursive which is not primitive recursive ". The results of the research were published in *C. Calude, S. Marcus, I. Țevy*, The First Example of a Recursive Function which Is Not Primitive Recursive, Historia Mathematica, 6 (1979), pp. 380–384. Many years later, in 2017, I remembered this event-episode when writing an article in the ICVL 2017 volume: "*History of Informatics. From recursivity to the Turing universal machine and Horn clauses*", then in 2018 on the occasion of the elaboration of vol. I and II of "*History of Romanian informatics*"(ROINFO project 2018-2020). Prof. *Cristian Calude* - came from New Zealand, was present at the launch of vol. I and II, which took place in amph. S. Haret at the Faculty of Mathematics and Informatics, 26 sept. 2019. In the presentation made on this occasion, *C. Calude* referred to this episode and confirmed the aspects related to those researches from 1974-1978. Prof. *Sergiu Rudeanu* (1935-2019) also paid homage - http://mvlada.blogspot.com/2019/07/in-memoriam-prof-dr-sergiu-rudeanu.html, for his contribution to the development of programming pseudoboolean, which today underlies quantum computers. Solomon Marcus, in the book "*From Romanian mathematical thinking*", Scientific and Encyclopedic Publishing House, 1975, writes about these researches related to the recursive function *G. Sudan*.

2 The Pioneers in Computer Science/Informatics

David Hilbert, Wilhelm Acherman, Alonzo Church, Kurt Gödel, Alan Turing, John von Neumann, Norbert Wiener, Noam Chomsky

Fig. 1 The Pioneers in Computing (Computer Science /Informatics)

Worldwide, the American mathematician-of Hungarian origin, *John von Neumann* (1903 - 1957) is the author of the structure of the modern computer through "Von Neumann architecture", through the technical report "*First Draft of a Report on the EDVAC*" from 1945, architecture that was based on the work of the British mathematician *Alan Mathison Turing* (1912-1954), https://en.wikipedia.org/wiki/Alan_Turing- this was acknowledged by Neumann, who described the so-called abstract Turing machine) - "*On Computable Numbers, with an Application to the Entscheidungsproblem*", Proceedings of the London Mathematical Society, 2 42: 230–65, 1936. In 1943 Turing built-for the benefit of the British army, Colossus - the first digital electronic computer for decryption of German codes, and in the period 1945-1946 contributed to the prototype of the computer machine "*Automatic Computing Engine*", made physically later, in 1950. In 1946 Turing presented a work that represents The first detailed design of a computer with a stored program. Today, this architecture is recognized and valid.

The construction of the modern computer was preceded by research and scientific papers on the construction of a computing machine to perform calculations, but also operations with symbols. This is how the "*decision procedure*" (https://en.wikipedia.org/wiki/Decision_problem) arose from the computability theory and computational complexity theory. Decision problems usually arise in mathematical questions of decision-making, ie the problem of the existence of an effective method for determining the existence of an object or its membership in a set; some of the most important problems in mathematics are undecidable. The field of computational complexity classifies decision problems determined by how difficult they are to solve. "Difficult" in this sense is described in terms of the computational resources required for the most efficient algorithm for a given problem. Meanwhile, the field of recursive theory classifies undecidable decision problems according to the degree of *Turing*, which is a measure of the non-computability inherent in any solution.

The origin of the decision problem dates back to the mathematician *Gottfried Leibniz*, who in the seventeenth century, after building a mechanical calculating machine, dreamed of building a machine that could manipulate symbols to determine the truth value of a statement. mathematical. He realized that the first step should be formal language, and much of his later work was directed toward that goal. In 1928, *David Hilbert* and *Wilhelm Ackermann* put the issue in the form presented above. Following his "program", Hilbert asked three questions at an international conference in 1928, the third of which became known as "*Hilbert's Entscheidungsproblem*". In 1929, *Moses Schönfinkel* published an article on the particular cases of the decision problem, which were prepared by *Paul Bernays*. Even in 1930, Hilbert believed that there were no unsolvable problems.

Lambda vs. the universal Turing machine and the LISP language

In 1936, *Alonzo Church* (1903–1995), https://en.wikipedia.org/wiki/Alonzo_Church and Alan Turing independently published papers showing that a general solution to the decision problem was impossible, assuming that the intuitive notion of " *actually calculable*"is captured by the functions that can be calculated by a *Turing machine* (or, equivalently, by those expressed in the lambda calculation). This hypothesis is now known as the *Church – Turing thesis* (https://en.wikipedia.org/wiki/Church%E2%80%93Turing_thesis). Alan Turing was extremely influential in the development of computer science, providing a formalization of the concepts of "*Algorithm*" and "*Computing*" by defining the *Turing machine*, which played an important role in the creation of modern computer. In 1930 he defined the concept of the universal machine that underlies the computer science revolution. In 1945 *Alan Turing* was a pioneer in the construction of an electronic computer, in parallel with the project of *John von Neumann* (EDVAC Report 1945). But Turing's real important role was in the scientific understanding of the workings of the human mind, which led to the famous "*Turing Test*" to define the intelligence of computing machines and predictions for the 21st century. The famous mathematician *Alan Turing* also made history, as today he is considered to be one of the forerunners of Computer Science and Artificial Intelligence. Worldwide, Turing's contribution to the development of various sciences and disciplines is recognized: mathematics, computer science, computer science, bioinformatics, computers and information technology, morphogenesis (morphogenesis, mathematical biology), artificial intelligence, philosophy and the rest of the scientific world. *Lambda calculus* (λ calculus) influenced the design of the LISP programming language (list processing) and functional programming languages in general. Church-type coding is named in his honor. In his honor, the Alonzo Church Award for Outstanding Contributions in Logic and Computing was established in 2015 by the Computing Machinery Special Interest Group for Logic and Computation (ACM SIGLOG), the European Association for Theoretical Computer Science (EATCS). Computer Science Logic (EACSL) and for the Kurt Gödel Society (KGS). The award is for a remarkable contribution in the field published in the last 25 years and has not yet received recognition through another important award, such as the Turing Award, the Paris Kanellakis Award or the Gödel Prize.

Kurt Gödel, David Hilbert, the development of mathematical logic and PROLOG language

Kurt Friedrich Gödel 1906-1978) - https://en.wikipedia.org/wiki/Kurt_G%C3%B6del, https://plato.stanford.edu/entries/goedel/, was one of the main founders of the modern era , metamathematics, in mathematical logic. He is known for his incompleteness theorems, which are among the landmark theorems in twentieth-century mathematics, and his research has touched on every area of mathematical logic. Based on his doctoral dissertation "*On the Completeness of the Calculus of Logic*" (1929), Gödel published the two theorems of incompleteness in 1931, when he was 25 years old, one year after completion of his doctorate at the University of Vienna. The first theorem of incompleteness states that for any self-consistent recursive axiomatic system strong enough to describe the arithmetic of natural numbers (eg, Peano arithmetic), there are true sentences about natural numbers that cannot be proved from axioms. To prove this theorem, Gödel developed a technique, now known as Gödel numbers, which encodes formal expressions as natural numbers. He also made important contributions to proof theory by clarifying the connections between classical logic, intuitionistic logic and modal logic. Participating in a lecture by *David Hilbert* in Bologna on the completeness and coherence of mathematical systems could have established the course of Gödel's life. In 1928, David Hilbert and Wilhelm Ackermann published "*Grundzüge der teoretischen Logik*" (Principles of Mathematical Logic), an introduction to first-order logic in which the question of completeness was posed: the axioms of a formal system are sufficient to result in any statement that is it true in all system models? This research in mathematical logic (propositional calculus theory and predicate calculus) led to the development of automated theorem proving theory, and to the design and implementation of the PROLOG (artificial intelligence) logic programming language, being the first language written on the basis of first-order logic.

The automatic proof theorem was pioneered in the 1960s by *Davis* and *Putnam* in propositional calculus. He also used *Herbrand's theorem* as a fundamental result of the mathematical logic obtained by *Jacques Herbrand* (1930). In essence, it allows a certain kind of reduction of first-order logic to propositional logic. Although Herbrand (1908-1930) initially proved his theorem for arbitrary first-order logic formulas, the simpler version presented, restricted to prenex formulas, which contain only existential quantifiers, became more popular. A complete automation (in the sense of a semi-decision procedure) of classical first-order logic was proposed in 1965 by *J.A. Robinson* (1930-2016) - https://en.wikipedia.org/wiki/John_Alan_Robinson, with a single rule uniform inference called resolution (unification / matching / matching procedures). Robinson's principle of resolution - inspired by the research of mathematicians Post and Herbrand (1930, 1930) is based on solving equations in free algebras (ie term structures), using the unification algorithm (J.A. Robinson, *A Machine-Oriented Logic Based on the Resolution Principle*, Journal of the ACM (JACM), January 1965, https://dl.acm.org/doi/10.1145/321250.321253). Many refinements of the resolution were studied in the 1970s, but few convincing implementations were made, except that the PROLOG language is, in a sense, conceived from this effort. Alan Robinson's major contribution is to the substantiation of the automatic proof theorem. Its unification algorithm eliminated a source of combinatorial explosion in the resolution procedure; it also prepared the ground for the logic programming paradigm, especially for the Prolog language. *J. A. Robinson* received the Herbrand Prize in 1996 for his distinguished contributions to automatic reasoning. Details: HANDBOOK OF AUTOMATED REASONIN, Edited by *Alan Robinson* and *Andrei Voronkov*, Elsevier Science Publishers B.V., 2001.

Norbert Wiener's Cybernetics (1894-1964) vs. Cybernetics of Ștefan Odobleja (1902-1978)

The mathematician *Norbert Wiener* - https://en.wikipedia.org/wiki/Norbert_Wiener is considered the founder of cybernetics, the basic principles being described in his work „*Cybernetics or Control and Communication in the Animal and the Machine*” (1948), even if 10 years previously the Romanian Dr. *Ştefan Odobleja*-military doctor, published in French the fundamental work in 2 volumes, "*Consonantal Psychology*" (1938-1939), in which he defined the bases of a new science, Cybernetics, which will propel the construction of the modern computer and developing a new science: Computer science. *Odobleja* established the fundamental ideas of Cybernetics - the 9 universal laws (http://mvlada.blogspot.com/2019/10/stefan-odobleja-precursor-al.html), the most important referring to feedback. *Norbert Wiener* is regarded as one of the first to theorize that all intelligent behavior was the result of feedback mechanisms, which could be simulated by machines and was an important early step towards the development of modern artificial intelligence. Wiener's name frequently appears in the context of computer development, where he made important contributions to solving differential equations (1940). His World War II preoccupation with directing artillery fire led Wiener to develop a communication and transmission system for cybernetics. Thus, the birth of cybernetics took place in 1943, and in 1947 Wiener reached an agreement with other scientists to use the term "cybernetics" - a Greek term (κυβερνήτης - helmsmen). It is a term that includes the regulation and linking of systems in the field of static mechanics, technology and systems in the world of living organisms.

Noam Chomsky's formal languages and grammars

Algorithms, cybernetic systems and formal languages. *Noam Chomsky* (b. 1928), https://en.wikipedia.org/wiki/Noam_Chomsky, known as the "father of modern linguistics" and the one who described the "*Chomsky hierarchy*" for grammars, developed the theory of transformational grammars.) through which he earned his doctorate in 1955, and in 1957 he appeared as a significant figure in linguistics with his landmark work "*Syntactic Structures*", which played a major role in reshaping language studies. He created or co-created the theory of universal grammar, generative grammar theory, the Chomsky hierarchy and the minimalist program. Based on descriptions based on grammar rules, Chomsky grouped natural languages into a series of four increasingly complex subsets and types, known as the "*Chomsky hierarchy*." This classification was and remains fundamental for the theory of formal languages and relevant for theoretical informatics, especially the theory of programming languages, the construction of compilers and the theory of automata. Today, there are over 700 programming languages according to some classifications: https://en.wikipedia.org/wiki/List_of_programming_languages, https://codelani.com/posts/how-many-programming-languages-are-there-in- t ....

3 The Pioneers in Romanian Informatics

Gabriel Sudan, Ştefan Odobleja, Grigore C. Moisil, Tiberiu Popoviciu, Victor Toma, Wilhelm Löwenfeld, Iosif Kaufmann, Solomon Marcus, Sergiu Rudeanu

Romania can be proud of the contribution of Romanian scientists - mathematicians and engineers, in several fields of scientific research, on the fundamentals of calculability theory, the fundamentals of cybernetics, algebraic theory of automatic mechanisms, mathematical logic applied to building and using the first electronic computers in Romania. A key role was played by acad. *Grigore C. Moisil* (1906-1973), considered the founder of Romanian computer science, together with the engineers who built and developed the Romanian computer industry.

Fig. 2 The Pioneers in Romanian Informatics

Also, today, it is known that the new science Cybernetics was born in Romania, in 1938 and 1939, when Dr. *Ștefan Odobleja*-military doctor, published in French the fundamental work in 2 volumes, "Consonantal Psychology". He defined the foundations of a new science, Cybernetics, which will propel the construction of the modern computer and the development of a new science: Computer Science, which will contribute to the development of Artificial Intelligence. Odobleja established the fundamental ideas of Cybernetics (the 9 universal laws), the most important referring to feedback.

Romania in those years, before and after World War II, was connected to the scientific and technical activity on the emergence of new sciences: Cybernetics and Informatics, through the scientific efforts of the world community, to the construction of computer systems. In the '60s, Romania was considered among the first countries in the world (after the USA, England, USSR, Germany, France, Japan, Austria, Holland, Italy, Denmark) regarding research and efforts to build the electronic computer. The Romanian school of mathematics developed under the influence of Romanian mathematicians who defended their doctorates with prestigious mathematicians from France, Germany, Italy. For example, the mathematician *Gabriel Sudan* (1899-1977) published in 1927 (before *W. Ackermann*, 1928), the first non-primitive recursive function.

Gabriel Sudan (1899-1977) and the study of recursive functions

Gheorghe Păun reports in [1]: In April 1973, before leaving for Canada, *Moisil* told *Solomon Marcus* that *Sudan*, a student of *Hilbert* with *Ackermann* in the 1920s in Göttingen, 1925 - would have produced such an example. *Moisil* did not have time to give details, it is not clear what details he had, and in Canada he died, as a result of which, later reported in various places, Professor *Solomon Marcus*, a real detective operation was launched, in search, first of all, of the work. in which *Gabriel Sudan* had that example - of course, in a completely different context and with a different terminology than that of recursive functions, a field developed only in the 1930s. Ionel Ţevy, researcher at the Institute of Mathematics of the Romanian Academy. "*After a careful* *examination of all the articles and books of Prof. Sudan, Cristian Calude turns his attention to the article Sur le nombre transfini ω ^ ω [omega-la-omega], published in the Bulletin Mathématique de la Société Roumaine Gabriel Sudan des Sciences, vol .30, 1927, fasc. 1, pp. 11–30* "(S. Marcus, From Romanian mathematical thinking, Scientific and Encyclopedic Publishing House, Bucharest, 1975).

Gheorghe Păun [1]: The text of Gr. C. Moisil, about a completely remarkable Romanian contribution, from the 1960s, to quantum computing: for several years, quantum computers of a restrictive, non-universal type, capable of solving some problems, have been produced. which are reduced to pseudo-Boolean programming, a topic developed by professors Sergiu Rudeanu and Peter Hammer (then Ivănescu), in Bucharest, at a time when there was no talk of quantum computers (the first speculations appear in the 1970s). Says Moisil: "The place that the school in Bucharest has, in the foundation and development of pseudo-Boolean programming, is a pride of the Faculty of Mathematics and the Institute of Mathematics". (*Florin Gheorghe Filip*, Romanian Civilization (coord. *Victor Spinei*) - Science and information technology in Romania, Romanian Academy Publishing House Bucharest, 2018, pp. 119-121).

Cybernetics was born in Romania - Cybernetics of Stefan Odobleja (1902-1978)

"*I coveted my whole life for the comfort of big cities, but fate, more prudent than me, protected me from this danger. I can believe that the realization of this psychology with a pronounced character of cybernetics is also due to the fact that its author lived his life in the province, closer to nature. The training in nature and the permanent contact with nature and its realities put me in the optimal conditions to reflect on my thinking and at the same time they imprinted on me an independent, personal and realistic attitude*"Dr. Ştefan Odobleja.

Dr. Ştefan Odobleja - military doctor, was a great scientific personality too much wronged. Between 1938 and 1939, 10 years ago, as the American mathematician *Norbert Wiener* (1894 - 1964), considered the father of Cybernetics, published his fundamental work "*Cybernetics or Control and Communication in the Animal and the Machine*", Odobleja wrote in French fundamental work in 2 volumes, "*Consonantist Psychology*." It defined the foundations of a new science, Cybernetics, which will propel the construction of the modern computer and the development of a new science: Computer Science. In 1939, he himself sent 150 books to scientific personalities, universities and large libraries in Europe, America and Asia, only to come to mankind, World War II and, who else wanted to analyze a deeply scientific work, which He was talking about new concepts at the time.Today, it is known that in 1941, the American scientist SM Strong published in the journal "Psychologists cal abstracts "a review of" Consonantal Psychology "which, by the way, had been sent to the world's major libraries, including American universities, but generally had very few reviews and was virtually ignored for a long time. It is also known that Dr. *A. Rosenblueth*, *Kurt Levin*, psychologist, as well as the mathematician Norbert Wiener, reprofiled after 1938 in psychology and neurophysiology, had information about the "*Consonantal psychology*" of the Romanian scientist *Stefan Odobleja*. This work aroused their interest in consulting the original. The mathematician *Wiener* knew French very well, lecturing in France, and the neurophysiologist *Rosenblueth* had studied medicine in France. Odobleja did not give a practical application to his ideas. He just wanted to show how the human psyche works, by studying and understanding the processes that take place in the human body coordinated by the human brain and mind.

Odobleja managed to send about 20 copies to university and medical libraries around the world and 20 copies to a number of foreign specialists. To *William Seaman Bainbridge* - American general, who participated in the International Congress of Military Medicine in Bucharest, June 8-

12, 1939, Odobleja sent him five copies, and the American doctor assured him that he would place them in the most suitable places. *Ştefan Odobleja* continued his research, especially in the direction of elaborating a logic from which tens of thousands of pages remained in the manuscript stage. Since 1972, when he read Norbert Wiener's autobiography, *Ştefan Odobleja* devoted himself to demonstrating the idea that the origin of cybernetics is in psychology and that "*Cybernetics was born in Romania in 1938*" through his work "*Consonantist Psychology*". In this sense, in order to mark his partnership, he published a special work, which appeared in the very year of his death, 1978: "*Consonantal Psychology and Cybernetics*", with a substantial preface by *Mihai Golu*.

It is also to be noticed that the author himself – *Ștefan Odobleja* – has diffused the prospect by which he announced the participants at the International of Military Medicine about the appearance of this paper "*Psychologie consonantiste*". That Congress took place at Bucharest between 8- June, 12th, 1937. At this Congress also participated a delegation of the Military Navy of USA, lead by Dr. *W.S. Bainbridge* who invited Odobleja to visit USA. In 1966 he moves back to Turnu Severin where he finds Norbert Wiener's book "*Cybernetics*" and becomes intrigued with the similarities to his own "*Psychologie consonantiste*". From this moment Odobleja started to wonder who had the priority of discovering cybernetics, given that Wiener's book had been published in 1948 ten years later after his and was translated in Romania, in 1966, two years after the authors death. Consequently, Odobleja launched some pertinent arguments about the way his rough manuscript could have got in the hands of Wiener. In 1938 he had send 5 copies to Dr. W.S. Bainbridge, who met Wiener when the USA Military Navy ordered the Technological Institute in Massachusetts, where Wiener was a member, to build devices for the anti-air raid cannons from battle ships. Beginning with 1972, when he read Norbert Wiener's autobiography, Ștefan Odobleja devoted his time to prove that the origin of cybernetics is in psychology. He published a special creation named "The consonantist psychology and cybernetics". He died on the September, 4th, 1978 in misery (Source: http://www.bdmsoft.com/ieeecontest/life.php).

Grigore C. Moisil (1906-1978) - the founder of Romanian informatics and the algebraic theory of automatic mechanisms

Grigore C. Moisil receives - post-mortem, in 1996, *Computer Pioneer Award* (Computer Pioneer Award - IEEE Computer Society) - the only Romanian who received this medal "*For the development of polyvalent logical switching circuits, the Romanian School of Computing, and support of the first Romanian computers*." (Https://www.computer.org/profiles/grigore-moisil)

Between 1934-1942, at the University of Iași, the mathematician Grigore C. Moisil (1906-1973) dealt with "Logic and the theory of demonstration" and aiming to "*learn mathematics from the beginning*", he studied at the "*wonderful library*" of the Mathematical Seminar in Iași, the book by *Hilbert* and *Ackermann*, but also the 3 volumes Principia Mathematica by Russel and Whitehead. Moisil learned about Lukasiewicz's multi-valued logics in the spring of 1935, when *T. Kotarbinski*, a professor at the University of Warsaw, gave 3 public lectures and a short lecture at the Mathematical Seminar on Lukasiewicz's writing without parentheses.

Between 1953-1954, Romania ranked third in the world, after the USA and the USSR, in the research activity on Theory of switching circuits, activity coordinated by *Grigore C. Moisil*, at the Faculty of Mathematics in Bucharest and at the Institute of Mathematics - after no. of articles (Grigore C. Moisil, CCUB Activity, AMC magazine, Technical Publishing House, no. 13-14, 1970). About the beginning of Romanian informatics. Univ. 1959/1960, when at the Faculty of Mathematics and Physics - University of Bucharest, acad. Grigore C. Moisil founded the section "Computing Machines", which was followed by students in the last two years of study (at that time studies in mathematics lasted 5 years). Testimony acad. Solomon Marcus - In 2013, in amph. Spiru Haret from the Faculty of Mathematics and Informatics, at the anniversary meeting of the

1978 promotion - Informatics, acad. Solomon Marcus (1925-2016) made the observation that Informatics in Romania has its sources, earlier, in 1954, when the foundations of the “Computing Machines” section were laid, through the free course “*Algebraic Theory of Automatic Mechanisms*” held of acad. *Grigore C. Moisil*. He also mentioned that in 1956 Grigore C. Moisil became the chairman of the Automation Commission of the Romanian Academy, and later, in 1965, he became the chairman of the Cybernetics Commission of the Romanian Academy.

The role of the *Computing Center of the University of Bucharest* (CCUB). In 1962, *Grigore C. Moisil* established, at the Faculty of Mathematics, the Computing Center, with the status of Laboratory under the Department of Algebra led by Gr. C. Moisil, which will become the Computing Center of the University of Bucharest (CCUB), the first with this profile in the country and which will have an important role in the training of computer scientists in Romania). He contributed decisively to equipping CCUB with the IBM / 360/30 computer system, a computer on which many generations of computer scientists were trained, and on which written programs were executed to solve problems in many scientific, economic, administrative etc. fields.

The mathematician Tiberiu Popoviciu and the Romanian computer DACCIC

Tiberiu Popoviciu (1906-1975), a visionary scientist, was a personality with important achievements in founding computer science in Romania in the '50s, both in terms of hardware and software. Notably, *Tiberiu Popoviciu* is the author of the first monograph in Romania on numerical analysis and approximation theory, 1937. We briefly list the following steps / arguments on the contribution of acad. T. Popoviciu at the founding of Romanian informatics ("Tiberiu Popoviciu" Institute of Computing Cluj-Napoca, Romanian Academy, https: //ictp.acad.ro/ro/tiberiu-popoviciu-unul-din-fondatorii-informatic ...):

- T. Popoviciu founded, in 1951, the Institute of Computing, within the Romanian Academy, its purpose extending in 1957 from mathematical research to the construction of electronic computers. Popoviciu's vision was to incorporate three valences of the notion of calculation. A first computer (MARICA, 1959), with electromagnetic relays, is made in just two years, being an experimental one. Currently, the Computing Institute is named after the visionary scientist who founded it (ICTP - Tiberiu Popoviciu Computing Institute).
- In 1958, on the initiative of acad. T. Popoviciu, the first *National Cybernetics Conference* in Romania is organized at the Institute of Computing. It is well known that, after the installation of communism in Romania, Cybernetics was defined as "reactionary pseudo-science invented by the bourgeoisie to divert the attention of the proletariat from the class struggle." How was this definition abandoned in Romania and how did cybernetics become useful? It is difficult to answer accurately and documented. We can think that the communist states had to give up this attitude when, in order to keep up with the western countries, they decided to build electronic computers.
- In 1962, the Department of Computing Machines for students from years IV-V was established at the “Babeș-Bolyai” University of Cluj-Napoca, a department where he started teaching computer science.
- In 1963, the Institute of Computing completed the construction of the electronic computer DACCIC-1 - the first computer in the country with transistors and internal memory (ferrite).
- In 1968, the construction of DACCIC-200 was completed in Cluj, the first Romanian computer with operating system and compiler, the most powerful computer designed and built in Romania.

- In 1971, the first computer science high schools in the country were established, in Bucharest, Cluj, Timișoara and Iași. Sophists trained at ICTP, and then at ITC, write some of the first computer textbooks for high school, teaching in the first years in class.

Eng. Victor Toma (1922-2008), the pioneer of the construction of Romanian computers

Thanks to Eng. *Victor Toma* and under his direct guidance, a series of electronic computers were made on tubes starting with CIFA-1 (April 1957), CIFA-2 (1959), CIFA-3 (1960), CIFA-4 (1962). , and then on transistors CET-500 (1964) and CET-501 (1966). The CIFA-101 (1962) and CIFA-102 (1963) computers were also made in the section led by Victor Toma. In 1962, Professor Grigore Moisil also spoke in emotional words about Victor Toma: "*It is the undeniable merit of the leadership of the Institute of Atomic Physics to have understood the importance of building electronic computers and to have supported this issue*". It is a sign of special appreciation and recognition of the undeniable merits of the great Professor Horia Hulubei, the director of the I.F.A., who lovingly encouraged the initial search by saying, "*Let Thomas take care of his tins*". Testimony of V. Toma: "*The idea of a computer grew gradually, with the support of the Institute of Atomic Physics (IFA); it was nothing at once. Here's why: IFA needed digital technology to measure radioactivity in large units: betatron, reactor and other units. So, as a result, Professor Huluba, who was the director of the Institute of Atomic Physics, set up an electronics lab, because at that time no one was thinking about computers. We started there to produce measuring equipment for various IFA workshops, competitive equipment, in competition with what was produced abroad. The measuring devices I worked on at that time, with use in nuclear research, had an electronic counter with an accuracy of 10 microseconds and a frequency of up to 100Khz. Some were patented and awarded, being announced at that time by academic journals in Romania and the USSR. At the same time, the Electronics magazine appeared, a magazine that promoted the results of our research, constituting a strong impetus for us* ".

There were no analysts and programmers yet to identify the problems to be solved on the computer, programs had to be made. Gradually, mathematicians began to take programming courses through which they taught the beneficiaries to make their own programs, in the machine code. In the following year (1956) we were assigned three graduates from the Faculty of Mathematics: *Zamfirescu, Vaida* and *Moldovan*. This was the first wave of trainees, but others followed. After another two years, I put into operation the CIFA 3 computer that was made by V. Toma together with Mihaela Ionescu and others, now having a team of 10-12 very good people, who worked hard. The CIFA 3 computer was commissioned by the Dubna Nuclear Research Institute in Russia (USSR), a powerful institute but lacking a computing system. In fact, there was an order for two computers, CIFA 3 and CIFA 4 for the Institute in Dubna. But when the construction of the CIFA 3 computer was completed, the interest of the Dubna Institute for these computers with more modest performance no longer existed. Therefore, the CIFA 3 computer, after working in IFA for a year and a half, was (re) bought by the Computing Center of the Faculty of Mathematics in Bucharest, where the director was Professor Moisil, very concerned about the new technique. Within the Collaboration Agreement between the Romanian Academy and the Bulgarian Academy of Sciences, the Vitoşa computer was made in Bulgaria, between 1960-1962, according to the CIFA-3 model. CIFA 4 meant a further increase in reliability and operational safety and, implicitly, a broadening of the spectrum of use of this computer model.

Wilhelm Löwenfeld and Iosif Kaufmann, creators of the MECIPT computer in Timisoara

„*Wili Lowenfeld was without a doubt the soul of MECIPT (Electronic Computing Machine of the Timișoara Polytechnic Institute). We cannot deny the merits of Iosif Kaufmann as a brain of MECIPT, but without Wili the computer certainly would not have appeared. Out of an extraordinary vitality, with a perseverance that I always took as a model without success, Loewenfeld managed to coordinate the few resources that were for the completion of the project in a way that many project managers today could envy him. In 1961, as a fourth year student at the Faculty of Electrical Engineering in Timisoara, I was approached by Vili Lowenfeld, one of the two creators of MECIPT - a project that was already talked about, but not out loud. Vili brought me to the computer then before I was born and I started working with Iosif Kaufmann, in the form of a fashionable student circle at that time. It was the moment when, after the initial impulses of Grigore C. Moisil, I decided that I wanted to work in the field of computers at any cost*. ” Prof. Dr. Ing. Vasile Baltac, http://evocari.blogspot.com/2008/07/wili-loewenfeld-primul-pionier-al.html

- Interns at MECIPT-1: “The MECIPT-1 computer was, in 1963, the only one in the entire network of higher education institutes in Romania. I think it was Professor Moisil's initiative that the practice of some of the students who finished the 4th year of the mathematics faculties be done on this computer. The practice was carried out, between 1963 and 1966 inclusive, in July, with about thirty students, led by a specialist from the Computer Center of the University of Bucharest. In the first year students came from Bucharest, Cluj and Iasi, in the following year from Bucharest and Cluj, then only from Bucharest. Students were given daily lessons, theoretical or practical, about MECIPT. These lessons were also attended by other people interested in programming. After presenting the principles of computer operation, made by the builders, in the last two weeks I talked to them about programming. At the end, there was a colloquium, to which, of course, no one fell, but which was not formal at all ”(*Dan D. Farcaș*).
- Programs and calculations on the MECIPT-1 computer: “One winter, in the early‘ 60s, the dome of the central pavilion of the national exhibition (today “Romexpo”, in the Free Press Square) flattened under the weight of the snow. The restoration of the dome (which has been resisting since then) was entrusted to a team from the Timisoara Polytechnic, under the leadership of academician Mateescu, and the related calculations were performed on MECIPT-1, the programmer being Vasile Baltac. Also here were elaborated, in detail, the plans according to which the concrete was poured in the dam from Vidraru. An article in the press of the time estimated that these calculations would have required, manually, 9 months, and on the computer they were completed in 18 days, including the transcription in final form of the tables, which could be sent directly to the site. Simulations were also made for a possible hydropower plant on the Danube, with the Bulgarians, in the Izlaz-Somovit area, the water network of Arad municipality was dimensioned, the resistance calculations were made for several tall buildings, etc. ” (Dan *D. Farcaș*).

Solomon Marcus (1925-2916), the mathematician of frontier and interdisciplinarity

Academician Solomon Marcus, a renowned scientist with a solid international career, developed over 65 years, the Romanian mathematician and computer scientist whose name is quoted in major international encyclopedias, has published over 50 volumes and 400 articles scientific, in various fields: mathematical analysis, mathematical linguistics, theoretical informatics, mathematical poetics, semiotics, history and philosophy of science, mathematical models in the natural sciences, history and philosophy of science and in the socio-human sciences. Solomon Marcus was the author of several interdisciplinary studies and books on the use of mathematics in linguistics, theatrical analysis, natural and social sciences. He was a permanent animator among students and specialists, for the promotion and dissemination of mathematics and computer science in the most different fields: literature, history, archeology, economics, music, cinematography, etc.

- "He is the only Romanian mathematician with the Erdös number equal to one. He has carried out his research activity in mathematical analysis, topology, theoretical informatics, linguistics, poetry, semiotics, history and philosophy of science and applications of mathematics to natural sciences or society. His book Finished Grammars and Automata of 1964 is one of the first in the world in formal language theory, the theoretical basis in the study of deprogramming languages. " Acad. Prof. Dr. *Marius Iosifescu* in response to the reception speech at the Romanian Academy, Thursday, March 27, 2008.
- "We miss Moisil - since March 2016, this year, we also miss his great friend and successor, Professor Solomon Marcus. Two classics of Romanian mathematics and culture, two large personalities, founders with vocation, school creators, two consciences, landmarks, models. Unrepeatable, but that's why it would be useful for us to try to imitate them. To be forgotten - as some of the texts in the book say and as they all prove - cannot be forgotten anyway ... ". Acad. *Gheorghe Păun*, Moisil 110, Tiparg Publishing House, Curtea de Argeş, 2016.
- „The intellectual meeting with professor Solomon Marcus took place at the seminar of the Mathematical Analysis course of professor Miron Nicolescu from years I and II (1952-1953). Our assistant enjoyed all the freedom of initiative. The course and the seminar dissociated themselves from the treatment of N. Luzin's books of analysis of the time, which insisted on insignificant calculations, books that were not even quoted to us as the fashion of the period would have required. There was a mathematical battle on the board. The seminar turns into a thriller, the problems posed meeting the characteristics of the genre, the suspense, the tension and the solution as a revelation. The teacher assumes something of the role of the character Harley Quin in Agatha Christie looking to develop in us the ability to solve. Those math hours and conversations can't be forgotten. I remembered them when I was a doctoral student in Moscow and I was walking, unknown to anyone, in a way of being or not being, in the deserted corridor, in front of the office of IG Petrovski, the then rector of the huge University of Moscow. State of Moscow MGU where I was preparing my doctoral thesis with Prof. Alexander Gennadyevich Kurosh (1908-1971) (Professor Marcus's field of research was related to Petrovsky's). Kurosh was an illustrious algebraist, in the tradition / line of those considered, foundations for Theoretical Informatics in Romania. So I had the exceptional chance of an early meeting with a great personality and chosen culture like Professor Marcus, with whom I still communicate today, on such diverse topics ". *Dragoș Vaida*, „Acad. Solomon Marcus at the age of 90 or about living the culture. " Libertas Mathematica, vol 35, no. 2, 2015.

The mathematician Sergiu Rudeanu (1930-2019) and the structures of discrete mathematics

Prof. Dr. *Dragoș Vaida*: Sergiu Rudeanu was a mathematician who fully deserved the international recognition and echo, from which you had something to learn, not how to make your life easy, but certainly how to make a solid, unitary, coherent work, to which you should forget with gratitude and later.

The emergence of the interest of some mathematicians for computer science coincides happily with the manifestation of the interest for Axiomatic Algebra. The 1960s find Sergiu Rudeanu educated about his mathematical identity. Moisil's article, Gr. C, The activity of the Computing

Center of the University of Bucharest, AMC 13-14 (1970), 9-20, reveals as a major achievement the appearance of two new fields in the scientific literature from us and abroad, namely mathematical linguistics, due to acad. Solomon Marcus and later the pseudo-boolean programming theory, thanks to professors Sergiu Rudeanu and L. Peter Hammer-Ivănescu and Egon Balas.

"A very valuable research in the field of linear programming (transport problem) has been developed at the Institute of Mathematics of the Academy. Researchers at the Institute of Mathematics, together with a young mathematician from the Czechoslovak Republic, who came to us for specialization studies in the theory of discrete automata, have created a new chapter in Mathematical Economics: The Theory of Pseudoboolean Programming. This theory uses logic algebra techniques to solve economics problems. In pseudo-Boolean programming, the unknowns have only the values 0 and 1 (corresponding to the ideas of false and true in logic), but the functions that intervene have some real values. Numerous papers have been published in this theory, synthesized in a volume published in English by the Springer publishing house (P. Ivănescu, S. Rudeanu, Boolean methods in operations research and related areas, 1967) " Grigore C. Moisil, 1970.

Cristian S. Calude and *Marian Gbeorghe* (Fundamenta Informaticae, vol. 131/2014): Research activity of Sergiu Rudeanu in lattice theory, algebra of logics, universal and Boolean algebras (see pseudo-Boolean programming (a subject he has initiated with PLHammer), automata theory and graph theory is internationally well-known and appreciated. A very good lecturer, who devoted time and energy to write many textbooks Prof. Rudeanu was also an excellent supervisor.The Mathematics Genealogy Project, http://www.genealogy.math.ndsu.nodak.edu/id.php?id= 60012, lists his 12 PhD students (including well-known researchers as D. Simovici, A. Iorgulescu and S. Istrail) and 13 descendants. ".

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ROINFO 2018-2020 Project "Romanian Informatics" 60 years of Romanian Informatics

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Abstract

The article describes the results obtained by developing the national project ROINFO 2018-2020 "Romanian Informatics". Through studies and research activities, numerous arguments have been brought in "deciphering" the phenomenon of Romanian informatics. Some aspects were known, others not, and those that were known were known by very few people, students and pupils. Results that Romania should be proud of: 1. In 1953-1954, Romania ranked third in the world, after the USA and the USSR, in the research activity on "Theory of switching circuits" - according to the number of articles, applications of mathematical logic in technical (Grigore C. Moisil, CCUB Activity, AMC magazine, Technical Publishing House, no. 13-14, 1970); 2. In the period 1955-1957, Romania designed and built its first electronic digital computer (1957, CIFA 1 computer), by a team led by Eng. Victor Toma, at the Institute of Atomic Physics (IFA) - Măgurele Bucharest; 3. Romania was the 8th country in the world to design and build an electronic computer (1957) and the 11th country in the world to build an electronic computer with transistors (1963).

Keywords: Computer Science, Computer System, Computing, Informatics, Concepts, Theories

MOTTO: "*Any science that does not dissolve in practical applications is a crippled and useless science. The great inventions were made by scientists who were at the same time scholars. With simple incursions, not much can be done. It must be attacked on a broad front. Only in such a way will it be possible to produce a more important breakthrough in the enemy front of the unknown*." Dr. Ștefan Odobleja (1902-1978), Father of general cybernetics, post-mortem member of the Romanian Academy

"*The value of a scientific work is judged by the influence it exerts on the evolution of science. There are also clogged roads in science, rivers that instead of flowing into rivers and thus into seas and oceans, fail in a small lake or simply in a puddle*" Solomon Marcus (1925-2016)

2 Introduction

"*Calculus, in all its generality, is one of the fundamental human skills; we are born with this predisposition. It took a historic effort to perform a molecular analysis of human calculus in its irreducible components, an effort that culminated in the result of the British Alan Turing 80 years ago, in what science refers to as the Turing machine. Prefaced the electronic program-based computer developed by John von Neumann and his team in 1948. Inadmissibly, this itinerary, which makes the transition from traditional, numerical to qualitative computing, with entities of an abstract, unspecified nature, is missing from the program school*. " Acad. *Solomon Marcus* (1925-2016).

Contemporary society has as primary objectives to reach a knowledge society (knowledge society), because human society organizes its technical reality, economic, social, etc., based on the level of development of knowledge. The volume of knowledge we have at our disposal is currently doubling every 5 years, through research and the results of all sciences. The need to know nature and the world has led to the emergence and development of science, which are representations and virtual models of knowledge. The evolution and development of science are continuous processes, because "*the limits of knowledge and scientific predictions cannot be predicted*" as *Dimitri Mendeleev* (1834-1907) states, and theories and methods are invented because "*Imagination is more important than knowledge. Knowledge is limited, imagination goes around the world*"according to Albert Einstein (1879-1955). He also says that "*the only source of knowledge is experience, and information is not knowledge.*" Also, "*Our science is the sum of the thoughts and experiences of countless minds*" says *Ralph Waldo Emerson* (1803-1882). On the other hand, according to *Francis Bacon* (1561-1626) "Knowledge is in itself power", but with the advent of electronic computers and the development of Computing (hardware + software), the information held by man makes it powerful. The national project ROINFO "*Romanian achievements in the field of Informatics*" aims to develop studies and research to describe and explain the "phenomenon" of the emergence, evolution and development of informatics in Romania. This approach cannot be complete and comprehensive, being a beginning, unless we take into account the diversity of variables in time and space. We are aware that studies will be characterized by subjectivism, being people, events, institutions, processes, theories and applications, methods and technologies, evolutions and changes, etc. Also, our approach is all the more opportune and major, given the fact that there are still living scientists, professors, researchers, engineers, economists, etc., who lived in the '50s and' 60s, when it was consolidating. Computing worldwide and, when the first electronic computers of generation’s I-III were built.

Definition [2].

The pioneer of Romanian informatics is the institution or scientist, professor, researcher, engineer, etc., which has contributions in (when Informatics / Computer Science acquired its status as an independent science, during 1955-1990):

- studies and research in the field of Computing (hardware and software, The 2012 ACM Computing Classification System - DL: DIGITAL LIBRARY), https://dl.acm.org/ccs/ccs_flat.cfm);
- development of Computer Science and Information and Communication Technology (IT&C) theories, methods and techniques, including the development of software and hardware products;
- the use of software installed on the computer to solve problems in the scientific, engineering, economic, health, education, military etc.;
- promoting and spreading the use of computers by all categories of people, including pupils and students;
- Promoting and participating in scientific events in the field of Computing (hardware and software), including through connections and exchange of ideas among the international community in the field.

The first results of the national project ROINFO 2018-2010 appeared by publishing the first 2 volumes of “History of Romanian Informatics. Emergence, development and impact”: Volume I “Computing - The international context”, Volume II “Computing - The national context”. The volumes were elaborated out of the desire to describe relevantly and with evidence of the events unfolding in the reality of the time, the correct understanding of the evolution of Romanian informatics, both for contemporaries - for those who lived some of these stages in Romanian informatics, and for future generations. Specialists. In this way, in the future, it will be much easier to understand the evolution of theories, methods and technologies in the field of Informatics and Information Technology (IT).

Fig. 1 The Romanian Pioneers in Computing (Computer Science /Informatics)

Recently, volumes III (chapters 3-6) and IV (chapters 7-10) have been completed and prepared for publication, which complete the completion of studies on the "phenomenon" of Romanian informatics, and thus it can be stated that it was "deciphered "The way of appearance and development of Romanian informatics. The idea of writing a history of Romanian informatics did not appear suddenly. Just as in nature the phenomena and processes that take place need conditions and time to appear and be exercised through their functions, just as the conception and elaboration of a history of Romanian informatics needed time and some conditions for:

- understanding the multiple and various stages in the emergence and development of the concept of Computing (= computing technique; methods and techniques, equipment etc. - hardware and software);
- testing and using problem-solving methods using the computer, understanding the role and impact of theoretical informatics in the development of information science and technology (IT);

- the need to use the facilities offered by the computer in the development of human society, the need to use the computer in all areas of activity for efficiency and optimization of activities;
- the need to use the new technologies offered by the computer in the educational system, the use of the computer in the field of discoveries and researches in science and technology etc.

The volumes "History of Romanian informatics. Appearance, development and impact", MATRIXROM Publishing House, 2019-2020:

- Volume I (*Computing - International Context*), contains Chapter 1: 1. The International Context to the Emergence and Evolution of Computers.
- Volume II (*Computing - National Context*) contains chapter 2: 2 The national context on the foundation of Romanian informatics.

Fig. 2 The volumes I and II"History of Romanian informatics. Appearance, development and impact"

- Volume III (*Computing: Emergence and Development*) further includes 4 chapters (chapters 3-6): 3. The development of the computer industry in Romania; 4. Grigore C. Moisil-Computer Pioneer, founder of informatics in Romania; 5. Solomon Marcus, a life dedicated to mathematics and informatics: 6. The pioneers of Romanian informatics - University of Bucharest.
- Volume IV (*Computing: Development and impact*) further includes 4 chapters (chapters 7-10): 7. The pioneers of Romanian informatics - People and institutions; 8. Development and impact of informatics in Romania; 9. Computer Science and Cybernetics at the Academy of Economic Studies (ASE); 10. The history of computerization in the Romanian pre-university environment 1985-2018.

Fig. 3 The volumes III and IV "History of Romanian informatics. Appearance, development and impact"

2 Why "History of Romanian Informatics"?

Today, it can be strongly and convincingly stated that Romania must be proud of the efforts and important contributions of scientists, professors, researchers, engineers, etc., in the emergence and development of informatics in Romania. Young people have the right and duty to find out these aspects regarding the appearance and development of informatics in Romania - in school through textbooks, in universities through courses in Romanian computer science history - and to be proud of these remarkable achievements of the forerunners, who have influence in education. research, industry, economy, etc., now, but also in the future. In the study on the emergence and development of Romanian informatics it can be seen that Romanian scientists (*mathematicians, engineers, physicists, economists, sociologists, linguists, logicians*etc.) led *by Grigore C. Moisil, Tudor Tănăsescu, Tiberiu Popoviciu, Mihai Drăgănescu, Mircea Malița* etc., have influenced and determined the Romanian leadership since then, to quickly find that there is a need to use electronic computers in the economy and in all activities of Romanian society. It is noteworthy that in those years, in the field of construction and use of electronic computers, decisions were made from the bottom up - in the political regime of the time, it was usually the other way around - and sometimes not all of these decisions were good.

Arguments through which we are proud to have a Romanian informatics (Computer Science, IT, Computing = hardware + software)

Today, it is known that the mathematician acad. *Grigore C. Moisil* is considered the founder of Romanian informatics for his efforts in the emergence and development of informatics in Romania, and many of his collaborators are pioneers of Romanian informatics, being specialists with significant in the field of Computing / IT (hardware and software), with many results. pioneering in these fields. In 1996 his activity was recognizedresults internationally by awarding the *Computer Pioneer Award* (https://www.computer.org/profiles/grigore-moisil) "For the development of versatile logical switching circuits, the Romanian School of Computing, and support of the first Romanian computers". After 1950, Moisil was the key figure in the promotion of informatics and cybernetics in the Romanian academic, university and high school environments. This state was at a time when Romania was strongly influenced by Soviet political domination. At that time, the official Philosophical Dictionary, translated from Russian and published in 1953, still described *Cybernetics* as a "*reactionary bourgeois science directed against the working class*". Following the installation of communism in Romania, after the Second World War, Cybernetics was considered a reactionary science: "*Cybernetics - the reactionary pseudoscience invented by the international bourgeoisie to divert the attention of the proletariat from the class struggle*".

In Romania, the first electronic computer of parallel type with electronic tubes was built in 1957 (for measuring the degree of radioactivity at the Magurele nuclear reactor), at the Institute of Atomic Physics (IFA) - director acad. *Horia Hulubei*, under the leadership of Eng. *Victor Toma* and is named CIFA-1. In 1961, the MECIPT-1 computer with electronic tubes was built at the Polytechnic Institute of Timişoara (IPT). Between 1959-1963, at the Cluj Computing Institute, the construction of the DACICC-1 computer (*Automatic Computing Device of the Cluj Computing Institute*) followed, having as constructive elements electronic tubes and transistors. Then other computers that were built in the country: FELIX series C-256/1024, INDEPENDENT, CORAL and some types of personal computers. The construction of these computers was carried out starting with 1970 at the Electronic Computer Factory in Bucharest (Felix) and at ITC.

1958 - the first *National Symposium of Cybernetics* in Romania, organized at the Cluj Computing Institute. It is the indisputable merit of acad. Tiberiu Popoviciu to have organized the first National Symposium of Cybernetics in Cluj, at the Institute of Computing, in 1958. We appreciate that this was probably possible due to the fact that the Soviet Union had produced its first electronic computers for several years, and therefore the mentality about this "*reactionary pseudoscience Cybernetic*s" had changed.In order to stimulate research in the field of computers, in the academic year 1959/1969 acad. *Grigore C. Moisil* founded *the Department of Computing Machines* (the last 2 years of 5 years of study), and in February 1962, he founded the *Computing Center of the University of Bucharest* (CCUB), at the Faculty of Mathematics and Physics, the first with this profile from the country. The establishment request, handwritten by Moisil, was approved by the then Minister of Education, Prof. *Ştefan Bălan*, a former colleague of Moisil at the Polytechnic Institute in Bucharest (in the 1940s). CCUB was established as a Laboratory under the *Department of Algebra* led by Moisil, he being also the first Director of the Center.

An example regarding the promotion of Cybernetics in Romania is the Cybernetics Course held by acad. *Grigore C. Moisil* and having as secretary Mr. *Petre Dimo*, at the Popular University of Bucharest "*Ioan I. Dalles*", in the univ. 1964-1965 (third year of activity). The program of the course "CYBERNETICS", director acad. *Grigore C. Moisil*, secretary eng. *Petre Dimo*: 1. What is cybernetics; 2-3. Elements of mathematics; 4. What is a model; 5. Analog computers; 6. Finite automata - numbering systems; 7. Digital computers; 8. CIFA computers; 9. Computer programming; 10. MECIPT computer; 11. New types of digital computers; 12. Use of computers in economics; 13. Use of computers in transport; 14. The successes of the Romanian school of numerical analysis; 15. Automatic adjustment systems; 16. Elements of automatic systems; 17. Properties of automatic systems; 18. Use of computers in automation; 19. Biological models; 20. Automatic biological systems; 21. Endocrine regulation; 22-23. What is neurocybernetics; 24. Cybernetics and psychology; 25. Artificial intelligence; 26. Mathematical linguistics; 27. Automatic translation; 28. The philosophical implications of cybernetics; 29. Achievements of the Romanian School of Cybernetics; 30. The perspectives of cybernetics.

In 1966, an important event that contributed to increasing the quality of CCUB activity, was the International Colloquium "*Computing Techniques and Computers*" organized by the University of Bucharest, ASE and Polytechnic of Bucharest, based on consistent financial support from the Romanian Government. The young researchers of CCUB, Acad. *Grigore C. Moisil* and Acad. *Nicolae Teodorescu*-dean of the Faculty of Mathematics contributed substantially to the organization of this Colloquium. The colloquium brought new experiences in the country in the field of computers.

The *Third International Congress of Cybernetics and General Systems* (Third International Congress of Cybernetics and Systems, Romania) organized in Bucharest, between August 25-29, 1975, under the auspices of the *World Organization of General Systems and Cybernetics* (WOSGC) - http://wosc.co / wosc-congresses /, with the cooperation of the Romanian Organizing Committee. The Romanian Committee and the Congress Secretariat were based at the Academy of Economic Studies, at the Laboratories of the Department of Economic Cybernetics (LCCE), as well as the location of the Congress Adviser, Dr. *John Rose* - the Director General of WOSGC. The International Patronage Committee of the Congress included 2 NOBEL laureates and 15 academy presidents. The Secretariat of the Congress is located at ASE, at the Faculty of Economic Cybernetics, Informatics and Statistics, and the Operative Secretariat, made available to participants (about 1,500 from 30 countries) Also on the ground floor of the Palace Hall was organized, on the occasion of the Congress, an Exhibition International Computer and Auxiliary Equipment (August 20-30, 1975), represented by the largest computer, automation and telecommunications companies in the world (IBM, Control Data, ICL, Elliott, Siemens and Bull).

The theme of the Round Table of the Congress was: "*Development of informatics in the next 25 years*", organized by ICI. The open forum, chaired by Signor *A. Peccei*, President of the Club of Rome, included three conferences entitled "*The Perspectives of Science and Technology in the Next 30 Years*", given by: Dr. *S.L. Fawcet* - President of the Battelle Institute; by Dr. *H. Chilver* - Vice Chancellor of the Cranfield Institute of Technology in the United Kingdom; and by Prof. univ. dr. *Mircea Malița* - University of Bucharest. Dr. *Ștefan Odobleja* (1902-1978) also participated in this Congress - then, unknown, and today, a post-mortem member of the Romanian Academy, considered the father of generalized cybernetics, because he published the monumental work, in 2 volumes "*Consonantist Psychology*", Librairie Maloine, vol.I, 1938; vol. II, 1939, 10 years before the work of the mathematician *Norbert Wiener* (1894-1964) "*Cybernetics: Or Control and Communication in the Animal and the Machine*", Paris, 1948. The paper presented at the Third Congress, Bucharest, 1975 was published in The Proceedings are published as: Modern Trends in Cybernetics and Systems, ed. J. Rose & C. Bilciu, Editura Technică, Bucharest and Springer, New York, 1977 ("*Cybernetics and Consonantal Psychology*", vol. III, section 7 Neuro- and Bio-Cybernetics, pag. 1211).The international recognition of Dr. *Ștefan Odobleja* as a forerunner of Cybernetics, was made in August 1978, at the Fourth Congress, Amsterdam, when his work was presented to the participants by Dr. Eng. *Stelian Bajureanu* (with a doctorate in Cybernetics, 1975). Initially, the Congress was organized in honor of the mathematician *Norbert Wiener*, on the anniversary of "*30 Years of Cybernetics*", but after the presentation of Dr. *Stefan Odobleja's* scientific paper, the participants applauded for several minutes and chanted "*40 Years of Cybernetics*". The paper was published in The Proceedings are published as Current Topics in Cybernetics and Systems, ed. J. Rose, WOGSC, Springer-Verlag, Berlin, 1978 (Ștefan Odobleja - Romania, "Diversity and Unity in Cybernetics"). After this event, Dr. Ștefan Odobleja was also recognized in Romania, by publishing the collective work "Romanian Precursors of Cybernetics", Romanian Academy Publishing House, 1979, and "*Odobleja between Ampere and Wiener*", 1981, and in 1990 he was elected member post-mortem of the Romanian Academy.

3 Research aspects for "deciphering" the Romanian Informatics phenomenon

Some aspects were known, others not, and those that were known were known by very few people, students and pupils. In order to understand each other better, I would like to tell an episode from my student time at the *Faculty of Mathematics of the University of Bucharest*, being a student at the *Computer Science Department*, with a computer science program in year I. From the third year of college I used to I participate in various scientific events: scientific sessions, scientific symposia, conferences, doctoral theses, etc. I think it was 1978 (or 1979), when I attended the conference "*Research on the contribution of the mathematician Gabriel Sudan on the first example of a recursive function that is not primitive recursive*" (title in memory) given by professors *Cristian Calude*, *Solomon Marcus* and *Ionel Țevy*, in amph. Spiru Haret from the Faculty of Mathematics. It was a matter of calculability theory. Then, it never crossed my mind that after years and years this episode will have an important role in the history of Romanian informatics. In 2017, when I wrote the article "*Ştefan Odobleja: A Scientific Visionary, forerunner of Cybernetics and Artificial Intelligence*", In Proceedings of the *12th International Conference on Virtual Learning* (ICVL), I remembered that research he presented *Cristian Calude*. Then, in 2018, when I started working for the ROINFO Project, I consulted by e-mail with acad. *Gheorghe Păun* on this subject. In the coord. of acad. *Florin Gheorghe Filip*, Romanian Civilization (coord. Victor Spinei) - *Science and information technology in Romania*, Romanian Academy Publishing House Bucharest, 2018, acad. *Gheorghe Păun* makes the following approach regarding pages in the history of Romanian theoretical informatics: "*We will still recall a series of significant moments in the evolution of the field in our country. We will go back to the "prehistory" of (theoretical) computer science, even before the establishment of "computer science" in the world (I take the current phrase, computer science, used in English), invoking Gabriel Sudan, who, in 1927 , produced - without having this intention, because the terminology did not exist at that time - the first example of a recursive function that is not primitive recursive, then insisting on the two founders of Romanian (theoretical) informatics, Grigore C. Moisil and Solomon Marcus, reaching nowadays, the multitude of contributions of Romanian computer scientists to the most diverse internationally active research directions* ".This was one of the topics that needed to be researched to correctly describe the phenomenon of Romanian informatics.

Next, we will give more details about this studied topic.In April 1973, before leaving for Canada, *Moisil* told *Solomon Marcus* that G. *Sudan*, a student of the German mathematician *David Hilbert* with *Ackermann* in the 1920s in Göttingen - he had defended his doctoral dissertation in 1925 - had produced a such an example. Gr. C. Moisil did not have time to give details, it is not clear what details he had, and in Canada he died, as a result of which, later reported in various places Professor *Solomon Marcus*. A real detective operation was launched, in search, first of all, of the work in which Gabriel Sudan had the respective example - of course, in a completely different context and with a different terminology than that of recursive functions, a field developed only in the 1930s. the search for *Cristian Calude*, then a student at the Faculty of Mathematics of the University of Bucharest, and *Ionel Țevy*, a researcher at the Institute of Mathematics of the Romanian Academy. "*After a careful examination of all the articles and books of Prof. Sudan, Cristian Calude turns his attention to the article Sur le nombre transfini ω ^ ω [omega-la-omega], published in the Bulletin Mathématique de la Société Roumaine Gabriel Sudan des Sciences, vol .30, 1927, fasc. 1, pp. 11–30*." (Source: *S. Marcus*, From Romanian mathematical thinking, Scientific and Encyclopedic Publishing House, Bucharest, 1975).

Following the work of *C. Calude, S. Marcus, I. Țevy* „The First Example of a Recursive Function which Is Not Primitive Recursive", Historia Mathematica, 6 (1979), pp. 380–384, both mathematicians, *W. Ackermann* and *Gabriel Sudan* are now considered to be simultaneously and independently the authors of the first example of such a function.Testimony of Prof. Dr. *Cristian Calude* held on September 26, 2019 on the occasion of the launch of vol. I & II of "*History of Romanian Informatics*", amf. S. Haret, Faculty of Mathematics and Informatics: "*At the beginning of my research career I worked (together with Acad. S. Marcus and Prof. I. Țevy) to document the paternity of the Romanian mathematician Gabriel Sudan in a problem of calculability theory. Our results, published in the journal Historia Mathematica in 1979, could only prove the simultaneity* *of the construction of Sudan with that of the German mathematician W. Ackermann (the only quote in literature up to that time). The mere publication of this article would not have changed the attitude of the international community towards this paternity; it took concerted efforts, personal relationships, repeated citations in articles and books, returns, spread over more than 15 years for the name Ackermann to be replaced by Ackermann-Sudan in the main monographs of the field. The priority is obtained first of all through scientific evidence, but also through social efforts* ”.

Fig. 4 September 26, 2019, Meeting of Romanian computer scientists, launching volumes I and II, Amf. S. Haret, Faculty of Mathematics and Computer Science

Now it can be stated that, in fact, the objectives of the ROINFO project continue some previous approaches regarding the history of informatics in Romania. The first approach is made by acad. *Grigore C. Moisil* through the article “*Activity of the Computing Center of the University of Bucharest - CCUB*”, AMC no. 13-14, 1970, Technical Publishing House (http://c3.cniv.ro/?q=2018/restituiri). The second ademers is made by the Vietnamese *Pham GiaDuc*, “*The History of the Establishment and Development of Computer Science in the R.S.R.* ”, 1972 (The doctoral thesis has 185 pages and has the number IV 40230 in the catalog of the National Library of Romania). In 1972 through the doctoral thesis (http://c3.cniv.ro/?q=2018/duc). The third approach is *Marius Guran's* book, Monograph of Informatics in Romania, Historical Landmarks, AGIR Publishing House Bucharest, 2012, 705 pages.After the conception and elaboration of the first 2 volumes of the ROINFO project, important conclusions were drawn by understanding the phenomenon of Romanian informatics. Thus, in the two papers were highlighted the important efforts and contributions of scientists, professors, researchers, engineers, etc., on the emergence and development of informatics in Romania. Therefore, the phrase "*Romanian informatics*" is argued by examples, studies, achievements, initiatives and actions.

These aspects were described in the Preface to Volume III:

1. RESEARCH ON RECURSIVE FUNCTIONS, LOGIC AND THEORY OF DEMONSTRATION - In 1927, the Romanian mathematician Gabriel Sudan (1899-1977), with his doctorate at David Hilbert, gave the first example of a non-primitive recursive function, before Wilhelm Ackermann (1928). Between 1934-1942, at the University of Iași, the mathematician Grigore C. Moisil (1906-1973) dealt with "Logic and the theory of demonstration" and aiming to "learn mathematics from the beginning", he studied at the "wonderful library" of the Mathematical Seminar from Iași, the book by Hilbert and Ackermann, but also the 3 volumes “Principia Mathematica” by Russel and Whitehead. Professor Moisil learned about Lukasiewicz's multi-valued logics in the spring of 1935, when T. Kotarbinski, a professor at the University of Warsaw, gave 3 public lectures and a short lecture at the Mathematical Seminar on Lukasiewicz's writing without parentheses.
2. CYBERNETICS WAS BORN IN ROMANIA (1938-1939) - Today it is known that, 10 years before the book of the American mathematician Norbert Wiener (1894-1964) “Cybernetics: Or Control and Communication in the Animal and the Machine”, the Romanian Dr. Ștefan Odobleja (1902-1978) - military doctor (post-mortem member of the Romanian Academy, 1990), published in 2 volumes "Consonantal Psychology", 1938-1939, at the Publishing House "Maloine", Paris, in French (totaling over 800 pages), in which he establishes general laws, which he applies to both the sciences of inert nature and the sciences of the living world, psychology and economic and social phenomena. Dr. Ştefan Odobleja makes a description of the psychological functions using a general scheme of a cybernetic system, where the sense organs, which receive information from the environment, represent the inputs (INPUT), and the muscles are considered the outputs (OUTPUT). They take "steps beyond the boundaries of psychology" moving from man to other complex systems (communities, social organizations, etc.), inventing a new science: Cybernetics.
3. FUNDAMENTALS OF MODELS FOR COMPUTING AND DEVELOPMENT IN THE FIELD OF COMPUTING - In the period 1953-1954, ROMANIA ranked third in the world, after the USA and the USSR, in the research activity on "Theory of switching circuits" - after no. of articles (Gr. C. Moisil, CCUB Activity, AMC magazine, Technical Publishing House, no. 13-14, 1970). Programs for the national computer and management system, regarding the endowment with computer technology in the period 1971-1980 (1967, 1971, 1972).
4. MAKING ROMANIAN COMPUTERS - Between 1955-1957, ROMANIA designed and built its first electronic digital computer (1957, CIFA 1 computer), by a team led by Victor Toma, at the Institute of Atomic Physics (IFA) - Magurele Bucharest.
5. DEVELOPMENT OF COMPUTERS IN THE WORLD - ROMANIA was the 8th country in the world to design and build an electronic computer (1957) and the 11th country in the world to build an electronic computer with transistors (1963).

Some examples for arguing the phenomenon of Romanian informatics, through various development strategies, initiatives and concrete results.

Of course, I can achieve this after I have covered almost all the objectives of the ROINFO project "Romanian Informatics" 2018-2020 (http://c3.cniv.ro/?q=2018/iir), materialized by publishing 4 volumes , volume V being in progress, after which we will continue with 1-2 volumes on the presentation of prestigious computer scientists in Romania. This objective has been announced since the launch of the project, in May 2018, in the Centenary year of the Great Union. It is an objective that requires a lot of effort, but through a good information and promotion, through the involvement of as many specialists in Computing (hardware + software), this important approach has been achieved. I mention the fact that 114 authors contributed to the 4 volumes: 15 authors - vol. I, 41 authors - vol. II, 34 authors - vol. III, 24 authors - vol. IV. In this way, we will conclude an overview of the emergence, development and impact of informatics in Romania, by highlighting an evolution regarding the contributions of some people, institutions, concepts, theories and technologies.

It should be noted that all this evolution would not have taken place if in the period 1955-1965 the field of Automation was not supported by research, design and production. In 1955, the Institute of Electrotechnical Research (ICET, the future ICPE) was established, after which the company "Automatica" was established, which included "Termotehnica", in 1960. In 1962, by concentrating the profile companies in industrial groups, the Factories for Electrotechnical Equipment and Automation Installations (GUAEIA), which includes several enterprises: Electrical Engineering, Electromagnetics, Electrical Appliance, Automation, including the Research and Design Institute for Automation (IPA). "*Association of the fields Logic - Automation - Informatics: Professor Gr. C. Moisil told me that this association expresses his vision on informatics*." says prof. univ. Dr. *Dragoș Vaida*.

For argumentation, I present only a few significant examples that we studied during our research on the phenomenon of Romanian informatics, within the ROINFO project.

The Government of Romania adopts strategic development programs - The program for equipping the economy with electronic computers and the Computerization Plan of the country in the period 1971-1980:

1. On June 21, 1967, the "*Program for equipping the national economy with modern computing equipment and data processing*" was launched, the first computerization program in Romania (National Archives 33/1967). This program was developed by the team of specialists: Professor Mihai Drăgănescu, Professor Mircea Petrescu, Nicolae Costake, Vlad Iancovici, Ștefan Bârlea, Emil Mitescu, Cornel Mihulecea, Edmond Nicolau, Radu Sipoș, Simion Florea and Nicolae Sucitulescu. This program provided for the creation of a specialized institute (ITC), specialized factories, a service enterprise, a computer institute (ICI), a network of Territorial Centers of Electronic Computing (CTCE), of some departmental Computing Centers etc.
2. Elaboration of the strategic program, Period 1970-1971 - Debates and clarifications - Decision of the CC of the PCR (April 1972) „Improvement of the economic-social information system, introduction of management systems with means of automatic data processing and endowment of the national economy with calculation in the period 1971–1980 ".
3. It is approved (Decision of the CC of the PCR, April 1972) "The program on the improvement of the economic-social information system, the introduction of management systems with means of automatic data processing and the endowment of the national economy with computer technology in the period 1971 - 1980" by which dissolves the Governmental Commission for the endowment with computing equipment and the automation of data processing, and the transfer of its attributions to the National Council for Science and Technology (CNST), created in 1967.
4. A number of 18 Territorial Centers for Electronic Computing were established (CTCE, Object of activity: research, development of programs and implementation of computer systems; data processing on computer equipment; training and improvement of staff for computer science) - economic units and 5 High schools for informatics (training of staff with secondary education for informatics) - budgetary units; COUNCIL OF MINISTERS, DECISION No. 1312 of October 6, 1973 on the application of Decree no.

499/1973 regarding the unitary organization of the informatics activity and some measures for the improvement of the elaboration of the economic management systems.

Even if Romanian computers appeared (CIFA, MECIPT, DACICC etc.), until 1969 we did not have an electronic computer factory. Therefore, they were purchased from abroad - e.g. IBM 360 computer, third generation electronic computers:

- At the University of Bucharest, Faculty of Mathematics, an IBM 360 model 30 with which the Computing Center of the University of Bucharest (CCUB) was equipped. In 1963, the Ministry of Education purchased an analog MEDA computer with which CCUB was equipped.
- The Siemens computer from the Computer Center of the Ministry of Transport, whose director was Dr. Eng. Mihai Mihăiță, the current president of AGIR and ASTR.
- The Siemens computer from the National Statistics Directorate.
- The Elliott computer from the Hunedoara Plant, where specific applications were operated, although other types of applications from other fields of activity were sometimes accepted there.
- The Elliott computer from the National Electricity Dispatcher.
- An IBM 360 system from the “Tractorul” Plant in Brașov.

Courses on the use of electronic computers held at the headquarters of the following institutions, during 1963-1969, when Gr. C. Moisil was director of CCUB: Computing Center of the University of Bucharest (CCUB), Institute of Mathematics of the Academy, Energy Institute of the Academy, Astronomical Observatory of the Academy, Institute of Fluid Mechanics of the Academy, Aerodynamic Research Center, Ministry of Petroleum and Chemistry, Ministry of Machine Constructions, Ministry of Railways, Ministry of Armed Forces, Bucharest Military Academy, Bucharest Polytechnic Institute, Bucharest Institute of Construction, Faculty of Mathematics from Iași, Design Institutes, ISPE, IPROMET, ISCAS, CEPECA, IPACH, CSCAS. (Source: Gr. C. Moisil, CCUB Activity, AMC no. 13-14 1970, Technical Publishing House).

In the field of electronic computers, an important moment in Romania was the period 1968/1969, when the establishment (founding decision in 1970) of the electronic computer company Felix (ICE Felix) - French license IRIS 50, as a result of the contract provisions, was discussed. license agreement signed with CII (France), being a reproduction of the construction of the similar factory in Toulouse of the licensing company.

Significant arguments to put Dr. Ștefan Odobleja in the right place in the memory of Romanians

For me, Dr. *Ștefan Odobleja* (1902-1978) - military doctor (post-mortem member of the Romanian Academy), was a mystery, because I did not have the opportunity to know his work or its merits in the field of Cybernetics. The first time I met his name was at some conferences and scientific sessions I attended when I was a student at the Faculty of Mathematics of the University of Bucharest. I didn't pay much attention. I remember that at some conferences I saw Eng. *Victor Toma*, a pioneer of informatics, the one who coordinated the construction of the first Romanian electronic computer CIFA 1 (1957).

The construction of the computer system (computer systems) and the advent of computer science in the world did not take place if, before, a new science of Cybernetics (science of systems) did not appear and remarkable results in the field of computability were not obtained by mathematicians: *David Hilbert* (1862 - 1943).), *Alonzo Church* (1903 - 1995), *Kurt Friedrich Gödel* (1906-1978), *John von Neumann* (1903 - 1957), *Alan Mathison* Turing (1912 - 1954) etc. After the invention of the 2 domains and through the results obtained in the period 1930-1945, we came to the appearance and development of the domain *Computing* (hardware + software). Now we highlight the mystery we were talking about, namely that, in the years 1938-1939, Dr. *Ștefan Odobleja*, in Lugoj, "far from the scientific world" published in 2 volumes "*Consonantal Psychology*", at the Publishing House "Maloine", Paris, in the language French (totaling over 800 pages), in which he establishes general laws, which he applies to both the sciences of inert nature and the sciences of the living world, psychology and economic and social phenomena. As I have learned in recent years - since I began to study his life and work, Dr. *Stefan Odobleja* had a destiny with ups and downs, with a hard life considering that he was a military doctor in World War I, initially against the USSR, then, being persecuted by the security and the political regime of the time. Many scientists did not understand his work because he was a visionary, and the new concepts and laws he defined required an understanding in the context of the level of knowledge from other sciences. Many challenged him for this reason, others, on the contrary, helped him in his endeavor.

Fig. 5 November 15, 2019, Meeting with students and teachers of Stefan Odobleja College from Craiova: launching volumes I and II

I will give two significant examples. The first example is the (general) concept of system introduced by Odobleja in the 2 volumes from 1938-1939. I was even surprised to find that all the concepts he studied were described by clear and precise "Definitions," as mathematicians are accustomed to in their theories, as he is not a mathematician. Many years later, at the Congress of Amsterdam in 1978 (before he died), he was granted paternity for the term "feedback" on the systems. The second example refers to the field of Artificial Intelligence that began to develop after 1950, the founder being the English mathematician AlanTuring. Being a doctor, in the two volumes he studies the development of physical and mental processes in the human body, focusing on the human mind ("We do not see with the eyes, but with the mind. If the mind is empty, the eyes look without seeing" dr. Ștefan Odobleja, https://odobleja.ro/), from here Odobleja foresees the construction of a machine that can work through a “*Mechanized Thinking*”, coming to predict the appearance over the years of today's robot.

The international recognition of Dr. *Ștefan Odobleja* as a forerunner of Cybernetics, was made in August 1978, at the *Fourth Congress of Cybernetcs, Amsterdam*, when his work was presented to the participants by Dr. Eng. *Stelian Bajureanu* (with a doctorate in Cybernetics, 1975). In his memory, his son, eng. Ștefan Odobleja jr., Founded the “Ștefan Odobleja” Foundation Drobeta-Turnu Severin, for the arrangement of the memorial house and for the publication of the work of the great scientist. Personally, in collaboration with Mr. *Ștefan Odobleja jr*., And with the IT support offered by the company Advanced Technology Systems from Târgoviște, I created a website of the foundation that will be updated this year.

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An Educational Ontology for Formal Languages and Compilers

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Abstract

Two fundamental courses for Computer Science and Informatics specializations are Formal languages and Compilers. Other courses are based on them, such as, computer programming, programming languages, artificial intelligence, natural languages processing, intelligent interfaces etc. Identifying and defining the basic and advanced concepts from the domains of Formal languages and Compilers as well as the relationships between the concepts under the form of an educational ontology can provide useful knowledge to be shared by undergraduate students as well as by computer science and informatics specialists. The paper presents an educational ontology for the domains of Formal Languages and Compilers that was developed with Protégé, in the OWL format, and some potential applications.

Keywords: Educational ontology, Formal languages, Translators, Compilers

1 Introduction

Formal languages and Compilers are two important disciplines of study for the Computer Science and Informatics student specializations. Some more advanced courses taught at undergraduate or master level are based on them, such as Artificial intelligence, Natural language processing, Human-computer interaction, Intelligent interfaces, Pattern recognition. Examples of specific topics are: compiler-based analysis for software engineering, software security and speech recognition. Providing computer-based educational resources that contain knowledge from the formal languages and compilers fields, to be shared by students it is imperative for the development of efficient e-learning platforms and intelligent tutoring systems in the Computer Science domain. Educational ontologies offer one of the best solutions for knowledge representation. In this paper it is presented a prototype educational ontology, Onto-FormalLanguages-Compilers-1, that we have developed in Protégé 4.3, for the course of Formal languages and Compilers that is taught to undergraduate Computer Science students at Petroleum-Gas University of Ploiesti.

The paper is organized as follows. Section 2 presents briefly some basic issues from the formal languages and compilers domains. The methodology that was followed for the ontology development as well as the ontology itself are described in section 3. The final section concludes the paper and highlights some future work.

2 Formal Languages and Compilers

Languages (natural or artificial) facilitate communication. Natural languages are used for the communication between humans, while programming languages (which are artificial languages) are used for the communication between humans and computers, or between computers (e.g.

connected in a computer network). Formal languages theory provides various methods for representing the structure of a language (i.e. its syntactic form). The main formalisms that can specify a language are: formal grammars, automata and regular expressions.

Basically, a language is a set of words composed with symbols from an alphabet, according to some rules that define well-formed words. A grammar is composed of an alphabet (defined as a set of terminal and non-terminal symbols), a start symbol and a set of production rules that are used for the derivation of well-formed words. There are various types of grammars. According to Chomsky, formal grammars are classified in four main classes: 0-type grammars (general grammars), 1-type grammar (context-sensitive grammars), 2-type grammar (context-free grammars) and 3-type grammars (regular grammars). Correspondingly, formal languages are classified in general languages, context-sensitive languages, context-free languages and regular languages.

The automata theory is the basis for the formal language theory and it can be applied, for example, to compilers design and text processing. There are different types of automata, as for example, finite automata, push-down automata, and translation automata.

Compilers are fundamental software tools for programming languages, in particular. In general, a compiler is composed of a lexical analyzer (scanner), a syntactic analyzer (parser), a semantic analyzer, an intermediate code generator, a module for code optimization, and an object code generator. A programming language compiler takes as input a program written in the specific programming language, performs an extended analysis (lexical, syntactical and semantically) and in case no errors occur it continue with a synthesis phase at the end of which it is generated the translation of the program in the object code. If some errors occur (e.g. syntactic or semantic errors) they must be corrected in order to continue with the synthesis phase.

The main domains that are fundamental for the Formal languages and Compilers fields are represented in Figure 1.

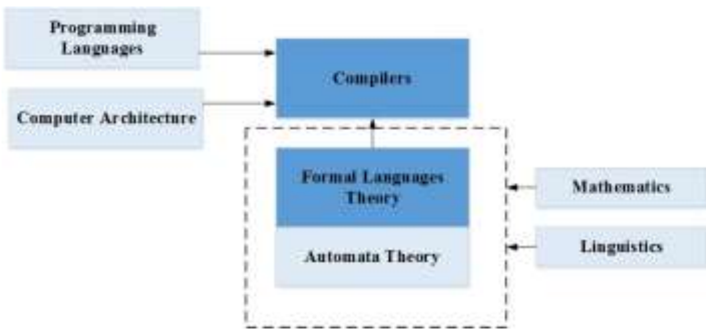

Figure 1. Fundamental domains for the Formal languages and Compilers fields

These domains are Automata theory, Mathematics, Linguistic, Programming languages and Computer architecture. Automata theory and Formal languages theory are applied in the Compiler field (see e.g. a practical example in (de Graaf, 2017))

The importance of Compilers course for undergraduate students is highlighted in (Hall et al., 2009). The authors argue that compiler algorithms are educational value for students and various applications can illustrate their use, as for example, virus detection based on compiler technology.

Formal languages and compilers have several real world applications, as for example: compilers designed for industrial network processors (see e.g. (Wagner and Leupers, 2001), computer and network security (Sassaman et al., 2013), pattern recognition (see e.g. the applications described in (Martín-Vide et al., 2004)). Some educational software tools were developed for teaching formal languages and automata (see. e.g. the FLUTE system (Devedzic et al., 2000), an intelligent tutoring system, and FLApp (Pereira and Terra, 2018), a mobile application.

3 The OWL Onto-FormalLanguages-Compilers-1 Ontology

3.1 The methodology

The educational ontology, Onto-FormalLanguages-Compilers-1 was developed by following a methodology that integrates some basic guidelines reported in the literature as e.g. the specific frameworks for ontology engineering described in (Mizoguchi, 2004) and the guidelines for collaborative ontology development for higher education presented in (Oprea, 2016).

The main steps of the applied methodology are given below.

Methodology

Input: Formal languages and Compilers course specification and course resources
Output: Onto-FormalLanguages-Compilers-1 educational ontology

Step 1. Identify the main domains related to the course of *Formal languages and Compilers*;
Step 2. Identify, define and characterize the basic and advanced concepts of each domain identified in *Step 1*, used in the course of *Formal languages and Compilers*;
Step 3. Identify, define and characterize the relations between the concepts that were identified in *Step 2*;
Step 4. Develop the taxonomy and the derived ontology by using the concepts and relations identified in *Step 2* and *Step 3*;
Step 5. Implement and test the ontology with an ontology editor or ontology development software tool that was chosen.

The course specification includes course title and level, pre-requisite courses, year of study, number of hours/week for course teaching and laboratory work. The main course resources are textbooks, books, research papers, lecture notes (as e.g PowerPoint slides, PDF files) and software tools. The output of the methodology is the educational ontology for the Formal Languages and Compilers course, Onto-FormalLanguages-Compilers-1, that is composed of two sub-ontologies, Onto-FormalLanguages and Onto-Compilers, and a related sub-ontology, Onto-ProgrammingLanguages.

The course specification and the main resources of the *Formal languages and Compilers* course are:

Course specification:

- Course title: *Formal languages and Compilers*;
- Course level: undergraduate;
- Year of study: fourth year, first semester;
- Prerequisite courses: *Programming languages*; *Computer architecture*; *Data structures 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:

- (Aho et al., 2007) for basic and advanced concepts of compilers;
- (Șerbănați, 1987) for basic knowledge of programming languages and compilers design;
- (Grune et al., 2012) for basic knowledge on modern compilers design;

- (Martín-Vide et al., 2004) for basic knowledge of formal languages and applications;

Course lecture notes:

- PowerPoint slides for 2019-2020 academic year (first semester);

Other educational resources (research papers, technical reports etc)

- (Taylor and Moore, 2006) - an adaptive programming languages tutor;
- (Wagner and Leupers, 2001) - application example (C compiler design);
- (de Graaf, 2017) - practical use of automata and formal languages in compilers design;
- (Oprea, 2020) - compiler implementation in Prolog and syntactic analyzer implemented in Haskell;

Software tools (programming languages):

- C++/Java and optional Prolog/Haskell.

Examples of identified concepts and relations will be given in the next section.

3.2 The prototype ontology

We have designed a prototype educational ontology for the *Formal languages and Compilers* course taught at Petroleum-Gas University of Ploiesti by following the steps of the methodology described in the previous section, and we have implemented the resulted ontology in Protégé as an OWL ontology.

The ontology implementation was performed in Protégé 4.3 under the OWL format. Each identified concept and relation of the ontology was defined as a class in Protégé. Figure 2 shows a screenshot with some concepts that were included in the prototype ontology.

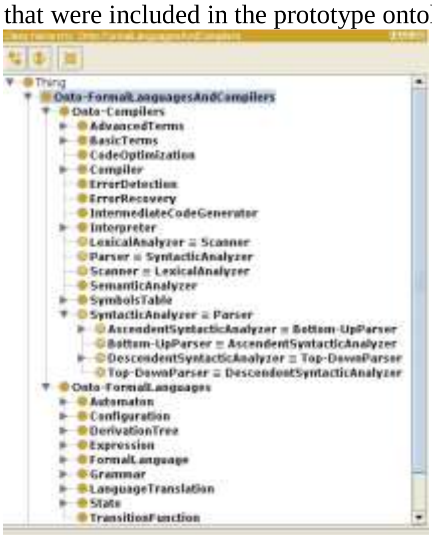

Figure 2. Screenshot with some concepts of the Onto-FormalLanguages-Compilers-1 prototype ontology (Protégé 4.3)

Examples of concepts that were defined are:

- in the Onto-FormalLanguages sub-ontology: FormalLanguage, Language, Alphabet, Grammar, Automaton, DerivationTree etc;
- in the Onto-Compilers sub-ontology: LexicalAnalyzer (synonym with Scanner), SyntacticAnalyzer (synonym with Parser), SemanticAnalyzer, CodeOptimization etc;

- in the Onto-ProgrammingLanguages ontology: Variable, Identifier, Statement, Declaration, DataType, Scope, ParameterTransfer, Procedure, Function etc.

We have defined some data properties (e.g. *grammarType*, *languageType*, *automatonType*, *arrayDimension*, *functionArity*, *variableName*, *stringLength*) and the relations between concepts as object properties. Our ontology uses the implicit relations between classes (i.e. the taxonomic relations *is_a* and *has*) that are provided by Protégé and some new relations as for example, *specifiedBy*, *hasArity*, *hasGrammar*, *part-1-of-a-compiler*, *hasIdentifier*.

Figure 3 presents examples of concepts and relations between them from the Onto-Compilers sub-ontology.

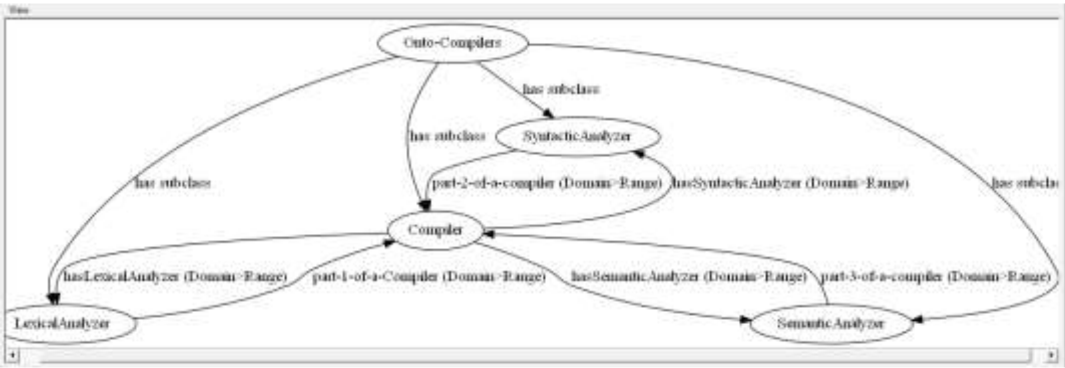

Figure 3. Graph with some concepts and relations from the Onto-Compilers sub-ontology

Some examples of concepts and relations between them from the Onto-FormalLanguages sub-ontology are given in Figure 4.

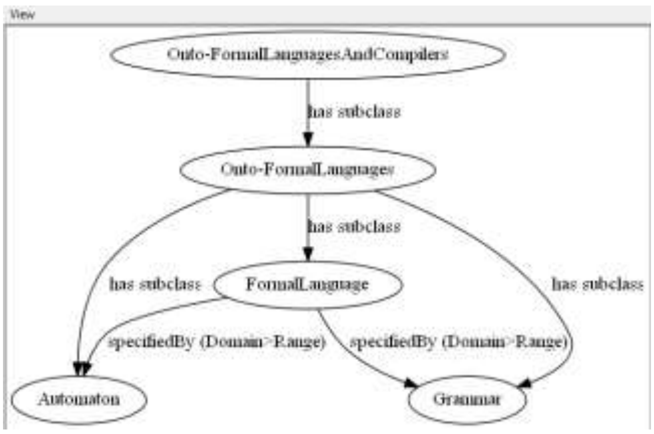

Figure 4. Graph with some concepts and relations from the Onto-FormalLanguages sub-ontology

A taxonomic tree (in OWL Viz, Protégé 4.3) for Onto-Compilers sub-ontology is shown in Figure 5.

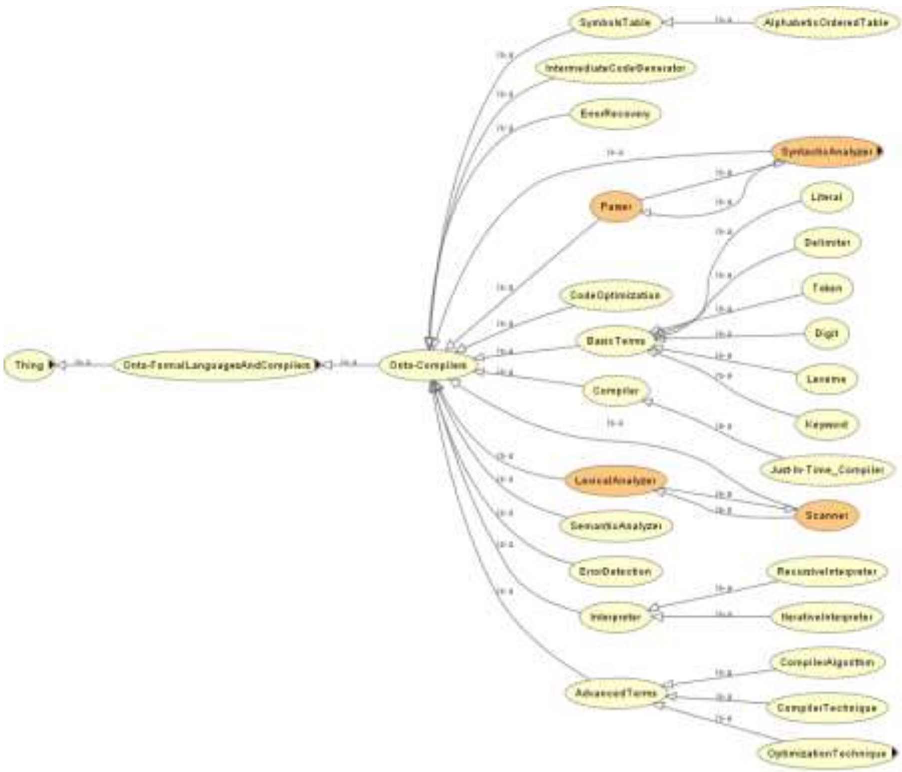

Figure 5. Taxonomic tree for the Onto-Compilers sub-ontology (in OWL Viz)

Another example of taxonomic tree from the Onto-FormalLanguages sub-ontology is presented in Figure 6.

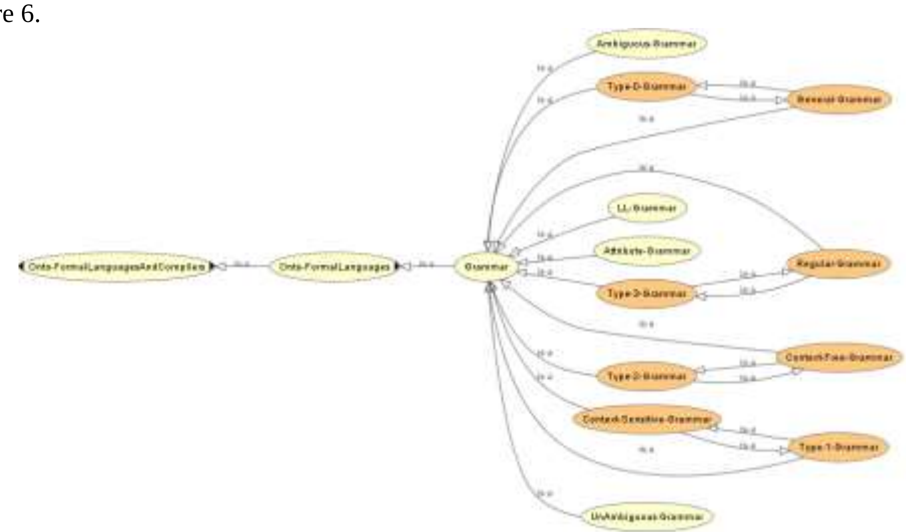

Figure 6. Taxonomic tree for the Onto-FormalLanguages sub-ontology (in OWL Viz)

The educational ontology was developed to be used in a first stage by students as a vocabulary of terms for the course of Formal languages and Compilers. Other examples of applications for which the ontology can be used are:

- compilers testing (see a recent reported example in (Li and Wotawa, 2020));
- program analysis (see an example in (Zhao et al., 2016));
- educational annotations (see an example in (Gayoso-Cabada et al., 2019));
- the examples discussed at the end of section 2.

Conclusion and Future Work

The paper presented an OWL prototype educational ontology for the course of Formal languages and Compilers, Onto-FormalLanguages-Compilers-1, that can be used by undergraduate students of the Computer Science specialization. The ontology was developed by following the guidelines of a methodology that was described in section 3 and was implemented in Protégé 4.3.

As a future work we intend to extend the ontology with more concepts related to the applications that were highlighted at the end of the third section of the paper.

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Some Educational Applications of Artificial Intelligence to Real World Problem Solving

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Abstract

Teaching the course of Artificial intelligence to undergraduate students can become more efficient when real world examples of applications developed as simulations are used in the form of educational resources. Such applications can be developed by students at their diploma project or at the semester project, under the supervision of the professor that teach the course of Artificial Intelligence who can distribute some thematic subjects according to the chapters of the course. Thus, next generation of students can learn from the experience of previous generation of students. The paper presents two educational applications of artificial intelligence to real world problem solving, developed by students from the Computer Science specialization of the Petroleum-Gas University of Ploiesti at their diploma project: an air pollution prediction system based on deep learning and a cooperative multi-robot system simulated in Webots.

Keywords: Educational application, Artificial intelligence, Deep learning, Multi-robot system coordination

1 Introduction

In the last decade, it was recorded a significant increase of artificial intelligence applications to various real world problems solving from almost all domains, reflected by the number of research papers published in the specialized literature. This fact has grown the students' interest in studying the course of Artificial Intelligence (AI) and also, the necessity for teachers to adapt the AI course to the current trends in the domain, according to the academic study program, and their pedagogic-methodological approach.

A solution can be given by the inclusion in the AI course resources of some real world educational applications developed as simulations by students of current academic year generation and used by next academic year students generation. Such applications can be developed by students at the semester AI project or at their diploma project, under the supervision of the professor that teach the AI course and manage the projects' topics distribution. Starting from this idea, the paper presents two educational applications of AI developed as simulations by undergraduate students from the Computer Science specialization at the Petroleum-Gas University of Ploiesti for their diploma project, presented in July 2020.

The paper is organized as follows. Section 2 briefly presents basic issues and current trends in the domain of AI. Two educational applications of AI approaches are detailed in section 3, an air pollution prediction system based on deep learning and a cooperative multi-robot system simulated in Webots. The final section concludes the paper.

2 Artificial Intelligence: Basic Issues and Current Trends

Artificial intelligence is a vast domain, under continuous development, intersecting other domains such as Computer Science, Computer Engineering, Robotics, Mathematics, Philosophy, Physics, Biology. During the AI history (of almost 70 years), a variety of distinct fields were included in the AI domain: machine learning, case-based reasoning, knowledge-based systems, expert systems, pattern recognition, intelligent robots, intelligent agents, multi-agent systems, artificial neural networks, genetic algorithms, swarm intelligence etc. Basically, two types of approaches are used by AI: symbolic logic based approaches and computational intelligence approaches. The approaches of first type are part of the traditional or classical AI in which knowledge and reasoning are fundamental, while the second type is oriented more on computation models that copy different natural systems.

Among the current general trends in the AI domain we mention two:

- The development of new computational intelligence techniques (usually, nature-inspired – improved versions of ant colony optimization, particle swarm optimization, artificial bees, grey wolf optimizer, firefly and new techniques) that are applied to solve real world complex problems (e.g. optimization problems from engineering).
- The development of new intelligent systems that apply various AI methods and techniques (e.g. intelligent manufacturing systems, intelligent renewable energy systems, intelligent tutoring and learning systems for universities).

Some specific trends are: the development of more powerful machine learning methods, as for example, deep learning, and the design and implementation of intelligent mono and multi-robot systems for industry (as e.g. automotive).

Engineering is one of the general domains that frequently applies AI techniques. We have selected some examples of AI engineering applications:

- Smart manufacturing (Cioffi et al., 2020);
- Robotic welding process control with artificial neural networks (Bucur et al., 2002);
- Air quality prediction with deep learning (Freeman et al., 2018);
- Intelligent multi-robots systems coordination in flexible manufacturing (see the examples given in the survey (Cortés and Egerstedt, 2017));
- Knowledge based systems for optimal process control (the Expert_AT system described in (Oprea, 2017));

Education is also a general domain where AI was applied and more applications can be developed in the future. A critical analysis of the research that reported AI applications in higher education is made in (Zawacki-Richter et al., 2019). The authors identified in the literature four areas of AI applications for institutional services, academic support services, and administrative services: profiling and prediction; assessment and evaluation; intelligent tutoring systems; adaptive systems and personalization. They highlighted several problems such as the risk of using AI in education and the weak connection to the theoretical pedagogical perspectives.

3 The Educational Applications of AI

One of the best textbooks in teaching AI is *Artificial Intelligence - A Modern Approach*, its last edition appeared this year (Russel and Norvig, 2020), written by Stuart Russel and Peter Norvig. This book covers the important fields of AI and presents apart from the theoretical and historical issues, examples and applications of the described methods. We are using this textbook as a basic reference for the Artificial Intelligence course taught in the fourth year to undergraduate students studying Computer Science. Also, we have used in the last three academic years the book (Oprea,

2017) in which are described some intelligent systems developed at Petroleum-Gas University of Ploiesti under research projects. These applications are used as educational resources for teaching the AI course. More educational applications were developed by students for their semester AI project or their diploma project.

We have selected two diploma projects that were developed by two students in the academic year 2019-2020 and were presented in July 2020, with topics from machine learning, and intelligent robotics.

3.1 Deep learning application

The first application tackles the problem of air pollution prediction with an AI method, deep learning. Starting from the need of a reliable predictive system, that provides more accurate forecasts of air pollution, the BSc Thesis (Vartan, 2020) describes how such a system was developed using the latest technologies in the fields of Artificial Intelligence and Artificial Neural Networks (Aggarwal, 2018). The dataset for this application was created during a three months' period from the 23rd of March up to July 8th 2020 by collecting data of atmospheric pollutants concentrations measured by the air pollution monitoring stations of The Romanian National Air Quality Monitoring Network (http://www.calitateaer.ro).

The neural network that made use of this dataset has been designed and implemented with the Python programming language. The choice was made in favor of this language because it provides the best support regarding all manners of artificial intelligence applications and data science and a sizeable collection of modules, libraries and tools necessary for deep learning. The IDE on which the application was developed is known as Jupyter Notebook, a program from the Anaconda Python distribution. In the predictive application the newest versions from Keras, Pandas, Matplotlib, Tensorflow and Scikit-learn software tools have been put to use in order to create a neural network. First, the dataset containing 845 entries has been inserted into the program, converted into an array and later preprocessed using the min_max_scaler function. The artificial neural network's architecture was in essence a sequential model of a deep artificial neural network (i.e. a feed forward artificial neural network with more hidden layers for deep learning), that contains the input layer, two hidden layers of 32 neurons each activated by a ReLU function and an output layer activated by a sigmoid function.

Figure 1 shows the structure of the artificial neural network that was used as prediction model.

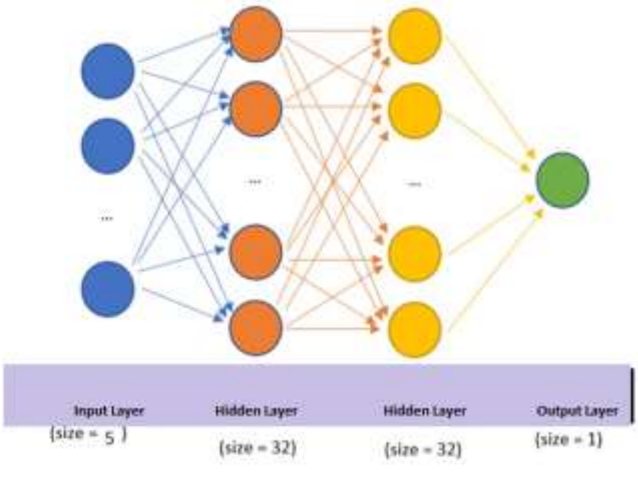

Figure 1. The prediction artificial neural network structure

The model has been optimized using the stochastic gradient descent method, and the loss function used was mean squared error (MSE). The model has been trained for 100 epochs and so far the accuracy of the neural network model has increased from 60% up to 76% due to repeated runs of the same dataset. Figure 2 shows the accuracy of the mathematical model for two tests run.

```
In [20]: model.evaluate(X_test, Y_test)[1]
         127/127 [==============================] - 0s 40us/step
Out[20]: 0.6062092215156555

In [19]: model.evaluate(X_test, Y_test)[1]
         127/127 [==============================] - 0s 43us/step
Out[19]: 0.7007874250411987
```

Figure 2. The accuracy of the mathematical model for two tests run

The developed predictive system offers a satisfying accuracy and prediction in order to combat one of the most pressing matters of the modern world: atmospheric pollution.

The main benefits highlighted by the student that developed this application were: a comprehensive understanding of a deep artificial neural network model design and implementation with some free software tools for a real world application, that of air pollution prediction in urban areas, with real datasets of air pollutants concentrations. Apart from learning a specific prediction problem solving AI-based method (deep learning), the student learned new software tools, as well as how to program in Python language.

3.2 Cooperative multi-robot system application

The second educational application focuses on intelligent multi-robot systems that can cooperate to perform certain tasks. In such intelligent systems, the robots has sensors and actuators and they can be coordinated to solve real world problems by cooperation. Starting from the current trend in the field of Intelligent Robotics that of developing intelligent cooperative multi-robot systems in various industrial fields for carrying complex tasks, systems that have a higher performance in comparison with single robot systems, the BSc Thesis (Vatamanu, 2020) developed an educational application that solve a problem of transport and storage with an intelligent multi-robot system implemented as a simulation in Webots, a robot systems simulation software package. The system is composed of three e-puck mobile robots (see Figure 3), two cooperative robots that transport by pushing a box to a certain location, and one robot that takes the box from the location where it was transported by the other two robots and perform box transportation and storage to a known location.

Figure 3. The e-puck mobile robot model in Webots

The e-puck robot has position sensors, proximity sensors, light sensors, camera, accelerometer, ground sensors.

The experiments that were run in Webots showed a good performance of the multi-robot system in solving the proposed problem in terms of task completion time. Figure 4 shows an example of working environment simulated for this application. This is actually the start configuration of the working scene for our experiment. The two mobile robots that perform the transportation task by pushing the box follow a simple navigation algorithm, while the third robot has a more complex navigation algorithm that performs obstacle avoidance with some basic mobile robot motion functions (see code in Figure 5).

Figure 4. An example of working environment simulated for the multi-robot system

```
void turn_right(WbDeviceTag left_wheel, WbDeviceTag right_wheel)
{
  wb_motor_set_velocity(left_wheel, 4.0);
  wb_motor_set_velocity(right_wheel, 0.0);
}

void turn_left(WbDeviceTag left_wheel, WbDeviceTag right_wheel)
{
  wb_motor_set_velocity(left_wheel, 0.0);
  wb_motor_set_velocity(right_wheel, 4.0);
}
```

Figure 5. Example of some basic mobile robot motion function code

Figure 6 shows the next three steps toward cooperative multi-robot system task completion as a simulation for solving the box transportation and storage problem.

Figure 6. Steps toward cooperative multi-robot system task completion

The main benefits emphasized by the student that developed this application were: a comprehensive understanding of some mobile robot navigation and coordination algorithms, the design of the multi-robot system for a real world problem (transport and storage), and its implementation as a simulation in Webots, an educational and research free software tool.

Conclusion

The paper presented two educational applications of artificial intelligence to real world problem solving developed as simulations by Computer Science undergraduate students at their diploma project. The approaches that were used in the two projects, deep learning and cooperative multi-robot systems are currently among the challenges research topics in applied AI. The two simulated applications will be included as educational resources for the AI course that will be taught to the next academic year students from the Computer Science program of study, facilitating a better understanding of specific artificial intelligence methods.

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Learning about ICT-based Collaborative Practices in Urban Regeneration

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Abstract

This paper starts from a research topic approached within an internal fellowship in Babeş-Bolyai University, Cluj-Napoca, Romania. The project, Smart Collaborative Practices in Urban Regeneration in Cluj-Napoca, assessed the necessity that the local university provides innovative services using ICT, in cooperation with local NGOs, which would support the development of the local community. As part of the project, we present the stages of an online research on urban regeneration collaborative practices, which use the ICT, through which local communities are activated to take part at the decision-making process concerning their development. Therefore, our aim was to identify, present and analyse the web-based resources (i.e. good practice examples) available for smart collaborative practices, considering the results of the fellowship project and their use in further activities involving the ICT and implemented by various stakeholders in local development (i.e. the academia, the local NGOs, and the citizens). In addition, we focused on the advantages of the online research on the topic, from the perspective of what university geography students could learn, when in service learning, field trips, and field research were not possible. This was the case of the fellowship project implemented in March-April 2020, which overlapped over the lockdown period in Romania, caused by the COVID-19 health and societal crises.

Keywords: Digital civics, Web sources, Urban development, COVID-19

1. Introduction

A research topic approached within an internal fellowship in Babeş-Bolyai University, Cluj-Napoca, Romania, is at the basis of this paper. The project, titled *Smart Collaborative Practices in Urban Regeneration in Cluj-Napoca*, assessed the necessity that the local university provides innovative services using ICT, in cooperation with local NGOs, which support the development of the local community.

In this paper, we present the first part of the project results, which consists of the stages of an online research on urban regeneration collaborative practices using the ICT, through which local communities are activated to take part at the decision-making process concerning their development.

Thus, our research aimed at identifying, presenting, and analysing those web-based resources (i.e. good practice examples) available for such smart collaborative practices (i.e. including ICT). In this process, we considered two perspectives: that of urban regeneration and the educational one. Therefore, first, we present the results of the fellowship project and their possible use in further activities involving the ICT and implemented by various stakeholders in local development (i.e. the academia, the local NGOs, and the citizens). Secondly, we present several considerations from the perspective of what university geography students could learn, when in service learning, field trips, and field research were not possible. This was the case of the fellowship project that was implemented in March and April 2020, which overlapped over the lockdown period in Romania, caused by the COVID-19 health and societal crises.

2. Material and Method

2.1. Data Collecting, Procedure and Research Material

We collected the necessary data on the topic of ICT-based collaborative practices in urban regeneration through bibliographic research on the Internet. The research material consisted of the research process performed by the authors within the online environment and the results of this documentation (i.e. the reported good practice examples from the selected articles). Then, we analysed the content of the sources.

2.2. Participants

The fellowship project defined its target group:
(1) outside the university (i.e. of the provided services will benefit two non-governmental associations: Colectiv A Association, with the project La Terenuri – spațiu comun Mănăștur [At the Playgrounds – Common Space in Mănăștur] and miniMASS Association, with the project Someș Delivery, together with the local communities), and (2) within Babeș-Bolyai University (i.e. the members of the Centre for Research on Settlements and Urbanism, as well as the academic community of the whole university who would freely use the research results).

Dr. Oana-Ramona Ilovan, the fellowship holder and scientific coordinator, implemented the activities of this research in March and April 2020.

3. Results and Discussions

This section is divided into two main parts, presenting and discussing (1) the usefulness and challenges of web-based resources available for smart collaborative practices in the urban area and (2) the educational advantages of web-based research for university geography students on the topic, during a period when only this form of research was possible, namely the COVID-19 lockdown period in Romania.

3.1. Web-based resources available for smart collaborative practices in cities

In this part, we present and analyse the web-based resources (including good practice examples) available for smart collaborative practices in the urban area, involving regular citizens in participating at the development of their communities. Web-based research for identifying solutions to activating citizens through ICT, and thus enabling them to participate at the development of their community, focused on the following (as identified in the studies published so far):

(1) mobilizing the community through mobile apps;

(2) awareness raising actions about community issues, using mobile apps (including social media: Facebook, Instagram, Twitter, etc.);

(3) challenges/problems/limitations concerning the first two points above;

(4) the actors involved in realizing research (typology, training, necessary funds);

(5) availability (who, when, how, why) concerning the implementation of certain mobile apps that enable the realization of the first two points above;

(6) solutions and synthesis of good practice examples.

In scientific specialty literature, authors discuss how communities can contribute to their own development, through *Local Community Initiatives*, which, besides previously established objectives (solving certain dysfunctions, helping disadvantaged classes/communities, developing local economy), target also at strengthening the relationships among community members (Ferreira and Pantidi, 2018).

There are numerous ways in which the community can be determined to use digital technologies. They noticed that an aspect that was restricting access of the communities to digital technologies was the lack of project initiators who had programming knowledge in order to realise more specialised mobile apps. However, there were programmers who created platforms that enabled the creation of apps in an easier manner.

Sensr is a platform that helped creating mobile apps used by citizens to monitor air quality, drillings for extracting natural gases, identifying invasive plants with students' help (Kim et al., 2013). App Movement (Olivier and Wright, 2015; Garbett et al., 2016) is an online platform that helps communities propose and promote apps according to their needs, so that later to create designs that can be personalised. Thus, it is proven that technologies are not created with a singular, fixed, and predetermined aim, but they may be used in the manner that the community needs them (Garbett et al., 2016). Fischer and Scharff (2000) are among the first to argue that users of apps should be free to come up with ideas in what the design of an app is concerned.

Under these circumstances, when technology becomes more and more accessible, it starts to be used to encourage the mobilization of the community (Ferreira and Pantidi, 2018). However, the role of technology in studying local communities is not enough studied (Asad and Dantec, 2017; Ferreira and Pantidi, 2018), because up to the present, it was used only in the case of natural disasters (Starbird and Palen, 2011; De Visser et al., 2015) and of political conflicts, such as the protest movement titled the Arab Spring (Howard et al., 2011). Another type of projects where community can be mobilized is represented by musical videos. Fans of certain music bands would film live concerts and later those videos were integrated into official videos (Schonfield et al., 2015).

In order to announce the community concerning projects that are to be implemented, some researchers or associations consider classical means, accessible to the larger public: flyers posted within the neighbourhood or the central area, announcements in the local newspaper, e-mails addressed to communitarian organisations and news spread from person to person (DiSalvo et al., 2008).

Social media may be used to establish networks of activists in a field and to mobilize the community to act (Tayebi, 2013). The mobile technologies enable communities to access information and encourage participation at various projects (Han et al., 2016). Digital technologies may be used successfully for age groups that use smartphones frequently (Ferreira and Pantidi, 2018).

The technologies used in projects addressed to communities should consider their values, improving cohesion among their members, improving trust, and offering the possibility to realise connections with entities outside those communities (Ferreira and Pantidi, 2018).

The challenges that may appear in projects using digital technologies are diverse. Thus, the safety of technology was considered in the study realised by Ferreira and Pantidi (2018), in the sense that certain apps need users' personal data (cf. The European Parliament and the Council of the European Union, 2016), and, in the situation in which these data are not safe to cyber security attacks, users would avoid using technology. On the other hand, certain apps require variants of the operation systems that are up to date, thus encouraging buying new telephones and ceasing to use the old ones. This practice is against the principle of sustainability, considered implicitly in those projects (Ferreira and Pantidi, 2018). It was demonstrated, through case studies, that technologies can contribute to strengthening relationships among community members, but face-to-face ones should not be restricted or replaced (Ferreira and Pantidi, 2018).

3.2. Good practice examples

3.2.1. Case study 1. Interactive digital panels

Although this first case study was from the rural area, it can be successfully replicated in towns and cities and their neighbourhoods, that is why we took it into account as a good practice example. For announcing certain events in the community, *digital interactive panels* were used and Taylor and Cheverst (2012) show how these panels influence the life of the community over a four years period. The placement of the panels is crucial as they are more used in places where people spend more time than in the ones people just pass by. Thus, the interactions with the panels are dependent on the placement of the social and spatial context (Bil et al., 2020).

The first digital panel within the project was placed at the mayor's office of a rural settlement in the north-west of England, named Wray, and which had a population of about 500 inhabitants (Taylor and Cheverst, 2012, p. 28). There, it was placed a touchscreen, connected to a hidden computer that displayed photographs from local events. Interested viewers could roll down those photographs and upload new ones or download them using Bluetooth. To get the community's feedback, a notebook was placed near the screen. The notebook collected many positive comments, people were happy to be able to see again photographs from the events they missed. People also suggested that older photographs and videos of the village should be displayed. A problem that users underlined concerned the transfer of photographs, as they considered that a web app would have been more appropriate than the classic Bluetooth (Taylor and Cheverst, 2012, p. 28).

After a trial period at the mayor's office, the screen was moved to the local store, due to the fact that this was acknowledged as the preferred meeting place of the community members in order to socialise (Taylor and Cheverst, 2012, p. 28). Due to the change of location, the people's interaction with the screen was five times higher than in the case of the mayor's office. All this time, researchers analysed which were the most frequently accessed content, the number of logins, thus appearing a behavioural profile of the community members concerning the use of the respective screen (Taylor and Cheverst, 2012, p. 28). The residents were also interviewed, and they were asked to explain how they used the screen and what kind of improvement should be brought (Taylor and Cheverst, 2012, p. 28). A second screen was placed, and it attracted more and more users. Following discussions, the interface was improved, and new functions were added: comments could be posted, and photographs could be sent on e-mail in the form of digital postcards (Taylor and Cheverst, 2012, p. 29).

New photographs of the village were added to the old ones and the first no longer had only yearly events, but also certain news, meteorological phenomena, weddings, etc. The inhabitants noticed that the screen could display local advertisements, news about future events and could also play the role of a newsletter. So that certain events were not forgotten, a Reminder was constantly displayed on the screen. Thus, the screen ended up in being used for various news (charity events, public meetings, objects on sale, or services provided by the locals) (Taylor and Cheverst, 2012, p. 29).

One should consider that such screens are useful not only for the locals, but also for tourists who want to find information about the respective community. For tourists especially, maps and guided tours were displayed. The ones interested to move in the village used the screens to have their first contact with the community (Taylor and Cheverst, 2012, p. 31).

The screens had the role of enabling relationships among community members, because they would gather around them and discuss based on the photographs of the events that had already taken place. After the project ended, the screens continued to be used, but they needed specialists to monitor their functioning. That is why, for future actions, simpler apps could me more appropriate, the ones that could be managed by the community (Taylor and Cheverst, 2012, p. 32).

Other studies which considered the use of digital screens for informing the communities were realised by Redhead and Brereton (2009) and Maunder et al. (2011).

3.2.2. Case Study 2. Social Media Supporting Community Causes

Another paper, written by Crivellaro et al. (2014), underlines *the role of social networks in supporting a community cause*. In the town of Tynemouth (UK), there was a swimming pool dating back to 1925 (Crivellaro et al., 2014, p. 3575). In time, it was no longer maintained, and it was rearranged as a natural site for preserving the flora and fauna, but also this initiative failed. In 2010, a Facebook page was created by a group of locals that supported the return to its initial function, of swimming pool, but only a few community members accepted this idea (Crivellaro et al., 2014, p. 3575).

In 2012, the public authorities realised a plan through which they proposed that the swimming pool to be transformed into a volley field, with an open-air amphitheatre. This information was posted on the Facebook page and this triggered the opposition of the community, proven by their many comments. Only then the community mobilised and manifested their interest for restoring the swimming pool. Protests were organised and a campaign was promoted through the Facebook network. Inhabitants posted old photographs and videos from the time when the swimming pool functioned. Their objections were sent to the authorities and the plan was not implemented. A group of volunteers and professionals was set up and they developed a plan for restoring the swimming pool, followed by campaigns for collecting funds to implement the project (Crivellaro et al., 2014, p. 3576).

The data were collected from the Facebook page of the project, where there were 620 posts and 3,987 comments, posted between August 2012 and January 2013, and the methods used for interpreting them was discourse analysis (Crivellaro et al., 2014, p. 3576). One of the problems was the censorship of negative answers by the administrators of the page, who considered that once the aim of the movement was established (restoring the swimming pool), non-constructive comments were useless (Crivellaro et al., 2014, p. 3580).

The fact that inhabitants posted photographs and shared their memories related to the swimming pool could be considered an act of political protest and of solidarity (Crivellaro et al., 2014, p. 3580). The authors of the respective study concluded that Facebook is the network where people could express “their cultural voice” (Crivellaro et al., 2014, p. 3581).

3.2.3. Case Study 3. Social Media Raising Awareness

Social media can be used to spread in the community various political ideas that would finally create the necessary fund to install a political regime (Howard et al., 2011). This is the case of the Arab Spring when militants for democracy filmed protests and then posted them on Facebook, Twitter and YouTube, co-opting others that would share their ideas (Howard et al., 2011, p. 1). The implications of the social media were studied in Tunisia and Egypt (Howard et al., 2011, p. 1). Researchers used the following methods: they created a database with information collected from media networks and analysed users' comments (Howard et al., 2011, p. 24). The conclusion of the study was that social media had the main role in political debates (Howard et al., 2011, p. 22).

The group that took care of the posts on the socializing networks was made of young persons, from the urban area, with university studies, most of them women. They pressured the government both before and during revolutions, using Facebook, Twitter and YouTube (Howard et al., 2011, p. 1). Moreover, the information and the causes supported by protesters were broadcasted by the television and then further on by BBC and CNN (Howard et al., 2011, p. 2). Results showed that, using digital technologies, the supporters of democracy managed to spread ideas about freedom and the revolution among a significant number of persons (Howard et al., 2011, p. 2).

It is not known whether street protests started because of the online conversations or if the large crowds of people in the streets caused the online comments. However, it is a fact that online conversations had a decisive role in stimulating public opinion. Discussions about freedom, democracy and revolution on the blogs and Twitter were almost immediately followed by mass protests. Noticing the power of the socialising networks in mobilising masses, officials tried to block Facebook and the other websites, they arrested bloggers and other persons that shared political information. At that moment, the bloggers in Tunisia asked for the hackers' help to block the online services of the governments. The supporters of democracy in Egypt had their servers in London, therefore the officials were not able to block them (Howard et al., 2011, p. 2).

Another result of using social media was sharing information with people from other states who made public the respective situation and attracted the attention of the global community. Thus, protests in Tunisia and Egypt served as examples for other states where later revolts broke out (Howard et al., 2011, pp. 2-3).

3.3. Educational advantages of web-based research for university geography students

Geography university students can use web sources to form their literature background on a certain subject. They have to recognize which sources are credible and worth to be mentioned in a scientific paper. They learn how to search for articles, how to "scan" them and how to quote correctly. However, in addition to this classical use of Internet resources for research (cf. Vlada and Adăscăliței, 2014; Vlada and Jugureanu, 2007), the approached topic in this research required that students use the online environment for collecting information, due to the fact that the subject focused on ICT in urban regeneration, which are quite recent practices and more likely to be reported online. In addition, the articles posted on blogs or official pages of the urban regeneration projects can be read by multiple Internet users and they can comment upon a certain topic. The students have the possibility to see different opinions and reactions, even if these are not enabled through face-to-face interaction, as in the case of field research.

Moreover, asking students to look for good practice examples reported online, starting from several points they should pay attention to, is a powerful strategy of offering feedforward in university education (Dulamă and Ilovan, 2016). In the reported case studies, one idea attracting students' attentions was the installation of interactive digital panels (Taylor and Cheverst, 2012), which had multiple functions and could be used both by the locals and the tourists. Using local photos, the community sense was enhanced, the people felt more belonging to the place and proved that territorial identity is relevant for development (cf. Ilovan et al., 2016b). As a result, implementing rehabilitation projects of the built heritage (Fantazi, Hecham, and Petrișor, 2019; Tache et al., 2018) and ensuring resilience (Petrișor, Meita, and Petre, 2016), in the context of creating smart cities (cf. ISO/IEC JTC 1, Information Technology, 2014), are more easily achieved.

Also, previous studies showed that university students in Geography make use of Internet sources for their specialty training (Dulamă et al., 2015; Ilovan et al., 2016a; Osaci-Costache et al., 2015) and are interested in connecting ICT with traditional research methods for studying the territory (Ilovan et al., 2019). Therefore, such a research project, especially during a period when access to field research was not possible, was an opportunity for students' exercising their online research skills and increasing their competence level on the subject. An extra advantage is that the students are constrained to read studies written in English or in other languages, so they are constantly improving their language skills and they have the chance to get used to the scientific vocabulary.

4. Conclusions

The literature so far has not focused on how communities are announced concerning events and projects. This aspect is mentioned in passing in some sources and does not appear at all in others. This could be a reminiscent of a practice that does not involve citizens in decision making or of the socialist past when the state and some external actors decided the fate of communities without asking their opinion.

Nowadays, there are a lot of resources that can be used to bring news to people's attention. The society encourages the use of the online resources rather than the classic ones (paper posters, flyers), but not all the members of a community have the means to access the online environment. Therefore, the organising team of projects have to come with something available for any user type.

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Feedforward for University Geographical Online Education during the COVID-19 Pandemic

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Abstract

During the COVID-19 pandemic period in Romania, traditional face-to-face university education was replaced by the online one, realised on a series of platforms and employing web-based methods. This transformed it into distance education. Starting from papers published worldwide on e-learning during the period when universities were closed because of the health crisis, I presented and discussed the advantages, challenges, problems and recommendations concerning online education at the university level, briefly discussing the case of geography. To achieve this aim, a literature review is performed on papers treating online university education during the COVID-19 pandemic in 2020, and participant observation, considering my personal teaching experience on the subject. Challenges are discussed from the perspectives of both professors and students and solutions are identified. Conclusions emphasize the benefits of online education when appropriate approaches are employed.

Keywords: Digitalisation of universities, E-teaching, E-learning, Digital pedagogy, Geography higher education

1. Introduction and Theoretical Background

Starting with the 15th of March 2020, e-learning was introduced after the state of emergency was declared in Romania, which meant forced confinement, because of the Corona Virus Disease 2019 (COVID-19) pandemic. In the Fall semester of 2020-2021, in Babeş-Bolyai University of Cluj-Napoca, Geography will be taught completely online, after previous courses had been designed for direct (face-to-face) instruction.

The aim of my paper is to identify, based on scientific literature and personal observations in the institution, which are the most appropriate solutions for ensuring an improved performance of professors and students in Geography, at Babeş-Bolyai University.

Higher education is defined as "a socially immersive and participatory learning experience" (Watermeyer et al., 2020, p. 9) and it has been abruptly and radically changed by the COVID-19 pandemic. Although e-learning can enrich students' experience and improve access for many (Walwyn, 2020, p. 2), capitalising on the opportunities offered by a new digital pedagogy (la Velle et al., 2020), studies show that learning management is crucial for successful e-learning in higher education and that the fluctuating student satisfaction depends on professors' approach of online instruction and assessment (Edelhauser and Lupu-Dima, 2020, p. 6).

Recent research focused on factors supporting e-learning and on challenges to be faced during COVID-19 (Almaiah, Al-Khasawneh and Althunibat, 2020), on guiding assessment in higher education during the pandemic (Jose Garcia-Penalvo et al., 2020), and, generally, on digital technology and associated teaching and learning practices. Reporting on experiencing communication and connectivity for adapting to the COVID-19 pandemic and reality (Al-Taweel et al., 2020), as well as on practice and mentoring during this period, can offer solutions for coping with new challenges in the higher education system (Assuncao Flores and Gago, 2020).

The pandemic is seen as a crisis and as an opportunity for paradigmatic changes in university education. The crisis is an opportunity for the modernization of education, for pedagogic approaches using digital solutions (Anderson, 2020; Trombly, 2020) and for ensuring the resilience of the system (Alvarez de Barrios, 2020). However, in this context of the emergency remote teaching and of the technology-led transformation of learning (Krishnamurthy, 2020), some discuss the utopian imagery referring to the fact that technology and the digital solution could save both population from the disease and the education system, suggesting ways to fight neoliberal educational reforms (Burns, 2020).

Despite the many solutions that learning management systems offer, some researchers argue that students' interaction, discussions and problem-solving capabilities are reduced (Alturise, 2020), while others advocate for the high communicative potential that distance learning methods have (Iglesias Leon et al., 2020) and underline that the success of implementation and e-learning readiness depend on technology (Ebner et al., 2020, p. 3).

E-learning implies distance and connectivity at the same time (Mulla et al., 2020, p. 449): "Online education is not limited to distance education, as it regards a grouping of learning/teaching procedures completed in cyberspace" (de Oliveira Araujo et al., 2020, p. 1). E-learning includes three components: "e-communication (material communication), e-training (LMS system approach) and e-assessment (assessment of learning outcomes indicators)" (Ana et al., 2020, p. 20). After placing the learner in the centre (Mulla et al., 2020, p. 447), research questions enquire about the best forms of delivering education that are most likely to advance students' learning, to develop their communication and social skills, to support their emotional and psychological development, and to ensure their professional development and resilience in their future job environment.

Technical and psychological readiness are among the first assessed and discussed. The latter is related to the increase of tasks and workload in education, as well as to more family responsibilities both for professors and students (Prokopenko and Berezhna, 2020, p. 133).

In spite of the low level of e-learning expertise, in Romania, digitalisation is perceived as progress in education (Edelhauser and Lupu-Dima, 2020, p. 6; Vlada et al., 2010; Vlada, Jugureanu and Albeanu, 2011; Vlada, Jugureanu and Istrate, 2009). During the pandemic period, the Zoom software is preferred in the education system of Romania (free and easy to use), by those who used videoconferencing (under 50% of the users) (Edelhauser and Lupu-Dima, 2020, p. 19, p. 21).

2. Material and Method

My research findings are the result of the literature review considering papers indexed in the Web of Science database by the end of August 2020, referring to university online education during the COVID-19 pandemic. The research material consisted of these papers from the existing literature published in 2020 and of the author's participant observation during the teaching-learning process, in the Spring semester, at the Faculty of Geography within Babeş-Bolyai University in Cluj-Napoca, Romania.

3. Results and Discussions

The topic I searched for on the Web of Science was "university education Covid". As of the end of August 2020, using these keywords, the database generated 133 entries. According to Web of Science, most of the published entries fall in the following categories: educational research (28), internal/general medicine (13), education scientific disciplines (9), and public environmental occupational health (8). Following next, with six, five and four entries are these categories: environmental sciences, health care services, information science/library science, management, multidisciplinary sciences, dentristry, oral surgery/medicine, environmental studies, green sustainable science technology, health policy services, experimental medicine research, political science, and surgery. One can see that the research focus is on education, health, and environment, underlining the top societal priorities during the COVID-19 pandemic. Out of the 133 entries, 112 are articles, 12 are editorial materials, five are reviews, and four are letters.

In the following pages, I present the results of the literature review and of my participant observation in the Faculty of Geography within Babeş-Bolyai University in Cluj-Napoca, considering the advantages, challenges, problems, and recommendations referring to online education in the university during the COVID-19 pandemic.

3.1. Advantages of Online University Education

The most frequently mentioned advantages of online learning are flexibility concerning time and location of classes, thus supporting remote learning, easy administration, accessibility, and comfort. Another advantage is student-centred learning (i.e. self-directed learning, asynchronous learning) (Mukhtar et al., 2020, p. 4). Distance learning influences positively self-organisation and self-discipline, making all more responsible. University education is also more accessible regardless of students' residence and health issues. Finally, besides connectivity and inclusivity, online university education is an opportunity for pedagogical reinvention (Watermeyer et al., 2020).

3.2. Challenges and Problems of Online University Education

3.2.1. Technology-related challenges and problems

Poor Internet connection, slowdown or even collapse of the network during demand peaks, issues with the video and audio functions may impair students' experience and satisfaction with e-learning (Mulla et al., 2020, p. 448) and also the professors' with e-teaching. Other challenges are: limited capacity for the transmitted material (up to a certain number of Mb), different time zones (thus, asynchronous e-learning is advised for), lack or inappropriate hardware equipment (e.g. no printers at home, necessary for solving certain tasks) (Nuere and de Miguel, 2020, p. 9).

A challenge for both professors and students is learning the available online software from scratch, in record time, and sometimes even without systematic support from their institution. Added to this is the online access to no or a small number of library materials, in the context of no physical access to such resources.

3.2.2. Pedagogy-related challenges and problems

While face-to-face schooling was presented and represented as a threat (Murphy, 2020), the new ways of learning, teaching, and assessment made up a disorienting and unwelcome experience of e-teaching (Watermeyer et al., 2020, p. 2), results showing also students' decreasing success rates for an increase of their course load online (Hamann et al., 2020). Presence is lower in virtual classes than in face-to-face ones (Edelhauser and Lupu-Dima, 2020, p. 17) and the dropout rates are higher in e-learning (Edelhauser and Lupu-Dima, 2020, p. 4). Some part of the activities (i.e. practicals, field trips, internships in companies) is not possible to be conducted online (Sahu, 2020). Students are more anxious, worried about their practical training and thus enjoy less the provided online replacements (Peloso et al., 2020; Roy et al., 2020). Therefore, students need help to build their learning (contents and process) under these unfavourable circumstances.

Activities require much time as professors should develop expertise both in course development and design in the virtual environment and in the digital pedagogy enabling the e-teaching and e-learning processes (Mulla et al., 2020, p. 448). There is also the risk for professors to become talking heads, while students run the risk of losing interest (Gewin, 2020). Among the main problems are the following: instructional design; no or less interactivity (Mulla et al., 2020,

p. 447); students talk less; new teaching and learning skills need to be acquired in the digital environment for both professors and students, in record time; limited or no paralinguistic communication; difficult to enable micro-teaching; limited possibilities for group activities.

There are limitations such as inefficiency (unable to teach and learn skills, lack of student feedback, no possible assessment of students' understanding during online classes, limited attention span, lack of attentiveness, resource intensive), and difficulties or failure in maintaining academic integrity (lack of discipline, as some students misbehave during assessments, and plagiarism) (Mukhtar et al., 2020, p. 4, p. 27, p. 30).

The assessment part is still underdeveloped (Sahu, 2020), requiring that the authenticity of students' homework/projects and products should be tested and certified. Concerning limitation of utilization, automatized assignments decrease the quality of the assessment process in what professors' feedback and students' knowledge are concerned.

Resistance against e-learning in the academia can be explained by the usual resistance to change, but also by the perceived risk of pedagogical deprofessionalisation, workload intensification than in face-to-face activities (Gewin, 2020), of no balance between teaching and research, and by professors feeling unprepared or ill prepared for digitalization.

3.2.3. Social and psychological challenges and problems

The difficult assessing of losses affecting higher education is discussed (Ahlburg, 2020), together with social and psychological related challenges and problems that impact the system because of the mental health state of the involved human resource. The abrupt and violent change induced by COVID-19 may have affected the mental health of academics and students (Sahu, 2020), because of stress, uncertainty, anxiety, and fear (Baba, 2020, p. 1). Irrespective of the fact that a new teaching paradigm is born or not (and thus replacing the old one, based on face-to-face education) (Laura Picon, 2020), in the academia, disturbance in professors' professional and personal lives, and erosion of work-personal life balance was reported (Watermeyer et al., 2020).

Despite the counterbalancing provided by online activities, research reports the lost sense of community for students (Anderi et al., 2020) and the negative psychological effects of online education complemented by isolation (de Oliveira Araujo et al., 2020). Damaging the attractivity of university education and life, with its whole experience (e.g. student life, socializing with peers, socializing with professors, etc.) cannot be ignored.

Moreover, the issue of inclusivity is debated. Vulnerable groups are affected more by this transition to online education. The disabled students, coping with online learning in a context of health crisis and historic cuts in the public education system, are disadvantaged (Douat, 2020). Vulnerable international students are in a similar situation.

3.2.4. Concluding remarks

To sum up the part on challenges and problems induced by online education in the university, research shows that these and the factors influencing e-learning are various. Factors influencing e-learning are: "trust (trust of Internet, security, digital signatures, electronic payment, law and regulation), e-learning system quality (efficiency, usefulness, ease of use, reliability, content design), culture (ICT literacy, e-society social media), self-efficacy (increase awareness, training programs)" (Almaiah, Al-Khasawneh and Althunibat, 2020, p. 11). Failure is triggered by "technological difficulties for students and professors, slow speed of Internet, lack of technical support, students lack of awareness concerning their e-learning, lack of university readiness; lower quality of online courses compared to face-to-face ones, especially because of lower interactivity level, lack of adaptation of content to the online environment and students' needs; weak IT skills of faculty members/professors; professors not accepting technology; professors' lack of training to use elearning; privacy concerns about the students' and professors' personal information; lack of inappropriate technological infrastructure within universities" (Almaiah, Al-Khasawneh and Althunibat, 2020, p. 11).

Challenges also include: "financial support issues (projects delay, lack of financial support), change management issues (lack of awareness, lack of citizens' interest, resistance to change), e-learning system technical issues (usability, ease of use, usefulness, access to e-service)" (Almaiah, Al-Khasawneh and Althunibat, 2020, p. 11). Other challenges and problems refer to bureaucracy of management in state universities; process-oriented education instead of focus on results; educational conformism; professors' and students' lack of motivation and self-discipline (Klapkiv and Dluhopolska, 2020, p. 90).

Despite challenges to online education – communication issues, assessment of students' learning results, technology use, online experience, anxiety and stress induced by the pandemic, time management and technophobia (Rajab, Gazal and Alkattan, 2020) –, case based research reports that e-learning had a positive impact on the educational practice and system (Rajab, Gazal and Alkattan, 2020).

3.3. Recommendations for Quality Online University Education

Solutions should be simple (concerning technology), personal (based on interaction), and fast (referring to the learners' needs) (Ana et al., 2020, pp. 23-24). Offices for pedagogy and IT support, which could offer permanent pedagogical and IT staff support are advocated for (Mulla et al., 2020, p. 447), as well as counselling (in financial, social and health matters) for all those involved in the process. Implementation of digital health along the process of instruction is paid much attention to (Mulla et al., 2020, p. 449).

3.3.1. Technology-related recommendations

Flexibility in using the available IT resources is advised (Klapkiv and Dluhopolska, 2020, p. 90). To ensure a high-quality e-learning setting for emergency remote teaching to be turned into higher quality e-learning, instructions should be published concerning the use of technology for e-learning in the university. Solutions also include availability and use of collaborative learning platforms, virtual libraries, and virtual classes (Edelhauser and Lupu-Dima, 2020, p. 27) and permanent update of the ICT used for online education (Nuere and de Miguel, 2020, p. 5).

In addition, especially for replacing practicals, innovations such as technology and simulation-based learning that can support experiential education should be implemented where necessary (Peisachovich et al., 2020; Roskvist, Eggleton and Goodyear-Smith, 2020; Walwyn, 2020). Moreover, a video portal could be set up (lecture and event videos) to promote building a community of learning (Ebner et al., 2020). Likewise, social media is important for communication in the university system during this period (AI-Youbi et al., 2020; Edelhauser and Lupu-Dima, 2020, p. 18).

A functional anti-plagiarism system, to check students' projects and solved tasks should be available. And all this could not be implemented properly without the non-teaching staff toiling to maintain the technology working.

3.3.2. Pedagogy-related recommendations

Professors are contributing to improve the existing educational models in the online environment, striving to enable learning, thus shifting the focus from teaching. They also shift from instructors to enablers (Nuere and de Miguel, 2020, p. 4). Discussing the changing role of educators nowadays, depending on major disruptions and students' new needs (Hill et al., 2020), research shows that the role of university professors is also updated in terms of giving advice to students concerning their learning process, not only mentoring them related to the learned contents (Prokopenko and Berezhna, 2020, p. 133).

Quick adaptation to online teaching and online learning is the solution, with advantages and disadvantages (Moorhouse, 2020; Zhu, 2020). Innovations are called for in the form of synchronous and asynchronous online learning based on high levels of interaction (Scull et al., 2020).

Under these circumstances, it could be useful that an educational technology team to be set up at the university level, whose activity is to focus on the users' education and training, considering e-learning and innovative teaching (cf. Ebner et al., 2020, p. 7). The education technology team should offer regular consultation hours besides available online materials, it should develop materials for lectures adapted to the virtual environment, thus transforming residential courses into quality remote online ones and offering permanent support to all faculty members to transition online (to professors for online teaching and to students for online learning) (cf. Ebner et al., 2020).

This is a useful idea, to set up a community of coaches (to coach faculty members and help develop online resources that could ensure efficient online instruction and e-learning), and, in the process, to encourage and use the contribution of educational departments in the university. Thus, coaches for professors and students could be available in order to create a teaching community and a learning community. Under such conditions, institutional leadership is significant in finding qualified human resources within and outside the university, which could enable the advanced and well-ahead organization of all learning activities. All this would build confidence in addressing learners' needs for both professors and students (Kessler et al., 2020, p. 596).

Changes in training academics should be implemented. Training with specialists is needed for designing e-content and e-tests (Edelhauser and Lupu-Dima, 2020, p. 27). Training is needed in online course design (a redesign of the material and content approach). Much time and patience are needed to identify the best teaching approaches for a certain subject matter and then for a topic within it. Students' feedback is important to improve the lecture and overall course activities (Gewin, 2020). To invite students to present their learning experiences can help adjust our teaching approaches (Sahu, 2020).

Student engagement is behavioural, cognitive, and emotional (Edelhauser and Lupu-Dima, 2020, p. 4). Students' self-regulation of their learning is required. To enable this, it is important for professors to receive students' feedback, even if anecdotal, while eye contact during synchronous online activities is important. Professors should provide detailed instructions, as more information about organization, coordination and solving tasks are required than in face-to-face interactions. A structured approached would ensure the necessary virtual environment for students to be able to learn independently. At the same time, students should become self-accountable during online assessment, their professional training and future practice depending on this awareness of their responsibility (Vanka, Vanka and Wali, 2020).

So far, research shows that in order to ensure accessibility and quality of online education, one needs to be succinct, to reduce goals or the number of course objectives that can be attained (Gewin, 2020), this meaning to focus on the core learning objectives that can be *achieved with the available tools and resources*, to reduce cognitive load and increase interactivity (Mukhtar et al., 2020, p. 27), to adopt a combination of synchronous and asynchronous instruction, to support students' learning styles, to provide "leaner-generated contexts and content" (Edelhauser and Lupu-Dima, 2020, p. 4), which is at least co-creating content and materials with students, involving them in a process of active learning, to identify and support struggling students, and use software that can detect cheating and plagiarism (Mukhtar et al., 2020, p. 30).

Training in e-teaching is necessary for faculty members and training in e-learning is necessary for students. Availability of a website with sharable IT and pedagogy resources, of internal discussion forums about resources and best practices in the virtual educational environment, is compulsory for successful online university education. Thus, offering pedagogical support for remote learning should be realized also in the form of a central university website with resources for online teaching, a unique and reliable place with a set of sharable materials. To develop remote teaching resources and remote learning materials on a common space should be grounded in learning research (Kessler et al., 2020, p. 594). The website should have one section on pedagogy, led by those who are experienced in online teaching and one about IT support tools.

This new website with resources for faculty (to teach) and for students (to learn), could also host community events, where good practices are shared, concerned with the use of technology to support online teaching and learning. Complementarily, the higher education institution should provide faculty members with virtual sessions and tutorials on online teaching (webinars and training sessions) and should provide proactive support for all students (including tailor-made support for the vulnerable categories) (Kessler et al., 2020, pp. 592-593). To sum up, studies advocate for fast and permanent educational and information support for academics and students (Terenko and Ogienko, 2020).

Also, social media during the COVID-19 crisis has proven useful for a sustainable management of higher education. Research shows that traditional communication is revolutionized by social media and contributes greatly to the following areas: administrative resilience, education sustainability, community responsibility, students' positive feeling, community bonds, and delivery of promised value, in an integrated strategy able to answer efficiently to users' needs and questions (AI-Youbi et al., 2020, p. 1, p. 5). A social media account of the university and of the faculty, having the following higher education management uses during the pandemic is advised for and aims at educational sustainability: "online defence for master's and doctoral students; student award announcements for various online competitions; online short courses on using Blackboard and online meeting platforms; communication […] of spiritual, reassuring and encouraging messages to students, helping them to be positive and to overcome the side effects of the pandemic; disabled students and students with autism [to be] provided with specialized online courses to keep them engaged in the academic environment during COVID-19 pandemic; academic advice and psychological counselling" (AI-Youbi et al., 2020, p. 13). To do this, more investment in needed in digital learning.

3.3.3. Social and psychological recommendations

Self-awareness, self-motivation, along emotional stability, are very important for professors' and students' mental health. Therefore, studies discuss solutions to reduce isolation, to ensure effective learning, and inclusiveness for socially vulnerable students, considering community, creativity, and connectivity (Kalloo, Mitchell and Kamalodeen, 2020).

To sum up, all those involved in online education should show flexibility and patience. Recent research on university online education during the COVID-19 pandemic offers plenty of advice on IT and pedagogy, the most frequent recommendations being concerned with teaching and assessment (reduced cognitive load, faculty development, increased interactivity, case based-learning, revision classes, proper assessment, development of standard operating procedures), and quality enhancement (proctoring, using premium applications) (Mukhtar et al., 2020, p. 4).

3.4. Geography Online Education

The Faculty of Geography at Babeş-Bolyai University in Cluj-Napoca, Romania, traditionally provides mainly presence training, with physical lectures, and, at present (Fall semester of the 2020-2021 academic year), educational activities are performed exclusively online, encouraging lectures on conferencing platforms.

Although striving to take e-teaching and e-learning from an elementary to an advanced form, certain difficulties cannot be solved because of the special conditions or the equipment required for unfolding activities, like in the case of Physical and Technical Geography. Thus, the requirements of practical subjects cannot be met. The same situation is true for field trips or in the case of in-service training in state and private institutions and companies. Also, difficulties appear especially for highly dialogic lectures and seminars, where professors act as facilitators.

Making teaching materials available for other colleagues, sharing materials and experience in e-teaching and e-learning, and getting feedback from peers and students should be supported both at the leadership level and technologically, by making available a dedicated shared online space. Resources for e-learning should be on a single platform of the university or of the faculty. However, similar to other faculties in universities worldwide, quality of delivery depends on the professors' technological skills and quality of their hardware at home, not only on their professional/subject-based and pedagogical knowledge.

4. Conclusions

My paper provides information for a successful use of e-learning, aiming at the policy makers in universities and faculties to revise and improve the current situation of the educational process. The above-mentioned results of the literature review and participant observation could pave the way to improved online education. At the same time, it should be considered how learning takes place online, being aware of the pedagogy of online teaching and e-learning.

Literature argues that our attitudes and behaviour towards online teaching will change, online learning will change learning styles and teaching styles and various reports on current approaches to online learning enable us reimagine universities and the roles of academics and students. However, for quality e-learning, time, expertise, and investments are required, as pedagogical skills in e-teaching and e-learning are necessary and the human resource should be trained considering that, at present, many are unprepared for the digital challenges in education. Higher digital literacy of professors and students is needed.

Although results show that online education trains students to be self-directed learners, which is important for lifelong learning (Mukhtar et al., 2020, p. 30), so far, the effectiveness of e-learning is merely anecdotal, as more research is needed to understand how online education can replace and whether it should replace (at least in pandemic times) face-to-face classes (Moorhouse, 2020, p. 3). In addition, close collaboration of professors, students, and technicians is mandatory for successful implementation of online education, while flexibility is a keyword for success in e-learning.

Finally, focus should be not only on how contents is taught, but also on what is taught and can be taught by means of a specific technology (Walwyn, 2020, p. 1). Therefore, both the teaching practice (i.e. pedagogy) and the contents should be rethought to match each other.

Meanwhile, struggling to find the balance between a dystopian perspective (e-learning is time-consuming and ineffective) and a utopian one (e-learning should completely replace the classical face-to-face education), this health, societal and educational crisis caused by the COVID-19 pandemic could be considered an opportunity to look for alternatives to the traditional ways of formal education.

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Valorization of Educational Platforms in Teaching-Learning-Evaluation in Romania. Comparative Study

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Abstract

After the suspension of face-to-face activities, teachers used various social media platforms and applications adopted by the educational environment. We comparatively analyzed, from the user's perspective, several platforms that were used predominantly by teachers both at K-12 and university education. The following platforms were analyzed: Microsoft Teams, Moodle, Wand.education, Livresq, Google Meet and Zoom. We found that in Romania, at the university level, teaching activities for part-time study programs and open distance learning programs, take place formally, on specialized platforms that ensure learning management in compliance with certain rules, but also by providing additional resources by using other applications. In universities, the teaching activities within the study programs with frequency were carried out either on specialized platforms or on videoconferencing platforms and/ or by using other applications and tools. At K-12 level, they used private, informal educational platforms, which offered educational resources, facilities, and tools for their creation and for the integral organization of online teaching activities. If at the university level there is a small degree of sharing of educational resources, visible in the use of platforms, at K-12 level, a greater willingness to share personal experience and a rapid transfer of information are characteristic.

Keywords: COVID-19 pandemic, Educational platforms, University, Pre-university education, Online training

1. Introduction and Theoretical Background

The COVID-19 pandemic forced educational institutions to reinvent themselves in order to overcome the generated crisis situation. In the new teaching-learning scenarios, online teaching is a must, challenging educators to reflect and assess the usefulness of the new technologies (Nuere and de Miguel, 2020). In Romania, especially at the university level, eLearning platforms are largely used, among the most popular ones being those that encourage collaboration during the educational activities (e.g. those designed by Microsoft and Google) (Edelhauser and Lupu-Dima, 2020). However, online video-conferencing platforms are not fully adapted to the new users' educational needs, particularly in what teamwork is concerned (Peisachovich et al., 2020). Thus, research focuses on identifying the benefits and challenges of distance-learning (Prokopenko and Berezhna, 2020), as well as on the opportunities provided by the digital pedagogy and interactive online learning (Terenko and Ogienko, 2020).

In Romania, after the suspension of face-to-face courses on March 11, 2020, teachers had to find solutions to continue the teaching activities (Botnariuc et al., 2020). They used different social media platforms and applications adopted by the educational environment for communication with students, parents and other teachers, for collaboration: e-mail and groups (Google, Yahoo), instant messaging (IM) (Skype, WhatsApp) (Holotescu and Grosseck, 2014), an approach supported by previous history of using ICT and online education in Romania (Magdaş and Pop, 2015; Magdaş and Răduţ-Taciu, 2016; Manea and Stan, 2016, 2018; Vlada and Jugureanu, 2007; Vlada, Jugureanu and Albeanu, 2011; Vlada, Jugureanu and Istrate, 2009; Vlada et al., 2010). For sharing educational content with users, they also considered other applications such as: social networks (Facebook), Youtube (video sharing), Instagram (image sharing), Prezi and Slideshare (presentation sharing), Scribd (Files/ documents/ books sharing), wiki collaborative spaces (Wikispaces, MediaWiki), Digital storytelling and others (Holotescu and Grosseck, 2014). In the settlements without internet access, the teacher-student communication was done by phone and by innovative methods. For example, the "store" method consists in leaving the worksheets at the village store, in order to be taken over by the parents and taken to the children for solving and be returned later (Andrei, 2020).

In this research, we will analyze comparatively, from the user's perspective, several platforms that were used predominantly by professors and teachers in the context of the rapid transition from face-to-face educational activity to online, a situation in which teachers had to identify and use software solutions and technical ways to ensure the continuity of teaching with university students or pupils.

2. Methodology

Data Collecting, Procedure and Research Material. We collected some of the data through the observation method: the activity carried out by teachers and students on platforms, modalities of log in and communication, platform design, structure, and appearance of the screen during the activity. Data on the use of platforms (operation, difficulties, advantages) we collected through the interview method. We subjected the platforms to a subjective and repetitive analysis regarding structure, tools, facilities, and functionality (Băban, 2002; Ilovan and Doroftei, 2017). The research material consisted of the content provided by the analyzed platforms, the observations resulting from the monitoring of the activities on the platforms and the answers to the questions from the interview.

Participants. In the research, the authors of this study were involved. They were in a position to use for educational purposes various platforms at university and pre-university level, from the perspective of the teacher/professor and of the student. At both levels (university and pre-university) and from both perspectives (professor or student), researchers are actively involved and faced with several challenges.

3. Results and discussions

3.1. Online Learning Platforms

The educational systems presented in various sources use a wide variety of platforms for organizing the online teaching-learning-assessment activity. Whittemore (2020) identified six types of online learning platforms: Learning Destination Sites (LDS), Traditional Learning

Management System (LMS), Open Source Learning Management System, Modern Learning Management Solutions, Learning Management Ecosystems, and Custom-Built Learning Platform.

Learning Destination Sites (LDS) is a shared website that offers courses from several different providers (e.g. Coursera). It provides tools for creating courses, which are then uploaded to the site (Whittemore, 2020). Traditional Learning Management System (LMS) provides means for creating, storing, sharing courses, conducting tests and questionnaires, managing learning, reporting grades and progress, and other simple functionalities required (e.g. Blackboard) (Blackboard, 2020; Hutchinson, 2019; Whittemore, 2020). Open Source Learning Management System is a platform similar to L.M.S, but which offers free functionality for an online course and can be customized (for example, Moodle) (Whittemore, 2020).

Unified Communication and Collaboration Systems (UC&C) are platforms (e.g. Microsoft Teams) that allow information storage, audio and video communication, evaluation, and integration of applications. They have an interface for mobile terminals and can accommodate many users (Microsoft, 2020). Video and Teleconferencing Systems are not like the previous ones but are used for virtual classes due to their ease of conducting synchronous audiovisual virtual meetings (e.g. Zoom). They have limited facilities for personalization, group management, time, or information management, do not offer online feedback or evaluation solutions (Zoom Video Communication, 2020). Studies conducted in Romania during the Covid-19 pandemic claim that most surveyed teachers chose video conferencing platforms as working tools precisely because of their accessibility, freeness, and simplicity of use (Botnariuc et al., 2020).

3.2. Microsoft Teams and Moodle

At Babeș-Bolyai University, both platforms are used, in particular for the organization of open distance learning and part-time education. The activity is managed by the Center for Continuing, Distance and Low Frequency Education, being provided specialized assistance in informatics. In the context of the Covid-19 pandemic, at the institutional level, for full-time study programs, teachers were able to create "virtual classes" independently on the Microsoft Teams platform to ensure the continuity of courses, seminars, assessment activities and more. In parallel with the activity on the two platforms, the teachers used other online platforms or applications (Google Drive, Google Meet, Zoom, Skype, closed Facebook groups, etc.).

Moodle (Modular Object-Oriented Dynamic Learning Environment) is one of the most used Open Source LMS platforms, a Virtual Learning Space. The Moodle project has been under development since 2001, being coordinated by the Australian company Moodle HQ (Moodle, 2020). The platform is free, it is constantly improved, the latest version is from 2010. Microsoft Teams is a unified communication and collaboration system available for a fee (Office 365, $ 5 per month for each user). It offers a free version (Office 365 E) and a test package, which can be used for 6 months (Microsoft, Microsoft 365, 2020).

From the analysis of the use of these platforms, we found that they are also available for mobile devices (phone, tablet, etc.) and that they allow the secure organization of classes by teachers, students having access only to their class, based on passwords. Compared to conference platforms, students can enter to platform in their group, whenever they want, and outside of scheduled meetings, without requiring direct acceptance from the group organizer.

Both platforms offer tools for organizing teaching-learning activities (lectures, seminars, case studies, debates), evaluation (quizzes with different types of items; the possibility of creating questionnaires), collecting and centralizing answers. The platforms offer tools for the transmission and evaluation of homework, for teacher's visualizing of students' written documents and for providing feedback. Both platforms allow uploading interactive and multimedia materials on the platform, recording and saving lessons / courses in the cloud, storing information in the cloud and managing resources (course materials, auxiliary teaching materials, audio or video files).

Both platforms allow audio and video communication but initiating a video session on Moodle is not as intuitive as in Microsoft Teams, requiring some experience and documentation. If the teacher records a video session on Microsoft Teams, the recording is saved in Microsoft Stream and, depending on the option of the record holder, it can be viewed by other people in the institution who are enroled on Microsoft Teams even if they are not part of that virtual class. Moodle allows fast and efficient communication between users of the platform through Chat or Forum tools, allows the organization of collaborative activities, in which students, working in groups can share their own experiences with others and can learn from each other.

Microsoft Teams provide chat, and the teacher can use or restrict communication, and, if necessary, conduct an interactive chat. The teacher can call any person in Teams even if they do not have the application open and can use or restrict the microphone, as appropriate. From the didactical perspective, both platforms allow share screen by teachers or students. Thus, is possible to share teaching materials with students, using the virtual whiteboard, accessing documents (PowerPoint presentations, word documents, charts, maps, schematic drawings, animated films, and documentaries, etc.) from the computer or from the Internet. Microsoft Teams allows recording, watching, and downloading an audio-video activity carried out on the platform, an important feature in situations where the student has not attended an activity or wants to review the activity.

At the end of the analysis, we mention a few aspects. At distance and low frequency education, the weakness is that the materials uploaded to the platform in one year are archived and must be reloaded the following year. Regarding the didactic activity carried out with the students from the full-time study programs, we noticed that the teachers also used hybrid solutions. In the situation where there were series of students who went through the same study programs in full time or distance/low frequency mode, to increase the volume of resources offered and their access to interactive activities in which students have different levels of competence (student, novice, who were preparing to become teachers and senior teachers in education), all students had been included in closed groups on the social network Facebook. For the written assessment, some teachers took tests in Google Forms, and for oral assessments, they used video conferencing platforms on Zoom or Google Meet and other applications. To increase the efficiency of the activity, both from the perspective of the professor and the students, it would be preferable to use a single platform, for the student being difficult if each teacher uses different e-learning solutions.

3.3. Wand.education and Livresq

For the pre-university level, we chose these two platforms that we frame at Learning Destination Sites (LDS), both of which are shared websites that offer educational resources from many different providers.

Wand.education is an online educational platform created for teachers who are looking for a solution that is easy to adopt in the teaching process, fast and creative in producing educational content for teaching and assessment. Wand.education™ was launched by Siveco Belgium, the Brussels subsidiary of Siveco Romania S.A. (Siveco, 2020). The platform is available in English and Romanian. The platform is constantly updated. Starting with December 5, 2016 (Siveco, 2020), teachers were able to create their Wand Create account permanently free of charge, thus having immediate access to 512 Mb of storage space (for 15+ learning activities, Student Groups), Multimedia Resource Library, at the Lesson Library created by other teachers, at the Learning Reports. The platform offers tutorials that guide the teacher in using this platform. In 2018, the House of Teaching Staff Bacău organized: "Design, development and evaluation of learning activities using virtual platforms; Wand" training courses. There are over 5,000 Romanian teachers who use this platform for free (5th May 2020) (digitaledu, 2020).

LIVRESQ is an online platform for the creation, publication, editing, consultation and online management of interactive digital textbooks, books, and materials. It was created by Ascendia S.A. and launched on August 6, 2019 in Bucharest (Ascendia S.A., 2020). The platform is constantly updated. Teachers can create a free livresq account for a year. The teacher receives support from the technical team but can also access various tutorials that present the LIVRESQ platform and how to work. Between the 1st of March 2020 and the 1st of July 2020, teachers from over 4,000 educational institutions created accounts on the platform and published 1,409 interactive lessons (ElearningRomania, 2020). Lessons made in LIVRESQ can be published on school websites, in learning platforms, in blogs, and can be downloaded for use without the Internet. The LIVRESQ virtual library contains lessons published free of charge by teachers. These lessons can be used by any teacher in teaching, without the need to create an account on the platform. The certification program "Creator of educational software LIVRESQ" for teachers has been launched (Ascendia S.A., 2020). Following the publication of three lessons on this platform, teachers receive a software creator certificate.

Both platforms are available for computer, android, and tablet. Educational resources are stored in the library. From here the teacher can choose, download, and edit lessons designed by other colleagues or can create their own educational resources. The LIVRESQ platform allows the creation of more diverse types of materials (online lessons, textbooks, workbooks, atlases, magazines, newspapers, tests), than the Wand.education platform which allows the realization of a smaller number of materials types (online lessons, tests and homework assignments). On both platforms, the teacher can access editable content (projects, sections, resources, effects) already created and can add this content to personal projects. With a minimum of informatics technology knowledge, teachers can create complete lessons, assessments, animated and interactive games. In designing educational resources, teacher have the opportunity to enter images, audio and video files, text with several types of formats (.pdf, .word), and can add hyperlinks of any type of resource. The resources created can be private or public, uploaded to the library. The teacher can customize and send educational content to students using Groups.

The two platforms allow the creation of assessment sheets with pre-validated answers. Both platforms have functions for grading, assessment, and monitoring of pupils' schooling. Teachers can see what the students have learned and where they have gaps in knowledge, and can send them feedback, and follow the results obtained in tests throughout the school year. Student performance can be summarized using reports. One can create report sheets for each student, but also for the whole class. Homework sent to students is accompanied by information on their start date, as well as the deadline by which homework can be completed, and students' progress can be monitored. Both platforms are easy to use by the teacher, there are video tutorials that coordinate the teacher in designing educational resources. The LIVRESQ platform offers teachers the technical and administrative support service for the homologation of digital lessons by Ministerul Educației și Cercetării [Ministry of Education and Research] (MEC). The lessons approved by the MEC will be highlighted in the Livresq library.

3.4. Google Meet and Zoom

Google Meet is a video communications service developed by Google, a version of which has been offered for free since May 2020 (Google, 2020). Teachers with a Google account can create a video activity of up to 60 minutes for free for up to 100 participants. Until September 30, 2020, an activity organized on the free version can last up to 24 hours. To participate in the activity, the teacher sends the link or meeting ID to all participants, and this link is active during the activity. In the case of recurring teaching activities, the link remains active during the time interval in which the activity is repeated with the same group. Only persons approved by the owner can participate in the activity. Guests can connect to online video conferencing from computers that have a modern web browser, without software installation, and from mobile devices, through Google Meet applications.

Zoom Meetings and Chat is provided by an American IT company Zoom Video Communications, Inc., from the USA, created in 2011 (Zoom Meetings and Chat, 2020). The application can be used on computer android and tablet but requires application download on the device. In the free version, one can initiate and conduct meetings of 40 minutes, which is an disadvantage, but one can have an unlimited number of meetings. The freeversion can host up to 100 participants. On the screen, 49 videos are accepted simultaneously, but when sharing the screen, the teacher can only see some of the participants in the video conference, which is a disadvantage. Paid packages ($ 15 for each host) offer several benefits/ services.

Both video conferencing platforms offer several facilities for teaching: sharing teaching materials with pupils or students, sharing screen, using a virtual whiteboard, accessing documents, computer/ internet educational clips, sharing and editing word files. Screen sharing is easily done by any participant on Google meet, but on Zoom.us, only with the owner's approval. Both offer the possibility to record individual or group activities (a video presentation) and allow saving the video in the cloud and later it can be sent to participants.

Registration on Zoom.us has the advantage of having less mega. Both offer the possibility of written communication through chat, in parallel with video communication, which allows the formulation of questions during the presentation and hearing of the conference/ lecture/ presentation/ activity, thus increasing the degree of interactivity of the activity. Through the "File" button in the chat, documents can be uploaded so that students download them during the lesson. Hyperlinks can also be sent to various study materials, or to various applications. The teacher can manage the use of microphones (closing to reduce disturbing sounds for hearing or to increase the accuracy of the sound from the source), he or she can invite a particular participant to exhibit or share a material on the screen.

The Zoom platform offers the possibility to use an interactive whiteboard by choosing the option "Whiteboard Share" on which you can draw, write, etc. Connected students can also contribute to this virtual board. Unlike the Microsoft Teams and Moodle platforms, these video conferencing platforms are more friendly and are more similar with face to face communication because the faces of the participants can be seen on the screen, which explains the teachers' preference to use them for teaching activities. From the audience's perspective, they can decide to cut the sound and image on their own device, a situation in which the teacher is not sure of students' authentic participation in the activity.

4. Conclusions

Regarding these case studies, several conclusions are outlined. In Romania at university level, the teaching activities for part-time study programs and open distance learning programs take place formally, on specialized platforms that ensure learning management (Microsoft Teams and Moodle), in compliance with certain rules, but also by providing additional resources using other applications. In the pandemic context, the teaching activities within the study programs with frequency were carried out either on specialized platforms, but initiated and managed by each teacher, or on videoconferencing platforms and/ or by using other applications and tools.

At K-12 level, we notice the existence of private, informal educational platforms, which offer educational resources, facilities and tools for their creation and for the integral organization of online teaching activities. If at university level, there is a low degree of sharing of educational resources, visible in the use of platforms, at K-12 level, it is specific a greater willingness to share personal experience and a rapid transfer of information, solutions to problem-situations in teachers' communities organized informally, especially through Facebook social network. At K-12 level, the two platforms analyzed indicate teachers' growing interest in creating multimedia educational content.

At the end of the study, we emphasize that activities in the virtual environment, on educational platforms of various types, require medium and high-level digital skills for teachers and large resources for preparing the content to be delivered. We also note that the degree of difficulty in managing the online activity is higher, compared to the face-to-face activity because the teacher uses, in parallel, a series of tools to deliver content to pupils and students and has fewer ways to monitor and direct the pupils' and students' activity.

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The Use of Animation Film in Studying Some Natural Phenomena and Forming Representations

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Abstract

Animation films that focus on narrative topics are frequently watched by pupils, while animation films that focus on natural phenomena are fewer and less watched. The purpose of this study is to analyse a learning activity that uses a film about the consequences of the Earth's rotation and revolutionary motions: the formation of days and nights and the formation of seasons. We analysed the following: the process of selecting the film, the activity of watching the film individually, at home, the activity carried out by the teacher and students on the Zoom platform, the students' results in three tests and in a gap text game, created with the Wordwall application. At the end of the research, we concluded that a learning activity in which animation films and interactive games are used and in which knowledge is mediated by the teacher is more effective than an individual viewing of an animation film about natural phenomena.

Keywords: Wordwall application, Rotation and revolutionary motions, Primary education, Zoom, e-learning, COVID-19

1. Introduction and Theoretical Background

The advantages and challenges of ICT and online learning are discussed more and more in the Romanian education system (Manea and Stan, 2016, 2018; Vlada and Jugureanu, 2007; Vlada, Jugureanu and Albeanu, 2011; Vlada, Jugureanu and Istrate, 2009; Vlada et al., 2010). In the literature, the importance of animated films for knowledge and learning is mentioned. The phenomena that occur at the macroscopic or microscopic level can be attractively illustrated by animated films. Computer modelling and animations are used to describe, explain, and predict processes, contributing to science and education (Barak, Ashkar and Dori, 2011; Petrişor, 2015;

Petrişor and Petrişor, 2017, 2018). Animation can provide dynamic information that is not visible or available in static visuals (Lowe, 2003). Through animation films, dangerous phenomena are represented (Dulamă, 2001, 2008, 2013), such as volcanic eruptions, atmospheric phenomena (Vereș, Dulamă and Magdaș, 2020), geomorphological (Dulamă and Gurscă, 2006), hydrological, cosmic systems (Vereș and Magdaș, 2020) and others (Dulamă and Ilovan, 2007). Animations are used to improve the transitions from abstract to concrete mental operations and vice versa (Barak and Dori, 2005; Dori and Belcher, 2005).

The teacher has an essential role in the correct and deep understanding of the contents represented in the animated films, in establishing the connections between the old knowledge and the new information presented in them (Vereș and Magdaș, 2020). In the process of deciphering the content of animated films, groups of children use various strategies (Maine and Hofmann, 2016). Eker and Karadeniz (2014) found an increase in students' academic performance and level of knowledge retention due to the use of animated films. Along with highlighting the role of animated films in learning, the literature claims that the use of game elements motivates students to learn and positively affects learning outcomes (Havola et al., 2020; Magdaș, Vereș and Dulamă, 2019).

The aim of the research is to investigate the role of animated films in understanding some natural phenomena that occur at the macroscopic level. We are looking for the answers to some questions: How do we find and choose the most appropriate film about the motions of the Earth and the consequences of these motions? What is the volume of knowledge gained as a result of students' individual viewing of the film? Is there a connection between the number of views of the film and the students' volume of knowledge? What is the role of the teacher after the students watched the animated film?

2. Material and Method

2.1. Research design. The research was conducted in August 2020. (1) In the first stage, we applied a pretest created in Google Drive (cf. Vlada, 2014) to the children, which we sent to them to chat on the Zoom.us platform, in order to establish the level of knowledge on the theme of the film and for sampling. In order to obtain the most accurate results, the students were invited to solve the items themselves. (2) In the second stage, we sent on the Facebook class group, the link to the animated film "Paxi - Day and Night. The Seasons," with the invitation to watch it alone, at home, with the specification of noting how many times they watched this movie, but without insisting on the movie to be viewed several times. (3) In the third stage, we applied the second test (posttest) to check the information volume acquired by children as a result of watching the movie. To determine the efficiency of the viewing, we asked the students, by turn, how many times they viewed the animated film. (4) In the fourth stage, we talked to the students on the Zoom.us platform, to check if they formed correct representations (knowledge) about the Earth's motions (route, duration, consequences) and about the formation of the seasons. We answered the students' questions, we explained and clarified the concepts (phenomena, processes) not understood by some of the children, based on a PowerPoint presentation realised by the teacher. (5) In the fifth stage, to fix the knowledge, the students played individually the game "Day and Night. The Seasons" created by the teacher. (6) In the sixth stage, we applied the retest created in Google Drive and sent it to the students on the Zoom.us platform, in the chat.

2.2. Data Collecting, Procedure and Research Material. The data were collected through the three tests applied to the students, from the discussions based on the film and from the game. We analysed the students' answers to the tests through the method of numerical analysis and content analysis. The text of the film was subjected to a thematic analysis of content, and we analysed the images in the film by visual methods. We analysed the individual learning activity carried out by students at home through an interview and the frontal activity carried out with students on the Zoom platform. The research material included the students' test results, the game, the students' answers to the interview and their own observations.

2.3. Participants. This research was attended by 11 first grade students from "Lucian Blaga" Gymnasium School, in Jibou, Sălaj County, Romania, astronomy enthusiasts participating in the "AstroKids" Summer School, organized by the primary school teacher of the class, the first author, Ph.D. student at Babeș-Bolyai University. Students were selected based on the initial test to have a similar level of knowledge and form a homogenous group based on this. One student participated in tests and activities, but was excluded from the research because he obtained poorer results in the posttest although he watched the film several times and this result was explained by the presence of another child of the same age who represented a disruptive factor. Students made the connection and entry on Zoom.us themselves because during this period they participated in many online activities.

3. Results and Discussions

3.1. Analysis of the animation film selection process

To choose the most suitable animated film for the theme "Earth's Motions and the Formation of the Seasons," we watched on YouTube several animated films: "Paxi - Day and Night. The Seasons" offered by the European Space Agency ESA (2017), "Day and Night, video for kids" and "Seasons in Earth - video for kids" offered by Learning Junction (2017, 2018), "Day and Night Explanation, Causes. Science for Kids" offered by Makemegenius (2014). We selected the animated film taking into account the previously identified criteria: soundtrack in Romanian, explanations offered by an animated character, known to children, short duration, content adapted to the children's age and level of knowledge (Vereș, Dulamă and Magdaș, 2020), and the existence of the explanation for the formation of days, nights and seasons.

3.2. Analysis of the animation film

The film "Paxi - Day and Night. The Seasons" is part of a series of films in which the main character is Paxi, an alien from the planet Ally-O, who plays the role of a guide who came to Earth on vacation and helps children discover the world. Paxi approaches the children as friends with whom he "had so many adventures in space", he addresses them familiarly ("I'm glad to see you again!"). The duration of the film (3.52 minutes) is optimal for children aged 7-8. The oral text of the film (482 words) is a collage of narrative texts, explanatory texts, and informative texts. Paxi tells, informs, explains, describes, and indicates. From a didactic perspective, Paxi stimulates and motivates children for knowledge, arouses their curiosity, invites them to a journey, to an adventure in space, initiates them to observe cosmic bodies and their dynamics and to ask questions. He puts them in trouble and helps them see the contradictions ("It looks like the Sun is moving around the Earth. But is this really happening?"; "The Earth orbits the Sun"; From Earth, it looks like "the Sun and the stars move, but in fact it is the Earth that revolves").

In this narrative context, the film provides a lot of scientific information, and of this, about 30 concepts are needed to understand the formation of days, nights, and seasons. Many concepts are specific to astronomy (rotational motion, revolutionary motion, Earth's axis), to physics (optical phenomena: light, brightness, optical illusion, day, night, sunset, sunrise), to geography (effects of rotational motion and revolutionary motion).

3.3. Analysis of how to increase the interactivity degree of the lesson by using the *Wordwall* platform

The platform for creating educational resources, *Wordwall*, offers the possibility of creating interactive activities and printable teaching materials. We created the game “Day and Night. The Seasons” (Vereș, 2020) using the “Missing Word” template provided by the platform. We designed a series of incomplete sentences and, in each of them, the children chose the right word from a list of 3 answers (Table 1).

Table 1. The game “Day and Night. The Seasons”

Statement	Correct answer	Wrong answers
The earth receives light and heat from ...	Sun	Moon; Mars
The rotational motion of the Earth around its axis is done in … hours.	24	23; 25
When the Sun … begins the day.	Rises	Sets; stay up
The imaginary line that connects the North Pole with the South Pole, and around which the Earth revolves, is called …	Axis	Orbit; Moon
The Earth makes a complete rotation around the Sun during …	365 days and 6 hours	365 days; 366 days
Compared to the surface of the orbit, the axis of the Earth is …	Tilted	Right; horizontal
When the Earth is tilted with the northern hemisphere toward the Sun, in the northern hemisphere is the season …	Summer	Spring; winter
The length of the days is longer in the season …	Summer	Winter; spring
When the Earth is tilted with the southern hemisphere toward the Sun, in the northern hemisphere is the season …	Winter	Spring; autumn
The formation … is influenced by the inclination of the Earth’s axis.	Of the seasons	Of days; of nights

Children must give the correct answers within a time frame given by the teacher, and at the end of the game, they receive the result (correct and wrong answers), the correct answer to the question they answered wrong, the place in the class ranking.

3.4. Analysis of the teaching activity

Watching the film. The students watched the film at home as many times as they wanted, at the time of their choice. To determine if there is a link between the number of views and the results in the posttest, in the discussion with the group on the Zoom platform, when the teacher asked how many times they watched it, we found that three students watched the movie once, four students watched it two times, and four students watched it three or more times. The students who watched the animated film several times are passionate about the topic and motivated that they were curious, that they found the film interesting, that they wanted to better understand its content, that they wanted to clarify some information, to retain and learn it. Four students discussed the content of the film with their parents or older siblings.

Discussions with the teacher and colleagues based on the film. In the 45-minute meeting, initiated on Zoom.us, we discussed the content of the film with the students. We asked them, in turn, to say what they found difficult to understand, what they did not understand. The children asked “what is the South Pole and the North Pole,” “why it is summer when the Earth is farther from the Sun.” We found that they had misrepresentations of the position of the Sun in the Solar

System (they believed that the Sun is the one that moves) and that not everyone understood how the revolutionary motion of the Earth is realized. We used a PowerPoint material through which we explained these notions.

We supported the students to notice that the Earth received light from the Sun, that on the illuminated side it was day, and on the opposite side it was night. We explained the formation of days and nights. We explained the difference between the real size of the Sun, compared to the Earth, we specified the real distance between the two cosmic bodies and the length of time that elapsed while light moved between them. We directed the students to observe the axis of the Earth, its inclination to the plane of the orbit and we helped them understand that, due to this fact and the shape of the planet, the sun's rays did not distribute evenly heat and light over the entire surface of the Earth. We explained the formation of the seasons as a consequence of the inclination of the axis of rotation and of the rotational and revolutionary motions of the Earth. In the absence of these explanations, animated films and cartoon representations of the revolutionary motions can lead to the formation of misrepresentations about the Sun and the Earth, their motions, and the consequences of these motions.

The game. In the last 10 minutes of the activity, we sent the children, via chat, the link to the game "Day and Night. The Seasons" created on Wordwall. All the children participated happily. At the end of the game, everyone said that they found it interesting and that they could learn from mistakes. At the end of the game, the students received the analysis of the answers, and the place they occupied in the class ranking.

3.5. Analysis of student results

The grade point average of the class in *Test 1 (pretest)* was 9.73, indicating that students have the prior knowledge necessary to understand the content of the animated film. Students obtained an average of 8.09 in *Test 2 (posttest),* which is lower than in the initial test. The range of scores was between 7 and 9. The result can be explained by the fact that this test included items with a higher degree of difficulty and that could be solved only if students understood correctly the motions of the Earth and the formation of seasons, as well as other concepts and if their knowledge is well fixed in memory. In Table 2, the connection between the number of views of the animated film and the results obtained by the students is observed. We found that a single viewing of the animated film does not lead to a thorough acquisition of knowledge regarding the formation of days, nights and seasons, the rotational motion and the revolutionary motion of the Earth. Although they have watched the film several times, in order to understand the phenomena and processes represented, students need a teacher to explain the content of the watched film.

Table 2. Number of views of the animated film and the students' results in the posttest

Number of students	Number of views	Average
3	1	7.33
4	2	7.75
3	3	9
1	5	9

The results of the students in *Test 3* were better, compared to the previous test (m - 9.91), which indicates the efficiency of the activity carried out together with the teacher. 10 students obtained the maximum score. The average obtained by the students at the game "Day and Night. The Seasons" was very high (m - 9.45). Analysing the students' results in the three tests and the applied game (Table 3), we find that the students have made progress.

Table 3. Students' results in the three tests and game

Test 1 (Pretest)	Test 2 (Posttest)	Game	Test 3
9.73	8.09	9.45	9.91

4. Conclusions

In this research, we found that students watch with interest animated films about cosmic bodies. The results indicate that a single viewing of the animated film is not enough to understand and acquire the knowledge about the rotational and revolutionary motion of the Earth, the formation of days, nights, and seasons. We found that the teacher has an important role in students' correct representations formed on the basis of the film, especially in situations where some aspects of reality cannot be represented correctly (shape and size of cosmic bodies, distances between them) or require explanations wider and additional visual aids to facilitate understanding.

The teacher can involve students in an interactive activity on the Zoom platform, after they have been involved in a learning situation based on perception, in which they had a passive role, as spectators. Through the discussion on the platform and through the tools offered by various applications (Google Drives, Wordwall), the teacher increases the degree of teacher-student interactivity, provides additional information, asks questions, listens to answers and provides feedback, leading to active learning, which results in the understanding, deepening and fixing of knowledge by students. Finally, we consider that a learning activity in which the animation film and the interactive game are used and in which knowledge is mediated by the teacher is more effective than an individual viewing of an animation film about natural phenomena.

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Educational Films in Understanding the Relations of Organisms with Their Living Environment

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Abstract

The purpose of this research is to analyse how two educational videos from YouTube could be useful for learning activities. The content of these videos refers to the environmental adaptation of forest creatures during autumn and winter. Thus an online experiment was designed, on Zoom platform, which was structured in several stages: the initial testing; the pupils' individual watching of two educational videos, on their own, at home; the after watching testing; the learning activity based on conversations held on Zoom platform; playing an interactive game with the help of Mentimeter; the final testing. Considering the analysis of the videos, the unfolded activities, and the results obtained by the pupils from the primary education cycle, the efficiency of both learning strategies used by the teacher and educational videos were equally established.

Keywords:Mentimeter application, Online education, Learning platform, Primary education, Zoom

1. Introduction and Theoretical Background

Visual Technology is a way to bring the world to the student (Good, 2019), to enable the study of faraway places, of dangerous phenomena or of those that happen within a wide area and taking much time (DulamăandRoșcovan, 2007). Films and videos are an excellent way for children to observe the components of the environment, where plants and animals live, as well as their influence on the living creatures (Dulamă, 2012). They contribute to the process of raising awareness about the vulnerability, resilience and sustainability of geographical systems and of the complex relationships within our living environment (Cocean and Ilovan, 2008;Petrișor, Petreand Meita, 2016; Petrișor, Meita and Petre, 2016; Roșian et al., 2016).

The field literature review shows teachers' tendency of using films and videos in order to facilitate the process of obtaining information about a certain topic (Michel, Roebersand

Schneider, 2007; Vereș andMagdaș, 2020), to assimilate concepts and to increase the level of knowledge (Wijnker et al., 2019), and to build representations about the environment (Dulamă and Ilovan, 2007).

Teachers use various films with educational purpose, even animations (Roosand Van den Bulck, 2019; Vereș, Dulamă andMagdaș, 2019, 2020),a great variety of videos that can be classified in terms of quantity and structure of the information, the audio-visual way of presenting the contents (Wijnker et al., 2019).

Some studies state that by means of the films and videos, not only the interest for knowledge is stimulated, but also the efficiency of teaching, the received volume of information and its long lasting is equally enhanced (Markiewicz-Patkowska et al., 2019). Previous research proved that both the right educational film and the teacher's guidance on the understanding process related to the representation of the visual content, help pupils from the primary school to improve their observation and thinking skills, to build proper representation about the environment and to increase the production of knowledge (Ilieand Cristea, 2020;Ilie et al., 2020).

In the context of previous research on implementing educational software and products in Romania (Vlada and Jugureanu, 2007; Vlada, Jugureanu and Istrate, 2009), the aim of the study is to investigate the role of the educational films and videos in understanding the relationship between organisms and their living environment. Furthermore, we seek answers to several questions: How do we find and choose the most appropriate educational videos to show the relationship between plants and wild animals in the woods? Which is the volume of knowledge gained by the pupils after watching on their own the suggested videos? What role does the teacher play afterwards, when the pupils had already watched the videos?

2. Material and Method

2.1. Research design

In August2020, we prepared a learning activity that included the following steps: first, a knowledge test was shared on the classroom's Facebook group, then the links for two educational videos about understanding the environment - organism interaction were posted. The pupils were asked to watch them attentively, on their own, at home (the reverse learning method), thus having the opportunity to watch them again in case of need. After pupils confirmed that they had watched the two videos, we created a Messenger group chat where we added solely the parents whose children had previously filled out Test no. 1 (the initial test) and watched the films. In this chat group, after the independent watching of the videos, the second test was uploaded, using Google Forms once again, in order to verify if the pupils' level of knowledge about the influence of the environment on the organisms increased.

We organised two asynchronousmeetings, on Zoom platform, where we discussed the topics of the two videos with the pupils, making sure that the concepts were correctly understood, as well as the relationships between plants and wild animals and the environment where they lived in (the forest, during autumn and winter season). At the end of the discussion, the pupils played a game in real time (a game designed by means of the Mentimeter) and got the chance to check the answers and the results at the end of the game.

The last step involved solving the third test, characterised by a higher degree of difficulty, which had the same purpose as the two previously applied tests. All three tests were intermediated by the parents who read the items to their children, while the pupils were the ones who checked the right answers. They were all familiar with this type of questionnaire because it was constantly used during the online learning system, on Zoom platform. It is worth mentioning that neither the questionnaire, nor Mentimeter as evaluation tools were used for the first time in the process of learning. The latter was engaged in an extracurricular activity, that was held online, with a banking company.

2.2. Data Collecting, Procedure and Research Material.

Research data was provided by the answers to the three tests that were carried out, by the content and the manner in which the learning activity was performed, based on the two educational videos, and the results that the pupils received at the end of the designed game. Through the three tests, administered with the help of Google Forms and through the above mentioned game, we aimed to create learning contexts in which the pupils would define concepts (flora and fauna, species, organisms, herbivorous animals, carnivorous animals, hibernation), to indicate the components of the environment and food chains, to analyse the continental domain, the influence of the environmental factors on the plants and animals, the relationships within the ecosystem (forest). The pupils' answers at the three tests were subjected to both numerical analysis and content analysis. The speech from the two educational videos was analysed by means of the thematic analysis method, and the images through visual methods. We observed and analysed the learning activity performed on Zoom platform. Besides the answers to the items from the three tests, the research material was also represented by assertions during the discussion and the answers to the teacher's questions.

2.3. Participants

On this research, a number of 16 pupils in preschool from "Gh. Ruşeţ-Roznovanu", inRoznov, Neamț County, participated along with their teacher for primary education, the first author, who is also a Ph.D. student at Babeș-BolyaiUniversity in Cluj-Napoca. The selection of the participants was based on the initial test during which 19 pupils had filled in the first test, to have a similar level of knowledge and to form a group of the same level. Three pupils were excluded from the study because, despite the fact that they filled in the initial test, one of them did not watch the videos in the allocated time (two days), blaming the lack of access to technology because his parents were at work; another student filled in Test no. 2 without having seen the videos previously and the third pupil could not take part in the activity organised by the teacher, on Zoom platform, because the meeting unfolded while his both parents were at work and he was not able to connect to the platform (he could only use his parents' phones).

3. Results and Discussions

3.1. Selection process analysis of the educational videos

Finding the most appropriate video started on YouTube website, known for the wide collection of films and videos that can be used for educational purposes. According to the present operational objectives, the following keywords "wild animals of the forest" were entered into the search engine. A series of videos were listed below, which were sequentially watched. The one with comments and explanations was considered to be a better option for the educational purpose of the activity than the videos that only had a musical background (Ilieand Cristea, 2020).

"Wildlife in Bukovina's Mountains during Autumn" was the first option, given all the additional written information. While watching this documentary, a series of recommended videos emerged, among which, the second part of the previously selected educational film, entitled "Wildlife in Bukovina's Mountains during Winter." This was also chosen as learning material.

Next, the presented information was written down in order to extract the main ideas from the two videos for the future learning strategies. The process of selection was quite difficult given the fact that the films had to match a topic and, to do so, a great amount of time was spent on watching and selecting them. Furthermore, they had to correspond to several criteria identified in previous research (design, purpose, author, time, filming position, destination, speed (Ilie et al., 2020).

3.2. Analysis of the educational videos

The two educational films, selected from YouTube, present the influence of the environment on the organisms who live in the forest, during autumn and winter seasons. The first educational video ("Wildlife in Bukovina's Mountains during Autumn", 2014,https://www.youtube.com/watch?v=vf6-onHMyGQ) lasts for 27 minutes and 41 seconds, while the second one ("Wildlife in Bukovina's Mountains during Winter", 2015,https://www.youtube.com/watch?v=tJT8KoYxsR4) lasts for 30 minutes and 33 seconds. Both videos were created by "Wild Bukovina" Association; documented with information by StelianBodnariandMarius MarcuOrhean; edited by StelianBodnari. These documentaries reveal aspects of the wildlife of the Bukovina's Mountains. Although the best average time length of an educational video is around 10-15 minutes (Ilieand Cristea, 2020), we decided to use the two above mentioned films because we took into account the fact that they would be seen by the pupils at home, on their own, in their own rhythm and at the right moments.

The videos fulfil several criteria of the previously stated ones in previous research: qualitative (clear image, normal frequencies of the video frames, soundtrack in Romanian), technical (digital formats, usable with the devices that teachers own), pedagogical (highlights the studied topic, the content matches the learning objectives and the characteristics of the pupils, allows the teacher to use different learning strategies) (Ilieand Cristea, 2020).

The oral speech of the first educational video (the one about autumn) contains 638 words, while the second one (about winter) contains 1,021 words. The main concepts from the documentaries refer to flora, fauna, species, organisms, herbivorous animals, carnivorous animals, hibernation, food chains, and the continental domain. The main ideas relate to the components of life environment, the influence of the environmental factors on plants, animals, and relationships within the respective ecosystem. The text of the documentaries is very valuable in terms of concepts' explanations and compatibility with the proposed topic. The added comments match the presented frames and complement the images.

3.3. Analysis of the interactivity degree enhancement of the lesson by using Mentimeter Application

Mentimeter is a digital instrument of brainstorming or feedback which allows creating both interactive presentations and interactions with virtual audiences in real-time, being used for making lessons more activating. The most important advantages of this application are the following: it does not need to be installed; each user can create unlimited events; the number of users is also unlimited; it allows data export; it intermediates the share of knowledge between pupils and teachers, having a wide range of presentation models.

With the help of this application, a three-slide presentation was designed. The first slide contained a multiple-choice item which required that pupils select the images of the plants that grow in the forest (nine right answers out of 13 possibly ones). The second slide asked them to choose 18 suitable options (out of a total of 25 probable right answers). The third slide showed the picture of the teacher and a thanking message which the pupils could react to by sending a heart symbol to express their satisfaction towards the solved tasks. The advantage of this evaluation instrument was represented by the feedback that the pupils received immediately on the mail address that they had inserted on the last slide.

3.4. The analysis of the educational activity

Watching the videos. During the discussion with the teacher, the pupils declared that they enjoyed watching the documentaries and the explanations of the author which were very interesting. One pupil watched the second video twice, motivating his action with the desire to see in chronological order both movies because he had initially started with the documentary about winter and, in addition to this, he wanted to see it on a larger screen (he passed from laptop to TV).

The fact that the other pupils did not watch again the videos was argued by the length of the documentaries and the short period of the time allocated for watching them (two days). The parents were asked not to provide further explanation or help their children to fill in the three tests. The pupils were happy to find out that they could also watch on YouTube, a similar video, focused on the life of plants and wild animals in the forest, during spring and summer ("Wildlife in Bukovina's Mountains during Spring-Summer", 2012, https://www.youtube.com/watch?v=5WWduPjgSD8, lasting for 30 minutes and 46 seconds). This educational movie was not on the list of recommendations, along with the other two videos, because the Autumn and Winter seasons presentations had already a high amount of informationand the pupils would have lost their interest in watching all of them in such a short time.

The discussion with the teacher and pupils. Firstly, an asynchronous meeting was held on Zoom platform, but due to the high number of pupils who took part in this research, a second meeting was organised right afterwards, in order to offer them the possibility to detail the issues and potential difficulties that they confronted while watching the documentaries. During the discussion, questions from the first two tests were addressed with the purpose of verifying the representations that the pupils had built in their minds based on the documentaries, of helping them to build proper representations and offering them appropriate feedback. The dialogue with the pupils included questions like: *What kind of plants grow in the forest? What type of wild animals live in the forest? What kind of animals eat only plants? What is the name of the deer female? What is the name of the venomous snake which lives in the forest? What type of plant grows in the forest in shady places? What is the name of the fir fruit? What does the wild cat eat? What kind of animals eat only meat?*

A series of other topics were equally brought into discussion with the pupils: hibernation, food, and birds' migration, the falling of the tree leaves, the relationship between plants, animals and water, the adaptation of the animals to low temperatures, life and behaviour of deer (how females become more affectionate and males begin to thump), the adjustment of animals to the environment and survival strategies, measures of preservation of the species.

The pupils improved their knowledge about the influence of the environment on the organisms, as the discussion with the teacher during the online activity showed.

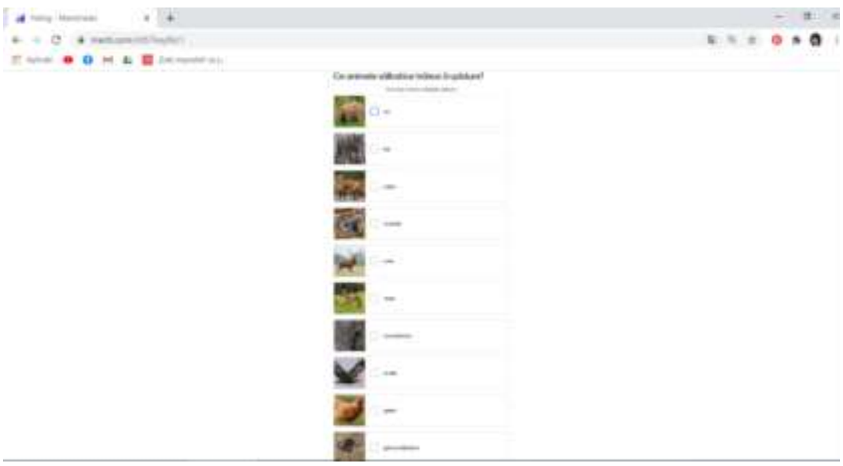

Figure 1. Screenshot of "What type of wild animals live in the forest?" item from the game that was created using Mentimeter application

The level of difficulty of the subject was very high, given the fact that the pupils had just finished the preparation educational stage, and understanding complex information as the one presented in the two documentaries requires several learning activities with the teacher. By analysingpupils' answers, we learned that those who live near the forest had obtained better results in comparison with their peers.

The didactic game. In the last 10 minutes of the activity, we sent to the children, by chat, the link to the application website (www.menti.com) and the code of the Web page (The forest – relationships of the organisms with the environment), designed with the help of Mentimeter application. The children enjoyed playing the game and, in the end, they received the results after the analysis of their answers.

3.6. Analysis of the pupils' results

For Test no. 1 (the initial one), the percentage of right answers given by the group was 33.87% (m - 10.5 out of 31 maximum of possible points), which indicates the need of learning support and assistance provided by the teacher so that the pupils could properly understand the presented information. Taking into account both the wide range of correct answers (5 - 25 points) and the similarintellectual level of the pupils, we assumed that the two students who scored 20 and 25 points, were helped by their parents in choosing the right answers. One of them lived in an apartment and neither of them had relatives interested in forestry. Considering the high difficulty of questions, we concluded that the two results did not reflect the reality in terms of pupils' knowledge. Moreover, during the discussion with the pupils, on Zoom platform, we asked them some questions that were correctly answered within Test no. 1, but when rephrased, the two pupils gave wrong answers.

The percentage of right answers for Test no. 2, which was administered after the individual watching of the two documentaries, was 69.47% (m - 11.81 out of a total of 17 points) and varied between 8-15 right answers, given by each pupil.

At the final test, the pupils obtained between 7 and 17 points (m - 11.69 out of a total of 20 points), representing 58.45%. It can be observed an increase with 24.58% in comparison to Test no. 1, but also a decrease with 11.02% in comparison to Test no. 2, distributed after watching the videos. This diminution was caused by the high difficulty level of the items from the final test, that compared to the second one, introduced new questions about the food chains and questions that required detailed answers about the food of wild animals. This test was filled in in the evening and this probably influencedpupils' levels of concentration and attention.

Previous research (Ilieand Cristea, 2020) showed that pupils obtainedweaker results when watching a documentary that lacked explanations and comments in contrast to watching activities accompanied by teacher's explanations on what they saw, offering the necessary information to enable understanding.

For this learning activity, which was held online, the teacher could not supervise either the way the pupils watched the educational videos, or the way they filled in the three tests. For these reasons, the results could have been influenced by unknown factors (parents, siblings, etc.). To ensure the attainment of relevant data, the evaluation activities of the students should be organised in the presence of the teacher, in real-time, irrespective if they are online or face to face (in the case of synchronous learning).

Figure 2 and Figure 3 present the results obtained by the 14 pupils to the game created with the help of Mentimeter application. Two students did not participate in this game. At the first item "What kind of plants grow in the forest?", 13 answers were listed as options, out of which four were wrong from the beginning. 100% represents all the answers of the pupils (right and wrong ones). The percentage listed above every column illustrates the share of the answer from 100%. It can be noticed that most pupils had selected the right answers: ferns, flowers, mushrooms, and blackberries. At the second item, “What type of wild animals live in the forest?”, from 25 choices, 7 were wrong from the beginning. The pupils did not opt for wrong answers.

Figure 2. The answers of the pupils to “What kind of plants grow in the forest?”

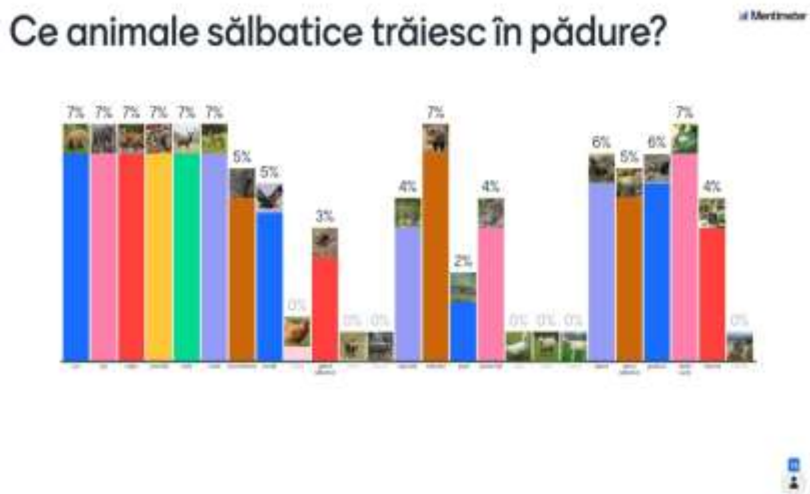

Figure 3. The answers of the pupils to “What type of wild animals live in the forest?”

4. Conclusions

At the end of the study, it is worth mentioning that pupils expressed a real interest in watching the documentaries that captured the reality, the more so as the presented aspects could not have been seen by all pupils directly, which is very important in the process of building representations.

Regarding the acquired knowledge from watching the educational videos, we observed the predominance of the ones related to the characteristics of the plants, animals, and their environment. Besides, we identified difficulties in understanding the relationships between organisms (e.g. food chain) and their environment, which can be explained in terms of high difficulty level of the content and the pupils’low level of knowledge and understanding. Concerning the way that both pupils in preschool and their families adapt to the online educational activity, we perceived parents’ availability in providing the essential equipment and devices (i.e.

laptops), ensuring surveillance of pupils'activities of watching and solving tasks, and, probably, assisting and helping their children to do their homework.

As a consequence of the results that the pupils had obtained in tests, along with the observations made during the activity with the teacher, we put an emphasis on the great role of the learning activities organised by the teacher, associated with watching educational videos and films, accompanied by appropriate comments and explanations. By designing such learning contexts, pupils can easily understand the relationships that are established between the components of their living environment, an ecosystem, the influence of environmental factors upon plants and animals, they can analyse the continental life domain and can define specific concepts.

From the teacher's point of view, who prepared the e-learning activity, it should be underlined the high amount of time consumption in order to identify suitable videos for the chosen topic, to design tests and items for the game and to create them using Mentimeter and Google Forms applications. The activity of e-learning itself was a real challenge for the teacher who had to use various software applications, available for free on the Internet and employ them with the help of the digital competence already owned at the beginning of the study. However, this competence was also developed due to the use of new applications which were all assembled in an online/virtual education system.

Finally, with this case study, we assert the advantages of introducing educational videos and digital instruments in learning contexts due to the positive impact that they have on both pupils' level of involvement and on the attractiveness degree of lessons.

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Selecting Photographs from Web Sources for Online Learning Activities. Working with Representations

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Abstract

The research starts from the finding that primary school teachers have difficulties in choosing photographs for online learning activities. In order to investigate these difficulties and their causes, as a primary school teacher, the first author conducted an internet search and chose five photographs for several topics in the field of geography (rural settlements, urban settlements, landforms, running waters, lakes and others). For comparison, another contributor of our research group, with expertise in the didactics of geography research field, chose another suite of photographs. As a result, both similarities and differences were identified based on this comparison. During the discussions with the two researchers, we identified the reasons for choosing the photographs (the considered criteria) and the difficulties. At the end of the research, we spotted several causes that determined the inappropriate choice of photographs for a certain topic.

Keywords: Competence, Landscape, Primary education, Learning concepts, Selection criteria

1. Introduction and Theoretical Background

In the pre-university education system, plenty of photographs are used in order to facilitate the students' understanding of the world, to build representations as truthful as possible, and to acquire knowledge (Dulamă, 1996). Thus, it is generally assumed that photographs are appropriate for the teaching-learning process in primary school (Triacca, 2017).

Previous studies have shown that pre-university teachers have difficulties in choosing photographs due to the absence of photographs related to certain topics, the gap in photographs adapted to the children's age and to the topic of the lessons, and the lack of internet access in some schools (Antal, Dulamă and Ilovan, 2020b, p. 33). However, other studies have suggested that teachers have difficulties in using photographs efficiently (Alenizi, 2015).

Regarding the process of choosing photographs for didactic purposes, in the literature of educational sciences, the classification criteria of photographs as well as some criteria based on which they are selected in particular contexts have been introduced. Therefore, two criteria that underlie the classification and analysis of photographs have been explicitly stated within the didactics of geography: the place where the photograph is taken and the photographing axis (Dulamă, 2004, pp. 207-208; Dulamă and Roșcovan, 2007; Dulamă, 2010). Concerning the selection of photographs for use in lessons the Romanian literature recommends that the pictures should be well made, clear, simple, easy to interpret, and large (Dulamă, 2001, p. 101). Further, according to Dulamă (1996, p. 95) blurred pictures, loaded with too many details, i.e. those which do not convey accurate geographical messages should be avoided. In this respect, the most important aspect in choosing the pictures is the content (Dulamă, 1996, p. 96) that ought to be meaningful and representative to the studied phenomenon (Dulamă, 2004, p. 111). Dulamă (2004, p. 111) stresses that in educational contexts, the favourite photographs are those which capture impressionable and unprecedented aspects, as well as the colourful ones, which reflect reality more accurately than black-and-white photographs.

According to the latest research studies, primary school teachers tend to take into account certain features of the photographs they use (e.g. content, organization of elements, colour, clarity, shape, details, message, size, photograph plans, compliance with reality, etc.), of the pupil (e.g. needs and interests, learning style and pace, age-specific), of the lesson (e.g. objectives, topic, content, available time, type), and of the intended effects derived from their use (e.g. understanding the topic, identification of the items/ phenomena/ structure/ characteristics, deduction of connections, generalization) in the selection process (Antal, Dulamă and Ilovan, 2020, p. 26).

Furthermore, on the one hand, the geography students as future teachers seem to be more interested in photographs of "beautiful" natural landscapes instead of photographs of anthropogenic landscapes and those where spectacular natural processes are captured (e.g. tornadoes, landslides, and floods) (Antal, Dulamă and Ilovan, 2020a). On the other hand, some studies have alluded to the photographs from the digital textbooks of *Mathematics and environmental exploration* in Romania, also noticing their high frequency (Buzilă et al., 2017; Dulamă et al., 2017; Magdaș et al., 2017; Ilovan et al., 2018a).

At the university level, studies have focused on the use of photographs in learning about cultural landscapes (Dulamă, Ilovan and Buș, 2016), in developing students' competence to analyse landscapes (Ilovan et al., 2018b), in assessing students regarding territorial planning (Dulamă, Vana and Ilovan, 2016). Moreover, students' skills to research online sources (Ilovan et al., 2015) and visual materials from web sources in studying Regional Geography (Magdaș et al., 2018) have also been analysed.

The aim of this research is to investigate the teachers' way of selecting photographs for didactic purposes. Accordingly, the research seeks to address the following questions: What are the criteria employed by the teachers to select the photographs identified on the Internet for a particular topic? Which difficulties do teachers face in the process of identifying and selecting photographs? What are the mistakes teachers make in selecting photographs? Several steps were followed in order to achieve the purpose of the research and to find the answers to the questions. Firstly, two teachers selected 40 photographs for specific topics. Then, they analysed the selected photographs. Finally, the teachers analysed the resulting photographs selection process.

2. Material and Method

Participants. In the research, two teachers were involved as subjects: a teacher of primary education, who was also a doctoral student at Babeș-Bolyai University of Cluj-Napoca, as the first author of the research, and a university professor at the same university with expertise in Didactics of Geography, who is the third author of the research.

Research design. The two participants were commissioned to choose five photographs from the Internet, for each of the eight established themes (i.e. village, town, deciduous forest, mountains, the Danube Delta, road communication routes, running waters, lakes) and then to enter the photographs in a table.

Data Collecting, Procedure and Research Material. Through the interview method, the opinions of the two teachers about the criteria based on which they chose the photographs were collected. In addition, we identified the difficulties they encountered in their choice. Further, the method of content analysis analysed the answers. Visual methods were employed to analyse the photographs. Henceforth, the research material includes the photographs chosen by the two researchers and their answers in the interview.

3. Results and Discussions

3.1. Analysis of the task given to the subjects. The university professor structured the task and the choice of topics. At this level, she took into account the fact that the chosen topics are studied in primary education and that all the concepts proposed for illustration through photographs are used. The designations of the proposed topics represent concepts (i.e. village, town, deciduous forest, mountains, road communication routes, running waters, lakes), except for the Danube Delta, which is a major landform unit in Romania.

At the time the task was submitted only the purpose of the research was specified. The primary school teacher did not previously choose photographs for the topics mentioned above and stated that during the initial and ongoing education, there were not too many contexts for her to learn how to choose photographs for a topic and how to use them during classes for teaching purposes. The university professor chose photographs to present the topics in various contexts: classification of postcards from own collection; studying the topics with pupils in geography lectures; achievement of PowerPoint presentations for students preparing to become teachers for pre-primary and primary education and geography teachers; conducting other research in Educational Sciences (Dulamă, Ilovan and Buș, 2016; Dulamă, Vana and Ilovan, 2016).

3.2. ***Analysis of the criteria for selecting photographs from the internet.*** The teachers selected the photographs based on several criteria related to: photographing (i.e. time and place of the photographing, the photographing axis, author, and purpose), technical characteristics of photographs (i.e. colour, clarity, brightness, format, size), content of photographs (photographed environment, "nature"/origin of the photographed aspects), photograph processing (degree of processing), the relevance of the photograph to the topic.

Photographing criteria

Time and place of the photographing. Both researchers chose photographs taken from the ground, or as bird's-eye-view (aerial) perspective, and not those taken from the satellite, from hundreds of kilometres (aerophotographs). Also, they both preferred aerial photography of rural and urban settlements, of some lakes, of the Danube River, and of some aspects of the Danube Delta. Choosing of photographs within this category is optimal since it offers the possibility of observing a whole or a large part of a human settlement or a lake. In addition, the adjacent spaces could also be observed. In the case of photographs taken from "above" (the mountain peak or mountaintop), component parts of the mountains and some lakes were captured. Still, most of the photographs were taken from the ground, to represent forests, roads, some running water, and some aspects of the delta.

Axis of the photographing. The first teacher chose a vertical photography of an island in the Danube Delta. In some horizontal photos, aspects of the forest and the delta or roads were captured. In most photographs, the photographing axis is oblique (aerial photographs, those taken from a height).

Author and purpose of the photographing. The research did not intend to identify the competence and high expertise of the authors (professional or amateur photographer). Since the photographs chosen by the two researchers were not included in scientific or art works, we did not consider them scientific or artistic photographs, but photographs targeting the general audience.

Criteria regarding the technical characteristics of the photograph

Colour. The two teachers selected multicoloured photos or other types (e.g. sepia colour) instead of the non-colour ones (black and white).

Clarity. The teachers mentioned that they selected the clearest photographs from those available.

Brightness and the time of photographing. Being chosen by the teachers, who predominantly use photographs for didactic purposes, all the photographs were taken during the day, so that the photographed elements benefited from maximum visibility.

Format. The primary school teacher selected seven portrait-orientation photographs and 33 landscape-orientation photographs, whereas the professor opted only for landscape photographs, motivating that they can be arranged in the table boxes with a more pleasing visual impact, but also on the PowerPoint slides. In addition, the professor preferred the landscape photographs format since childhood when used to collect postcards.

Criteria regarding the content of the photograph

"Nature" (origin) of the photographed aspects. Regarding the proposed themes, it is noteworthy that most of them focus on natural aspects (mountains, running waters, the Danube Delta, deciduous forests, lakes), and only three focus on man-made elements (village, town, roads). Although some anthropogenic interventions were also observed in the photographs where the natural elements predominate, all of the photographs were included in the landscapes category, with the meaning explained in the *Explanatory Dictionary of Language* (DEX, 2009): "part of nature that makes an artistic ensemble and is contained at a glance", "aspect of a certain territory, resulting from the combination of the natural factors with the man-made ones." In the art of photography, landscape photography is considered "scenic photography" or "environmental" photography where both "natural scenes" are photographed which may be either large and grandiose or small and more intimate, as well as artificial ones, such as urban or rural landscapes (Adminul, 2020). Given the fact that landscape photography is one of the most popular, common, and available on the Internet, this represents an opportunity for teachers nowadays because they have a considerable number of options/photographs to choose from.

The photographed environment. As the proposed topics refer to the environmental elements located on the continents, all chosen photographs targeted the terrestrial environment. In addition, underwater photographs and astrophotographs ("astrolandscape") were not chosen because they were considered inappropriate for the topics.

The photographed territory. All chosen photographs represent places in Romania, even if the Google search engine offered photographs from other countries, too.

Criterion related to photo processing (*Naturalness and degree of processing*). The two teachers chose photographs in which the post-processing is not noticeable. However, they identified some interventions at the level of colour intensity made in order to ensure fidelity with the cut out from reality captured in the photography. Therefore, the chosen photographs were included in the category of the original ones and with a low degree of processing. In order to provide pupils the context of analysing the reality represented in photographs, it is important to use photographs that introduce reality as truthful as possible and not counterfeit.

Criteria related to relevance to the proposed topic. To this research, this criterion was the most important in the process of selecting photographs. The term "relevance" is explained in dictionaries by the terms “meaning”, “significance” (MDA2, 2010), while the term “relevant” is considered as something that “highlights”, “emphasises something”, “distinctive” (MDA2, 2010), “stands out” (DEX, 2009).

First of all, it is worth stressing that to choose a photography relevant to a topic, the teacher should have a very good knowledge of the content of that topic (the essential properties of the environmental components, e.g. those of the mountain; of a geographical system, e.g. of a running water or a lake, and to recognize them in reality or in visual materials, such as photographs, drawings, paintings, etc.)

Table 1 comprises the content elements as the basis of the photographs selection activities carried out by the two teachers. Although the task did not specify that these photographs should be used in primary school classes, both teachers performed the assignment from this perspective. The primary school teacher chose the photographs to facilitate learning at this level. The photographs were chosen empirically, depending on the teacher’s mental visual representations: the emergence of the nucleus of the village; the extent of the town compared to the village; differences in the lane-street-boulevard; the changing in structure of the forest depending on the season; the size of the running waters from the small ones to the large ones; differences in road infrastructure; representative elements for the delta (e.g. water lilies, birds, boat).

The university professor chose the photographs according to the essential aspects for each topic and from a scientific perspective. More than that, she did not take into account either the recipients’ level of education or the content proposed in curricula and textbooks. The professor aimed to make visible the essential features mentioned in the definitions of the terms, the components of the geographical systems, and their types by photographs. If the primary school teacher selected the photographs based on an inductive reasoning, that is from concrete to abstract, the university professor selected them by deductive reasoning, namely from abstract to concrete.

Table 1. Content elements according to which the teachers selected the photographs

Topic/subject	Content elements	
	Primary school teacher	University professor
Village	Nucleus of the village, different organization depending on the landform	Definition, elements of rural settlement (nucleus of the village, estate), types of villages (scattered, nucleated, dispersed)
Town	Characteristics: extent, appearance (streets, boulevards, buildings)	Definition, elements of the urban settlement, types of towns by evolution (differences in the urban landscape: medieval centre, ward of flats and houses, rectangular street network)
Deciduous forest	Structure depending on the season	Definition, types of forests (oak, beech, birch, black locust), stratification
Mountains	Heights compared to hills, composition of hard rocks (e.g. limestone), the shape of the peaks	Definition, components (peak, mountain top/interfluves/ridge, slope, valley), gorge
The Danube Delta	Representative elements: village, Letea forest, birds and water lilies, boat	Definition, hydrographical units and land units, birds, vegetation
Road routes	Highway, poor infrastructure road	Types (highway, expressway, road, street, lane)
Running	From small waters	Components (spring, watercourse,

waters	(stream) to large ones (river); from the local horizon (Iza izbuc) to faraway places	spilling), water types (brook, stream, river), confluence, flood
Lakes	Depending on the relief (glaciers), dam at the reservoir	Types of lakes (volcanic crater, glacier, sea firth, salty)

The two approaches also generated different photographs search strategies. The primary school teacher searched for photographs using keywords in the referred topics (village, town, deciduous forest, mountains, Danube Delta, road communication routes, running water, lakes). On the other hand, the university professor adopted a progressive strategy starting from the concept or theme, but adding words by which the territory was narrowed (from the world to the national level; from the country level to a certain settlement; from a town level to a certain ward), was deepened (for example, from running water to spring, river) and customized (for example, from the category of lakes, to a certain lake).

Table 2. Keywords according to which the teachers searched the photographs

Topic/subject	Keywords (original ones in Romanian)	
	Primary school teacher	University professor
Village	Village	Scattered village, Apuseni mountains, dispersed village, nucleated villages; Viscri; aerial
Town	Town	Town, town Romania, town Romania aerial; Cluj-Napoca ward Gheorgheni, ward Mănăștur, București, Constanța
Deciduous forest	Deciduous forest	Deciduous forest, oak forest, beech forest, birch forest, black locust forest
Mountains	Mountains	Mountains, mountains România, mountains România valley, mountains România gorge
The Danube Delta	The Danube Delta	The Danube Delta, spilling Black Sea
Road communication routes	Road communication routes	Highway, express road, road, street, lane
Running waters	Running waters	Running waters, spring, brook, stream, river
Lakes	Lakes	Lakes, Sfânta Ana Lake, firth

3.3. Difficulties in selecting photographs from the internet

The two teachers faced similar difficulties in the process of selecting photographs and in other contexts, as follows: the large number of available photographs; the poor quality of photographs currently available on the Internet; the absence of the appellation of the place they pose or even the incorrect mention of it (see Fig. 1. Wrong location of the photographed place: The Danube Delta, in Romania, instead of Thailand); the impossibility to take over by copying/downloading; processing and even falsifying photographs (see Fig. 2) in Adobe Photoshop or other applications.

3.4. Mistakes in selecting photographs from the Internet

The fact that teachers face the aforementioned problems may pose a risk in selecting photographs for a particular topic. Consequently, these issues can lead to wrong choices. A student misused the photograph in Fig. 1 on the topic "Danube Delta", due to the fact that there are no pink/red water lilies (*Nymphaea zenkeri*) in this geographical unit but only white water lilies (*Nymphaea alba*) and yellow water lilies (*Nuphar luteum*). The student took the photograph from a site where the Danube Delta was wrongly assigned and, not having adequate knowledge about the vegetation of the Danube Delta, he considered the photo-place association to be correct and therefore did not carry out any checks.

Fig. 1. Wrong location of the photographed place: Danube Delta instead of Thailand. Source: https://ro-mania.tumblr.com/post/116018655372/rolandiatravel-la-poupee-deporcelaine-delta

Fig. 2. Modified photography that does not represent reality. Source: https://www.digi24.ro/stiri/externe/ue/spania-si-portugalia-sub-amenintarea-unui-tsunami-devastator-698514

In order to present the tsunami in class, a geography teacher used a similar photography to that of Fig. 2. A quick Internet search gave us information about the tsunami: "*A series of seismic waves, known as 'tsunamis' and often exceeding 30 meters in height, hit Hokkaido's east coast on Tuesday.*" (DCR2, 1997).

If we analyse the height of the blocks in the photograph, based on the estimation of a level or floor at 2.5-3 m, it can be deduced that they have a maximum height of 30 m, and the height of the wave is 2-3 times higher, resulting an unrealistic background. From the analysis of the photographs searched on Google engine using the tsunami keyword, it could be observed that many of them are processed or falsified. However, to verify the authenticity of a given photograph, one solution would be to read the information on the site or page where they were posted.

In some cases where the teachers take the photographs, they mistakenly frame the place they are photographing: for example, only part of a church can be seen (part of the tower); half of the photograph space is covered by sky; part of the photograph is the dashboard of the car from which the photograph was taken; the facade of the photographed building is shadowed; the shining solar disk covers a part of the photograph.

3.5. Causes of incorrect selection of photographs from the Internet

In previous research, it has been emphasized that, in order to be useful in the learning process, photographs should have some characteristics: they should be clear, "the photographed object should be able to be totally seen," "they ought to be large in size, namely to occupy a high proportion of the space in the photograph," "it should be illuminated, not shadowed" (Dulamă, 2014, p. 66).

Lack of a precise educational objective targeted using photographs. If teachers want to show the pupils the villages, they will randomly choose the photographs. Teachers should decide, for example, what is relevant for pupils to observe in photographs of villages: households located at great distances from each other in a scattered village of the Apuseni Mountains; houses joined by a brick wall in the villages built by the Germans in Romania (i.e. Viscri); or a household with a stable and shed.

Low level of expertise in the field. The higher the level of competence of a teacher in the field he or she is looking for photographs, the more likely he or she is to make a better selection of them. If the teacher has few or poor representations about a place or a subject, he or she has few chances to choose the most relevant photographs to illustrate that subject and to visually substantiate the formation of a concept.

Lack or insufficient documentation. Even if a teacher does not have the necessary knowledge to choose the most relevant photographs for a topic, he/she can do some research. Moreover, even if the same photograph can be found on “a hundred sites”, it does not mean that it shows the reality. The teacher should read the text that accompanies the targeted photograph to be certain that it represents what claims to represent.

Taking photographs from scientifically invalidated sources. If the photograph is distributed in several places on the Internet, it is important to identify the original source or a credible one (for example, a specialized site).

4. Conclusions

The most important conclusions we reached at the end of this study are listed below. In order to be able to select the most relevant photographs for a topic, from a large number of available photographs, the most significant aspect is to clearly set the objectives and the person’s level of competence correlated to that topic. The low level of expertise in the field and the lack of documentation are the main causes that generate most of the mistakes in choosing photographs for educational purposes.

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E-learning Natural Sciences and Visual Imagery

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Abstract

This research aims to analyse an online learning activity based on an original training model and the preschoolers' learning outcomes. A narrative text and a PowerPoint presentation regarding the environment of a rural household, the domestic birds and their connections and living environment were created to approach this activity. The evaluation of children's knowledge was achieved through an online game. The following were studied: the storyline, the PowerPoint presentation, the learning activity, the children' scores, and the learning efficiency as a result of using this audio-visual resource.

Keywords: Representations, Rural area, Learning outcomes, COVID-19, Online education

1. Introduction and Theoretical Background

Studies show that visual literacy underlies comprehension processes (Sinatra, 1986, p. 4) and that experience in visual environments contribute to the improvement of cognitive skills (Messaris, 1994, p. 3). Visual aids (films, photographs, drawings and others) are necessary and useful in shaping representations about the environment (Dulamă and Magdaş, 2014; Dulamă et al., 2017; Antal et al., 2020a, 2020b; Drăghici et al., 2020), or spatial representations (Ilovan et al., 2019). Photographs play a key role in deepening the living experience in nature (Socha et al., 2016). As such, curiosity and interest are stimulated and the engagement rate in environmental education activities increases (Dulamă, 2012; Ardoin et al., 2014). The use of photographs is very valuable when preschoolers cannot directly explore those aspects in reality (Dulamă, 2012).

PowerPoint presentations are frequently used by teachers in their teaching activities (Magdaș, Vereș and Dulamă, 2019). The efficient use of PowerPoint in the classroom is influenced by the PowerPoint structure and management, the topic and the teacher's teaching skills (Abdelrahman, Attaran and Hai-Leng, 2013). In previous studies, we found that the curiosity and interest of preschoolers for natural science is stimulated by a story or the teacher's narrative-informative-descriptive commentary, visually supported by a PowerPoint presentation and complemented by a game on the Zoom platform (Drăghici et al., 2020).

In order to provide preschoolers new contexts for natural science online learning, after the stop of face-to-face activities in March, 2020, because of the coronavirus pandemic, and considering previous research on e-learning in Romania (Magdaş and Răduţ-Taciu, 2016; Manea and Stan, 2016, 2018; Vlada and Jugureanu, 2007; Vlada, Jugureanu and Albeanu, 2011; Vlada, Jugureanu and Istrate, 2009; Vlada et al., 2010), we set out to conceive a story and deliver it to them on the video conferencing Zoom platform during a PowerPoint presentation. The aim of the research is to analyze the process that the teacher goes through in creating original aids (literary text and collages from photographs), designed to facilitate learning a topic in natural sciences, consolidating and systematizing preschoolers' knowledge about a familiar topic, and to assess the impact of these online resources provided through the Zoom platform.

2. Material and Method

2.1. Research design. This research included several stages: preparing the resources (outlining the story plot; searching for appropriate visual aids to illustrate the story; making a collage of these visual aids; making PowerPoint presentations); carrying out activities with preschoolers on the Zoom platform in August, 2020 (storytelling accompanied by visual aid; evaluation of preschoolers' scores through a game adjusted to the videoconferencing platform); analyzing the online activity and the preschoolers' outcomes.

2.2. Participants. 5 preschoolers aged 4-6 from the "Reconstrucţia" Kindergarten of Petru Rareș Highschool, Feldioara, Brașov County were benevolently involved in the research. Parents' consent was requested to involve preschoolers in a Saturday activity, during a time interval when they were available to help them use devices (smartphone, tablet, computer) and to supervise their children. The first author was perceived by preschoolers as a teacher for preschool education.

2.3. Data Collecting, Procedure and Research Material. We collected the data about the way of looking for the visual aids, about making collages of these visual aids and making the PowerPoint presentation, about the online activity through the method of the semi-structured interview and through participatory observation. We used the text analysis for the data provided by the interview and the storyline created by the teacher. We used the visual methods to analyze the visual aids in the collages and the slides in the PowerPoint presentation. Overall, being a single activity, the research is a case study. We collected the preschoolers' scores through a game and processed them by statistical methods. The research material includes: the storyline and the visual aid created by the teacher, the teacher's observations, answers and opinions, the preschoolers' answers to the questions in the game and those provided during the learning activity, and the online activity.

3. Results and Discussions

3.1. Analysis of the cooperation process in the virtual community of teachers for preschool education

There is a private group called *Activităţi Grădiniţă* [Kindergarten Activities] created on Facebook social media on March 27, 2014 by the educators at no. 2 Kindergarten in Huși, Romania. The members of this group post several useful aids for the teaching process carried out in kindergartens. We chose to look for images on this group because these were great chances to find visual aids made by other teachers, suitable for this activity. In the process of searching for images with domestic birds, we discovered a collage containing several images of the way of life, food, and other elements specific to a species. Through a message addressed to the members of the group, we asked if there were similar collages for other birds in the household. As a result of the request, along with Likes and suggestions to search on Pinterest.com, we received the collage format, but with images about mammals in the household. When choosing the topic on 'Domestic birds', we targeted one apparently known by preschoolers, but less approached in preschool education. What we appreciate as significant in this informal professional group is that teachers can ask for support, ideas, resources, suggestions and colleagues, who have similar professional concerns, unconditionally share resources and personal expertise. There is a beneficial transfer of knowledge by sharing what we know, this group thus functioning as a learning community.

3.2. Analysis of the process of creating resources for online activity. Lacking the resources in the desired format, and having the one discovered on the Internet, but not with the targeted content (*Poultry*), we decided to make the collages for the other domestic birds following this model. The resources were designed in several stages. After choosing the topic and the format of the collage, we structured the PowerPoint presentation (number of slides; structure, format, content of the slide), we surfed the Internet and we selected the necessary photographs. We made the collages in word format, we performed some screenshots that we cut by using the Paint application and we saved them in image format (.png). The process of searching and processing the resources was carried out in an informal setting over three weeks, in about eight hours per week. We notice that, in order to design and make the aids needed for this activity, we have spent a large amount of time, which is not currently possible and is a good reason to share with other teachers the resources created to increase work efficiency at the level of the whole group of teachers for preschool education.

To this material, we associated a literary text that we created considering the objectives pursued and aiming to logically build the text, in relation to the collages and the presentation made. We inserted the visual aids – the collages – in a PowerPoint in a specific order, following the agreement between the text and the image. In making the necessary support aid for the activity, we identified a series of difficulties: the online images were not appropriate for the age level; lack of supporting texts for the activity; the need to know the applications necessary to make the support aid.

3.3. Analysis of the visual aid. We designed the visual aid according to the amount of knowledge and the preschoolers' level of understanding. To draw the preschoolers' attention and avoid monotony, we arranged the images in the template in Fig. 1. The presentation includes 7 slides: a slide with the title; two slides with the main character; four slides with domestic birds – one collage for each of the most common / known domestic birds in rural households (chicken, turkey, duck and goose). Regarding each bird, we presented photos with the bird, its mate, the chicks, the way of life (shelter, food), and benefits for people in the collage. This representation is, in fact, a bunch scheme, but the words have been replaced with photographs. This visual organizer helps preschoolers to systematically approach a topic and to systematize/ order/ mentally group their knowledge about birds.

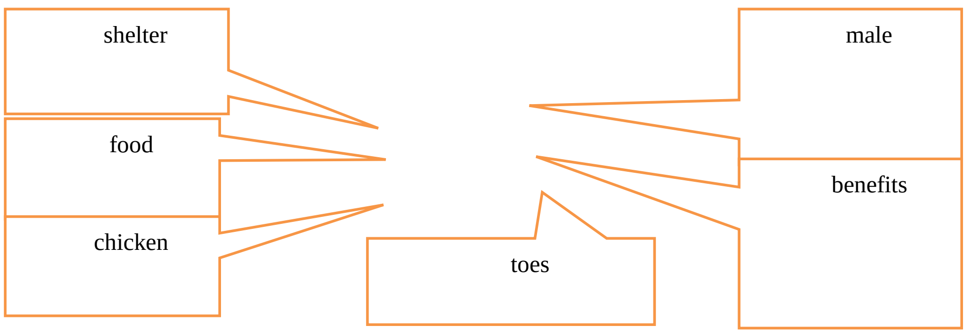

Figure 1. Collage template for the presentation of a domestic bird

3.4. Analysis of the storyline

Even if the topic on ‘Domestic birds’ belongs to the field of Science, to facilitate preschoolers’ access to knowledge, we included the information in this field in a narrative context, we introduced an innocent, newcomer, curious character – Duckling – to go through an exploratory journey into the world of domestic birds, whom preschoolers can identify with. The exploration is performed in a chronological order, having several stops where the little adventurer interviews, in a polite manner, Mrs. Hen and Mr. Rooster, Mr. and Mrs. Turkey, Mr. Gander and Mrs. Goose, Mr. and Mrs. Duck. The dialogue with each family develops in several directions: the name and appearance of their shelter, the shape and size of their eggs, the characteristics of the chicks, the features of the food, the benefits that people have from each bird species, some aspects of the environment and the adaptation of birds to various environments (for example, geese and ducks to the aquatic environment).

The text is also built to offer the child a behavioral model and use of some politeness formulas (“Thank you, Mr. Rooster!” “Goodbye”). Being an online resource where the teacher uses the spoken language on the Zoom platform, the text also contains onomatopoeias: quack-quack, cluck-cluck, and gobble-gobble-gobble. Although the story presents a foray into the real world, in order to adapt to the specifics of the preschoolers’ age, birds are personified: they talk about their current life and their purpose. The exploratory journey ends with the return at home of the curious and fearful duckling, where it talks about its discoveries and adventures. The conclusion was created so that the preschooler is taken out of the story and led under the protective wing of the mother, where he/she meditates on what is seen and heard.

3.5. Analysis of the experimental teaching activity on the Zoom Platform

The activity was carried out online during the preschoolers’ summer holiday. The invitation to participate in the activity and the confirmations were sent through messages on Whatsapp group of parents. The preschoolers had problems accessing the links for the activity, the success rate of the connection being 66.66%. The length of connection setup time for five preschoolers’ devices varied between 25 minutes for the first link and 15 minutes for the other one.

The time resources for the teaching activity were as follows: 30 minutes for the story, 15 minutes for the discussions about the birds in the story, 15 minutes for the True / False game. In order to be able to evaluate the preschoolers’ responses to the game, expressed by raising their hands, this session was recorded. The preschoolers liked Duckling, the main character, which proves that the choice of this character and his characteristics was suitable for preschoolers. A child specified that he has got all the birds that were characters in the story at home in his yard. Three children said they saw ducks and a swan in the pond near the village and that these birds really like the water.

The ‘True / False’ game included 30 questions about the Duckling character and the studied birds. The maximum score that could be reached by the preschoolers in the group is 150 points, and 30 points at the individual level (Table 1). The preschoolers managed to correctly identify 109 correct statements out of 150 possible, having a success rate per group of 74.66%. The high score can also be explained by the fact that preschoolers have previous knowledge about poultry.

Table 1. The preschoolers’ scores in the game about domestic birds

Types of questions	No. of statements	Score		Success rate (%)
		Maximum possible	Preschoolers	
Duckling	6	30	26	86.66
Duck	4	20	17	85
Turkey hen	8	40	28	70
Geese	5	25	16	64
Hens	7	35	22	63

Total	30	150	109	74.66

4. Conclusions

The success of the activities on the Zoom platform with preschoolers depends chronologically on the parents' availability to "assist" their children, on the existence and performance of devices, on the internet access, which limits access to online education, the teacher's educational support and the preschooler's willingness to get actively involved and intrinsically motivated. The results of this study prove that the attention of preschoolers is kept focused during a longer learning activity (30 minutes), which addresses information in the field of science, in a narrative context (story) where a character with whom children identify reveals his discoveries in an exploratory journey in a household and visually capitalizing on a series of photo collages.

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Learning through Discovery in the Online Environment. Examples, Principles, Advantages, and Difficulties. A Case Study on Renewable Energy

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Abstract

The aim of this research is to investigate how learning through discovery can be achieved by Z generationpupils using the textbook and the online available sources. We have analyzed a lesson from the textbook Mathematics and Environment Exploration and an animated film from the point of view of learning through discovery, an activity performed into the virtual classroom based on these materials.Weidentified the difficulties and the problems both pupils and teachers cope with, and wehighlighted certain principles and advantages of learning through discovery performed by accessing web sources. We concluded that the film proposed by the teacher for viewing on YouTube represented a valuable information source that corresponded to the pupils' level of knowledge and, more than that, satisfied their curiosity. However, the success of the educational activities depended much on parents' supervision and support.

Keywords: Digital natives, Virtual classroom, Digital skill, Primary education, COVID-19

1. Introduction and Theoretical Background

With the decision of the Romanian Ministry of Education and Research, beginning with March 11, 2020, face-to-face classes were suspended and the communication and cooperation methods in the educational system changed in order to ensure the continuity of the learning process (Botnariuc et al., 2020, p. 8). In this regard, impediments of technical, logistical, pedagogical, and content nature appeared on many school subjects, these being barriers or challenges for teachers, pupils, parents, and education decision-makers (Botnariuc et al., 2020, p. 9).Teachers were forced to a rapid change from face-to-face teaching with blackboard and chalk, from the classroom to the "virtual classroom", to the "online" method of delivering the education (Botnariuc et al., 2020) and to find, for themselves, the best strategies by which to carry out their teaching activities, so that the educational goals to be fulfilled as much as possible.However, previous research proves that Romanian teachers were familiar with online education (Adăscăliței et al., 2019; Magdaş and Pop, 2015; Magdaş and

Răduţ-Taciu, 2016; Manea and Stan, 2016, 2018; Vlada et al., 2010; Vlada, Jugureanu and Albeanu, 2011; Vlada, Jugureanu and Istrate, 2009).

Many teachers have digital skills developed at a certain level (Dulamă, Ilovan andMagdaş, 2017; Magdaş et al., 2017; Magdaş et al., 2018) which allow them to use technology on didactic activities (Magdaş, Ilovan andUrsu, 2018; Magdaş, VereşandDulamă, 2019). Studies referring to “digital manuals” in .pdf format for *Mathematics and Environment Exploration* indicate their features, including their weaknesses (Buzilă et al., 2017; Dulamă et al., 2017; Magdaş, et al., 2017; Ilovan et al., 2018a).

Regarding learning through discovery, in pedagogical literature, there is much information about its specificity, types of discoveries, stages, examples, importance (Bocoş, 2004; Cristea, 2005; Dulamă, 2008). The strategy of learning through discovery is considered an effective way of performing pragmatic learning (Petrovschi, 2009, p. 1).This strategy implies personal investigation performed by the pupil within an independent directed activity in order to acquire new knowledge from variousinformation sources (Petrovschi, 2009, p. 1). The study material is not presented in a final form to the person who learns, but it is to be discovered through a mental activity and then included into his or her cognitive structure (Petrovschi, 2009, pp. 1-2). Learning through discovery includes several stages: establishing contents to be discovered by the pupils; presenting the learning project and tasks; establishing the time resources given for solving tasks; distributing information sources; performing activities under the guidance and the consultancy offered by the teacher on request; acquired knowledge assessment; integration of the new knowledge acquired into the lesson (Iutiş, 2008, p. 66).

Research related to learning through discovery focused mainly on didactic activities performed in nature (Ilovan et al., 2018b; Deacet al.,2019), for which are used also Online Apps, Web Sources and Electronic Devices (Rus et al., 2019). At primary education level, in order to know the environment, during studies there were used educational films (Ilie and Cristea, 2020; Ilie et al., 2020) and animation films (Vereş andMagdaş, 2020; Vereş, Dulamă andMagdaş, 2020).

The purpose of this study is to investigate the way in which learning through discovery can be performed by pupils using the school textbook and the available online sources, while considering the topic of energy, relevant also for raising awareness about renewable energy sources (cf. Bălan et al., 2019) and understanding the resilience of territorial systems (Petrişor, Meitaand Petre, 2016). The research questions are: How much does the method of presenting a lesson from a textbook and the animation films favour learning through discovery performed by pupils? How can learning through discovery be organized in the virtual classroom? What are the principles, advantages, and difficulties teachersconsider when applying these strategies?

2. Material and Method

Procedure.The research took place in March 2020, a few days after the closing down of schools. In the documentation stage, we searched for and selected visual materials suitable for the topic, weanalyzedthe Google Classroom application, the text and illustrations from the textbook, and we designed the didactic activity. During the activity with the pupils, we sent them tasks and support materials on the account created on the Classroom application. We asked them to read the information from inside the textbook, to watch an animation film, to solve the tasks from the textbook, to photocopy/scan the pages from the textbook or their notebooks with solved tasks and to post them on their personal account.

The research material consists of: the text and illustrations from the lesson “Forms and Sources of Energy” from the *Mathematics and Environmental Exploration* textbook for the 1st grade, EdituraDidacticăşiPedagogică(Bălanet al., 2018); the animation film “Let’s Learn what Energy

Means" (AgențiapentruEficiențaEnergetică, 2018), the solutions to the pupils' tasks from the textbook posted on the Classroom application.

Data collecting and processing. We collected the data about the activities performed with pupils using the method of observation, and wecollected their solutions to the tasks by means of posting them on the account created on the Classroom application. Weanalyzed the information and the tasks from the textbook, the Classroom application, and the content analysis method for the pupils' solving of the tasks. Weanalyzed the animation film and the Classroom application with the aid of visual methods. We performed data processing using statistical methods.

Participants.In this research, 24 pupils, 7-8 years old, from a 1st grade of "Avram Iancu" Theoretical High School of Cluj-Napoca were benevolently involved. All pupils had internet access at home and laptops/tablets to use on their online activity. The first author, a primary school teacher was actively involved in the online activity, being perceived by the pupils as their teacher and not as a researcher. Knowing the class very well, she chose and analyzed materials, established tasks, communicated with herpupils using the Classroom application and analyzedeachpupil's activity.

3. Results and Discussions

3.1. Analyzing the content of a lesson from the "digital" textbook, considering the perspective of learning through discovery

Weanalyzed the lesson "Forms and Sources of Energy" which takes two pages from the 1st grade textbook*Mathematics and Environmental Exploration* (Bălan et al., 2018), posted on the website of the Ministry of National Education, at digital textbooks, https://www.manuale.edu.ro/

Form of the material to learn. The written information is presented in several forms: keywords (5), riddle (1), assertions (*"I remember!", "I recorded!", "Did you know that…?"*), structured list (an enumeration and a classification), questions (4), tasks or exercises (5). Visual material consists of a painting, a photography and 12 schematic drawings (Bălan et al., 2018, pp.84-85). The fact that only the structured list and the assertions present information apparently "ready" to memorize induces the perception that this material "to learn" corresponds to the request mentioned in literature regarding the process of learning through discovery because "it is not presented in a final form" (Petrovschi, 2009, p. 1).

Information volume designed for discovery. Information that should be learned results and is indicated mainly in the title of the lesson ("Forms and Sources of Energy"), through keywords ("forms of energy, sources of energy, electricity, exhaustible, inexhaustible, mine"), in structured lists which also include other concepts (light, heat, Sun, water, wind, coal, petrol/oil), in assertions (*"I remember!", "I recorded!", "Did you know that…?"*) (Bălan et al., 2018, pp. 84-85).

In literature, it is specified that "a certain volume of planned discovery" should be established (Cristea, 2005, p. 116). In this case, at a first analysis, we identified 13 concepts, but we noticed the fact that pupils already had some knowledge about the Sun, about water, wind, and heat. The volume designed for discovery is suggested or recommended by the questions in the textbook and tasks proposed for solving. In this lesson, the essential keyword is missing: energy. This concept is defined as being "the capacity of a system to perform a mechanical work or another equivalent action" (MDN '00, 2000) and can be understood with great difficulty by pupils.

Tasks proposed for performing the discovery.*Riddle.* Pupils are challenged to "guess" the concept (hydroelectric power plant) that has the attributes shown in the following riddle: "*Water stirs in* *the turbine/And from it, it makes light;/I am looking and keep wondering/How does it start running through the wire."* (Bălanet al., 2018, p. 84). Above the riddle, there is a picture of a hydroelectric power plant dam, but without specifying what it represents. When we search on Google for the keyword "hydroelectric power plant" (in Romanian), we find the definition: "Power plant in which electrical energy is obtained by converting hydraulic energy" (Marcu andManeca, 1986). Comparing the content of the riddle with the dictionary definition and taking into account the pupils' level of knowledge, we consider that these pupils have little chances to "discover" the concept of a hydroelectric power plant and to solve the "problem-situation."

If it were for another picture, in which the dam and the lake were visible, then chances the pupils found the answer were bigger, provided that they made the connection between the riddle and the picture. In this case, perceptual learning would be mainly favoured (through observation and intuition) (Dulamă, 2004, p. 75) if the teacher presented the picture and specified that it represented a hydroelectric power plant, thus helping the concept formation according to the ostensible model (Dulamă, 2004, p. 158) or visible model, "that can be shown or can be seen" (DEX, 2009). Applying this concept formation model, the children memorize ("label") the term without being able to characterize the object (Dulamă, 2004, p. 158).

Questions (1st task) (Bălan et al., 2018, p. 84). Pupils are asked to look at an image (a painting) (Figure 1) and to answer questions. Trying to discover "Who enjoys the light and the warmth of the Sun", we consider that nature and people could be the beneficiaries. For the second question, we consider that the home is lighted up and heated during wintertime with the aid of solar panels, but also using electricity. The third question is subject to interpretation or is badly worded. If it means the sources from which electric energy is produced, then the correct answer is: water, the Sun, wind and, possibly, coal. The last question creates problems to the respondent, too. The Sun, car, solar panels produce heat. Even if some questions are inappropriately worded, still, solving this task determines a mental activity (Petrovschi, 2009, p. 1), a discovering process, when pupilscan answer questions correctly. In order to give a correct answer, they should have previous knowledge or representations to be able to identify the objects from the painting: the correspondence term-image for the hydroelectric power plant, solar panel, wind turbine, mine entrance, wagon with coal, electricity transmission grid pillar.

1. Look at this picture and answer the questions:
a) Who enjoys the light and the warmth of the Sun?
b) How do people light up and heat their houses during wintertime?
c) Which are the sources for electrical energy production illustrated in this drawing?
d) What sources for heat production do you recognize in this drawing?

Figure 1. Image from the textbook (Bălan et al., 2018, p. 84)

Tasks. For the second task,pupils are asked to find energy forms into their classroom and their house and to name the energy sources used. Starting from the information given in the textbook, pupils should discover in the classroom and in their house all forms of energy mentioned. If this is a learning through discovery activity, then, they should be able to determine for themselves, based on previous knowledge, the connection source of energy - form of energy, in this case the correspondence Sun - source of light and heat (correct Sun - solar energy). Referring to electricity, it is more difficult for children to discover for themselves the sources from which electricity is produced, they need information from other sources then the textbook.

For the third task, pupils are challenged to present to an imaginary character (Pogo) the importance of electrical energy in a human's life. Based upon observations made at home and upon previous knowledge and experiences, pupils can discover certain aspects of the importance of electrical energy for humans. In order to solve the problem-situation, pupilsmay talk to their family members. For the fourth task, the association drawing-form of energy is being requested. Regarding the identification of the significance of the drawn elements, it will be easy for pupils to recognize the Sun and the tree, it will be a little bit more difficult to establish that the drawing represents a running water or a waterfall and we donot think that they will be able to identify the oil well unless with the aid of an adult who possesses this representation or knowledge. The associations pupils can make, according to the information presented into the textbook, are empirical (Table 1).

Table 1. Associations made using the information in the textbook

Empirical associations	**Correct associationssource - form of energy**
Sun - light, heat, electricity	*Sun - solar energy*
Running water - electricity	*Running water - hydraulic energy*
Tree - wind energy	*Wind - Aeolian energy*
Oil well - light, heat, electricity	*Oil/Petrol – fuel*

For the fifth task, pupils are asked to match the source of energy with the object it sets in motion. We identified: car, airplane, boat, wagon, and locomotive. Two sources of energy are offered: oil and coal. Pupils may associate petrol/oil with the car, airplane and the boat, and coal with the wagon and locomotive. Pupils may be confused because, nowadays, the sources of energy that set cars in motion are gasoline, diesel, electricity, and other sources, and not petrol/oil or crude oil. For the sixth task, pupils are asked to identify actions that can cause energy saving or, instead, actions that can prevent the waste of energy. By solving this task, pupils can be aware of the need for certain behaviours regarding natural sources.

3.2. Analyzing the animation film considering learning through discovery

Using the Google search engine and using keywords "energy sources video" (in Romanian), weidentified the animation film „Să învățăm ce înseamnă energie"["Let's Learn What Energy Means"] posted by the Energetic Efficiency Agency (AgențiapentruEficiențaEnergetică, 2018)on July 3, 2018. YouTube offers several films for this topic but not all of them are suitable for pupils' age and knowledge level and do not have the necessary information for the studied topic. The animation film has several strengths: short duration (3 minutes and 52 seconds); starts form a child's questions while observing the objects around him and wanting to know what their uses are, what their importance is (*"What are these mirrors on the roof of our house?", "What are they for?"*) and introduces a character (the grandfather) with much knowledge, who answers his questions in an accessible manner; the information volume about energy sources and their use is great, but reasonable as difficulty degree for children in primary school.

From a didactic point of view, the dialogue from the film is built using a progressive cognitive approach: closed question, question that needs explanation, assumption, or hypothesis. For the first stage, the child asks a question and receives the information ("*photo-voltaic panels"*), and for the second question he receives an explanation (how these panels are used). At the second stage, the child starts from an assumption ("*this pinwheel…is also used to heat the water*?*"*) and he receives the correct explanation. Another assumption follows (*"Like this, big cities are also illuminated, with the aid of wind turbines," "In water there is also energy?"*).The child, who has the age-specific curiosity, formulates questions and answers applying the method of trials and errors at cognitive and not practical level. At the third stage, his grandfather asks him questions: *"Why do you think we* *gather all this hay, the scrap wood from around the lathe, these dry twigs and leaves, every year?"* The child offers several answers (hypotheses), and the grandfather offers him the right answer, the answer the child did not discover. At the end of the film, the child formulates a series of questions, which represent the start point for future discoveries.

In the film, there are used 17 concepts regarding this topic: photo-voltaic panels, sunlight, photo-voltaic cells, solar collectors, wind energy, wind turbines, generator, electricity, bio-mass, bio-fuel, bio-gas, geothermal energy, geothermal pumps, heat pumps, soil, and ground-water. It is of great value that the logical route is followed between the source of energy (for example, wind), form of energy generated (wind energy), the way of collecting and processing this form of energy (wind turbines), the way of using the final form of energy (electrical). The weakness is represented by some errors regarding the use of heat pumps for extracting the heat "from the soil", when, in fact, it is from underground. To sum up, we consider that this film meets all requirements in order tosupport a learning through discovery activity.

3.3. Analyzingthe Google Classroom application

During theactivity, we noticed that this application offers several facilities or advantages: the teacher can send information, messages, tasks in front of all pupils, but also, he/she can communicate individually, privately with each pupil; tasks solved by a single pupil can be viewed only by the teacher, the others not having access to their colleagues' account; tasks solved and sent as a photograph can be corrected directly on the photo with a distinctive colour, and thus, the pupilcan see exactly the place where he/she did wrong and correct by himself/herself into his/her textbook/auxiliary/notebook; after correcting the solutions to the tasks, pupils can receive individual, private/particular feedback; points from 0 to 100 can be assigned to evaluate these solutions.

3.4. Analyzing learning through the discovery activity performed in the virtual classroom

Because this activity took place several days since theinterruption of face-to-face classes, teachers searched for solutions in order to carry on with their didactic process. For this lesson, pupils received an hour before the scheduled time, their tasks and indications regarding sources of information (textbook, animation film and such) and were asked to solve them and post solutions on their Classroom account. Each child chose his/her optimum time to solve tasks and could ask and benefit from the help of his/her family. The teacher did not supervise pupils' activity, but she assessed the solutions put done on their textbooks and handbooks and provided individual written feedback.

Table 2. Pupils' results regarding the solved tasks

Item	**Answers**					
	Correct		**Partly correct**		**Incorrect/ Missing**	
	No.	**%**	**No.**	**%**	**No.**	**%**
1. Look at the picture below and answer the questions.	21	87.5	2	8.33	1	4.16
2. Find forms of energy into your classroom and into your house.	20	83.33	1	4.16	3	12.49
3. Tell Pogo about the importance of electricity in human's life.	18	75	2	8.33	4	16.66
4.Look at the drawings below and write into the boxes the form of identified energy.	24	100	-	-	-	-
5. Match the source of energy with the object	24	100	-	-	-	-

it sets in motion.						
6. What do you have to do in order to save energy? Mark with an X the boxes.	24	100	-	-	-	-

In Table 2, it is noted that the tasks which pupils were asked to fill in, to make matches and to select correct information from a list of built answers, were correctly solved by all pupils (100%). Pupils had difficulties concerning the tasks, where they had to phrase written solutions (answers to questions, examples of energy sources, reasoning the importance of energy sources in human life) because, as they are still in the alphabet period, they do not have the skill to write well yet.

3.5. Principles, Advantages, and Difficulties

Based on the analysis of the didactic activity, the process performed by pupils based on the strategy of learning through discovery using the online environment, we deduced several principles, and we identified some advantages and difficulties.

Principles. In order to produce learning through discovery when children use online sources, several principles should be mainly complied with: the list of keywords or questions to be short; the concepts or topics proposed for discovery to be suitable for children's level of knowledge and understanding; children should be given the necessary time sources; the adult should demonstrate to them the application of some strategies and procedures for information searching and should explain how to evaluate information in the virtual environment.

Advantages. All children from this class have computers and almost all of them (except fortwo or three) receive support from their parents (supervision, communication, support for solving tasks). Under these circumstances, pupils can practice learning through discovery using the Ethernet as source, without being exposed to great risks.Using the strategy of learning through discovery under the teacher's (and parents') guidance and supervision, children benefit from the advantages of this strategy: they learn to search for information designed for learning and not for other recreational purposes; they learn to assess information (i.e. critical thinking) and to select the one that is suitable for them; they learn to process the information presented in various forms (documentary films, animation films, drawings, pictures, text, etc.); they learn how to formulate questions and how to search for answers to questions; they learn strategies to search for information (they formulate the question, use Google find and give the page where the answer is); they notice that there are different opinions about certain topics, contradictions, false and incomplete information and thus, they learn to be suspicious regarding the information; they learn how to make a selection from the diversity and variety of sources.

Difficulties. The children of this class had some difficulties during the investigation process in the online environment because their skill of written communication (reading and writing) was not developed at a superior level, they did not have the necessary ability to correctly evaluate the information, their abilities to search for information were not well-developed, they did not know how to make the difference between correct and wrong or false information and to choose relevant information.

4. Conclusions

Pupils from the 1st grade, "digital natives", involved in the didactic activity in which they applied the strategy of learning through discovery using sources from the online environment, had in their homes the necessary devices (i.e. computers) and had the digital skills developed at a level that allowed them to use those devices successfully, under their parents' supervision and support.

The lesson in the textbook, designed as a curricular auxiliary, proposes a series of tasks but without offering the necessary information for solving them and for this reason the pupils need to discover other sources of information, in this case, online and even to ask for their parents' support. The animation film proposed by the teacher for viewing on YouTube represented a valuable source of information that corresponded to the pupils' level of knowledge and, more than that, satisfied their curiosity.

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Experiential Learning. Students' Design and Production of Films on Zoom Platform

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Abstract

In the context of organizing online the graduation exams of the university programs, students who completed the study program for the didactic career made films in which they presented a part of their graduation portfolio. We analysed several tools and applications available for free on the Internet, we identified their advantages and disadvantages and we chose the Zoom platform for making these films. The research was focused on two directions: students' experiential learning process and their films. Research results will be capitalized in the future in carrying out other learning activities in the online environment. The experiential learning resulting from making films was considered useful by students in other contexts, including those in which they would help others make films.

Keywords: Digital natives, Higher education in geography, Didactics of geography, Representations

1. Introduction and Theoretical Background

The transfer of university teaching activities in online, from March 11, 2020, generated profound changes in organization of courses, seminars, and evaluation. Teachers and students had to adapt to the new conditions and obtain targeted results by using Information and Communication Technologies (ICT). In university education, full-time activities were ad-hoc experimented on e-learning platforms and other electronic means that were available or were made available at the institutional level. Both at the professors' and students' level, e-learning was practiced through experience in virtual environments, previous research on the educational system in Romania having already shown that using the virtual learning environment in sciences was undergoing steady development (Adăscăliței et al., 2019; Vlada and Adăscăliței, 2014; Vlada, Jugureanu and Istrate, 2009). Gradually, the transition was made from sending students educational resources (word documents, PowerPoint presentations and other materials) and tasks via email, to setting up Facebook or Yahoo discussion groups and virtual classes on various elearning platforms (Microsoft Teams, Moodle) and sharing educational content, and also through discussions on video conferencing platforms (Zoom, Google Meet).

Previous studies on the use of ICT by geography students at Babeș-Bolyai University, in Cluj-Napoca, Romania, have focused on several issues. Regarding the use of the Internet, it was found that they allocate very large time resources for various purposes, including professional (Dulamă, Magdaș and Osaci-Costache, 2015), such as using web sources in geography bibliographical research and learning (Ilovan et al., 2018), using visual materials from web sources in studying regional geography topics (Magdaș et al., 2018), for online documentation on emerging subjects in geographical research (Ilovan et al., 2020a), creating visual representations based on online sources (Ursu et al., 2020).

In addition, research involving students at the Faculty of Geography of the respective university shows that they have high level digital skills (Ilovan et al., 2016). Research indicates that students use various devices to search for information on the Internet (Ilovan et al., 2015), they use various applications to collect geographic data in the field with a smartphone (Magdaș et al., 2018), and they use digital mapping to learn about urban landscape changes in post-socialist Romania (Ilovan et al., 2019b). Many students used various tutorials available for free online to develop the skills of using GIS in initial professional training for territorial planning (Ilovan et al., 2016). Within some projects, they experimented with some applications for representing urban space (Dulamă et al., 2020).

Students had the opportunity to use private discussion groups on Facebook as a context for experiential learning when analyzing cultural landscapes (Dulamă, Ilovan and Buș, 2016), but also for evaluation (Dulamă, Vana and Ilovan, 2016). This type of learning was used in projects involving case studies on various topics: landscape analysis (Ilovan et al., 2019a) and analysis of river basins (Dulamă, Ilovan and Niţoaia, 2016).

For the geography specialization, there are specific applications developed in the field in which students learn to analyze the space directly. In these applications, they analyzed urban regeneration in Cluj-Napoca city (Ilovan et al., 2020b, 2020c, 2020d, 2020e), the relief, landscapes, and anthropogenic impact in Iara Valley (Rus et al., 2019; Rus et al., 2020). Geography students from Cluj have benefited from learning contexts in field applications developed in partnership with other universities in other countries and know the learning strategies used by geography (Dulamă et al., 2018).

In Geography teaching and learning, various multimedia products (videos, films, PowerPoint presentations), the Internet and the World Wide Web are used (Richter and Van der Westhuizen, 2005). In the didactic papers, it is recommended to use films in the study of geography (Dulamă, 1996; Dulamă and Roșcovan, 2007) and in acquiring knowledge of the geographical space (Dulamă, 2004). The films were also made by students in order to exemplify the use of educational means (maps, diagrams, photographs, geographical globe) in learning activities with students in geography (Dulamă et al., 2019). In some films made by teachers for primary and preschool education, the way of carrying out an activity by children was presented, under their direct coordination (Dulamă, Magdaș and Chiş, 2020).

In this research, we will analyze the context of online organization for graduation exams of university programs and the realization of experiential learning by geography students who completed the study program for the teaching career and made films in which they presented a part of their graduation portfolio. The research focused on two directions: the experiential learning process made by the student, the students' opinions about this process and the films made by them.

2. Material and Method

2.1. Participants. In making the films, the students from the Faculty of Geography, in Babeș-Bolyai University Cluj-Napoca, who are undergoing the Psychopedagogical Studies Program, in order to become teachers of geography, were involved. 55 students completed the first level of this program and the 3rd year of study of the specialization in the field of Geography (distributed as follows: 26 in Geography of tourism; 17 in Geography; six in Cartography: four in Territorial planning; two in Hydrology - Meteorology). 36 students (distributed on the specializations at the Bachelor level as follows: 29 in Geography of tourism; five in Geography; one in Cartography: one in Territorial planning) completed level II of this program and completed a Master's program in Geography. All students have previously made e-portfolios in all disciplines covered with the first author (each student realised four e-portfolios at first level and three e-portfolios at second level, respectively) and have made documents in Microsoft Word, PowerPoint presentations, charts in Excel, maps in GIS and others. Students, digital natives, have digital skills developed to a level that allows them to accomplish the given task. In designing the task and organizing the activity with the students, the first author was involved and was perceived by students as a teacher, not as a researcher.

2.2. Procedure. The research was carried out within the project *Valorificarea unor tehnologii avansate pentru realizarea unor filme didactice destinate predării-învățării în învățământul universitar* [Valorising Certain Advanced Technologies to Realise Didactic Films for Teaching-Learning in the University System] carried out in 2020. Students were given the task to make a video film on Zoom platform with the duration of maximum 5 minutes and maximum 10MB. The first level graduates could choose to present a document from their e-portfolio that includes all the materials made in the pedagogical disciplines, including a lesson project or part of it. The recipients of the film could be students in a pre-university class or the teacher who evaluated the film. The second level graduates were given the task to present the graduation paper for this level. Each student made in this paper a documentation for a geography lesson at high school level and several lesson projects and learning activities, structured based on several models (Evocation-Realization of meaning-Reflection; I know-I want to know-I learned and others). The task was sent to students by email and was posted in the private discussion group Facebook, Cultural Landscapes. The students sent the films by email.

2.3. Research material, data collecting, processing, and interpretation. The research material is represented by the films made by the students, the professor's observations (the first author) on the process of making these films, the students' opinions about the process of making those films. The text presented in the films was subjected to the thematic analysis of the content, and the visual imagery was analysed by visual methods. We obtained the data about the filmmaking process from students by email, during the task and until its completion. We collected the students' opinions about the process of making these films through the survey method, and, as a tool, we used a questionnaire made in Google Forms.

3. Results and Discussions

3.1. The analysis of the films making process. The students received the task and had about ten days to make the film. We had clarification discussions with the students on the private group Facebook, Cultural Landscapes (2020). To understand that it is not such a difficult task for them, we highlighted their digital competence "you have experience in making short films and PowerPoint Presentations". We specified they have the possibility to choose the optimal option for them: a) Make a PowerPoint Presentation in a lesson (they probably already have it) and record their voice when they explain what is on the slide. There can be two perspectives: to speak as they would explain to the children in class or to speak as if they were explaining to the professor how they wanted to do the lesson. It does not need to be a whole lesson, it can be a single short activity, organized in 3-5 slides with a duration of 5 minutes. b) The second possibility is to record when they speak, and their face will appear on the screen. In both variants, the first time they should present their name and surname, specialization, and year of study.

The students had different reactions when they received the assignments. Some asked questions for clarification, others sought solutions, while others expressed concern. The first option proposed by a master student to make the film was to use an application that puts sound in a PowerPoint presentation, but it had too many mega, and it had to be transmitted through wetransfer.com and it took up a lot of storage space. A student wrote that she made a project in PowerPoint, with sound, and sent it using a link on Google Drive. We also proposed making movies with the smartphone, but there was a risk that not all students had high-performance devices. We asked if they knew applications through which they could make the desired movie with a few mega. One student expressed his opinion: "in order to film with the phone and be small, we have to reduce the clarity, and nothing may be understood.” Following the request to do a test and send it, the student experimented and transmitted the result “I have made a 2-minute video, at a very good clarity and 45 mega came out”. I asked students if they were familiar or worked with the Microsoft Teams Platform and Zoom. They said yes. One student mentioned “For me, the version with Zoom, in which we film ourselves, sounds good, let’s see how it works. I will try it and write to you”. After experimenting, the conclusion was the following: “it works very easily and at a 7-minute filming, the file has 10,000kb = 10 MB. I am sending you the file by email, it is small, no wetransfer is needed. So, I say that this option should remain, but my colleagues should also express their opinion.” The student also proposed storing movies in Google Drive. To help her colleagues, the student made a document in which she described the procedure, attached a video and screenshots. A student pointed out her concern on the group “If we do not come to the faculty, it does not mean that we have more spare time. I had and still have so much to do that I hadn’t received in three semesters together. … We are in the final year and we have to write the Bachelor’s thesis. … The session is structured in 2 weeks with 8 exams. After the session ends, we have less than 10 days to complete the thesis. How are we going to handle it all?” Another student reflected, “I don’t understand why we have more work to do than if we took classes normally. All teachers have a lot of requirements. Little by little, they pile up and so we run out of time for writing the Bachelor’s theses.”

“I am sending you an email explaining how to complete the presentations in Zoom. You need to make a presentation of a small part of a lesson that has the role of concluding presentation of the pedagogical module. You choose what lesson you want. It doesn’t have to be a whole lesson, just a short part of a lesson. The presentation will take 5 minutes, no more! Email presentations to… by… May morning. Attach email presentations. Only if the presentations are too large, use wetransfer. (Normally, they shouldn’t be so large that they can’t be attached to the mail.)

Steps to follow to make such a presentation:

1. Prepare a PowerPoint presentation with the lesson in advance;

2. Log in to Zoom and sign in https://zoom.us/;

3. Receive an email, enter the link you received and activate your account;

4. If you are not already logged in, log in from “Sign in”;

5. Click on “host a meeting”, the “with video on” option. Also choose the audio test option to make sure you hear well;

6. Share the screen by tapping “share screen”. From there, choose which pages / documents you have opened on your computer that you want to share;

7. Upstairs is a dark gray bar. If it does not appear, move the cursor to the top of the eraser that will appear. Click on “more options” (the three points) and choose “Record” to record the presentation;

8. Introduce yourself;

9. When you want to finish, click on “more options” (the three points), then click on the last option: “End”;

10. The video will be automatically saved on your computer after you finish the presentation. Wait for the recording to convert, then choose the folder in which you want it to be saved;

I have attached images with the steps you need to follow;

I also attached a video made by me yesterday when I tried to see if this version works with Zoom.”

(C.T., third year student).

Attending the final years of some study programs, even if they did not carry out the academic activities face to face, still the students had a program loaded with the preparation of projects, exams, Bachelor's theses, dissertations, graduation of the pedagogical module. The online school has caused many changes in the way the system works, therefore it generated strong pressure on students and induced stress. Because it is very important that all students succeed in solving the given tasks as well as possible, all their problems made public need to be given positive, constructive, transparent feedback and students be encouraged ("Do not panic because you have much to do", "If you have difficulties, ask for help!", "It is a problem for me and for you that we have a lot to do, so the solution is to share knowledge and support each other"). This feedback was provided considering that students are preparing to become teachers.

By the set date, the students managed to make the films. One student used other applications and specified that he could not convert movies to no more than 10 MB. He also proposed sending the film by messenger. In the end, he remade the film observing the given requirements.

3.2. Analysis of students' opinions

We collected the students' opinions about films making through a questionnaire administered after finishing the studies of the first and second level of the pedagogical module. During a day and a half, 36 students responded voluntarily and anonymously, which represents a third of the total number. We specify that some of the students who have completed the first level continue their studies by enrolling in the second level and are now on holiday, and the others are no longer university students and probably some of them are employed.

Regarding the previous production of films and PowerPoint presentations, the results were surprising because they did not correspond to our perceptions and beliefs, of researchers and professors. According to our perception, most students have made films with the smartphone, a device that almost everyone has permanently, but only 3 (8.3%) said they made the movies in this way, while 91.7% said that they made films with other devices. Our belief was that students did not make films on the Zoom platform, but 28 students (77.8%) stated that they had made such films before. Being in their final year, we considered that all students had made PowerPoint presentations, but, to our surprise, only 19 (52.8%) confirmed, so they did not gain experience before.

Although they had a very busy schedule that semester and the students had a lot of work to do, however, to be successful in making the films, 72.2% of them did several rehearsals before recording the film, and 33.3% did one rehearsal. None of the students interviewed made the film without one previous rehearsal. The fact that they practiced was also visible in the film because they were in time, they spoke freely and with a lot of self-confidence. 24 students (66.7%) succeeded to make the film on the first try, which indicated a high degree of success and only two (5.6%) appreciated that they failed in making this film on the Zoom platform, but found other solutions to make the film or they made it without complying with all the requirements (a case in which they could not share the screen). Making the film was a learning activity through successful experience because all the students surveyed claimed that after making this film, they could make other films and 35 of them said that they could guide others to make such films.

In Table 2, we presented the students' opinions regarding the degree of difficulty and the usefulness of the process of making the film on a 5-points Likert scale, where value 1 means "a little" and 5 means "very much". Students perceived the task of making the film to have average difficulty (m - 2.42), but after solving it they perceived it to have a lower difficulty degree (m - 1.72), which indicates that the experiential learning of was effective, although they made only one film. The process of making the film included several activities, these being perceived with varying degrees of difficulty. The difficulty degree of the activities, in students' opinions, decreased from the task of making the film (m - 2.42), to the design of the text that will be exposed during the presentation (m - 2.06), the exposure (text) during the slide presentation (m - 2.00), making the PowerPoint presentation (m - 1.67), choosing the content of the PowerPoint presentation (m - 1.61). The students appreciated that they had less difficulty than in the activities that they had previously performed frequently (making PowerPoint presentations).

Table 1. Students' opinions about making films

Assertion	**Yes**		**No**	
	No.	%	No.	%
Before making this film, I had also made films on the Zoom platform.	28	77.8	8	22.2
Before making this film, I had made films with the smartphone.	3	8.3	33	91.7
Before making this film, I had made films with other devices.	33	91.7	3	8.3
Before making this film, I had made presentations in Power Point.	19	52.8	17	47.2
To make this film, I created an account on the Zoom platform.	35	97.2	1	2.8
I succeeded to make the film on the first try.	24	66.7	12	33.3
Before recording the film, I had rehearsed.	12	33.3	24	66.7
Before recording the film, I had done several rehearsals.	26	72.2	10	27.8
I failed to make this film on the Zoom platform.	2	5.6	34	94.4
After making this film, I can make more.	36	100	-	0
After making this film, I can help (guide) others to make it.	35	97.2	1	2.8

Table 2. Difficulty degree and usefulness of the filmmaking process

	Students' opinion	**Value / No. of students**					
		1	2	3	[illegible]	5	Mean
Difficulty level	When I was given the task of making this film, I found it difficult.	6	3	14	[illegible]	1	**2.42**
	Designing the text to present during the slide show was difficult.	12	3	8	[illegible]	-	**2.06**
	Exposing (text) during slide shows was difficult.	12	6	4	[illegible]	-	**2.00**
	After I made the film, I found it difficult to make.	18	1	6		-	**1.72**
	PowerPoint presentation (text and image selection; loading / assembling text and images on a slide / slides) was difficult.	18	3	4		-	**1.67**

	Choosing the content of the PowerPoint presentation was difficult.	20	0	6		-	**1.61**
Usefulness level	The information, explanations and screenshots provided by our colleague were useful to me.	2		6		19	**4.31**
	The experience gained by making this film is and will be useful to me.	3		3	1	16	**3.94**

3.3. Analysis of films made by students

Presentation format. 90 films out of 91 films made in mp4 format, and a student from the first level module sent a film in MOV format. Six students also sent the playback version (m3u format), five from the first level and one student from the second level. Seven students also sent the audio-only version (m4a format), six from the first level and one student from the second level.

Volume/ amount of information (Megabytes). At the first level, one film had 36 MB, two films exceeded 20 MB, 13 had 10-20 MB, and 49 films had less than 10 MB, so they met the given requirement. Three films had less than 4 MB. At the second level, 10 films had 10-17.4 MB, and 26 films had less than 10 MB. The smallest film was 4.9 MB (Table 3).

Film length. Even if some films have exceeded the upper limit of 10 MB, most films could be watched in 5-6 minutes (Table 3). The students were timed (it was allowed to exceed the duration of the presentation). They were able to control this parameter, even if they could not control the amount of information measured in megabytes.

Table 3. Number of students and compliance with the requirements in making films

	No. of students	**No. of films > 10 MB**	**No. of films of 5-6 minutes**
1st level	55	16	32
2nd level	36	10	17

Screen organization. Depending on the understanding of the task, the knowledge of the platform, of the devices and of the presentation conception, while watching films, the screen was organized spatially in several ways: (1) the PowerPoint presentation occupied the entire screen, without the author being visible; (2) the PowerPoint presentation took up the entire screen, but in the upper right corner was visible the face of the speaking student; (3) on the left side of the screen one could see the slides, in the center were located slides on the basis of which the presentation was realised, and in the upper left corner, the student was visible; (4) the student spoke freely without visual support, motivating that he / she could not share the screen because of the devices he / she had, a situation he / she had previously faced in other disciplines; (5) the student spoke without sharing the screen, but indicated certain aspects on a map located behind him. A student communicated with students in a class, asked them questions, and answers were heard, although students did not see each other. It gave the impression that it would be a face-to-face lesson.

The chosen theme. The first level students presented fragments from the lessons and addressed the students, except for one student, who presented how he wanted to organize the lesson, and addressed the evaluating professor. Two students chose topics that did not exist in the school curriculum: Muntenia, Global Seed Vault, Svalbard, and Norway. Most students chose the topics related to the Geography of Romania, the Regional Geography (of the continents), the Physical Geography and elements of astronomy. Such topics are helpful in enabling students develop their critical thinking while understanding the complexity of geographical processes and phenomena, and the factors influencing the resilience and sustainability of geographical systems (Petrişor, Petre and Meita, 2016; Petrişor, Meita and Petre, 2016; Roșian et al., 2016). Few students chose topics from Population Geography, Economic Geography and Geography of Settlements (Table 4). Only three topics were addressed by several students: The Depression of Transylvania, the Danube Delta, and Europe's climate. The students from level II presented the graduation paper, each with a certain theme. They presented either the entire paper or just a few learning activities.

Table 4. Examples of lesson topics approached in films by students

	Examples of topics
Romanian geography	The Black Sea, the Danube, the Dobrudja Plateau, the Romanian Field, the Danube Delta, the Apuseni Mountains, the Făgăraș Mountains, the Depression of Transylvania, the Moldavian Plateau, the Mehedinți Plateau, the Getic Plateau, the Subcarpathians, the Romanian Climate.
Regional geography	Countries: Spain, Italy, Germany, New Zealand; Characteristics of the continents: Europe's climate, Europe's pedogeographic cover, Africa, Asian vegetation, Europe's relief.
Physical geography and elements of astronomy	Elements of astronomy: The universe and the solar system, Lithosphere. General characteristics and importance, the Earth's geospheres, Physical geography: The major relief of the continents.
Geography of population and settlements	Metropolises and megalopolises, Structure by races, Structure by religions and distribution on the globe.
Economic geography	Natural resources and their capitalization.

Oral communication. The students spoke freely, even if there was written text on the screen. They showed that they knew the content very well. For the time frame, some students spoke very quickly. To reduce stress, students learned that some mistakes were allowed, so their presentations were natural, not directed and mechanically memorized.

Visual communication. Although it was recommended in other contexts to avoid writing in white, in some cases, the text was in white on a blue, black, or green background. Most presentations were richly illustrated with images (maps, diagrams, photographs, block diagrams, profiles), but without abusing them. Only in a few cases, the presentations did not include images, which was surprising because the students had already learned about the importance of using visual material in forming correct representations in geography. Students did not integrate animated films or documentaries in their presentations. They did not make dynamic presentations, because in previous contexts it was required that their presentations be static, in order not to distract the students from the essential aspects of the studied topic.

4. Conclusions

At the end of this research, in which we investigated the process of making didactic films by geography students and films made in the context of completing study programs designed to train them for the career of a geography teacher, we came to some conclusions. The task of making films was a challenge for the students, but, even if, in the beginning, it was perceived as difficult, as a result of teamwork, going through a detailed procedure explained by one of their colleagues and some rehearsals, the students managed to solve the task successfully. Regarding the films made, we found that most students met the requirements (use of the Zoom platform, maximum duration of 5-6 minutes, the film should not exceed 10 MB) and the suggestions given by their professor. The experiential learning resulting from making those films was considered by students to be useful in other contexts, including those in which they helped others make films.

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Guiding the Creation of Graphic Organizers through Films

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Abstract

The Romanian preuniversity geography teaching system rarely uses graphical organisers as information organisation tools, despite countless recommendations and examples found in scientific literature. YouTube contains numerous films in English, depicting how graphical organisers are developed using software and film apps and which present the way to create and use them in a didactic manner. However, YouTube offers few Romanian films on the two subject matters. The paper analyses the way to create such films, the software app used, the strategy proposed by the authors to aid others in creating this scheme, soundtrack concept (oral text) and the visual means.

Keywords: Geography, Visual imagery, Learning in university, Pre-university education, Tutorial, YouTube

1. Introduction and Theoretical Background

Graphical organisers are presented in Romanian didactic papers as teaching-learning-evaluation tools (Gavrilă and Nicolae, 2015, p. 3), used to organise information and build knowledge through a visual representation somewhere between text and illustration (p. 7). Information processing and organisation is classified by some didacticians as ability (Dulamă, 2010a, 2010b).

Scientific litererature describes and gives examples of several graphical organisers – tables, matrixes, schemes (linear, branch, cluster, pyramid, systemic, circular or sequential), diagrams/charts (Venn, Ishikawa) (Dulamă, 2000, 2008a) – classified based on how they look (Dulamă, 2009a, pp. 319-320). Several papers depict the ways to construct some graphical organisers: cluster (Dulamă, 2002a, 2002b), SWOT analysis (Dulamă, 2004a), tables (Dulamă, 2008b) and others (Steele, Meredith and Temple, 1998a, 1998b; Dulamă, 2002b, 2008a, 2009b). These are made by teachers on blackboards during lessons (Dulamă, 2002b, 2002c; Dulamă, 2004b), by pupils in their notebooks (Dulamă 2010a, 2010b) or during preuniversity (Dulamă, 2004b) or university assessment examinations (Dulamă and Ilovan, 2004).

When it comes to pupils learning about the manner to structure information in graphical organisers, the literature mentions the fact that such a process can be attained during the first classes, at any moment of the lesson, starting from simple procedures and ending with more intricate ones (Dulamă, 2009a, p. 319). Didactic papers recommend pupils first write down the graphical organisers (from now on GO) in their notebooks. Later, pupils can develop GOs in groups, pairs or individually (Dulamă, 2009a, p. 319). To graphically process information from a certain text, several steps must be taken: information analysis from the text, extracting essential information, and criteria-based information classification (Dulamă, 2009a, p. 319). Some teachers emphasize principles hierarchically, chronologically, and causally, this eventually aiding information organisation in diagrams (Gavrilă and Nicolae, 2015, p. 8).

When developing GOs alongside pupils, teachers must consider several aspects: the pupils' cognitive level and learning style, objectives to be attained during the learning process, personal experience of teachers and pupils in devising GOs (Gavrilă and Nicolae, 2015, p. 9). Some emphasize the connection between content specificity and GO characteristics through which it can be represented (Dulamă, 2009a), the need to follow proportions in drawings and texts, and to limit the length of texts (Gavrilă and Nicolae, 2015, p. 9).

There are very few Romanian studies regarding GOs usage by teachers in their didactic activity with pupils and students (Cîineanu, Miron and Dulamă, 2020), on the efficiency of using GOs in university studies (Cîineanu et al., 2020a, 2020b) – although their use could impact greatly learning about complex geographical processes and phenomena (Roșian et al., 2016) – and assessment procedures (Dulamă and Ilovan, 2004). Although didactics papers support the importance of GOs in gaining knowledge and creating abilities (Dulamă, 2010a, 2010b), that such work techniques help pupils "think, visualise and organise their own knowledge" (Gavrilă and Nicolae, 2015, p. 8), teachers rarely use graphical organisers in the educational process. In order to aid those students who will eventually become teachers as well as actual teachers to use different learning procedures and activities based, inclusively, on cluster techniques, several educational films have been uploaded on private Facebook groups (Dulamă et al., 2019; Dulamă, Magdaș and Chiș, 2020). We aim to analyse the available films on the Internet, especially those through which someone might comprehend the full importance of GOs in education, as well as how to create such GOs. The investigation will be twofold: films in English and films in Romanian. We aim to find answers for the following questions: Where and how to find films for developing GOs? What kind of GOs are presented in films? The creation of which GOs is presented on film? What kind of strategies to guide GOs creation are presented?

2. Method

Data Collecting, Procedure and Research Material. With the help of the observation method, we collected data regarding the strategies (methods, procedures, means) used by film creators, in order to help others learn how to create GOs. We applied the thematic, subjective, and reiterative analyses (Băban, 2002) on the content (text) of films. We also analysed GO features (colours, structure, components, etc.) using visual means. With the help of a focus grup, we collected information on the analysed films and their usage in the learning process. The research material is made of the content (text) and images of the analysed films, the observations from visualising those films, and the answers and observations from the focus grup.

The participants in this research are the authors of this study. They devised the research as three mentors teaching geography in preuniversity classes, a professor teaching geography classes at university, a geography researcher, and a professor teaching geography didactics at university.

3. Results and Discussions

The Internet currently provides a vast array of learning tutorials. We analysed the situation of those tutorials which provide guides for graphical organisers and other films tackling the subject.

3.1. Specificities of English films dedicated to creating graphical organisers

After analysing the films found on YouTube, it is clear there are two categories: films depicting GOs development through apps, which require and aim at digital abilities, and films depicting information organisation in different types of GOs, which require and aim at didactic competence and learning abilities.

a. Films for developing GOs using various software apps. YouTube provides a rich series of such short films, created by people with diverse backgrounds, who aim to freely share their knowledge and experience. Out of this vast offer, we analysed only a couple of films, generated in the first stage of research. Table 1 contains a list of various apps (Microsoft Word, PowerPoint, SmartArt) used to create GOs with the help of a PC. There similar ways to create different shaped boxes, line and arrow tracing, but there are some apps providing predetermined formats. These films have several important characteristics for learning: short length, which is crucial as they do not require extended amounts of time to watch; there are intuitive, therefore digital veterans can easily learn how to create a GO; information relay through auditory and visual cues; speaking speed allows for a better understading of information.

Table 1. Examples of films aimimg to demonstrate GOs development through software apps

Author	Length in minutes	Used app	Short description
The Tech Train, 2018	9.11	Microsoft Word	It explains and demonstrates how to create mind maps or brainstorms quickly and easily. Demo (writing, line tracing) also has auditory explanations (Fig. 1).
Wdvideoeducation, 2020	11.3	Microsoft Word	It depicts steps used to create flowcharts, mind maps, web, learning maps, etc. It shows how to create a pyramid structure (box creation, arranging them on a line, line tracing for connections, writing in boxes).
Hillaryjbrown 2018	5.45	PowerPoint	It explains and shows how to create a Mind Map. It shows how to write words in boxes, trace lines, creater oval shaped boxes (multiplication, page arrangement, size change, colouring) and assembling them into formats.
Software Spring, 2017	8.15	PowerPoint	It presents Flowchart creation. Visual demo has a musical background, with no verbal cues, only written. Visually, there are coloured boxes (rectangles), their alignment, and movement/arrangement in space.
Linkedin Learning, 2013	4.33	SmartArt	It presents creating pyramid structures, using a predetermined scheme. It presents text introduction, box creation, etc.

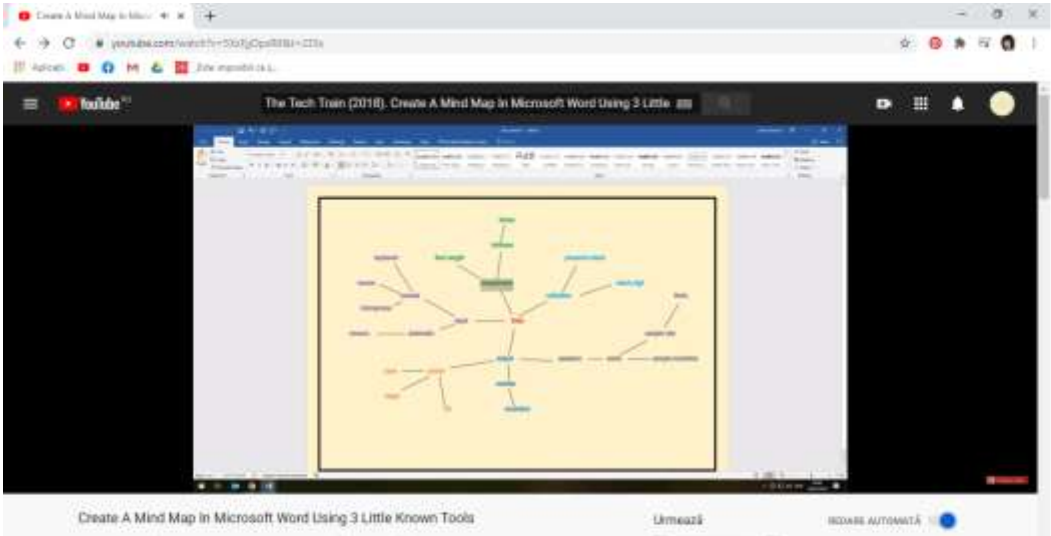

Figure 1. Screen capture of a tutorial on mental map creation using Microsoft Word (The Tech Train, 2018)

b. Diversity of available GOs and tutorial offer in MindMaster app. A 2.42-minute film promotes various types of GOs concepts, with a musical background (Wondershare Edraw, 2017) and recommends downloading Edraw MindMaster. The MindMaster app is a professional mind mapping tool, available on PC, tablet, smartphone, and websites, both user-friendly and versatile (Wondershare Edraw, 2019). It offers 12 different structures for education, economy and personal (individual) use: Graphic Organizer, Charts and Graphs, Engineering Diagram, Floor Plan, Science Illustration, Business Diagram. Graphic Organizer (Main Idea and Detail, Graphic Organizer, Vocabulary Study Graphic Organizer, Storyboard, Compare and Contrast Graphic Organizer, Sequence Chart, Grid and Matrix Graphic Organizer, Writing Graphic Organizer, Reading Graphic Organizer) (Wondershare Edraw, 2019). Flowchart, Mind Map (Mind Map; Concept Map; Bubble Diagram; Brainstorming Diagram), Basic diagram (Circular Diagram; Venn Diagram; Pyramid Diagram; List Diagram; Arrow Diagram; Circle Spoke Diagram; Timeline), Organizational Chart (Basic Organizational Chart; Photo Organizational Chart; Functional Organizational Chart; Matrix Organizational Chart; Family Tree; Genogram) are useful for information organisation in education (learning) environments (Wondershare Edraw, 2019). From an educational standpoint, it is highly important the large variety of classified schemes, which can be utilized for information structuring during the teaching, learning and evaluation processes. Moreover, the app provides technical support through a Video Tutorial**.**

c. *Films on GOs creation, in educational contexts.* YouTube provides several films after googling *Graphic Organizers*. A film (3.06 minutes), created by Teachings in Education (2018), presents numerous GOs: comparison GO (Venn diagram), concept GO (webbing), descriptive GO (T-Chart), and sequence GO (Events Chain). Content completion is exemplified on a Cause & Effect GO. The author writes and draws directly on the screen, verbally explaining as he does it. Another film (1.49 minutes), compiled by Wondershare Edraw (2019), hastily depicts 12 GOs: Venn diagram; Timeline; Story Map; Main Ideea & Details; Spider Map; Vocabulary Chart; Compare & Constrast; KWL & KWS; Hamburger Writting; Fact & Opinion chart; Observation Chart. For each category, its states the name, subtypes, visual GO organisation for each type and subtype. Both presentations are useful for coming into different GO formats. The presentation is fast-moving, thus requiring frequent pauses to enable a better comprehension and analysis. The films are designed for people familiar with GOs and an average ability level in creating such organisers.

3.2. Specificity of Romanian films, designed for graphical organiser creation

We identified several Romanian language films on YouTube presenting diagram development using PowerPoint (Iuga, 2008), Microsoft Excel (Net, 2013; Chiperi, 2016), and Google Sheets

(Ursan, 2017). The account “Lecţii Geografie” - Geography Classes (2020) contains tutorials about the creation of a climate-gram, a “line graph (of evolution)”, a “proportion graph” in Microsoft Excel. Although attention was paid to using ICT to improve the educational process in Romania (Vlada and Adăscăliței, 2014; Vlada and Jugureanu, 2007), Romanian films depicting the actual development process are extremely rare.

a. Films on GOs development through different software apps. We identified a film (Kalytheo, 2015) (7.04 minutes), which presents, in chronological order, with no verbal cues, the entire process of designing a logical structure with different shaped boxes (rectangles, diamonds, etc.) and arrows indicating the way to solve a math equation. Another film depicts how to create a conceptual map using the Wisemaping app. The author mentions that a person with basic digital knowledge can thus create, save, and download conceptual maps (Butuc-Brigai, 2020).

b. *Films on GO creation in educational context.* Only a handful of such films have been identified. A film created by several teachers partially shows how to attach photographs on an incomplete cluster with visible circles added (Comunastarchiojd, 2013).

A film (ACCED, 2019) (6.01 minutes) created during the “ACCesibilizarea ofertei de EDucație și formare pentru comunități școlare defavorizate din județul Tulcea, prin utilizarea resurselor educaționale deschise – ACCED” project, presents how to develop a mental map by an expert in didactic content (Fig. 2). It is also addressed to children. The film contains several static slides made in PowerPoint. As introduction, the author states she will create a mental map alongside viewers (children), also defining this concept (“A drawing like the branches of a tree, where you add information”). The tutorial mentions the necessary materials (large piece of paper, sharpee, coloured pencil), choosing a topic, and personal features (desire to explore, plenty of imagination, open mind, perseverance). The components of a “good” mental map are also listed: a central image – main subject; thick branches – essential themes of the subject, drawn in various colours; thinner, secondary branches, images, and words on them. When describing and demonstrating the six-step procedure, the author explains why a certain element must be created in a certain way. In the end, she emphasizes several advantages of mental maps: they are simple and to the point; they provide a general view of a theme; they allow planning and revision; they contribute to creativity enhancement.

Figure 2. Screen capture of a mental map depicted in a tutorial for children (ACCED, 2019)

In a film for students, Botez (2013) (8.52 minutes) presents how to create a mental map based on the existing information from "Mental maps" by Tony and Barry Buzan. In order to compile the film, he uses a digital board (IQBoard). He proposes that each student introduce a self-analysis in the map. As demonstration, the author puts an image of him in the centre of the board ("a caricature," in this case) and proposes several elements to be included in the analysis (personal attributes, family, friends, work, etc.). He also makes suggestions regarding designing mental maps: we write the word, then we draw the lines; if at first, we do not succeed, we try again.

Ina Ilie (OnlineTeachers, 2020) presents the mental map as an instrument, a method to learn for examinations. The presentation is structured based on questions that are gradually introduced as the demo and explanation run: *"What is a mental map?" "How do we create a mental map?" "Why do we put the topic in the middle?" "Why did we put this drawing in the middle?" "What do these branches mean?" "Why curved lines?" "How do I remember all this?"* The film is made for students and the definition of the mental map is built at another level: "as a scheme", which allows us to grasp "a large amount of info in a small place". Across the explanation, there are references to the way the human mind processes information and how mental maps help in this matter, a "wonderful instrument to organise and retain information".

In the *Didactic films* private group, we presented "Cultivated plants (cluster organiser)", for students preparing to become geography teachers. The introduction presents the importance of creating the cluster scheme (organization, mental information systematization based on logical criteria. The film emphasizes the description of the way to organise information: represented topic – title "Food plants" is placed in an oval in the centre of the page; plant categories written in ovals around the central theme, called "satellites" (cereals, oil plants, pulse, fruit, citrice, plants for drinks) and connected to the main represented subject through lines; names of plants from each category, written in the exterior ovals or circles. "Why is this scheme helpful?", we ask and then we emphasize that, looking at the general picture of this GO, we see the plants from each category. We also mention the fact that the scheme might be restructured considering the geographical area where each represented plant is cultivated. At the end of the film, we set some rules that must be observed: write a name in a circle, but not long texts; names must be correctly written; do not write in all capital letters as it is hard to read and comprehend, etc. As the film is made for future teachers, we also depicted the strategy each teacher must follow to help pupils create such organisers. At first, the teacher draws the organiser on the board, and the pupils copy it in their notebooks, taking into account the format on the board (landscape or vertical). Then, pupils can devise the organiser on their own, while the teacher monitors their activity.

4. Conclusions

Based on the films we analysed, several conclusions have been drawn. There is a large archive of English short films, created and freely distributed by people of different educational backgrounds, aiming to share their experience in developing graphical organisers with the help of apps (Microsoft Word, PowerPoint, SmartArt), but also films aiming to teach how to structure information in different types of graphical organisers. There is also specialised software in English that aids in creating graphical organisers for economics, education, personal use (MindMaster), this app being at the same time an excellent source of information about the many ways to systematise and present information.

YouTube hosts very few Romanian films. We identified films depicting how to create GOs using software, as well as films for information organisation into schemes. The Romanian films from the second category are created for a wide audience (children, pupils, students, teachers) and are made using various means (flip-chart, smart board, PC), various methods (flip-chart, explanation and demo on split screeen, static presentation in PowerPoint, or dynamic presentation, with object manipulation on screen). The text used by the films' authors is differently structured, depending on the authors' background (psychologist, expert on didactic content, teacher) and target audience (children, pupils, students, teachers). These films are especially useful for those who are aware of the importance of creating graphical organisers for structuring and acquiring information.

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Trends shaping education- measuring students attitudes (thinking skills) bringing technology in the classroom

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Abstract

Education is evolving at a faster pace than any other period in recent history. Because of this, it's more important than ever to understand how and where it's changing so that educators and schools can support students in preparing for challenges and careers that don't exist today.This report aims to identify and examine research-based by bringing technology to the usage in the classroom, in a technical university. The results are referring to the students' attitudes about HOTS and the learners' experiences with technology, used for educational purposes.

Keywords: ICT tools, technology attitudes, thinking skills, STEM.

1 Introduction

Learning is based on the opening and deep involvement of learners and is predicated on the social meaning of communities of learning such as inquiry-based learning, collaborative learning, video-games, project learning, and other findings. For this purpose, new ideas of teaching are concerning. The researchers (Chiappea, Ternent de Samperb, Willsc,2020) find that relevant activities for learners can remodel their skills, like those for the 21st century. These digital opportunities are often virtual and will be supporting the power for learners to collaborate with others globally, by using technology.

Related to OECD (2019) report, the data collected shows that students in colleges who used computers in their activities attended to have higher learning outcomes than learners used computers seldom. However, these findings square measure supported information collected through city testing and its interpretations cannot be generalized. Learning a continuous process and the new ICT teaching tools reflect what happens when there are used to create innovative activities

This paper provides a framework for the importance of the effect of using ICT tools in mathematics and science on future teachers' student's development of critical thinking skills.

3 Higher-order thinking skills (HOTS) and ICT tools in education

HOTS is based on Bloom Taxonomy of Educational Objectives (1956), revised by Anderson & Krathwohl et al (2001) in levels as remembering, understanding, applying, analyzing, revising, and creating.

Higher-order thinking skills are closely joined with a high level of learning and thinking. Usually, the role of a teacher as a mediator is a great thought of essential thinking skills, included under the term of behavior (Martinez &McGrath, 2014). Rutherfoord&Rutherfoord (2013) associate this idea to 'flipping the classroom' that technology has enabled for students. McMahon (2009) conducted a research about these ideas and the evidence correlate with specific activities links that children in operation in a video-games environments surroundings were ready to correlate to higher-order thinking skills. The same study shows that those with higher programming skills incontestable develop a bigger ability to transfer these skills and picks out combinations of new deep thinking skills than people who had lower programming skills.

Thinking skills and the use of technology has been closely connected as a region for analysis by researchers. Mojica (2010) and Zenisky(2014) conducted a big research about the benefits of using video tools and its interaction with thinking skills. This study is concerned by a range of digital sources like Lego® Mindstorms™ NXT artificial intelligence system, Digital Storytelling, Marble Maze Challenge,Kahoot and others. The research instrument (Cornell essential Thinking Test) explores the potential effect of using technology tools (like video tools) and its approaches in relation to high order thinking skills, results that are not confirmed in the cited study.

Computers and digital devices are like-minded to support the acquisition of procedural knowledge through explaining their understanding in mathematics and science, explaining style and structure of the text in mathematics and science, drawing inferences and generalizations from the text in mathematics and science, making predictions about what will happen next in mathematics and science, practice skills and procedures in maths and science, using ICT tools to process and analyze data in maths and science, processing and analyzing data in maths and science, solving problems with no obvious method of solution in maths and science using HOTS indicators. Computers conjointly already support additional or less complex kinds of adaptational learning, as an example by mechanically adjusting the issue of the projected tasks to this level of mastery of the scholars.

Other researchers write about the technology in education enhanced development higher order thinking skills at students in science and maths, like Vincent-Lancrin, Urgel, Kar, and Jacotin (2019). In the author's opinion, for example, practicing skills and procedures in mathswith ICT tools is a very important step in learning. In the same report, in education, academics report that the share of scholars oft mistreatment computers for practicing skills and procedures during eighth-grade arithmetic lessons has swollen by twenty-three share points on average (2007-2015). The average amendment between 2007 and 2015 has been positive for all OECD countries (participants at research), around twenty-three share points. At the OECD level, the share of eighth-grade students frequently mistreatment this learning strategy ranged from nearly 8% in Slovenia to over fifty-seven within the US (2015 data), according to the teachers' views. Another indicator of higher-order thinking skills is practicing and drilling. Vincent-Lancrin and all. (2019) found that the share of 15-year-old students mistreatment this learning using video-games in maths, apply a minimum of once a month practice. This activity is frequent in most countries, for example, in 2015, 100% of scholars in Japan used it a minimum of once a month, against seventy-four in the Scandinavian nation. European country recorded the biggest decline during this domain, of regarding sixteen share points. Whereas computers will currently build complex calculations with excellent accuracy, a part of this procedural data permits students to grasp however mathematicians suppose and assess a way to wear down mathematical problems.

The focus faraway from the information demand of thinking skills discussed by Starkey(2011) above strong evidence about the use of digital technologies in learning, despite there, is a massive number of teachers who do not have a high level of digital skills. In a full world of virtual learning, MOOCS platforms, online course, social media, learning sites,video-games and other adapted digital resources, useful for 21st-century learners, the need for an adaptive education, and new teaching strategies are increasing in every second (Mishra, Fahnoe, Henriksen,2013).

Measurement of thinking skills appears to be some rivalry concerning the way to live, in what is the signification of thinking is (Allen, 2004). There is a general meaning of the thought concept that is close to analyzing and evaluating data victimization sure psychological feature skills come through, a selected goal, or achieve a selected result. Definitions of vital thinking vary in step with different levels of learning and tasks, included explications, reasoning, reflection, judgments, analysis and transfer the meaning in other contexts, to improve learning and innovation.

About the importance of introducing technology in teaching and learning and developing the high order thinking skills at students and its practices will be described in the next Framework for the PISA 2021 ICT cycle(OECD 2019).

4 Research Methodology

4.1 Study purpose

The next stage described is the process of research questions:

1.Do students using ICT tools demonstrate better use of high-order thinking skills (analysis skills, synthesis skills, evaluation skills) than students using traditional tools?

2.Do students using ICT tools demonstrate better use of higher-order thinking skills(analysis skills, synthesis skills, evaluation skills) in maths and than students used traditional tools?

3.Do students using ICT tools demonstrate better use of higher-order thinking skills(analysis skills, synthesis skills, evaluation skills) in science than students used traditional tools?

4.2 Sample

The research group is composed of 172 students, in the first year of faculty in the field of engineering (STEM), to become teachers in secondary education The profile of respondents are presented in Table no 1. The total number of students involved in this research was 172, 71% male students and 28% female students, with the age with an age between 19 and 24 years.

4.3 Research instrument

This study used a pretest and posttest instrument research, based by indications of Kim & Mueller (1978). The treatment and comparison groups, which means all students future teachers, were given the questionnaire of HOTS processes in science and maths. After that, were selected the students that response they not use video tools for learning in science and maths, and they do in a traditional way, writing on their notebooks (comparison groups). For insurance, a questionnaire of HOTS development are used to compare all students involved in research (N=216) to be sure if the data processed are unaltered and all the respondents involved in the experimental group have the same level of development of HOTS, in science and maths. Watson-Glaser Critical Thinking Test (W-GCTA) are used to collect initial data and select de target groups, because it deals with testing of the 3 categories of HOTS (analysis, synthesis,evaluation) as well as the fact that this is a practical test to identify the level of development of skills. Because of the small number of students enrolled, it is not possible to apply research group sampling methods.

The questionnaire used 32 Likert-type questions noted with numbers 1-4 which 1- every or almost every day; 2-once or twice a week; 3-once or twice a month;4- never or rarely happened. The reliability coefficients of the pretest instrument for HOTS were calculated using data from all students involved in research (Alpha Cronbach= .78). The value reflects that the internal consistency of the research instrument is a good range, according to the research scales getting by DeVillis (1991). Measures of final research instrument produced Cronbach’s alpha coefficients ranging from 0.70 through to 0.78, which suggests that the self-perceived instrument of HOTS using ICT tools provides a reliable means of measuring students' skills.

4.4 Results and discussion

A analysis of variance was used to provide data from initial equivalence of HOTS skills respondents on the indicators instrument for pretest, about the level of high-orderthinking skills(HOTS). The ANOVA test indicated that, in the first step of research, there are no significant difference between the treatment groups and comparison groups(Table no.3).

ANOVA Test	**Gender**	**Age**
HOTS in science	x	x
HOTS in maths	x	x

Note used by author:X-no difference, - difference

Table 3. Summary of data showing the differences among demographic factors -pretest data

The results for HOTS using ICT tools (Table no.6) indicate that the difference between the scores for the final results of the research group was statistically significant. The research group scores (used ICT tools) were higher than the results of those who have not used these ICT tools, in performance on the synthesis and evaluation skills, but no significant difference in analysis skills. We do not know exactly what is the cause of these results obtained for the analysis, but for justification, it is necessary to use qualitative research tools (interviews with students) to identify the practices used in the use of ICT tools for learning.

Indicators	**Variable**	**Sum of squares**	**df**	**F-value**	**Significance of F**
Analysis	Between	574.227	1	33.629	0.000*
	Within	1451.383	86		
Synthesis	Between	2.060	1	0.092	0.762
	Within	1904.216	86		
Evaluation	Between	54.298	1	2.248	0.137
	Within	2053.105	86		

* Significant at the 0.05 level

Table 6. Summary of data showing the differences among research groups-analysis, syntethisis, evaluation

Analyzing in detail the data obtained, as can be seen in Diagram no1 and Diagram no2, the results obtained for the 3 categories of HOTS are different in the field of mathematics and science. Describing an example, the one of the synthesis category, we can see that, although the results indicate that the research group that uses ICT tools has developed high order thinking skills, they are different in the mathematical field from the one in the science field. For the synthesis skills category, the proportion that uses ICT tools to process and analyze data in mathematics every day is higher than in the science field. If we look at the case of students comparing texts with their own experiences using ICT tools, in mathematics, most use them once / twice a month and once / twice a month while for science, students do this activity every / almost day and once / twice a week. The differences between the areas, from the perspective of the use of ICT tools by students for different activities, is quite different.

The data obtained in this research, although extremely limited due to the small group, certifies that the use ICT tools can contribute to the development of HOTS. Of course, it is important to mark that, during the research, all learners also had access to traditional instruments, both the experimental and the comparison group. Therefore the conclusion should be that the use of these digital tools in the field of maths and science can be a real aid to student learning and can contribute to the development of HOTS, as long as it is used for the given limits.

The results of the study revealed that students are using ICT tools and there is a significant correlation between these ICT tools and the development of students' higher-order thinking skills in maths and science, but not in a plenary development (such as analysis skill). The research findings can be an important framework to introduce the use of digital tools for increasing students HOTS in class, as a daily practice, and for better learning in science and maths.

Surely, because the data are used from a student's perspective, as a self-perceived instrument, it can be an important limitation and is necessary to introduce validated tests, like used by McMahon (2009) and Ganapathy and Kit Wai (2017) to compare the results obtained.

Diagram no1: Students responses for the synthesis skills inmaths(part of HOTS)

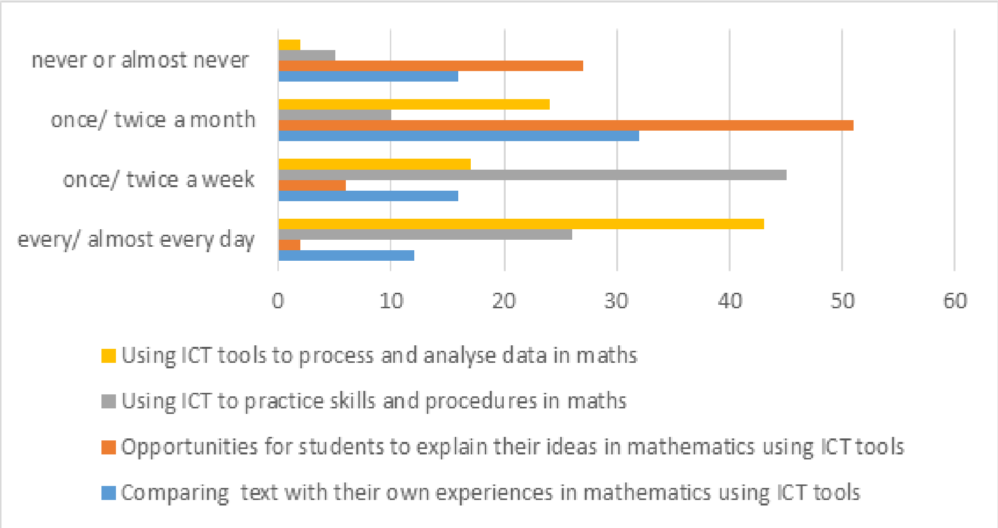
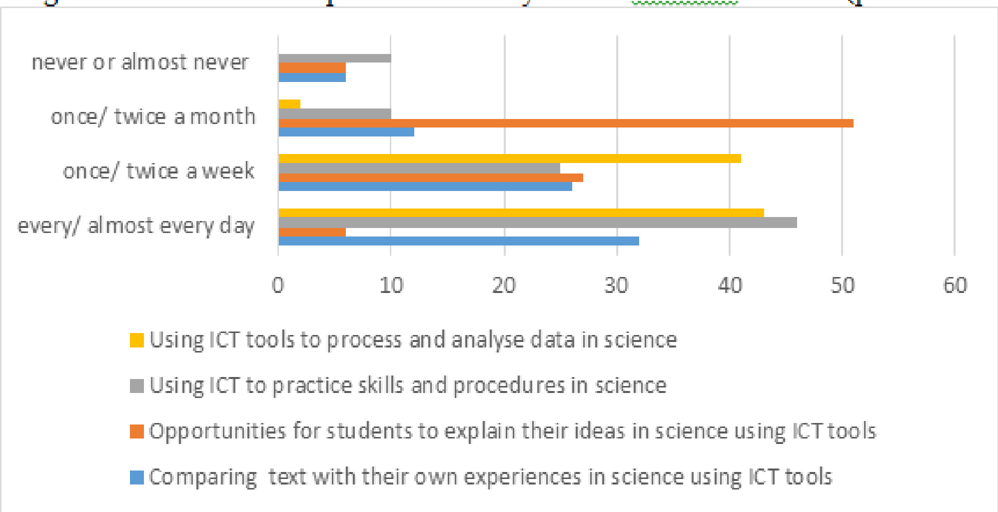


Diagram no2: Students responses for the synthesis skills in science (part of HOTS)



4 Conclusion

The data presented showed that the use of ICT tools in education, like in HOTS development can change the meaning of learning, for students engaged in the research.

Teaching HOTs ought to be a priority for each teacher as a result of it will greatly influence their students' long success. Edtech provides a range of opportunities for teachers to allow students an opportunity to observe these skills. With the correct Edtech solution, academics will greatly influence their students to imagine inventive solutions to the issues that face them. The research findings that there is a significant correlation between using video-games and the development of students higher-order thinking skills, especially in math and science and this can be an encouraging strategy for teachers practices to introduce these ICT tools in the classroom, early students use them to make individual learning easier, even if they do not use with the support of teachers.

Higher-order thinking (HOT) could be an important talent that students got to learn before they venture out into the important world. To achieve success outside of the school, students should learn to judge the knowledge before them and solve issues creatively. Nowadays, teachers have a variety of tools at their disposal to assist students to learn this all-important talent (HOT), however education tech development may well be able to play a polar role. The right Edtech programs (like video-games) and approaches will contribute to major growth in areas associated with important thinking, especially with deep thinking and learning. There are many of the foremost outstanding ways that teachers are mistreatment technology to assist their students to learn to suppose and rewrite arguments. Reflection and discussion prompt to encourage students to contemplate multiple viewpoints.

In the latest cycle of the OECD`s Teaching and Learning International Survey (OECD, 2019), participants were asked about their use of a range of teaching practices. The results are impressing: 58% of teachers said that frequently or always give a task that requires students to think critically, 50% of teachers have students work in small groups to come up with a joint solution to a problem or task, 45% of teachers ask students to decide on their procedures for solving complex tasks, 34% of teachers present tasks for which there is no obvious solution.

From meaning, putting their concepts down on paper forces students to look at wherever their thoughts STEM from. Some academics would possibly opt to assign freelance work prompts to allow students an opportunity to reflect on their progress in a very explicit space. Keeping a journal about schoolroom experiences in a folder like Google Doc is a method to form positive that their concepts are recorded. At the top of every semester, teachers will review this document along to ascertain wherever every student had the foremost important gains(and students too). Every student needs to post a solution to an issue or discussion topic, to moderating by teachers. Seeing all students thoughts on paper are often terribly useful, many folks opt to use mind maps or alternative sorts of diagrams to ascertain however their thoughts flow This can be an important issue to recommends requiring students to cite their sources within the reflections and discussion boards as to how to make sure they're mistreatment important thinking Most students got to observe their important thinking and their speechmaking skills, therefore why not bundle them each together? Podcasts are very simple tools that students have to form on a subject of teacher/own selecting. They need the liberty to gift the fabric in no matter manner they select, however they need to try and do all of the analysis on their own. This forces them to find out massive volumes of data, script it into a format that suits them, then record a finished product. Graphing their thoughts in diagrams will facilitate students to ascertain a lot of relationships between concepts and to attach the ideas to teach them. Educational tech tools will facilitate students to form their mind maps and flowcharts in Google Docs with the Lucidchart Diagrams add-on and other tools, free to use it. This makes it unbelievably simple for all kinds of students to digitalize their thoughts and modify them as they learn a lot of data.

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Challenges of teaching - personalized students learning by using video tools to improve thinking skills

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Abstract

Research in the field of education highlights the fact that teachers, in a significant proportion, continue to favor traditional rather than modern teaching strategies and are still dependent on methodological clichés that negatively influence curriculum implementation. Education and training systems need to be modernized to strengthen their efficiency and quality and to give people the skills and competencies they need to succeed in the labor market. Contemporary education systems are under increasing pressure from so-called "global challenges". More than ever, the immense opportunities for personal and social knowledge and affirmation of the individual and the spectacular advancement of science and technology contrast with economic polarization, mistrust, and violence, with the higher problems of natural resources and climate change.The paper is based on quantitative research data, collected in March-June 2020. The results are related to the new video skills of teachers, in a pandemic period and to the role of these tools to personalized student's experience in online teaching.

Keywords: video tools, personalized learning, HOTS, thinking skills, STEM.

1 Introduction

The speedy way of the dynamical nature of the rising technologies in our 21st-century society activities modification the maximum amount discussion, analysis, and unsupported assumptions because it will give claims concerning the “potentials” and “possibilities” that rising digitals tools provide. In this respect, that use of technology can“transform” education, “revolutionize” our curricula and “engage” students that have antecedently been unprecedented.

Australian Government Department of Industry, Innovation, and Science (2019) conducted research in which 64% of young Australians say that learning about science and technology is exciting. Alex Snow (2020) , Head of research at Foundation for Young Australians says that “Technology will transform the world of work. That presents a significant challenge as well as an opportunity to provide the right learning for young people. Tech can support that process through new learning platforms, and new types of learning content.”In Canada, over 1 in 3 children use digital technology for schoolwork (MediaSmarts, 2018). The Human Resources Professionals Association (2017) obtained data from research that suggesting than more than 70% of Ontario HR professionals believe that curricula modifications by using video-games in classes could help students acquire missing soft skills.

More and more teachers are asked children to use the information that they have stored in their brains, to use it in everyday life, to manage the own process of thinking, and to help students achieve their highest potential. The concept of HOTS is different from low-order thinking (which included most of the memorization skills) that are promoted students to remember facts and include synthesizing, analyzing reasoning, comprehending application, and evaluation-higher form of thinking.

The paper presents a study conducted in March-June 2020, belong students who are using video tools in learning in the math and science domain about the level of higher-order thinking skills, compared to the others used a traditional tool.

2 The need for higher-order thinking skills, video tools and digital skills

Regarding the need for HOTS and digital skills in the labor market, there are numerous arguments. As McLean (2018) said, there are ninety-two of future jobs that can like digital skills and forty percent of future jobs would call people who will tack together and work with confidence in digital environments. According to OECD (2019), researchers reinterred the idea of digital skills combined with high order thinking skills using at future work as a highlight that learners coming into classrooms in 2018.

Other ideas suggest that the digital skills aren't any longer perceived as a need move and this is a right for each child, to an adaptative world. In the curricula domain, it is a concern to replicate this idea- forty second of Australians believed that the present program is run out of time and half-hour aren't assured that kids are being ready for future jobs (Cowan, 2018). Schools are being able to incorporate video-games to create additional innovative and interesting teaching strategies.

In research realized by the OECD Programme for the International Assessment of Adult (2016) about three key domains((literacy, numeracy, and problem solving) for adult skills important in the labor market, there are evaluated a total of 50250 adults (aged 16-65). The results show that a connected profit is that the wage premium is related to digital skills. Peoples who don't have any expertise in working ICT earn eighteen less per hour, on average, than those that perform below level one within the research. When we take different suppositions into consideration, such as age, gender, academic profile, proficiency in attainment, and accomplishment the results suggest that digital skills are a special need for those people. A great example is the use of e-mail at job-workers with no expertise in working with ICT tools that can earn 6% less per hour than those who have not used the bottom level of proficiency (OECD, 2016). Workers, measured at level two or three in downside finding working with ICT tools earn twenty-sixth percent/ hour than those performing below level one. Staff with higher skills who used digital environments are paid more because they can involve bigger use of processing information and skills.

In the age of disinformation and fake news, it is crucial to use critical thinking digital skills in online contents (like in video-games) to evaluate the quality of messages, to extract the valuable arguments and to understand the nature and the source of resources (Dede, 2010).

Krueger (2020), from the International Society for Technology in Education (ISTE), said that working with video-games, students are practicing their higher-level thinking skills when they explore ICT tools to resolve more easily their homework or to collaborate others. Another project using HOTS with technology engaged is developed by Eileen Murph, when founded ThinkCERCA, a brilliant framework to help teachers using video-games to engage learners in critical thinking in social sciences, English, science, and math.

In developing methods to explain the significance of using video-games in learning, researchers (Cotton, 1988; Marso & Pigge, 1993) talks about the teaching practices in revealing that often the majority of time spending in the classroom is based on assessing lower-order skills, like recall of memorizing and this is not a needs. The changing world called skills beyond comprehension, like thinking about information, analyze them, synthesize concepts, evaluate arguments, create new content, and useless, making connections (Miscovich, 2017).

In research conducted by Ruth (2017) the results explain the connected relation between thinking and video games. The author used mixed methods to collect quantitative and qualitative data from nursing students about their perspective of using video-games to improve thinking. The results obtained confirm the research questions that students using video-games are practicing deeper thinking and is a real need to having different instructional approaches to engagement learning.

McMahon (2009) examined the relationship between students working with video-games and their development of higher-order thinking skills and the results confirms that there is a significant correlation between the students' computer skills and the development of critical thinking skills and there is a significant correlation between the length of time spent within the video-games environment and the development of critical higher-order thinking skills. The research instruments used were the Level of Technology Implementation (LoTI), the Australian Schools Computer Skills Competition (ASCSC), and Ennis' Weir Critical Thinking Essay Test (EWCTET). This approach is closely identified with the work of Ganapathy and Kit Wai (2017) and can conclude a strong relationship between HOTS and the video-games. In her review, the author highlights the impact of video-games on promoting HOTS among secondary school teachers in ESL classrooms and so the video-games booster learners' usage of deeper thinking skills. This paper provides a framework for the importance of the effect of video-games practices in mathematics and science on future teachers' students' development of thinking skills.

3 Research Methodology

3.1 Study purpose

The study looked at the effect of using video tools in mathematics and science on future teachers' students' development of higher-order thinking skills (self-perceived questionnaire). The HOTS meaning, in this research, is defined by Bloom`s taxonomy of learning (cognitive skills) and includes analysis, synthesis, and evaluation skills.

So, to that, were framed a series of hypotheses that could be accepted or rejected based on statistical analysis:

1.1 H0: There is no significant correlation between using video tools and the development of students in higher-order thinking skills.

H1: There is a significant correlation between using video tools and the development of students higher-order thinking skills

1.2 H0: There is no significant correlation between using video tools and the development of students in higher-order thinking skills in maths.

H2: There is a significant correlation between using video tools and the development of students in higher-order thinking skills in maths.

1.3 H0: There is no significant correlation between using video tools and the development of students in higher-order thinking skills in science.

H3: There is a significant correlation between video tools and the development of students in higher-order thinking skills in science.

To test the hypotheses were used SPSS and calculated the reliability coefficients, the correlation coefficients between data gained from these instruments, and the ANOVA test.

3.2 Sample

Participants included future teachers, students enrolled in a teaching program, from a technical university, voluntarily. The total number of students involved in research was initially 316, but, after several steps in research, remains 172). The research group (N=86) was the state of students who have selected the courses of the teaching program and are using video tools for learning science and maths(123 male students and 49 female students).

3.3 Research instrument

This study used the quantitative approach, a questionnaire of higher cognitive processes was adapted, tested, and selected designed to evaluate the attitude of future teachers using video tools for learning in science and maths. The indicators included in the index of video tools practices in mathematics and science using HOTS skills are presented in Table no.2(Likert-type questions). As can be seen, 17 indicators for science and 14 indicators for maths are selected in the final research instrument used. The reliability coefficient of pretest data was .84, while the coefficient derived from the posttest data procedure is reported as .82, which means that data research was valid. The respondent was testing by an anonymous survey, using G.Form while teaching program beginning classes (March-June 2020).

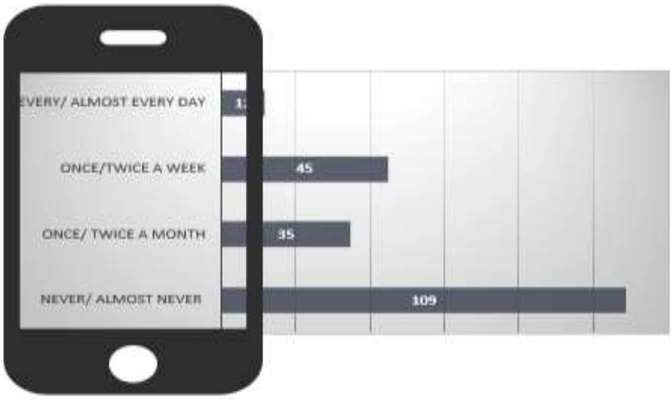
Math indicators	Science indicators
Use of video tools for mathematics Using video tools for playing simulations in maths Frequency of use of computer or a tablet at maths for mathslearning Students using video tools s to look up for information in maths Students explaining their understanding in mathematics using video tools Students explaining style and structure of text in mathematics using video Students drawing inferences and generalisations from text in mathematics using video tools Students identifying main ideas of text in mathematics using video tools Students comparing text with their own experiences in mathematics using video tools Opportunities for students to explain their ideas in mathematics using video Making predictions about what will happen next in mathematics using video tools Students using video tools to practice skills and procedures in maths Students using video tools to process and analyse data in maths Solving problems with no obvious method of solution in maths using video tools	Use of video tools for science Using of video tools for playing simulations in science Frequency of use of computer or a tablet at maths for science learning Students using video tools to look up for information in science Students explaining their understanding, using video tools in science Students explaining style and structure of text using video tools in science Students drawing inferences and generalisations from text using video tools in scienceStudents identifying main ideas of text using video tools in science Students comparing read text with their own experiences in science using video tools Opportunities for students to explain their ideas in science using video tools Making predictions about what will happen next in science using video tools Observing and describing phenomena, using video tools, in sciences Students designing and planning science experiments using video tools Students using video tools to practice skills and procedures in science Students using video tools to process and analyse data in science Processing and analysing using video tools in science Students drawing conclusions from an experiment in science using video tools

Table 2. Indicators included in index of video-games using in mathematics and science using HOTS

3.4 Results and discussion

Regarding the testing of the first hypothesis, if the students use video tools for learning in science and maths, the data below confirm this. Looking at the use (Graph no1) in mathematics, it can be observed that most students do not use video tools at all or almost at all (N = 109), once / twice a week (N = 35), once / twice a month (N = 35) or very few use ICT tools every / almost every day. If we look at the situation in science, the situation is different: most students (N = 92) use video tools once / twice of the week, followed by those who do not use at all or almost at all (N = 83), while 45 students use video tools for every / once a day or once / twice a week (N = 15). This means that digital instruments are used more often in the field of science.

Graph 1. Video tools using in learning science(frequency)



Graph 2. Video tools using in learning maths (frequency)

Regarding the testing of the second hypothesis, the use of video tools demonstrated better HOTS skills than HOTS students using traditional tools, as can be seen in Table no3, there are statistically significant differences. The one-way ANOVA test, used on posttest data presents the differences between groups. The results shows that was significant difference of HOTS improvement for these future teachers(Table no.4).

Variable	**Sum of Significance**	**df**	**F-value**	**Significance of F**
Treatment Between	1 242.957	1	9.764	0.003**
Within groups	9797.517	86		
Comparison Between	.107	1	0.002	0.968**
Within groups	5576.786	86		

** Significant at the 0.01 level

Table 4. Summary of data showing the differences among research groups(posttest data)

Looking at the latter hypothesis, if students using video tools demonstrate better use HOTS in maths and science than students using traditional tools, the statistical results confirm this. The evidence from data research presented in Table no.5 suggests that there are difference between the scores on science and maths HOTS. About science HOTS, the most interesting piece is about the synthesis skills with maximum scores in posttest data, and in maths a clear example is about evaluation skills improved.

Group tested	**Indicators**	**M**	**SD**

Science HOTS	Posttest no use of video tools	Analysis	18.93	4.06
		Synthesis	22.51	14.07
		Evaluation	23.00	6.43
	Posttest video tools use	Analysis	22.19	3.82
		Synthesis	26.00	7.80
		Evaluation	24.32	4.28
Maths HOTS	Posttest no use of video tools	Analysis	19.05	3.23
		Synthesis	23.05	5.17
		Evaluation	15.21	4.72
	Posttest video tools use	Analysis	19.32	4.23
		Synthesis	21.47	4.60
		Evaluation	20.36	3.48

Table 5. Summary of data showing the differences among research groups(HOTS), in science and maths

4 Conclusion

Video-games will have a major part to play in personalized learning experiences, based by data research obtained in this paper in that 98% of respondents see video as having a part to play in personalized learning experiences.

About the results of the obtained research, this research achieved its purpose, namely to demonstrate the importance of using video tools for personalizing learning, in the field of thinking skills development (HOTS). So there is a significant correlation between using video tools and the development of students in higher-order thinking skills, there is a significant correlation between using video tools and the development of students in higher-order thinking skills in maths and there is a significant correlation between video tools and the development of students in higher-order thinking skills in science, but in special circumstances. We do not have a concrete explanation of what are the specific video tools that improve students' thinking skills (HOTS), but it is important to mention that students looked for helpful options to meet the need for face-to-face teaching during the COVID 19 pandemic.

Although the use of ICT tools in education brings many benefits to learning and individualizing learning, it is important to note that the right to quality education is regulated for all children, not just those who may have digital tools. Therefore, in the present study, it is important to mention that the respondents had their own resources for using ICT tools and not provided by school institutions. In extensive research, Dogaru and Anghel (2019) drew attention to the existing risk factors in Romania, in terms of access to education, digital resources, and the limited support offered by schools to students in risk categories.

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Applied Digital Competences in the Innovative Didactic Methods: an overview study

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Abstract

Although in both European Union and national policies there are many premises to bring to an acceptable level the digital skills of teachers in pre-university and university education, the current pandemic has signaled us about the lack of attention to this topic from all the factors involved (authorities - managers of educational institutions - representatives of the academic environment - teachers - pupils / students - parents, etc.) in the digitization of the educational process. It is noteworthy the case of the Republic of Moldova where still in the documents of 2017 were formulated a series of issues tangent to the deficit of digital education and, as a result, of modern quality education. These documents list such shortcomings as: (1). Graduates of educational institutions do not possess practical skills for activity in an information society; (2.) The shortage of qualified ICT staff in schools. (3.) Low level of supply of educational software to educational institutions. (4.) Low level of use of open-source software. (5). The ICT curriculum is outdated and there is no institutionalized process of regular updating. The year 2020 confirmed that the set of items to be adjusted with reference to the digitization of the didactic process, digital education, the development of digital competences of teachers and pupils/students, etc. it is below the threshold necessary for the normal functioning of educational institutions, but especially for the transposition of traditional education into the distance-learning format. In this context, present research, analyses (a.) European documents and actions of digitization; (b.) digital premises for educational purposes; (c.) the classification of educational platforms, etc. The author proposes the implementation of innovative didactic methods based on IT solutions, as solving the partial remedy of the problems previously reviewed. Additionally, the author of this approach defines the concepts of applied digital competence (ADC), and innovative didactic methods (IDM), making the difference between traditional and innovative teaching methods.

Keywords: applied digital competence (ADC), innovative didactic methods (IDM), premises of digitization

1 Introduction or premises at the level of international and national policies and actions

In the last decade, we could attest an increased interest in everything that can be included in various phrases, having digital connotations: digital skills, digital economy, digital signature, etc. Thus, in the context of the digital expansion in the socio-economic environment, regardless of whether it is about business and / or education and / or citizenship, etc., various policies, actions, and legislative acts have been promoted and continue to be approved around the world.

All these initiatives are the premises for the beneficial development of both the human factor and the relevant environments in digital matters. Among the important legislative acts that marked the evolution of digital in the EU, the same as in the signatory countries of the pre-accession agreement, we can mention the following (see Table 1):

Table 1. Documents & actions issued by the EU on digitization

Document's title & link	Essence
European Skills Agenda for sustainable competitiveness, social fairness and resilience: shorturl.at/crDF7	
The agenda (European Commission, 2020) sets ambitious and quantitative targets for improving existing skills and / or retraining and / or training new skills in order to increase the	

quality of human capital within a maximum of 5 years.

The document emphasizes the importance of lifelong learning, formulates objectives for the development of important skills in the labor market in the conditions of digital and ecological transition. The given initiative is intended to mobilize companies, social partners, and state institutions to take significant measures in this regard.

Digital Europe. Draft Orientations for the preparation of the work programme(s) 2021-2022: shorturl.at/dhIO6

This document (European Commission, 2019) acknowledges that so far Europe has not invested enough in the latest technologies and there is a growing mismatch between supply and demand. Business, the public sector, and the academic community need to look more and more outside Europe to access the computing, data management, or cybersecurity capabilities they need, while citizens often lack the necessary skills, which would allow them to integrate and / or thrive in the new conditions of the digital economy. Additionally, the given document acknowledges that not all sectors and geographical regions in the EU have benefited equally from digital innovation.

The Digital Europe project aims to trigger investment from the EU, the Member States, and industry in key areas of artificial intelligence, advanced computing, and data manipulation, cybersecurity, etc.

The program aims to fund activities that no Member State can implement alone: collective action is needed at the European level. These will strengthen the positive impact of the digital transformation platform, Single Digital Gateway Regulation.

The European Framework for the Digital Competence of Educators (DigCompEd): shorturl.at/inux9

As the representatives of the teaching professions are always facing demands for rapid change, educators need to be supported in the formation of an increasingly extensive and sophisticated set of skills. Today, skills related to the ability to operate digital devices are of particular importance. Thus, especially because it is the duty of teachers to help their students to become proficient in technology and digital.

This paper (European Commission, 2017) analyzes and groups these tools, including them in a common European framework for digital competence of educators (DigCompEdu). The DigCompEdu framework is aimed at trainers at all levels of education, from early to higher and adult education, including general and vocational training, special needs education and non-formal learning contexts, etc.

Compared to other Eastern countries, **the case of the Republic of Moldova** is not the most outstanding in terms of shortcomings in digital education and / or integration of ICT in the educational process, although here we also see some progress that we will describe along the way. For example, in the *National Strategy for the Development of the Information Society "Digital Moldova 2020"*[1], approved in 2013 by Government of the Republic of Moldova, it was clearly stipulated **the need to integrate** "[…] **ICT in education**, in order to improve the educational and management process, at the system level, school and class levels […]".

And the 2017 documents - *Nomenclature of training areas and specialties of training of staff in higher education institutions* and *Qualifications Framework* - show that the demand for qualified teachers in digital education and / or with prominent digital skills cannot be met existing on the labor market (Ministry of Economy and Infrastructure of the Republic of Moldova, 2013). We are now in 2020, when the Republic of Moldova is focused on achieving new objectives that are already formulated, approved (on June 10, 2020), and published in the *National Development*

[1] shorturl.at/LMY57, accesed 2020.

Strategy of Moldova 2030[2], approved by Government of the Republic of Moldova in June 2020. One of the documents[3] (named *Relevant and quality education throughout life, 2020*) related to this strategy, issued by the working group responsible for education comes with findings made based on the Public Opinion Barometer which states that: (A.) "[...] the people are increasingly dissatisfied with the education that their children receive at the school, the basic formal education"; (B,) "The results in the education sector are poor in Moldova: in absolute terms, compared to neighboring countries, as well as from the perspective of equity. Human capital is a basic resource in the development of a country. In the case of the Republic of Moldova, it has lost its reputation as a qualified production factor" [ibidem]. We find that, although the Republic of Moldova has traveled a few years, it is still looking for a formula that would ensure a quality and relevant education throughout life. Thus, the working group organized to formulate a list of priorities, also called strategic measures, came up with constructive ideas, some of which we will note below (see Table 2):

Table 2. From strategic measures, the vision for Moldova 2030

<table>
<tr><th>Action / Measure</th><th colspan="2">Argument</th></tr>
<tr><td>Developing and favoring those educational profiles and specializations that will be well articulated with the needs and requirements of the national economy, discouraging specialties that are not required by the labor market.</td><td colspan="2">The aim is to attract the business environment in the elaboration of the educational offer and in the process of professional training of the staff (production practice) in order to increase the degree of correspondence of the professional training to the real needs of the national economy.</td></tr>
<tr><td>Complementing policies with talented teachers, well equipped to guide pupils and students to acquire the necessary skills in the future.</td><td colspan="2">An effective system must be based on capable teachers who are willing and ready to meet the challenges of preparing students for an increasingly evolved and complex future.</td></tr>
<tr><td>Extending education beyond classroom space.</td><td colspan="2">Teachers and parents need to equip pupils and students with skills and attitudes which they will implement the academic concepts outside the classroom and they will perceive learning as an organic process, not one limited to traditional teaching environments.</td></tr>
</table>

Based on the major issues, but also the arguments listed above, we consider that the continuous and concordant **training/education of teachers in the implementation of innovative methods based on the use of digital skills** continues to be of crucial importance. Currently in the Republic of Moldova are implementing several projects *(The Future Classroom lab, Tekwill in Every School, Educație online (Online Education))*, an annual series of *"uTeach"* projects launched under the logo *"Tekwill Ambassador Program"* and under the auspices of the National Association of ICT Companies (ATIC)). These projects are called to make up for the lack of necessary skills of teachers, representatives of various curricular areas. As a natural consequence of the implementation of these projects, it is also expected to expand the number of graduates of educational institutions who will have the practical skills for successful inclusion in the digital society. The situation created by the outbreak of the epidemiological crisis this year, but also in the

[2] shorturl.at/kpETZ, accesed 2020.
[3] shorturl.at/gkBM7, accesed 2020.

context of the actions taken by the European Commission regarding the process of digitization of society, in general, and, in particular, the need to overcome the situation faced by educational institutions, of different levels from all over the world, motivated the international organizations, the representatives of the academic and research environment, but also the teachers, in the area of interest whose ICT tools and their didactic potential are included, to support the transposition of the didactic process. Traditionally in the online environment.

2 Innovative application of digital skills: methodological and technological context

Given the specifics of distance learning with all its advantages and disadvantages, one of its biggest shortcomings is the lack or reduced presence of live interaction between teacher and student (s) and/or teacher and student (students). This fact motivates us to find either didactic or digital alternatives that would supplement and/or eliminate the effect of virtual communication between the actors of the educational activities and would somehow amplify that mutual action between the participants in the online lessons. One of the potential solutions for adding the element of live communication/collaboration between participants would be the introduction of innovative strategies based on combining the technological potential of IT tools with some interactive methods, applicable to the classroom and/or another contingent of students (larger or lower in number), even in online learning conditions.

Currently, only *collaboration platforms with the meaning of live-video communication and, partially, tools for teachers to create digital educational content* contribute to emulating a communication and, respectively, collaborations specific to the traditional teaching process. The given services have the ability to reproduce certain interactive, often personalized teaching activities that would enhance the virtual teaching dialogue between teacher-student (student) and/or student (student) / student (student) and/or student (student) - teacher. Thus, for the online lessons of major importance is the observance of **some ethical norms of virtual communication** between teacher-student (student) and/or student (student) / student (student) and/or student (student) - teacher.

Some valid rules are such as follows:

A. Choosing a virtual background decor. The action is responsible for creating the entourage of the virtual lesson, which must be a bit formal, so that those present find it easier to feel in a school and/or academic setting, etc. It refers to the aspect of the virtual space of the teacher, and also of the pupil or student. It has long been known that the ergonomics of the learning space influences the assimilation of the study material by the students; raises the level of concentration of students on those taught by the teacher, which, in total, increases the efficiency of contact teaching activities; the degree of constructive interaction between the learning actors being much higher. The setting of the virtual decor can be selected in video conferencing applications in the background settings compartment.

B. Ensuring sufficient illumination of the real and/or virtual teaching-learning-assessment space. The real circumstances of the organization and development of teaching activities also influence the virtual ones, causing some physical inconveniences and, as a psychological consequence, which affect the well-being of the actors of the educational process and, respectively, of the teaching activity, in general.

C. Observance to etiquette in online teaching activities involves paying attention to the form of addressing, the use of politeness formulas, but also the use of a polite speech and/or dialogue, without interruptions of the speaker, asking questions strictly in the question/answer session in within the lesson or in writing in the virtual lesson chat. Adherence to the given norms will diminish, even eliminate the chaos during the lesson.

D. Ensuring a decent / presentable aspect of those present and involved in the virtual lesson (of the students, of the teacher and, as the case may be, of the assistants). Here will be taken into account the outfit, the position of the body. Do not eat, chew, drink in front of the camera.

E. The presence of the spirit of punctuality is remarkable both for the teacher and for the student. Delays are not allowed either in the conditions of the traditional lesson, especially when they become a norm. This rule also implies compliance with deadlines regarding: (1.) the supply of the study material by the teacher; (2.) the distribution of teaching resources (which are supposed to be disseminated) by the teacher; (3.) the analysis of the results of evaluations and / or practical work and (4.) the announcement of the results of the formative and / or final evaluation activities by the teacher, as well as (5.) the submission of homework by the students (pupils / students) in the terms predetermined at the lesson.

F. Control of the speaker's image during virtual educational activities is a point responsible for the active user's speech being directed to the camera and not to the monitor. Thus, all the people involved in the virtual lesson session will be able to better focus on the content of the information transmitted. Equally important is that the active user, ie the one currently speaking and / or in control of the flow of communication, takes into account the expressiveness of body language and facial expressions: to understand the reduction and control of excessive gestures and improper facial expressions.

G. As a result, **the microphone control** will reduce the effect of sound interference in the virtual lesson and, accordingly: (1.) will save the computer resources of those present at the activity; (2.) will improve the quality of the video and audio signal in the lesson for the computers of your virtual "audience" ; (3.) will eliminate noise pollution of the virtual space of your lesson which is a factor that exhausts, causes stress to the public in any circumstances: real and / or virtual.

H. The prior verification of components, such as: (1.) hardware devices (laptop, desktop computer, speakers, microphone, keyboard, tablet, mobile phone, etc.); (2.) the Internet connection and / or the application / platform for conducting the virtual lesson; 3.) digital educational resources, ie the number of materials needed to carry out didactic activities: at all types of lessons and at all stages of the lessons, as follows: (A.) presentations *.ppt / *.pptx; (B.) MS Word documents; (C.) images / diagrams and graphical representations in various formats (*.jpeg, *.gif, *.tiff, *.png, *.bmp, etc.); (D.) animations and / or video sequences to be used in the formats compatible with the platform / application / the computer on which they will run (*.avi, *.mov, *.mp4, *.wmv, *.amv, *.svi, etc.).

In the context of those mentioned above, but also from own professional experience, we consider that only the synergy of all the components listed above, assisted by the type services as collaboration platforms with the meaning of live-video communication and, partially, tools for the creation of digital educational contents by teachers, correlated with certain didactic methods and procedures in a systemic, formative and creative way, it is possible to carry out a qualitative and innovative educational intervention.

3 Applied digital competences (ADC) and innovative didactic methods (IDM): notional delimitations

Because in the present research we aimed to study the applicability of digital skills along with special teaching-learning methods to be used in both traditional and online lessons so that it is possible to carry out an effective teaching approach, able to achieve the goals from the point of view of the trainer, and also from the point of view of the trainee, we consider it necessary to define the concept of the innovative didactic method (IDM).

Training methods are associated "[...] with the research methods (of science), in the sense that both lead to outlining facts, legalities, descriptions, interpretations as close as possible to reality" and, taking into account the fact that "[...] as a rule, the teaching methods show, convey sedimented knowledge at a given moment [...]", serving to communicate knowledge or to "[...] lead efforts towards rediscovering truths, we [...] " for those trained, but " [...] not for the scientific community " (Neacșu Ioan, 2016).

Thus, accepting this vision (Neacșu Ioan, 2016), we define the notion of the innovative method (especially in the context of online learning) as a formula with an increased effect of the organization and development of the teaching - learning process that correlates in a unique way with the other components of the training. As a rule, all together have the property to perfect both the process itself and the finalities which should be formed pursued by the educational activity in question, regardless of the format of the lesson (traditional or virtual). Based on the needs of the new teaching circumstances, those of transposition of education in online spaces, both teachers and pupils / students, and also representations of decision-makers rely heavily on the positive result of the combined implementation of innovative methods with digital skills of the actors of the educational process; the latter being applied in various didactic contexts and / or on different curricular dimensions and / or within different types of lessons.

Adapting the systemic approach to the instructive-educational process (Văideanu George, 1986) we developed the list of the particularities of didactic methods so that, in the most explicit way, to perceive the difference between the standard approach (synthesized from Neacșu Ioan, 2016) and the innovative one related to the given concept (see Table 3).

Table 3. Differentiation of the Standard Approach to Didactic Methods (SADM) vs. Innovative Approach to Didactic Methods (IADM)

SADM	**IADM, the author's vision**
Selected by the teacher and implemented in lessons and / or other extracurricular activities with the participation of students, and also for their benefit.	It can be selected by the teacher and / or student and is implemented in lessons and / or other extracurricular activities with the participation of students in order to increase the quality of teaching and strengthen the skills of the learner. In its version of IAMD are accepted for the educational activities of the teacher with the students both for lessons and for extracurricular activities, carried out either in traditional format (of contact lessons) or in the online format.
In all cases, the use of the method provides for the cooperation between the teacher and the students, as well as their participation in the search for solutions and / or for distinguishing the truth of error, etc.	In all cases, the method provides for the cooperation between the teacher and the students, as well as their participation in: (a.) the search for solutions and / or (b.) the elaboration of the algorithm and / or (c.) the elaboration of the algorithm implementation scenario and / or (d.) to distinguish the truth from error and / or (e.) the optimization of the solutions found, etc.
It is used in the form of selected and combined procedures, applied according to the level and / or needs and / or interests of students, in order to assimilate the knowledge thoroughly; of living values; and so on. Because the use of methods not only aims to assimilate knowledge, but also	It is used in the form of variants of developed strategies (the proceeding is only a complementary component of the method), based on selected and combined methods and procedures. Thus, the implementation of the given strategies would be carried out (as the case may be) depending on the level and / or the needs and / or interests of the students, in order to: (a.) solid assimilation of knowledge; (b.) stimulating the interest towards the intellectual activity (correlated with the study discipline, etc.); (c.) training and development of the innovative spirit; (d.) training and development of thinking (algorithmic, computational, critical, etc.); (e.) educating the spirit of self-identity; (f.) formation and development of the emotional intellect; and so on.

stimulates the creative spirit, etc.	
The method allows the teacher to manifest himself as a competent carrier of educational content and as an organizer of teaching processes during which the teacher can have different roles, such as facilitator, guide, evaluator, trainer, teaching being only one aspect of the educational process.	The method allows the teacher to manifest himself as a competent bearer of the educational contents and as an organizer of the didactic processes during which the teacher can have innovative roles, different from the traditional ones, such as: (a.) instructional design's developer (Burlacu Natalia, 2016); (b.) digital content designer; (c.) virtual mediator; (d.) e-learning tutor, (e.) software educational solutions designer; (f.) tester of IT didactic solutions, etc.

4 Conclusion

The simultaneous action of the digital competences applied with the innovative teaching-learning-assessment methods have a poly- functional character, in the sense that the actors involved can participate in concomitant or successively in the achievement of several educational purposes. Such a way of applying digital competences of the teacher, on the one hand, and of the learner, on the other hand, offers several options in terms of achieving the aims of learning, training, and development of general and specific competencies of school or academic subjects.

In addition to the fact that the context of the combined application of digital skills and innovative methods allows better assimilation of the subject of study and trans-, multi- and interdisciplinary integration of teaching contents; it increases the training of collaborative work skills and increased the level of emotional intelligence of the students in the conditions of carrying out the educational process in a framework of online didactic activities, a fact very difficult to obtain even in a traditional didactic conjuncture.

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Online School from the Student's Perspective

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Abstract

The success of an online school depends on how students manage to acquire new skills and knowledge. This process depends on many factors, and the problems that students face are diverse. In order to obtain quality in distance learning, we asked for feedback from students during the period when we switched to online learning. The students' answers were analyzed in this article, and the obtained results helped us maintain a high level of online schooling and the reputation of the institution on the one hand, and on the other hand, offer solutions on how to motivate students to study actively and end up with satisfied graduates.

Keywords: distance learning, online education, higher education

1 Introduction

Lately, the problems of online education have been receiving special attention from specialists in the field of education. The use of virtual learning environments has become the favourite topics of both scientists and users of online education. For everyone, the quality of this type of learning has become an important subject of debate. The issue of the success of the online learning/training system was raised, its the future depending not only on the quality of the contents and manners of online presentation, but also on the satisfaction of the consumers of this educational environment.

2 Debate Regarding the Advantages and Difficulties of Distance Learning

The term distance education „was referring to home study, independent study, correspondence study, external learning, self-directed learning, and telelearning – and today, of course, we read about cyber-learning, e-learning, mobile learning, virtual learning, and many more terms that are also canopied by the term distance education." (Diehl, 2019)

New technologies offer the opportunity to learn from any geographical location through the Internet and, at the same time, are a means of opening up to resources around the world.

Today, distance learning technologies, based on the creation of interactive environments, are actively being developed worldwide. In fact, this learning technology is student-centred and an opportunity to respond flexibly to the needs of society and of the individual.

Lately, more and more people choose to complete their education following distance/online studies and programs. These ways of education allow them to maintain their careers and family life, offer flexibility, give the opportunity to enrol in courses at multiple universities and in several different formats.

2.1 The Advantages of Distance Learning

Distance learning has a number of advantages:

- allows a large number of people to have access to training;
- favour access to trainers of international notoriety;
- stimulates the formation of skills in line with the requirements of today's society;
- saves time by individualizing learning and removing the necessity to travel;
- allows the reduction of training/education costs;
- ensures autonomy: choosing and deciding on an individual training route;
- favours the development of skills such as creativity, imagination, etc.

A study was recently published, in which 210 students responded "with their observations and perceptions of their personal online learning experience and how this experience impacted their work/life/school balance". This paper concludes that online learning „can enhance work-life balance for most students, especially when compared to the alternative of traditional fixed time and place classroom learning (Berry and Hughes, 2020)."

We adhere to the authors' conclusion and support the fact that distance learning has its specificity, and students who practice it benefit from:

- autonomy in planning courses and choosing topics (in accordance with their level of training);
- adapting the pace of learning (according to the ability to understand);
- interactive multimedia solutions;
- the possibility to self-evaluate;
- having a feeling of freedom, etc.

2.2 Difficulties Encountered by Students in the Context of Distance Learning

Research on distance education programs suggests the following reasons because of which students who practice distance learning drop out (Powell 1990; Garland, 1993; Williams and Nichols, 2004; Lao and Gonzales, 2005; Nash, 2005; Piercy and Lee, 2006):

- using online learning technologies is difficult;
- lack of high-speed access la Internet;
- lack of required technical equipment (some students feel that they should be provided financial assistance from the institution to pay for equipment and Internet charges);
- lack of physical communication and collaboration;
- difficulties engaging and maintaining online discussions;
- students do not always correctly anticipate the time needed for coursework;
- misunderstanding of academic rigour;
- difficulties when contacting staff members;
- a need for more mentoring;
- difficulty in gaining access to materials;
- lack of prerequisite knowledge;
- lack of interest;
- lack of time;
- lack of support (from peers or family).

„Students who learn from a distance enroll and drop courses for many of the same reasons: family commitments, jobs, time, and technology; all of these elements make distance education attractive, but also cause students to become overwhelmed and drop out." (S. Fey et al., 2018).

In a recent study, Karen E. Brinkley-Etzkorn concludes that teachers and students who participate in online learning are disappointed at the end of the course: "Findings reveal that, prior to and immediately following the training, instructors were highly optimistic about their course redesign and skill/knowledge development. After teaching the course online, participants were less optimistic and less satisfied with their training experience than they had been immediately prior to or following the training. Multiple instructors cited a need for additional or continued training and support" (K.E. Brinkley-Etzkorn, 2020).

2.3 Proposed Solutions for Optimizing Distance Learning

The implementation of distance learning in the daily practice of educational institutions is a complex activity. It requires investment in human and material resources. To ensure success in this area, a meticulously designed government and institutional strategy which takes the following into account is needed:

- ensuring infrastructure;
- permanent updating of curricula;
- training specialists in online teaching;
- providing technical assistance in educational institutions;
- continuous adaptation of technologies to new changes.

Of course, e-learning platforms and Online school face several challenges. To optimize the distance learning process, researchers have come forward with a number of proposals, including: coming up with the idea of personalizing the e-learning experience and to keep students motivated and engaged (Shearer, 2019; Moubayed et al., 2020), proposing effective designs of learning activities in online environments (Cundell and Sheepy, 2018), researching the relationship between students' characteristics and online learning (Baker, 2018), proposing the use of course formats adjusted to the different learning styles, etc.

3 Methodology of Research

The purpose of the study was determined by the desire to contribute to the development of online university education. In fact, we set out to find organizational and pedagogical conditions that would contribute to increasing the quality of distance learning.

In the study, we took into account the fact that most people who study at university have relatively stable characters and are less willing to change, which can make online learning more difficult for them. We also took into account the fact that giving up or partially studying the course leads to undesirable consequences, such as dissatisfaction, negative feedback, undermining the reputation of the educational institution.

In fact, we believe that developing distance learning and an online course system is part of the strategy for modernising education by:

- giving all people access to education and training;
- offering the possibility to choose an online program/course of quality (choosing and accessing courses from the best specialists in the world and from the best educational institutions).

Therefore, we believe that for the development of online education is very important that:

- the content of online education is of high quality;
- the training course is designed to cover/master the entire program;
- students are satisfied with the obtained results by the end.

In order to find the best solutions to make distance learning more efficient, we asked 219 students to give some feedback on the evaluation of online activity in the period of transition from traditional education to online education. For the purpose of assessment, we have developed a tool that includes a list of questions (Box.1) which encourages students to express their opinion, argue about it and provide constructive solutions for more attractive, easier and more efficient online learning.

The answers to the questionnaire questions were collected online, then grouped based on the similarity of the answer and each group of answers was assigned a common theme. Topic reports were then generated and the reports analyzed.

Box 1: List of Questions for Student Feedback on Online Learning

1. Express your opinion on your online learning experience.
2. What do you think about the way the content is taught, the communication methods, the specifics of the tasks, the time allocation, the evaluation method, etc. of the online curriculum?
3. What are the strengths and weaknesses of online learning?
4. How did you adapt to the "online strategy"?
5. What problems do you face?
6. What do you expect from teachers?
7. What mistakes did you notice regarding organising and teaching online?
8. How could your online learning experience be improved?

4 Analysis of the Results

The answers given by the students showed that they have very different opinions and attitudes regarding online education. Their views, although well-argued, may be completely opposite:

Opposite answers on attention

Student 1: Probably the biggest problem I face is attention, being distracted at home by a lot of things.

Student 2: I think that online education is ideal: it is very easy to learn from home, thus I can be much more attentive to what is taught.

Opposite answers on motivation

Student 3: When you go to University you are motivated by those around you, you have the support of colleagues and teachers. I can say that my motivation diminished as the teaching process progressed. I don't like this "online education" at all.

Student 4: Online learning has helped me develop my self-motivation and self-discipline.

Opposite answers regarding access to course materials

Student 5: From my perspective, online education is more difficult than traditional one, especially since in the online environment there may be difficulties in accessing courses at important times, and you do not have the opportunity to participate in all online activities.

Student 6: I think it is much more convenient to do the classes online, and we find the information much faster.

Opposite answers regarding communication

Student 7: There are people who learn and understand due to the atmosphere created by the teacher and his colleagues. Personally, I prefer studying at university, rather than "homeschooling".

Student 8: Being a shy person, the online environment helped me to communicate more with teachers during classes, to be active in classes, not to be so afraid to answer.

Opposite answers regarding the difficulty of the online program

Student 9: I work much harder since I'm at home, maybe it's my fault because I want to meet all the requirements perfectly.

Student 10: Some teachers explain to us, send us clear materials, and consequently we can solve homework easily.

Also, from the analysis of the answers we found that:

- students express their concern about the efficiency of online learning: "I have adapted quite quickly to the platform and online learning, it is much more convenient for me to do classes in front of a computer, but I do not think it is effective in the long run."
- students are not sure that they understand the topics correctly: "Classmates can also help at university, sometimes they explain more clearly and the teacher has more time for everyone, and in the online format we can misunderstand!" or “It is not enough for me to receive some materials and be told that I have to learn, I need an explanation. It helps me to listen to the teacher talking about a certain topic because then I feel that I understood the information better.”

Students find that distance learning has its advantages and disadvantages, which can be transformed in favour of education. Those in the first years of study are more open (and adapt more easily) to online education, compared to students in their final years (Chart 1).

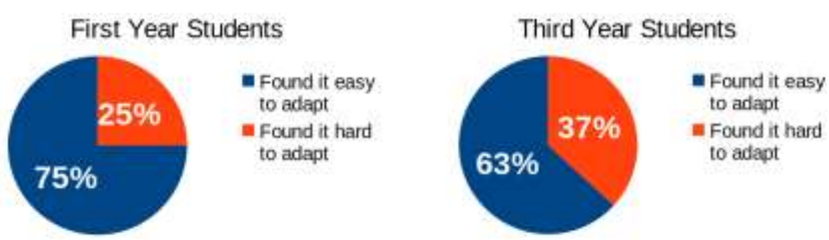

Chart 1: Student's adaptation to online learning

From the analysis of the students' answers, we concluded that the students who participated in our study highlighted the same advantages and disadvantages of distance learning, which we find mentioned in the literature on this topic. However, we would like to emphasize once again that the answers obtained in our research differ greatly from student to student, which suggests the idea that the effectiveness of online learning is related to the subjective reality of the student and the specifics of his personality. Therefore, it is very important to have a permanent connection with students who learn online, to listen to their feedback and to adapt to the specifics of each one of them.

5 Conclusions and Proposals

Given that the purpose of developing the online course system is to provide everyone with access to quality courses, we consider it necessary for teachers to adjust university education to the specifics of online teaching, which involves:

- providing materials to support online interactivity;
- structuring the material for easy and quick assimilation;
- motivating and stimulating the learning activity;
- creating the conditions for the individualization/differentiation of the educational path;
- adjusting the program to the psychological characteristics of the students;
- objective assessment of knowledge.

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Effective Online Assessment in Software Testing Education

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Abstract

Developing relevant learning activities that ensure competency acquisition is important. At the same degree, the design of effective assessments that address key concepts studied throughout course duration is necessary. During this endeavour, educators undertake both student and teacher concerns on having a fair evaluation. This paper examines issues related to rigorous, accurate, and equal online assessments in a software testing course. Results on applied assessment strategy are investigated and general recommendations are inventoried.

Keywords: online assessment, evaluation items, learning outcomes

1 Introduction

Skill acquisition verification through formative and summative assessments allow teachers to have accurate reflection of the actual knowledge in the learning process. Face to face evaluation through time-based written papers is commonly used. When various circumstances require adopting online assessment many aspects needs to be changed or adapted in order to preserve accuracy and academic integrity. As the COVID-19 pandemic circumstances required the switch to all teaching and assessment activities to the online medium, higher education teachers were challenged to tailor teaching activities and assessment tasks acccordingly.

This paper investigates the online assessment associated activities for the Test Design Techniques (TDT) elective course, taught for computer science 3rd year undergraduate students at Babes-Bolyai University of Cluj-Napoca, Romania.

The main contributions of this paper are an empirical analysis on various issues related to the online assessment aspects. Key elements that need to be promoted in both face to face and online assessment are reviewed. The evaluation items of the online assessment of the 2020 TDT course session are described together with the results obtained, emphasising the added value of the designed tasks for online evaluation in the context of learning test design techniques.

The paper is organized in several sections as follows. *Section 2* shortly describes TDT course learning goals, considering those testing topics mandatory for both junior and senior testers. Important view from the online assessment lens are analysed in *Section 3*. The participant profile and the evaluation items used to design assessment tasks are detailed in *Section 4*. *Section 5* presents the results of the online assessment for two different categories of evaluation items and the corresponding analysis. Lessons learned from teacher's perspective referring to preparation and actual online assessment tasks are inventoried in *Section 6*. The paper ends with conclusions and future improvements.

2. TDT Course Learning Goals

TDT course is proposed to several undergraduate specializations at the Faculty of Mathematics and Computer Science at Babes-Bolyai University of Cluj-Napoca, Romania. The educational objectives of this practical course focused on in applying test design techniques in software testing involve the followings:

- to enhance the students' understanding in testing activities and test design techniques;
- to create an learning environment for students to be able to explore software testing and test design concepts in various business scenarios;
- to induce a realistic and industry driven view of software testing concepts and their inherent benefits;
- to provide students the possibility to explore various test design techniques applied to different levels of testing;
- to improve the students' abilities to tackle information objectives driven testing;
- to enhance the students understanding of test design techniques value in software development;
- to gain the ability to use various tools for the testing process, i.e., test management, test running, test reporting and bug reporting;
- to gain the ability to design test cases according to established testing goals by using specific test design techniques in order to achieve specific information objectives.

The course content is based on Cem Kaner and Rebecca Fiedler's course (Kaner and Fiedler, 2016) that emphasizes the use of test design techniques following seven dimensions, focused on:

D1. **scope** – on *what* gets tested;
D2. **coverage** – on *how much* gets tested;
D3. **risk** – on why gets tested;
D4. **tester** – on *who* performs the actual testing;
D5. **activity** – on *how* testing is performed;
D6. **evaluation** – on *how* to decide whether the testing is successful or not;
D7. **desired results** – on *what* is the testing outcome;

For each dimension, students can study several test design techniques in order to reach various information objectives. For example, *function testing* technique can be applied in different contexts (Kaner and Fiedler, 2016) addressing various aspects:

- *scope*: the focus is on individual functions, testing them one by one;
- *coverage*: to test every function or a subset of functions;

Function testing technique does not actually address the following dimensions:

- *testers*: who does the testing;
- *risks*: what bugs the tester is looking for;
- activities: how to run the tests;
- evaluation / oracles: how to evaluate the test results.

Many techniques focus on more than one aspect. Therefore, a technique can be classified depending on the intent to use the technique and the mind-set of the actual test designer.

Bug reporting complements the testing activity by communicating in a structured way the issue identified during testing. Cem Kaner and Rebecca Fiedler presents in (Kaner and Fiedler, 2017) a strategy meant to help elaborating meaningful bug reports that motivate the developer to allocate resources to investigate the reported issue. The six steps strategy consists of: ***r***eplicate, ***i***solate, ***m***aximize, ***g***eneralize, ***e***xternalize, and to s***a***y it clearly and dispassionately, using the acronym RIMGEA.

There are four lab activities designed for this course. The testing topics and test design techniques approached help the students acquiring the skills to perform testing in different contexts. The formative assessment during lab activities is completed by the final assessment that is focused on mandatory skills to achieve efficient software testing.

3. Relevant Aspects of Online Assessment

Online assessment is defined in (Taylor, 2019) to be any means of evaluating student achievement, providing feedback, or moving the students forward in their learning process. These assessments can be either *formative*, designed to monitor students' progress during assigned tasks, or *summative*, designed to evaluate students against a standard or criteria (Dixon and Worrell, 2016).

Daradoumis et al. (Daradoumis et al, 2019) report that detailed feedback represents one of the most important benefits of online assessment that can be given in different forms: written, video-recorded, audio-recorded.

When online assessment is designed to replace the traditional face to face assessment, it is required to keep the same ***rigour*** levels to ensure the same learning outcomes. More, the ***validity*** of assessment tasks should be preserved as well.

There are several aspects related to online assessment that may represent reasonable concerns from both teachers and students. From the teachers' perspective, this activity requires a consistent time and effort to prepare properly all the assessment materials. In cases when LMSs are employed they need to be well organized such that information can be easily accessed.

Other issues that may concern the teacher are the students' integrity during online evaluation and possible technical issues that may impede participants to sit the actual online evaluation.

From the student perspective there is the concern on evaluation fairness and equality for all students, highly connected to the validity of online assessment. Another aspect that preoccupies students is the evaluation transparency during online assessment. Information availability on the methods used to determine grades, provide students with more comfort and understanding on exam equality (Khan and Khan, 2019). While using technology to perform assessment tasks, instructors need to make sure they know how to use the platforms employed and any technical issue will not have an impact on their grade.

4. TDT Assessment Setting

This section shortly presents the participant particularities and the evaluation items used to design assessment tasks for the TDT course during online assessment.

4.1 Participant Details

Students from various specialization and study lines (Romanian, English, German, Hungarian) were enrolled during the 2020 TDT course session. *Table 1* shows the distribution of the 81 students from the following undergraduate degrees: Computer Science (CS), Mathematics and Computer Science (MCS) and Mathematics (M).

Table 1. Students enrolled in 2020 TDT course session

Specialization	**# Students**
CS (Ro)	13
CS (En)	14
CS (Ge)	2
CS (Hu)	1
MCS (Ro)	31
MCS (En)	18
M	1
Erasmus	1
Total	**81**

Most of the students were 3rd year undergraduate degree. Still, over several learning sessions we have noticed that students enrolled in MCS (Ro, En) in 2nd year of study choose to study earlier test design techniques as an elective course.

4.2 Assessment Organization

The assessment activity was organized online because of the COVID-19 pandemic circumstances. The following evaluation items (**EI**s) were considered when the assessment tasks were designed for the online evaluation medium:

EI1. define and describe testing concepts;

EI2. provide examples to support the definition of the concepts;

EI3. compare and contrast testing concepts by emphasising similarities and differences between addressed notions;

EI4. define and describe test design techniques;

EI5. design test cases according to a given test design technique;

EI6. compare and contrast test design techniques providing advantages and weaknesses of using particular testing techniques in various contexts;

EI7. provide evidence on applying a particular test design technique for a specific application context to achieve certain information objectives;

EI8. elaborate a bug report following the RIMGEA (Kaner and Fiedler, 2017) for a specific bug.

Various exam subjects were prepared for students to be solved during the online assessment. The exam subject was organized in two parts. The *first part* required students to pick an issue at their choice and to investigate it following the RIMGEA bug reporting strategy. Each student selected a software bug different from their colleagues. Students worked for this task in advance and sent the issue report to the teacher on the exam day. The main goal in designing this assessment task was to allow students to document and reflect on the analysed issue and to prepare a bug report that highly motivates the developer to investigate it. This assessment task covered the item EI8 in the evaluation item list.

The *second part* of the assessment consisted of time-based tasks for which the students received the topics to address individually, in the beginning of the evaluation time slot. The subjects were various, focusing on the items **EI1** to **EI7** covering testing concepts, test design techniques and the testing dimensions discussed during course activities. The assessment exercises involved simple to complex tasks, from definition-based to particular application contexts that required use of specific test design techniques.

5. Results

This section focuses on the evaluation items **EI1** to **EI8** applied for the TDT course during the 2020 course session. It details results for the evaluation of basic and advanced testing concepts together with high level knowledge in bug report preparation.

5.1 Bug Report Evaluation

For the issue description based on RIMGEA strategy, most of the students indicated a unique software bug to investigate one week before the exam day. The issue report was turned in together with the second part of the written paper. From the 81 students enrolled in TDT course, 78 of them sat the online exam. *Figure 1* shows the number of students that investigated and turned in the solution for the assessment item **EI8**. Over 62% of the participants presented a thorough issue report that addressed more than three aspects of RIMGEA, e.g., maximize, generalize, externalize. They got from 2 to 3 points out of 3 available points. This result shows students took very seriously their role of bug reporters.

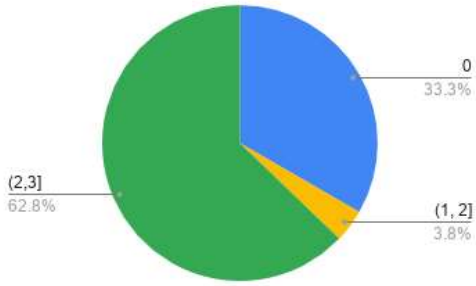

*Figure 1. Results of bug investigation evaluation (**EI8**).*

A consistent part of the students, represented by 33.3% from the participants, decided to do not work on this task prepared before the actual online exam. The computed final grade allowed them to pass the exam, as their got high grades on other course activities.

5.2 Test Design Technique Knowledge Evaluation

The knowledge on testing techniques was assessed following the evaluation items **EI1** to **EI7** in two consistent phases, with individual subjects for each student. First part evaluated basic testing concepts. The assessment tasks were formulated considering one of the two ways:

- several testing concepts definition and relevant examples;
- detailed information on a specific test design technique.

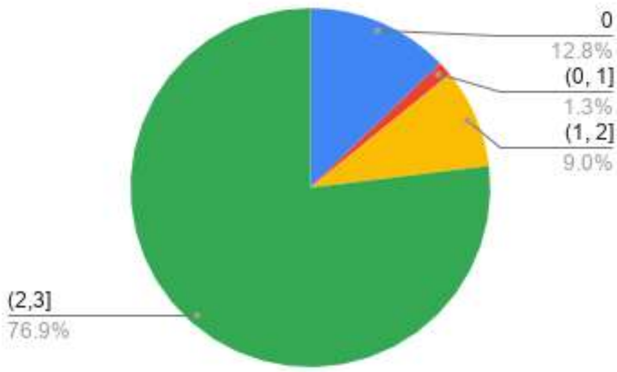

*Figure 2. Results of basic testing knowledge evaluation (**EI1** to **EI6**).*

For the evaluation of the basic testing concepts students provided consistent answers. *Figure 2* depicts the results of this part of the actual online assessment, where 76.9% of the students received from 2 to 3 points out of 3 allocated points. These values indicate good knowledge of theoretical concepts in testing. Still, 12.8% of the participants chose to not provide an answer to the basic testing knowledge evaluation

The second part of the exam evaluated practical knowledge and required deciding the most appropriate test design techniques to achieve some information objectives while applying software testing. this demanded to use some specific software application context and development constraints.

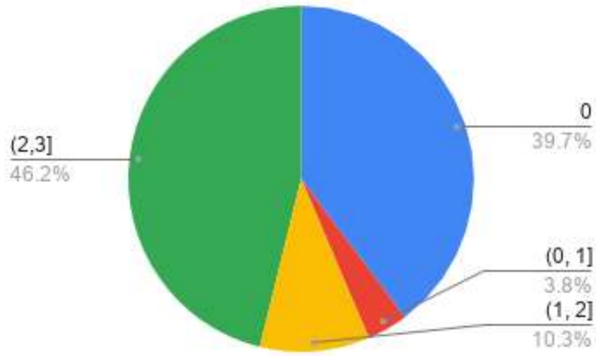

*Figure 3. Results of advanced testing knowledge evaluaion (**EI7**)*

Item **EI7** is a complex evaluation item that addresses the practical use of particular test design techniques and correlate them with information that recommend the techniques in specific application context. *Figure 3* presents the results obtained by students on the second part of the online assessment, related to the practical use of test design techniques. Only 46.2% of the students provided very good to excellent answers that were graded with 2 to 3 points from a total of 3 available points. Very close to this percent is the opposite one, 39.7% of students that did not provide any answer to this assessment task.

5.3 Analysis

As it was expected, the evaluation item **EI8** – prepared at home, not under exam time limitations – brought very good results (see *Figure 1*). Yet, the task required a larger amount of time to elaborate the issue report compared to the effort associated to items from **EI1** to **EI7**.

The basic knowledge assessment related to testing concepts emphasizes a good understanding of the testing topics. They were covered by over 85% of the participants that provided acceptable to excellent answers, i.e., 1 to 3 points, (see *Figure 2*).

The most challenging task for students was to clearly decide and provide evidence on the practical use of specific test design technique and indicate relevant test cases. This is represented by the evaluation item **EI7** indicated in *Figure 3*. The effort of the inquiry is highlighted by the close number of students that performed very well (46.2%) and those that did not performed at all (39.7%). This shows that just half of the students possess required testing comprehension in test design technique use. For advanced tasks on operating with test design techniques, deeper knowledge and additional practice is required.

Students that aim just a passing grade are usually found in those groups that cope with low level complexity tasks only. For those students focused on relevant skill acquirement in test design techniques, more advanced tasks that challenge them are the most appreciated and present to the teacher the critical thinking abilities needed in practical testing.

The exam passing rate is high for this course due the various types of activities students are involved in. the final exam represents a means to assess relevant items that indicate the competencies acquired in basic software testing and designing test cases based on the information objectives the stakeholders aim for.

6. Lessons Learned

Online assessment brings advantages and challenges while applying throughout online courses. ***Actual online evaluation*** deployment has several particularities that need to be addressed with care. For a successful online asessment teachers should state the instructions of the tasks in a clear and complete manner. This minimizes the number of questions asked by participants. During the online assessment, students may raise questions related to the approach required by the exam subjects. Teachers should prepare a communication channel available for all participants, so every student can see any question asked by other colleagues.

While preparing the ***online assessment tasks*** to be accomplished during the online evaluation, educators have to think of different types of subjects that allow students to prove their knowledge on the approached topics. Prior to the actual online assessment, teachers should discuss various aspects related to the academic integrity and provide a plan to achieve it within the virtual space. Instructors should have a backup plan for cases where technology impedes students to sit the online exam. The teacher must state before the actual online evaluation what the student responsibility is regarding to technology issues, e.g., to access and alternative internet connection, to access another communication tool if needed. Significant teacher effort in preparing an accurate online assessment was noticed. At the same degree, high accuracy in task evaluation needs to be preserved by each educator.

Conclusions

Formative and summative assessments are complementary tasks to be achieved in teaching, aiming to evaluate the learning outcomes. It is common for teachers and students to think upon evaluation as written paper-based tasks for face to face assessment. COVID-19 pandemic circumstances forced instructors in higher education to move all the teaching activities in the virtual space, assessments included. This paper addresses the learning goals of TDT elective course and the way assessment tasks were designed such that learning outcomes are kept and competencies are evaluated in the online medium. Some important aspects as the academic integrity rules and evaluation accuracy were addressed, as students were used to see for the face to face evaluations.

The results in designing online evaluation tasks that assess basic and advanced knowledge in test design technique use are presented and analysed. The investigation addressed items of software testing driven by information objectives accomplishment.

Future research in this area refers to proposing improved assessment tasks, especially designed for online assessment in the software testing area. These tasks, associated to suitable evaluation items help keeping assessment accuracy on virtual medium.

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eTwinning projects, European memory and democratic participation of the youth in society

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Abstract

The changes in the contemporary society at the end of the XXth century, the appearance of the Internet, with an impressive number of users and services, determined a spectaculous jump regarding the evolution of humanity from a simple read of information to Mc Luhan's "global village". This idea was born through the big scale utilisation of social network platforms such as Facebook or MySpace (eTwinning). The need for exchanging ideas and international collaboration lead to overcoming classrooms and to the discovery of new digital platforms and online instruments, easing the XXIst century specific competency acquiring. This study showcases the results of a three month research project, obtained from applying a questionnaire to approximately two hundred teachers on the eTwinning portal, regarding the impact of activities targeting the growth of students' civic and social competencies, but also their digital competencies. Learning history at school through utilising the eTwinning platform assures a sustainable type of learning based on creativity, critical thinking and interactivity in order to reconstruct and understand different sides of European history. We show a comparative analysis between the answers of Romanian and European teachers on the changes that occurred in their classrooms. The results of the study can be the basis on which virtual history lessons will be created in the near future because they showcase the benefits of using digital platforms and their quality, facilitating the labour market integration of the students.

Keywords: eTwinning, international collaboration, European history

1. Introduction

After 1990, the use of new technologies led to the development of distance learning (e-learning). The changes in contemporary society in the late twentieth century, the advent of the Internet, with an impressive number of users and various services offered have led to a dramatic leap in the evolution of humanity from a simple reading of information to the global village of Mc Luhan.

The Canadian writer Marshall Mc Luhan launched the *global village* concept in 1960. The author issued a theory according to which the world would become smaller after the launch of electronic communication. Citizens from all social categories will be able to meet people from the same environment forming communities, sharing the same interests. "The new electronic interdependence recreates the world in the image of the global village." "There are as many villages as there are interested villagers." "The planet has been reduced to the size of a village by the new media," the writer said. This idea came to life a few years later, through the widespread use of social networks such as Facebook or My Space (eTwinning).

2. European memory and the democratic participation of young people in society

The words of the writer and philosopher George Santayana, "Those who cannot remember the past, are doomed to repeat it" bring to the attention of the general public the importance of capitalizing on the past and historical heritage. The European continent so troubled by two world wars, by totalitarian regimes, then by the reconstruction of a continent divided by the "iron curtain" after 1945, should be better known to the younger generation.

Europe is one of the oldest continents that cannot be identified as a distinct geographical territory, instead it can be defined as a cultural area of extraordinary value, a keeper of common history and culture. Many of the recent events have their origins in the common historical past of

Europe. Given these considerations, we want to show that the understanding and preservation of the European past, the critical analysis of events determine changes in the mentality of young people and the importance of civic and democratic involvement in society.

The European institutions, particularly the European Commission, aim to invest in the education of young people and to involve young people in civic life and society. Surveys show that voluntary activities are a way to increase young people's participation in society. Direct consultation, participation in debates on various topics, simulation of the vote are ways to facilitate the understanding of the functioning of the European institutions and the involvement of young people in the decision-making process.

3. The eTwinning platform facilitates collaborative learning

The idea behind the eTwinning platform began in the late 1990s, when Connected Intelligence Schools was initiated by Madeira's Autonomous Ministry of Education for remote schools on the island and neighboring islands. It was thus desired to establish a network of schools consisting of middle school classes that have the same common goals: information collaboration and interconnection. Schools interacted, students used different pedagogical tools and created videos. This project received due attention at the Hanover Expo 2000.

At the Brussels Conference in 2005, at the initiative of kind-hearted teachers, the eTwinning network was set up on the basis of the twinning of two schools. Although initially, it started from identifying a partner and carrying out a project with students, later a valuable platform was developed, coordinated by European Schoolnet, available in 21 languages. The Conference was attended by 300 teachers, and since 2005 by more than 100,000 others.

Starting from this example, the guest Derrick De Kerkhove, the creator of collective intelligence and a close collaborator of Mc Luhan, participant in the first eTwinning conference in Brussels, in 2005, foreshadowed the direction that eTwinning 1.0 will develop.

eTwinning (including eTwinning Plus) is an official action, part of the Erasmus + Program, implemented with the agreement and support of the ministries of education of the member countries.

Since its founding, eTwinning has become a major catalyst and supported the expansion of collaboration between European schools. Since 2007, it has evolved from the platform stage to the virtual space included in the Lifelong Learning Program. After 2008, the role of social network is emphasized, being a space that offers professional training and a virtual cafe. After 2014, with the new ERASMUS + program, the role and importance of eTwinning has increased, adding new options such as training or networking, online working groups. Currently, the community has a total of 823,109 teachers and 108,226 projects.

4. Materials and methods

This article presents the results obtained from the application of the questionnaire "eTwinning projects, European memory and democratic participation of young people in society" which was addressed to teachers in pre-university, primary, secondary and high school, participants in the eTwinning program, who teach History and Social Sciences . The respondents were 119 teachers from Romania and the Republic of Moldova, respectively 102 teachers from different European eTwinning member countries.

We selected the target group of teachers who responded to the questionnaire by consulting their profile, posted on the eTwinning pages. After completing the questionnaire I used the Data Analysis Tool in Microsoft Excel using "ANOVA two factor without replication".

5. Methodology

The aim of the research was to study the opinion of teachers on the possibilities of developing social and civic skills in History and Socio-human classes and the democratic participation of young people in society through involvement in eTwinning projects.

We made comparisons between the answers of the two samples Romania and the Republic of Moldova, respectively other eTwinning and eTwinning Plus states and we formulated conclusions. Regarding eTwinning and eTwinning Plus, we referred to History teachers from eTwinning Member States, eTwinning Plus, members of the Mediterranean partnership, countries within the European Union and outside the European Union, with membership status of the partnership. (e.g. Tunisia, Azerbaijan, Armenia, Turkey, etc.).

6. Results

The first sample, consisting of teachers from Romania and the Republic of Moldova was made of 91.6% female and 8.4% male; as for teachers from different countries of the European Union or non-members of the European Union, they were 74.5% female and 25.5% male. This has shown that the majority of female teachers are predominant, although a greater involvement of men in the pre-university environment would be required, offering equal opportunities to all. Another observation found refers to the age of Romanian and European respondents, namely most of the respondents were between 41-45 years and over 50 years (24.4% and 37.8%, in Romania and the Republic of Moldova) and 32.4% and 34.3% eTwinning Member States. Regarding the age and teaching experience, most of the participants are over 25 years old, 42.9% of Romanians, and 28.4% the European colleagues. The distribution on the country of origin showed that most of the answers were provided by eTwinners from Romania 104, Moldova 15, Spain 13, Italy 12, Turkey 13, Greece, Portugal, Poland 9, Albania 7, France 6, Armenia, Bulgaria, Hungary 3, Croatia, Georgia, Macedonia 2, the rest of the countries have 1 answer Austria, Azerbaijan, Belgium, Cyprus, Serbia, Slovakia, Tunisia, Ukraine, Great Britain. The urban-rural distribution of teachers and schools involved reveals the preponderance of urban schools (77.3% urban and 22.7% rural in Romania and the Republic of Moldova and 66.7% urban, 33.3% rural in eTwinning and eTwinning Plus countries).

Regarding the first item of the questionnaire, namely the role of European history in understanding recent history and appreciating the common European heritage, 98% of Romanian and Moldovan respondents consider that the European collective memory is particularly important, as well as 95.1% of partner states eTwinning and eTwinning Plus.

Most teachers in the eTwinning community acknowledge the importance of the construction of Europe, the significance of the first international elections for the European Parliament in history, held in 1979 (89.1% of Romania and the Republic of Moldova, 83.3% of European countries and eTwinning Plus partner countries) and consider it important to discuss with their students about the role of democracy and free elections, as well as the importance of having representatives in the European forum, participating in decision-making. Analyzing the answers about the evolution of Europe over time and the importance of preserving the European memory in order to understand the common European heritage, I found that opinions were different, from enthusiasm and interest, desire to share experiences to prudence. Both European history teachers and Romanian history teachers have stated that Europe is the cradle of human civilization and that there can be no present and no future without knowing the past. The enrichment of the national memory, the rediscovery of the past contributes to the configuration of the common European memory. Here is a opinion from a teacher:” *I think that European history includes key moments in our society and that the youngest need to know and remember in order to lead better their own generation. European memory is not only important but also vital, so that to protect values, such as peace, democracy, freedom, equality, solidarity, social justice, social and political rights”*.

Regarding the 1979 European Parliament elections, the teachers surveyed say it is a milestone in Europe's history, when democratic values and the involvement of millions of citizens have gone together to build a better common future. *“Democratic principles are introduced and form the basis of the construction of Europe through the elections”*.

Another item referred to the difficulties encountered by teachers during the History and socio-human classes. On the school curriculum from Romania and the Republic of Moldova, teachers note that it is much too loaded (42 to a large extent, 57 to a medium extent, 15 to a small extent, 5 totally disagree). European teachers consider the school curriculum very busy (42 to a large extent, 45 to a medium extent, 13 to a small extent, 2 to disagree). Comparing the results I find that the problems faced by teachers are similar, namely the small number of hours, the curriculum is essential in European countries, emphasizing those fundamental themes of civic and social skills training and understanding of national and European history. One of the complicated problems faced by teachers in Romania and the Republic of Moldova are the poor material funds for modern teaching materials (computers, multimedia applications, ICT laboratories that allow access to the Internet and learning platforms). The results of the questionnaire show that the lack of modern materials is a problem to a large extent, for 70 respondents, on average 33, to a small extent 11, and 5 disagree. European teachers appreciate that there are sufficient funds allocated for materials in order to carry out an effective learning process, 26 to a large extent, 44 to a medium extent, 22 to a small extent, 10 to disagree.

Regarding the opinion on the changes observed in students after accessing and involvement in eTwinning projects, we find that 73 are largely involved, 44 on average and 2 to a small extent, in solving tasks using critical thinking. Another goal was to exchange ideas with other students from other countries, which contributed to the change of attitude towards colleagues and teamwork through cooperation in History lessons, 73 largely, 43 on average, 3 to a small extent. Teachers identify changes in the teaching process 85 to a large extent, 29 to a medium extent and 5 to a small extent. The changes produced in students do not stop here, but continue, influencing behavior, becoming responsible active citizens, both in everyday life and in the online environment, 61 to a large extent, 50 to a medium extent, 7 to a small extent, 1 disagreement.

Another noteworthy aspect is the use of digital tools, the eTwinning workspace, which has led to an increase in students 'autonomy, increased responsibility for their own education. Thus, the results of the survey show that teachers appreciate the increase in students' autonomy (50 to a large extent, 58 to a medium extent and 11 to a small extent).

According to the teachers surveyed, regarding the changes made to students in order to form civic and social skills to support diversity, respect for values and privacy 76 consider that there have been changes to a large extent, 35 in medium and 8 in small measure. European eTwinning and eTwinning Plus teachers appreciate that they have noticed the following beneficial effects: involvement in solving tasks using critical thinking 58 to a large extent, 38 to a medium extent, 4 to a small extent and 2 not at all; the exchange of ideas with colleagues from other countries, the interaction and change of behavior and attitude towards other classmates, a fact observed by teachers 65 to a large extent, 27 to a medium extent, 10 to a small extent. Increasing students' motivation for study and collaborative teamwork in classes on various topics of History and socio-human sciences, were other positive aspects recorded by European teachers, 69 largely, 27 on average, 5 to a small extent. Identifying online historical sources, critical analysis, the opportunity to exchange information contribute to increasing innovation. Applying opinion polls, signing online petitions, involving young people in the legislative process, participating in actions for charitable causes are all attitudes and behaviors that have influenced behavior to determine the active citizenship of young people, increasing their involvement in the physical environment but and online. The applied questionnaire revealed that European teachers perceive the importance of active citizenship and the actions they take in projects. Their actions changed the behavior of young people causing the acquisition of civic and social skills, and teachers' opinions on this issue are: 53 to a large extent, 41 to a medium extent, 5 to a small extent, 3 to disagree. Another positive aspect pointed out by European teachers was that during the classes by accessing eTwinning, young people can go through the tasks of working independently, becoming autonomous but at the same time responsible for the learning process. They also have access to the project at home, asynchronously, when they need to resume essential information. The results of the survey show that teachers appreciate that students have become responsible and have the ability to self-teach to a large extent 42, on average 49, to a small extent 9 and disagree 2.

These above ideas are reflected in the answers of European teachers to the questionnaire, stating that participation in projects on history causes changes in the formation of civic and social skills of young people, largely 56 participants. , on average, 39 participants and to a lesser extent 7 participants.

Figure 1. Changes at the level of students regarding the formation of social and civic competencies through involvement in eTwinning projects, Romanian and Moldovan teachers

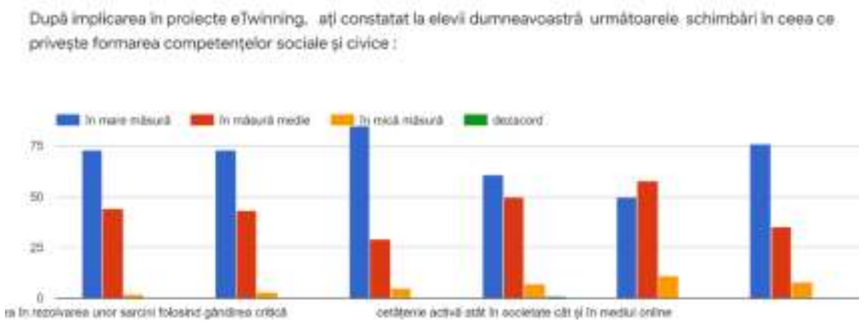
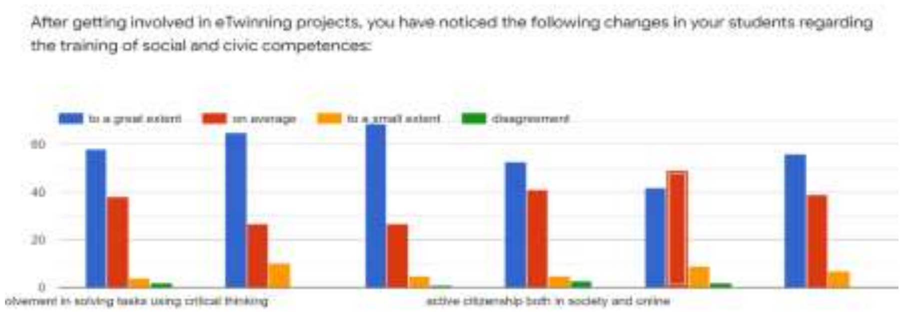


Figure 2. Changes at student level in the training of social and civic competences through involvement in eTwinning projects, European eTwinning teachers and eTwinning Plus

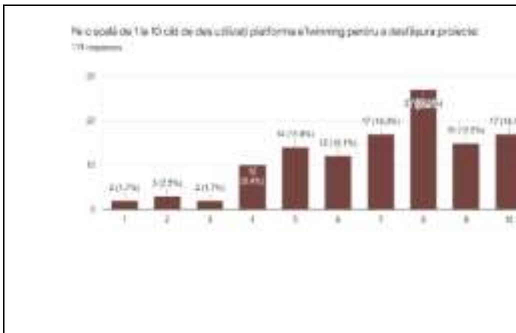


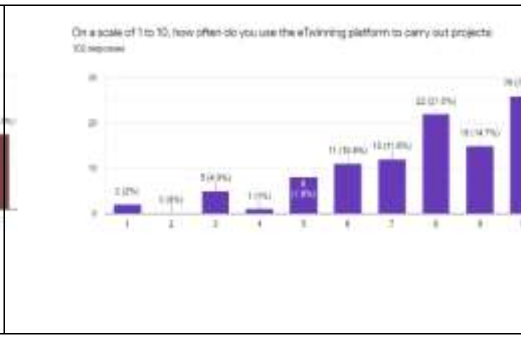
The conduct of History classes on the platform led to changes in the level of civic and social skills acquired by Romanian, Moldovan and European teachers. Thus, the lessons conducted on eTwinning led to better knowledge of students by the teacher, observation, planning and preparation of learning focused on student needs, better management of student behaviour and increased interactions within the group of students, appreciation practices and beneficial assessment for students, communication and collaboration with colleagues from other specialties in interdisciplinary classes, team building, better emotion management, designing effective inclusive activities and participating in volunteer activities.

Asked how often they use the eTwinning platform, Romanian and Moldovan teachers answered on a scale from 1 to 10, in which 10 is the most, that 17 of them access daily or several times a day (10), 15 of them quite frequently (9), 27 of them frequently (8), 17 teachers less frequent (7), 12 teachers rarely (6) 14 teachers very rarely (5), 10 extremely rare (4), 2 sometimes (3), 3 almost not at all (2), 1 not at all (1).

Figure 3. Use of eTwinning by Romanian and Moldovan teachers for projects

Figure 4.Use of eTwinning by European and eTwinning Plus teachers for projects





The opinion of European teachers and eTwinning Plus on the use of eTwinning to run projects was as follows: 26 consider that they access it daily (10), 15 access it almost daily (9), 22 use it frequently (8), 12 teachers use it less frequently (7), 11 teachers access rarely (6), 8 less frequently (5), 1 extremely rarely (4), 5 teachers use sometimes (3), 2 teachers not at all (1). From the above we find that European teachers are more active, being aware of the benefits of using online tools provided by eTwinning: it does not involve costs, being a free platform, facilitates learning using supporting materials (photos, videos, animations), student interaction is made in the project's Twinspace, they can add comments or materials made by them, the historical information can be accessed from anywhere, at any time, from any computer or mobile phone that has an Internet connection.

Regarding the use of the eTwinning platform by Romanian history and socio-human teachers, most 22.7% appreciate that collaborative disciplinary or interdisciplinary projects can be carried out. 12.6% and 14.3%. European teachers enter the platform almost daily to work with students in class or at home 25.5%. There are few teachers who access the platform just to participate in training courses or just to look for partners for a future ERASMUS + project. All specified the quality of projects and vocational training for career development and benefits in terms of preparing students for their future integration into the labor market.

Conclusion

The results presented in the research highlight the significance of preserving European memory, as well as the importance of training future citizens, achieved in History and socio-human classes using new technologies and especially the eTwinning platform. Analyzing different points of view of the teachers participating in the study, we conclude that the formation of civic and social skills using historical sources seen from different perspectives, activity in groups, is possible and is supported by the use of cooperation and collaboration in work teams. eTwinning. At the same time, young people need guidance to successfully exploit the pedagogical tools provided by eTwinning. In order to achieve authentic learning, students try to make connections between personal research and those provided by the teacher, while questioning information to remove false news, using only verified sources. Interactivity and use of Twinspace, Web 2.0 tools have allowed the reconstruction and increased understanding of different aspects of European history. The memory of history, the knowledge of the troubled contemporary European and national history of the twentieth century determined the critical, creative reflection and involvement of young people in decision-making by voting, at national and European level, for respect for human rights, equality and understanding, respect for democratic values. The results of the study revealed that History lessons conducted in the virtual environment have a huge impact on the training of young people, increasing their interest in studying and applying knowledge in a creative way, training skills to learn to learn and digital skills, later facilitating access on the labor market.

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Using Microsoft Teams for Teaching Romanian to Foreign Medical Students - A Comparative Skill-focused Analysis of Online vs. Onsite Progress in Learning

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Abstract

The foreign medical students from UMFST GE Palade of Târgu Mures study Romanian for the needs of communication and interaction, particularly during their clinical internships. They start from the basics this compulsory but non-core subject, whose allotted time of study is 2 years. Thus, the maximum efficiency of the teaching / learning process, through an impeccable organization of the methodology and course material, is essential in the traditional lecture room. This became even more important online, when the COVID-19 pandemic imposed an extremely fast translation of the real-life education into the virtual environment. During this accelerated transformation, I did not unnecessarily complicate the teaching and assessment methods, but I relied on continuity, in order to maintain this beginners course in a familiar area as much as possible. The E-Learning platform provided by the university was Microsoft Teams. As evaluation in each semester employed both formative and summative assessment, I performed a comparative analysis of the learning progress, distributed on receptive and productive language skills. The relatively small group of students (23) allowed an in-depth analysis which showed how online learning favored the strengthening of some language skills and disadvantaged others, even in conditions of limitations such as the shock generated by the fast transfer to virtual courses, the inherent technical problems or the questionable correctness of asynchronous assessment in an institutional framework.

Keywords: Romanian course, Language skills, Learning progress, Online, Onsite

1. Introduction

Mass access to Web 2.0 tools has started a revolution in the field of teaching / learning foreign languages. The possibilities to offer to those interested self-paced methods and alternative programs for acquiring language skills are very intensely explored and exploited. Thus, there are a multitude of programs that offer English lessons, at any level, for any type of learner, with or without an instructor and countless courses and exercises for the development of productive and receptive language skills. Nowadays, mobile applications are also advancing more and more in this territory of language learning.

If English is already a must, for a language too little known, such as Romanian, online training programs, although they exist, require a well-justified learning motivation, being successful especially those that offer guided-instruction. The foreign medical students from UMFST GE Palade of Târgu Mures study Romanian for the needs of communication and interaction, particularly during their clinical internships. They start from the basics this mandatory but non-core subject, whose allotted time of study is 2 years. In this short interval of time they should acquire limited working proficiency. This means that, in only 120 course hours, they should reach the A2 language level (elementary level), for which at least 180-200 guided hours are actually needed.

The motivation to learn the Romanian language is not so strong for these students, especially for those who do not know a Latin language. Thus, the maximum efficiency of the teaching / learning process, through an impeccable organization of the methodology and course material, is essential in the traditional lecture room. This became even more important online, when the

COVID-19 pandemic imposed an extremely fast translation of real-life education into the virtual environment. From this point of view, the global pandemic has become an opportunity for those concerned to study online and blended learning and for those skeptical, to discover the benefits of web-enhanced education.

1.1 Related literature

Most of the recent studies which compared virtual education with real-life education recommend combining them. Nicky Hockly referred to a meta-study published in 2010 by Means, Yoyama, Murphy, Bakia, and Jones who reviewed over 1,000 studies into online versus face-to-face learning conducted between 1996 and 2008, which found that ”a blended approach was most effective in terms of improved learning outcomes” (Hockly 2015).

Massive Open Online Courses (MOOCs) for language learning are expanding all over the world via universities from the United States, Spain, the United Kingdom etc. In 2016, two researchers from University of Virginia and Peking University China conducted an extensive study in order to compare the achievements and learning experiences of onsite and online students participating in a Massively Open Online Course (MOOC) in China, within an annual summer school, “New Media and Learning,” hosted by Peking University, one of the top universities in China. They found no statistically significant difference in the online and onsite students’ ratings (Chen and Jia, 2016).

In the field of languages, many enthusiasts develop online teaching tools, so attractive for the young generation, trying to overcome the resistance of those who prefer the classical school, because, in general, in Romanian educational institutions, the classroom represents the only environment for learning and practice. They consider that asynchronous Web 2.0 tools offer such students a venue for additional interesting and challenging activities, ensuring student-centeredness and autonomy but also interaction with peers and instructors and provide opportunities to practice reading, writing, speaking and listening outside the classroom walls at their own pace, in the safety of the virtual environment (Pop, 2010). Other researchers who appreciate the advantages and the potential of web-based courses point out that certain student characteristics play an important role in their success online, such as self-regulation, discipline, and consistency (Montiel-Chamorro, 2018).

Presently, many schools and universities produce and offer online language courses. These programs usually focus on all four classical language skills (speaking, reading, listening and writing), as well as on grammar and vocabulary. In such coursebooks, usually there are units on different themes with an integrated skills approach, and the students practice online reading, listening and writing, most of the time in asynchronous mode. As many researchers have observed, speaking seems to be the most disadvantaged skill online, requiring onsite face-to-face interactions, or synchronous online activities, for example via a videoconferencing platform (Hockly, 2015) or regular, recorded speaking assignments (Isenberg, 2010). Other researchers consider that a hybrid approach would be the most effective for oral proficiency, including online text-based chats (Payne and Whitney, 2002). Web-based teaching can include a great variety of grammar and vocabulary tests, depending on the instructors` available time, creativity and patience, unless they possess a collection of exercises provided by a publisher. To this extent, learners can make significant progress in grammar and vocabulary (Isenberg, 2010).

It is impossible to equate the learning experience of different courses delivered by different teachers via different formats and tasks, but making sure that students can easily move back and forth between onsite and online learning experiences should be made possible and should constitute a fundamental responsibility for a well-articulated language curriculum with online options (Blake, 2015). This is clearer than ever now, in 2020, when teaching and research personnel all over the world are trying to create the most efficient context for distance education and multimodal learning environments.

1.2 Study goals

In order to design an efficient blended learning program for the Romanian language course included in the curriculum of the medical faculty, an in-depth study to analyze the student's response to the educational offer in the virtual and real environment can help in finding a combination as functional as possible for the acquisition of the basic language skills in the short time available.

In this paper, I will present an exploratory study regarding the learning progress of a group of students in the virtual and real-life environment. The answers I sought in this study focuse on both the student and the subject taught, respectively on the components of the language studied (Romanian). I proposed here, in addition to the classical skills: speaking, writing, listening and writing , two more lines of development, grammar and vocabulary. The great majority of summative language tests in educational institutions focus on the last two, because they are essential for language reception and production, as pointed out by a famous British linguist, David Wilkins: “While without grammar little can be conveyed, without vocabulary nothing can be conveyed ".

2. Methods

The E-Learning platform provided by the university, for the second semester online courses during the Covid-19 pandemic, was Microsoft Teams. In the accelerated transformation of the teaching/learning paradigm, I did not unnecessarily complicate the teaching and assessment methods, but I relied on continuity, in order to maintain this beginners course in a familiar area as much as possible.

The course material from both semesters had, basically, the same structure: thematic units built on a specific vocabulary and a new grammatical concept. The classroom activities focused on the balanced development of the linguistic skills and included lectures, explanations, exercises, individual and group activities, presentations, class discussions, role-play, in-class written tasks, and additionally, homework. At the end of the semester, the continuous assessment was completed by a summative evaluation of grammatical and lexical acquisitions.

In the second semester, the didactic activity being 100% online, I adapted the Romanian course to the virtual communication mode, and to the teaching and evaluation possibilities offered by the Microsoft Teams platform. The course material was uploaded in advance, so that the students knew, as in the first semester, which unit would follow. I also exposed, from the beginning, the pattern of the online courses and my expectations for a good final mark, posted on the platform and verbally.

The development of language skills in the web-based context proved to be a challenge from the beginning. Reading online requires the involvement of more students in order to make sure that everybody follows the text, or did the tasks based on a text. Listening exercises were sometimes impaired by technical issues, however, students` feedback showed, most of the time, that they reacted synchronously to what they heard/saw (teacher, recordings, videos), which does not happen so often in the classroom. Writing was assessed during the course in the form of exercises (rephrase, complete, correct the sentence, put the words in the correct order to make a sentence) or more complex asynchronous assignments (letters, stories, descriptions etc.), placed in the respective folder of the learning platform. Speaking, which occurs naturally in the physical environment, was always prefaced online by the question "Teacher, can I say…?". But this question almost disappeared later after Microsoft Teams introduced the raise hand feature. Anyway, students‘ demand for synchronous speaking activities, interactions with instructor and peers, could not be covered entirely due to the time limits. The most successful speaking activities were presentations, role-play, describing a picture, class discussions.

Subsequent to the teaching session, students` acquisition was tested and they were very pleased to be able to see their scores almost instantaneously. They were also assigned homework tasks, to be uploaded on the platform within a certain time limit.

The formative assessment, both onsite and online, was based in part on direct communication between student and teacher, i.e. the interaction between a native speaker and a beginner in the study of language, in different conversational scenarios. This type of communication is exactly the purpose of the Romanian language course. The qualitative evaluation resulting from this is influenced by the subjectivity of the teacher, but corrected as the teacher's experience is greater. I agree with the view that language proficiency is not just about “knowing words, phrases, and verb conjugations, but being able to put those together to form coherent meaning and to use that meaning appropriately to engage in real or realistic communication with other speakers of the language” (Lord, 2015).

The online summative assessment consisted of a quiz of 50 questions that covered all the chapters studied, divided into equal shares on grammar and vocabulary.

2.1 Participants

The studied group consisted of 23 foreign students, in their first year at the Faculty of Medicine in English within GE Palade University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș, in the academic year 2019-2020. They come from different parts of the world, from Italy, Germany, Spain, UK, Israel, Canada, and so on.

In order to follow and present in more detail the students` learning progress, I differentiated 3 performance groups, depending on the grades obtained in the first semester, on a scale from 1 to 10: group A, consisting of 8 students with grades between 9-10, group B, consisting of 7 students with grades between 7-8.99, and group C - 8 students with grades between 4 and 6.99.

2.2 Procedure

In the context of such a special object of study, I was interested in discovering which learning activities were more effective online and which were more successful in the classroom, in both contexts being closely monitored by the teacher. As evaluation in each semester employed both formative and summative assessment, I conducted a comparative analysis of the learning progress, distributed on receptive and productive language skills.If many times, speaking, reading, writing and listening are considered macro-skills, and grammar and vocabulary - micro-skills, in the approach herein the first four will be considered formative directions of linguistic acquisition and assessment, and grammar and vocabulary will be considered summative directions of linguistic development and assessment.

For a clearer picture of the contribution of the online course to the development of the Romanian language skills, I had to take into account the natural learning progress that occurs during an academic year. It was necessary to eliminate from the start the standard increase of the scores obtained by the students in the second semester due to the acceleration of linguistic progress, as the foundation on which skills are built becomes more and more solid. Thus, I established some approximate corrective values necessary to prevent erroneous interpretations. These values are: 0.3p (on average), for students who learn Romanian very quickly, especially due to the fact that their mother tongue is a Latin language and they get good results from the beginning, with a slight increase in the second semester (group A); 0.5p for students with average results in the first semester (between 7-8.99), who usually have a more significant evolution in the second (group B); 0.7p for group C, composed of students who have grades between 4-6.99 in the first semester, and later they correct their marks, on average, to the extent mentioned above. Adding these values to the grades obtained in the first semester by the groups A, B and C, I obtained what I called predictive values for the second semester onsite. Practically, I did not compare the grades from the two semesters, but the predictive values for the second semester onsite with the results obtained by the students in the second semester of online language learning.

3. Results
3.1 Data

Table 1. Group A: Formative Assessment- onsite/online (max. score=10)

Group A	Reading	Listening	Speaking	Writing	Mean
Sem I onsite	9.53	9.26	9.42	9.21	9.35
Sem II-onsite prediction	9.83	9.56	9.72	9.51	Sem I +0.3p= 9.65
Sem II online	9.87	9.63	9.75	9.83	9.77

Table 2. Group A: Summative Assessment – onsite/online (max. score 50+50=100)

Group A	Grammar	Vocabulary	Total
Sem I onsite	41.45	46.10	87.55
Sem II-onsite prediction	42.95	47.95	Sem I+3p=90.55
Sem II online	45.50	47.20	92.7

Table 3. Group B: Formative Assessment- onsite/online (max. score=10)

Group B	Reading	Listening	Speaking	Writing	Mean
Sem I onsite	8.45	8.02	7.4	7.34	7.77
Sem II-onsite prediction	8.85	8.52	7.90	7.84	Sem I +0.5p=8.27
Sem II online	8.72	8.45	7.55	8.20	8.23

Table 4. Group B: Summative Assessment – onsite/online (max. score 50+50=100)

Group B	Grammar	Vocabulary	Total
Sem I onsite	32.50	41.50	74
Sem II-onsite prediction	35	44	Sem I +5p=79
Sem II online	37.45	43.75	82.20

Table 5. Group C: Formative Assessment- onsite/online (max. score=10)

Group C	Reading	Listening	Speaking	Writing	Mean
Sem I onsite	6.25	6.12	5.70	5.56	5.90
Sem II-onsite	6.95	6.82	6.40	6.26	Sem I +0.7p=6.60

prediction					
Sem II online	7.15	6.75	6.25	6.50	6.77

Table 6. Group C: Summative Assessment – onsite/online (max. score 50+50=100)

Group C	Grammar	Vocabulary	Total
Sem I onsite	20,80	33.50	54.30
Sem II onsite (prediction)	23.80	37.50	Sem I+7p=61.30
Sem II online	26.15	36.73	62.88

3.2 Discussion and limitations

First of all, the evolution of the students from group A is remarkable, they were extremely cooperative during the synchronous sessions and preoccupied to perform well in the evaluations. Groups B and C had mixed results, which led to moderate increases compared to the predicted average scores. In several specific cases, students in these groups became more active online, especially the timid, who in the classroom were somewhat "covered" by more vocal colleagues. Of the students who did not have such a solid foundation, a few were not able to recover online, but most struggled and benefited greatly from the help of colleagues, overt and / or hidden.

The comparison between the formative and summative evaluations, onsite and online, shows a more marked difference, when the verifications are made in the stricter conditions of the real-life classroom. Overall, the scores for listening are close in the two teaching environments, reading is slightly advantaged online, with a significant increase for group C. For writing, the results in the second semester-online exceeded expectations. Somewhat naturally, the scores for grammar and vocabulary also rose, certainly due to the increase in the frequency of these tests, which was possible online. Speaking was slightly disadvantaged, being even more difficult to assess, in the short time allotted to a student.

With regard to limitations, the most important was time: an online session of 100 minutes for 23 learners means a great effort on the part of the teacher, who should monitor closely everyone`s work, and a frustrating short speaking time for them. Another problem was the parallel communication between the students, that called into question even the tasks during the course, with a solving time of a few minutes. For the tasks that had a resolution time of a few days, it was impossible to determine to what extent they relied on the help of colleagues and friends (Romanian or not) or, for example, on Google-translate, obvious help in some cases.

Conclusion

For a course that aims a lot in a very short time, a blended learning formula could provide an extra space for the development of the Romanian language skills. In the first stage, when learners are absolute beginners, interaction with an instructor and peers in a traditional classroom is essential. The cultural and linguistic communication between teacher and students is very intense in this period when they have one thousand questions about real-life situations they faced after arriving in Romania, about the usual addressing formulas and essential structures of the language. The fact that this knowledge base and mutual trust between the instructor and the students had already been created in the first semester of the 2019-2020 academic year, helped enormously in the stage in which the course was completely transferred online.

With few exceptions, the development of language skills has made significant progress, especially due to synchronous activities, where the appetite for participation was very high, but unfortunately limited in time. The introduction of more synchronous speaking activities would certainly lead to a higher learning efficiency. And the group work was much more difficult online. On the other hand, listening and reading activities with immediate feedbak were very productive. Grammar and vocabulary quizzes have aroused a lot of interest, being a quick way of (self) evaluation and reinforcement of knowledge. Asynchronous tasks, such as more complex writing assignments, although better graded, raised some correctness issues because students tended to try to get good grades with minimal effort.

All in all, Web-based learning contexts can offer virtually unlimited opportunities for teachers and students in the field of language education, and can greatly contribute to the success of such an intensive course. And not only can, but they should, because today's students are part of the generation that loves to use the virtual tools in order to achieve their real life goals.

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Microlearning as a Facilitator of Learning Delivery

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Abstract

Students use different learning styles and technologies. The development of new skills and knowledge requires a variety of teaching methods and learning strategies, adapted to students. Previous research has shown that the millennial generation of university students needs new pedagogical strategies and new ways of learning. Therefore, in order to create an effective learning environment, teachers must use teaching methods that are appropriate to the needs of these students of the new tech-savvy generation. Now, more than ever, these can be supported by a multitude of emerging technologies, some of them already having a profound impact on the education process. In line with this trend, this paper aims to give insight into the concept of microlearning, as a new approach added to traditional ways of learning, based on the learning and retention habits of the millennials and the subsequent generations. The paper also describes the results of the research investigation for a case study in higher education. Thus, implementation and content aspects, as well as microlearning activities used in a computer graphics course are presented. The evaluation of the effect of microlearning activities, based on a comparison of the educational outcomes measured by the student grades, revealed the microlearning benefits in facilitating learning delivery.

Keywords: Microlearning, Higher education, Computer graphics

1 Introduction

Adults use different learning styles and technologies. Moreover, previous research has shown that the millennial generation of university students needs new pedagogical strategies and new ways of learning. The multitude of emerging technologies supports the development and adoption of teaching methods and learning strategies, adapted to current students.

According to the Forgetting Curve described by Hermann Ebbinghaus in 1885 as an exponential relationship between memory retention and time, adult learners forget a high average percentage of what they have learned, as we can see in Table 1 (Ebbinghaus, 2013). Of course, some people remember more or less, but, in general, the situation is well described by the forgetting curve.

Although the forgetting curve is a natural process, there are various solutions in order to change this curve and help learners to retain much of the information they needed later. One of the recommended solutions to slow down forgetting and to increase long-term retention is spaced repetition (repetition based on active recall). Reviewing the previously studied material ensures an increase in knowledge retention at higher levels.

Table 1. The average percentages of new information that is forgotten

Elapsed time since learning	Forgetting (average percentage)
1 hour	50%
24 hours	70%
30 days	80%

In order to implement a strategy that would reduce the level of forgetting in the learning process, but that would use emergent technologies, we chose the concept of microlearning. Microlearning, based on short learning content and short activities, could bring many benefits to all actors in education (e.g., teachers and learners). According to researchers, although microlearning addresses the learning and retention habits of the millennials and the subsequent generations, it’s not the best solution for every learning need. However, in some cases, to address certain issues, course designers could take advantage of microlearning.

1.1 Paper Contributions

This paper aims to answer the following research questions:

- What is microlearning?
- How does microlearning help learning?
- How can microlearning help teaching?
- What are the results of using microlearning in teaching an academic discipline?

In order to answer these questions, the paper continues with presenting some definitions of the microlearning concept, followed by a literature review of the use of microlearning. Section 3 envisages a situation frequently encountered in higher education and a possible solution described in a case study for a computer graphics course, a specific academic discipline offered by most of computer science faculties. Section 3.1 provides the empirical evaluation results for the proposed approach. Finally, we present some directions for further research and conclusions.

2 Literature Review and Related Work

Following the research questions previously mentioned, we conducted a scientific literature review. Some of the obtained results are presented below, following a few definitions of the microlearning concept.

2.1 Microlearning Definitions

Nowadays, there are many definitions for microlearning, but none of them is widely acknowledged. For example, microlearning, sometimes referred to as micro learning or micro-learning refers to short-term learning activities on small learning units (Kovachev et al, 2011).

According to (Job & Ogalo, 2012), microlearning “is based on the idea of developing small chunks of learning content and flexible technologies that can enable learners to access them more easily in specific moments and conditions of the day, for example during time breaks or while on the move”.

According to (Semingson et al., 2015), through the use of short videos, context-awareness, distributed and mobile delivery, microlearning principles overlap with “technology-assisted learning (e.g. mobile devices) and ubiquitous learning (e.g. any-time, anywhere learning)”. Thus, through microlearning, anyone could open, at any time, from anywhere, any short and focused learning content to which they have access.

2.2 Related Work

Worldwide were developed Massive Open Online Course (MOOC) platforms that can be accessed anytime, by anyone, from anywhere. For example, several such platforms can be mentioned, such as, Coursera, edX, Udemy, etc. Using MOOC platforms, various learners (students, employees or other types of adults) are able to incorporate learning modules into their daily routine, especially if they are microlearning (Gross, 2019). We can also mention multimodal resources that are widely available through open repositories and cloud-based sharing platforms.

In the last years, the number of publications related to microlearning topic has been increasing at a fast pace. The basic systematic literature review we have conducted in different electronic databases summarised, among other things, the number of publications presented in Table 2.

Table 2. The Number of Scientific Publications on "Micro-learning" OR Microlearning

Database	**Number of papers**
IEEE	63
ScienceDirect	94
Springer Link	487
Web of Science	231

Google Scholar	6310

Various research papers and studies focused on this concept and its features and highlighted the impact that microlearning has, and will have, on adult learning, training, and continuing education. Moreover, the benefits of microlearning for learning architects and developers could be mentioned. Thus, according to various researchers and learning architects, by creating microlearning, the cost of learning development could be reduce by 50% and the speed of development could be increased by 300% (Jimenez, 2006).

Although higher education and lifelong learning have many common features, because of space limitations, this paper addresses microlearning only from the perspective of higher education.

2.3 Microlearning in Higher Education

Microlearning is a concept that is already applied in the IT training for business, although, nowadays, it is not a widely adopted practice in education. Nonetheless, it can be seen that microlearning is constantly gaining attention in higher education due to the number of benefits offered to students. Thus, a research study revealed that the use of micro-learning units increased the learning and retention of course material by 18% (Mohammed et al, 2018). According to (Shail M. S., 2019) and to the findings of other authors, microlearning, viewed as “a multi-platform educational teaching tool”, “juxtaposed with the Primacy and Recency Effects, can facilitate the movement of learned material from short-term to long-term memory”, facilitating the increase of retention in learners.

The application of microlearning to higher education was investigated in (Shatte and Teague, 2020). This scoping review “aimed to synthesise the literature on technology-based microlearning in the context of higher education, highlighting current research and applications in the classroom and online”. The results of another systematic search of the literature on microlearning, but in health profession education, conducted “to identify key concepts, characterize microlearning as an educational strategy, and evaluate pedagogical outcomes experienced by health professions students” were presented in (De Gagne et al, 2019). According to the authors, microlearning is endorsed by health professions educators as “a response to the novel methods that students learn, socialize, and communicate”, being able to “facilitate and enhance student learning”.

There are also other scientific publications that analyse the impact and effectiveness of microlearning adoption in higher education and estimate that it will continue to evolve.

According to the results revealed by various scientific papers, using microlearning determines: easier and faster learning; higher student retention rate; student engagement; teacher satisfaction, etc. Some of the limitations of microlearning are related to the complexity of the topics that would be suitable only for this form of learning. In addition, adopting microlearning requires time-consuming and labor-intensive course planning. The implementation and effective use of mirolearning are not without challenges. But, because of space limitations, this paper does not address the issues related to the microlearning adoption in higher education. To demonstrate the microlearning benefits we have highlighted above, we considered a case study where we integrated the microlearning concept into the overall learning strategy created for our students.

3 Case Study: Using Microlearning in Computer Engineering Faculty

To illustrate some benefits of microlearning in higher education, we consider, as a case study the Elements of Computer Graphics (ECG) course, provided in the first semester of the 3rd year in the curriculum of the Computers undergraduate study program, in the field of Computers and Information Technology at the Faculty of Electrical Engineering and Computer Science from Ştefan cel Mare University of Suceava.

At the beginning of each academic year, the course syllabuses for all the disciplines provided in the curriculum of each active study program must be elaborated. For the engineering field, according to the standards of Romanian Agency for Quality Assurance in Higher Education (ARACIS in Romanian), the syllabus must include a set of minimum information, such as the elements for identifying the discipline in the curriculum (year of study, semester, discipline category, number of hours for course/ laboratory/ project, number of allocated credits, assessment type), as well as the teaching staff of the course and of the applied activities, respectively, the specific competencies accumulated, the objectives of the discipline, the basic thematic content, the distribution of the number of hours of course and applied activities on topics, student assessment system, minimum bibliography. To these may be added, where appropriate, information on curriculum prerequisites. The prerequisites of a course refer to courses that must be completed with passing grades before taking the current course. The prerequisites of the ECG course are courses of mathematics and introductory programming. However, even though the students passed these required courses, unfortunately, sometimes there are students with poor knowledge of mathematics, and/or with limited programming skills, respectively. This low level of specific knowledge is one of the reasons why some students fail to fully achieve the learning outcomes and to be able to satisfy assessment requirements of this computer graphics course.

Therefore, we tried to find solutions, but without relying solely on formal training. We tried to take advantage of the fact that all students have mobile devices, which they use, among other things, to access the Internet. We developed microlearning units as a way to help students to recap and solidify the knowledge they need. Thus, in order to fill knowledge gaps and to reinforce their math knowledge needed for a computer graphics course, we added to this course some properly designed microlearning units with the following objectives: Providing easy access to clear, relevant and concise content; Engaging students through various challenges; Ensuring quick access to reports on students' results; Providing a user-friendly learning experience through the use of diverse content formats: slideshows, video, quizzes, games, etc., optimized for all devices (desktops, tablets, and mobile phones).

At the beginning of the semester, we clearly specified the prerequisites for the computer graphics course and we invited students to take an anonymous test in order to assess their prerequisite knowledge. Thus, they were able to easily identify their knowledge gaps. Next, we wanted to enable students to control their own revision process. But, in order to help students to fill their knowledge gaps, we provided them with various microlearning units designed for the reviewing of important topics needed to understand elements of computer graphics. Each microlearning unit also offers information about the applicability of the reviewed concepts in the computer graphics context. In order to allow students to understand the importance of those concepts and the relationships between various content areas, information about the necessity of the considered concepts was presented as a knowledge map. Some examples of math prerequisites for ECG are analytic and differential geometry, linear algebra (such as, vector, matrix, dot product, cross product, matrix multiplication, normal vector, transformations), etc. In fact, the course ECG is, among other things, a way to show students how to apply maths in practice.

We organised the content of the microlearning units by defining logical categories. These categories could include various content types, presented through different file types, such as, PDF, PPT, DOCX, MP4 video, MP3 audio and images. Some of these were created by us, but we also included various free materials, selected from the Internet. We tried to provide the appropriate amount of content necessary for a subsequent application of the concepts in the computer graphics context. Students can also access a category that includes additional relevant materials. In order to facilitate understanding, we provided a glossary with definitions of required terms. These were not the only resources to foster students' knowledge.

Each microlearning unit ends with a short quiz in order to ensure students' understanding of reviewing outcomes. In order to identify skills gaps and properly address reviewing needs, random questions of different types and time limit are used for each quiz. A student could take any quiz at any time, even without going through the microlearning unit for revision. But if students failed a quiz, they had to follow the microlearning unit in order to refresh their knowledge. Even if students passed the quiz, they were able to decide to emphasize some aspects. In order to help students to practice as much as they liked without depending on teachers, we created some self-grading quizzes, which provided students with immediate answer feedback. We used various online tools to assess students' progress, such as auto-grading Google Quizz and Moodle. But, in order to keep students engaged and attentive we used various methods, even the power of gamification. For example, we used Quizziz. We designed various quizzes, with or without figures, and we challenged the students to compete with each other. In order to drive more meaningful outcomes, we gave feedback for any submitted assessment or test.

3.1 Results

Students were able to access any microlearning unit by themselves, any time and from anywhere. Consequently, they were not limited by a class timetable or classroom location. Thus, students were able to access learning contents on their own schedule and to work in their preferred time and rhythm. In fact, the students were co-creators of their learning path. The students appreciated the revision as easier and faster than that which did not involve microlearning and they reported microlearning integration was useful in their learning process. Although students enjoyed this solution for knowledge reinforcement and the full control of the content, time and location of their revision, they found it challenging.

The evaluation of the effect of microlearning activities on the successful completion of the course was made by analyzing the results obtained by the students, expressed by the marks obtained in the final exam. For comparisons the results obtained by students in 2018-2019 and 2019-2020 academic years were considered. In 2019-2020 academic year, unlike the previous year, students used microlearning in the learning process. Students using microlearning demonstrated statistically an improvement in the educational outcomes for the ECG field (Table 3).

Table 3. Statistics

Grades	**2018-2019**	**2019-2020**
<5	38.46%	8.74%
=5	1.28%	1.94%
=6	23.08%	28.16%
=7	12.82%	28.16%
=8	3.85%	15.53%
=9	3.85%	7.77%
=10	1.28%	0.97%

We have to mention the involvement of some students in making contributions to the extending of microlearning units. Thus, they sent us various proposals for relevant materials specific for different topics. They also proposed new questions for the quizzes at the end of a unit.

As teachers, our role was simplified. Namely, we made available the guidance for the necessary subjects and provided appropriate microlearning units. Therefore, benefiting from increased access and the capability to review materials repeatedly, students were better prepared in terms of prerequisite knowledge and it was easier to remember the information needed for a new particular topic. In this way, we had the opportunity to focus on how to apply this knowledge in the context of new information specific to the computer graphics course. Taking into account the fact that the learning process involving the use of microlearning was appreciated as deeper and richer for students, next year we will use all these micro-learning units. But, following the feedback received from students, some microlearning units will be updated. We will also try to add new ones for other topics.

The use of microlearning in the right context and properly made could play a significant role in building knowledge, but in order to enhance the way the teaching is performed, further research is needed.

4 Future Work

Analyzing the results obtained in these two years, we can conclude that microlearning could be very effective in facilitating learning and also teaching. But, for microlearning to be effective, it must adapt in real time to what each individual student knows or does not know. This type of microlearning could benefit from the new development in machine learning and artificial intelligence. Thus, in order to be able to close each student’s learning gaps and to adapt to different students’ specific needs and profiles, adaptive microlearning facilities should be used. For example, adaptive microlearning enables tailoring of delivered content according to the student. Also, it could help students to take recommended actions for continuous improvement. In fact, adaptive microlearning can build a personalized, individual learning journey for each student.

In order for microlearning to be implemented in higher education, it is necessary that the different learning and teaching strategies it involves be accepted and adopted in higher education.

5 Conclusion

Given the increased use of mobile devices both among students and teachers, new opportunities for teaching and learning are opening up. However, in the educational process, in addition to the tools that allow easy access to the learning content, it matters how this helps students to retain and retrieve knowledge and information. Microlearning represents a solution that allows the retrieval of the right information by the right students on the right device, at the right time.

In order to analyse the effect of microlearning activities, the present paper focused on a situation which has been frequently encountered in higher education. Thus, a course provided in the curriculum of a study program may require knowledge which has been introduced by other previous disciplines. Yet, there are cases, in which, unfortunately, even if a student took part and even passed those disciplines, he/she does not remember the appropriate information. This low level of specific knowledge is one of the reasons why some students fail to pass a course that requires knowledge from the previous disciplines.

The identification and the implementation of solutions for this situation call for a holistic perspective. In this paper as a case study we focused on a microlearning-based solution for the ECG course. In order to facilitate students' understanding and the use of the graphics concepts, during the last two academic years, the ECG course has been extended with properly designed and constantly updated microlearning units. The analysis of the students' activity and of their results both at the evaluations performed during the semester, and in the final exam, highlights the microlearning’s contribution in facilitating the learning delivery. Moreover, according to students’ feedback, they have had a positive perception regarding the microlearning units. This paper can help teachers in making the decision to incorporate microlearning-based review in their classroom.

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Online Teaching and Learning - An Educational Paradigm

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Abstract

Nowadays students have had access to Internet and to technology like laptops, smartphones or smartboards since the youngest years of their lives. With a quick search on the Internet they can find the answer to every question and, potentially, they can learn by themselves about every subject they are interested in with no need of leaving their own homes. Due to Covid-19 pandemy outbreak schools were forced to shift from traditional face-to-face teaching methods to online ones. Thus, online teaching and learning has turned out from option into necessity. A question which arises is how effective online education is in comparison to in-class education. Therefore, just after the three months of schools closure and online formal education in Romania, we conducted a survey, in the form of an online questionnaire, having the scope of assessing the satisfaction of secondary school students with respect to different aspects of this type of education.

Keywords: online education, questionnaire, assessment

1. Introduction

The advancement of Internet and media technologies has brought about the possibility of reshaping the methods of delivering education from in-class to online. Many specialists in education have considered the advantages and disadvantages of online teaching and learning. With respect to online teaching and learning, education, as state institution, faces problems like setting standards, managing to communicate with a large number of students that want to take part simultaneously at discussions or that fake their presence, programs accreditation, teachers preparation for the technological design and delivery of this type of courses and for a different type of evaluation, agree with new perspectives for teachers role in the educational process. Online-learning, being a service in the field of education, virtually delivered, has to fulfill quality criteria in transferring knowledge and in creating general and specific competencies. In order to use highly effective teaching and learning methods, a careful study of students' satisfaction and expectations has to be done. This paper is a qualitative research that makes use of the results of an online questionnaire conducted among secondary school students that have taken online courses due to the emergency state followed by the alert state generated by the Covid-19 pandemy outbreak in Romania, students enrolled in the schools that we teach in, having ages ranged from 12 to 19. Both schools that we work with are urban schools, located in important cities of Romania, children attending them having no problems with the accessibility to modern technology. Therefore, the results would be representative for urban secondary school students coming from middle-class and upper middle-class households. The sampling method used is purposeful sampling, our intention being to assess the level of satisfaction after the forced period of online teaching and learning compared with the traditional in-class way for those students that had access to technology. 355 students have taken part in the questionnaire, 186 of them being enrolled in the lower secondary school and 169 in the upper secondary school. The questionnaire contains 11 close-ended questions.

2. Objectives. Hypotheses. Results. Findings. Conclusions.

The first objective of this survey was to assess whether physical distancing between teachers and students during the forced period of online lessons also brought about a communication barrier between them. Our corresponding hypothesis was that the lack of face-to-face interaction would lessen the teacher-student communication. According to Figure 1, the result was different: 41.4% of them appreciated that teacher-student communication was very good and 52.7% considered it to be good. Therefore we concluded that, regardless of the physical distancing, online education doesn't raise a barrier of communication between teacher and students, on the contrary, it enhances interaction and cooperation.

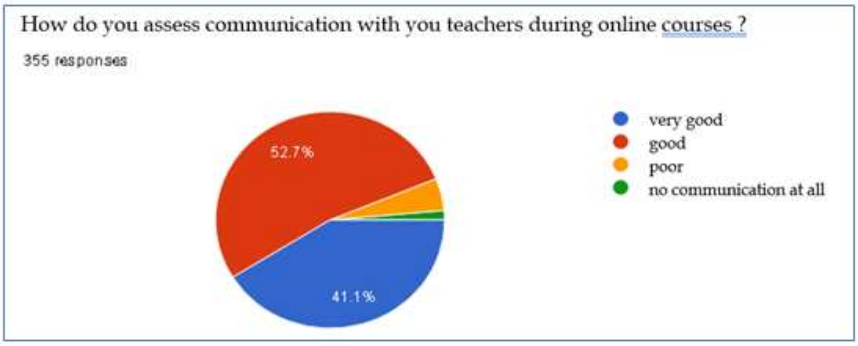

Figure 1. Responses to the first question

The second objective was to assess the degree of satisfaction regarding online lessons with respect to in-class lessons. Considering that secondary school students need face-to-face interaction in order to grow up properly, our corresponding hypothesis was that a low percentage of them would consider a good choice replacing in-class with online courses. According to Figure 2, the result was consistent with our hypothesis: 64.2% of them appreciated that only to a small extent online education can replace in-class education, 22.8% considered that online and in-class education are equally effective, 8.5% of them thought that, even if online education is not as performant as in-class education, it can replace it to a large extent, and 4.5% of them thought that online education is better than in-class education. Therefore, we concluded that it is difficult to replace the spontaneous and random interactions that constitute the learning experience taking place in a real classroom with the virtual interactions from behind a computer screen.

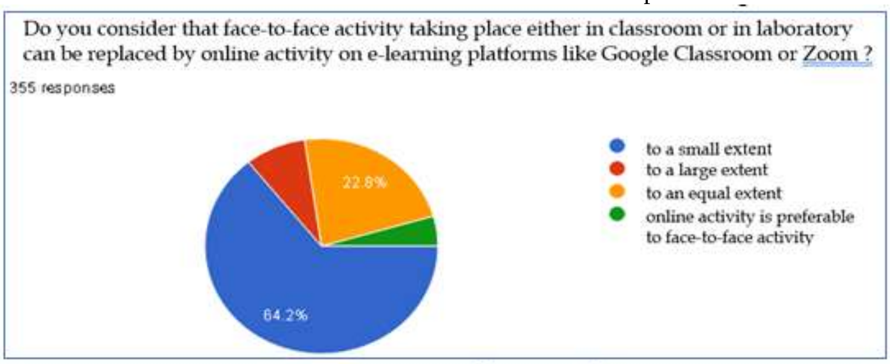

Figure 2. Responses to the second question

The third objective was to discover what aspects of online teaching and learning are preferred by students. In contrast to the traditional theoretical learning, computer-based 3D presentations are valuable resources of visual explanation that would help students grasp the new concepts more easily and make learning more enjoyable. Moreover, online learning takes place at convenient times, in the comfort of your own house, with no time lost in traffic. That is why our hypothesis was that most students would prefer to study at their own rate online presentation of the topics. According to Figure 3, the result was consistent with our hypothesis: 45.9 % of them chose to study documents, PowerPoint Presentations or video presentations at their own pace, 26.5% chose to work daily on an online platform following the same schedule as in traditional in-class school, 15.2 % would like to watch the recording of lessons taught by their teachers and 12.4 % would prefer a group project to study a topic by themselves and then share it with the rest of the class.

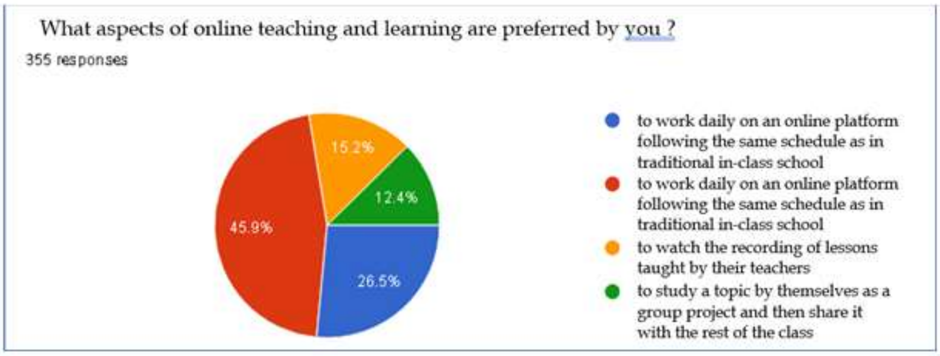

Figure 3. Responses to the third question

Thus we found out that the role of the teacher has started changing from knowledge transmitter to learning mediator. The fact that around a quarter of them wanted the usual school schedule to be kept, was related, in our opinion, with the fact that the respondents of this survey are in a large number very young students, that need teachers' assistance.

The fourth objective was to assess students' perception regarding the replacement of real laboratory experiments with virtual ones, by using interactive simulation platforms. Being known the fact that it's of great difficulty to create an alternative to courses that involve practical aspects, our hypothesis was that most students would consider that simulations cannot replace properly real experiments. According to Figure 4, the result was consistent with our hypothesis: 50.8% of them answered that simulations cannot replace real experiments, and 40.4% considered that simulations can replace real experiments, but to a small extent.

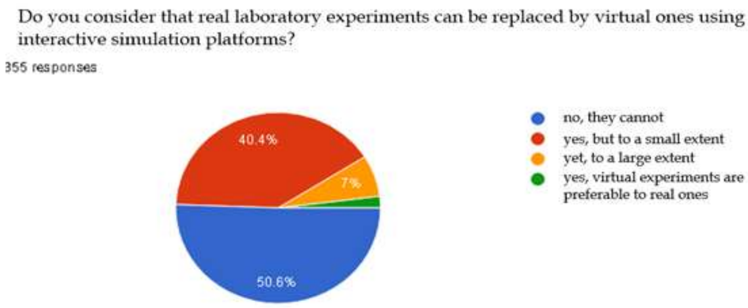

Figure 4. Responses to the fourth question

We concluded that the importance of traditional laboratory involving practical, real experiments and hands-on science has not decreased as a result of the increase of the number of computerized simulation experiments.

Due to modern applications, smartphones have become tools capable of performing real time experiments. This fact has brought about a new branch in teaching, called mobile-learning, shortly m-learning. M-learning could be used in flipped classes, classes that are likely to be used in the nowadays mix of partially online, partially in-class courses. Therefore, our fifth objective was to learn whether our students would feel stimulated by using their smartphones as measuring devices in order to perform experiments instead of using classical laboratory equipment.

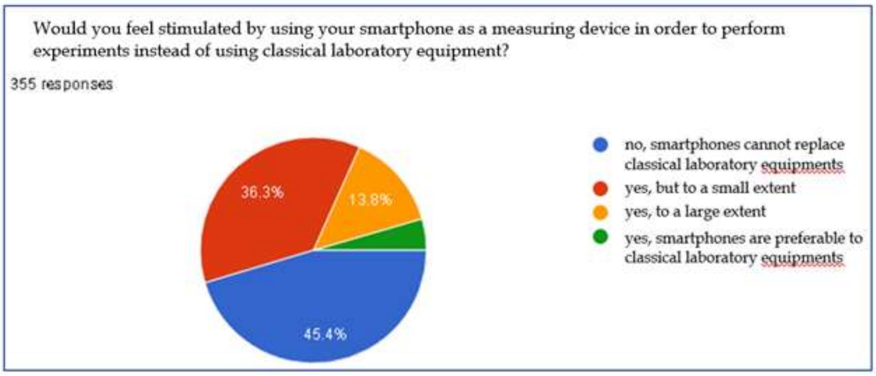

Figure 5. Responses to the fifth question

Because students are keen on their smartphones, we assumed that most of them would like to use their smartphones as measuring tools. According to Figure 5, our hypothesis was right: in total 54.6% of our students were willing to use their smartphones as laboratory tools. The large percentage of 45.4% of those considering that smartphones could not replace classical laboratory equipment shows that m-learning could be an extension to classical hands-on experiments, but it cannot fully replace them. Our sixth objective was to find out the degree of satisfaction that our students had regarding their study tasks during online learning. We supposed, based on students' reluctance for homework, that most of them would think that the tasks they received were unattractive. According to Figure 6, the resultant was inconsistent with our hypothesis. Around 80% of the students assessed them as useful and adequate, 12% assessed them as attractive, and around 8% assessed them as inappropriate and unattractive.

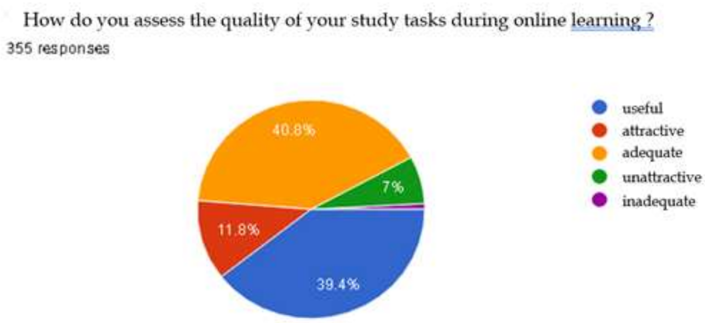

Figure 6. Responses to the sixth question

We concluded that study tasks provided online didn't reach the goal of sparkling students' curiosity and creating a really motivating academic environment, but they were thought wisely enough to be assessed by them as useful and adequate.

Our seventh objective was to assess to which extent our students are willing to learn the new concepts by themselves using online resources with a minimum involvement of their teachers. We predicted that they will not be willing to self-assume the learning of all new concepts, but that most of them will choose to learn by themselves the easier ones.

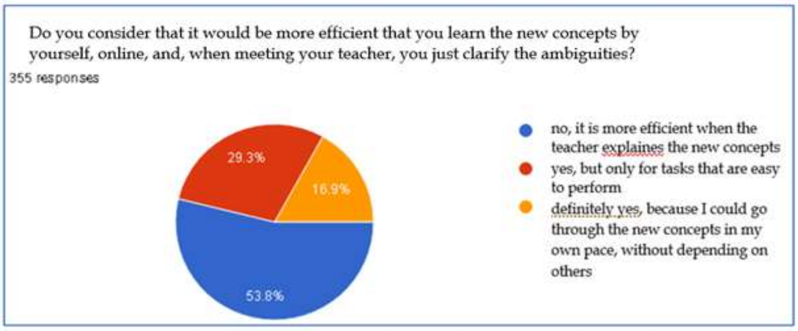

Figure 7. Responses to the seventh question

According to Figure 7, our hypothesis was invalidated by their answers: 53.8% of respondents said that they would prefer that their teachers teach them the new concepts regardless their degree of difficulty. We concluded that although online education seems simple, because students learn from the comfort of their homes and have facile access to information via media technologies, in fact it is more demanding in terms of concentration and cognitive requirements.

Our eighth objective was to assess to what extent secondary school students would be willing to take part in the future in flipped classes: partly face-to-face and partly online. Our hypothesis was that most of them would agree with this possibility. According to Figure 8, their responses disagreed with our hypothesis: 51% of them would not like that in the future online activity to be a part of educational practices because they consider face-to-face activity to be superior to online activity. We concluded that it is very difficult to replace in-class education with online one because classrooms are real places where teachers engage students' participation and develop the ideas raised by them. These kinds of interactions are really difficult to be duplicated in virtual classrooms.

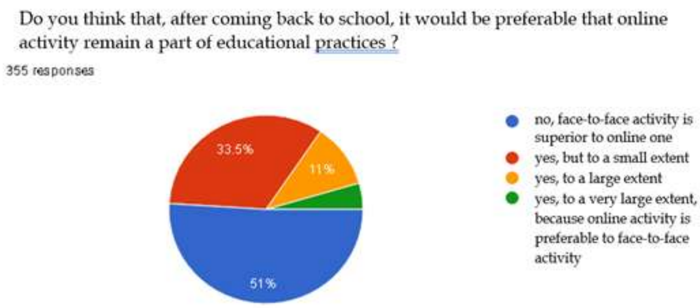

Figure 8. Responses to the eighth question

The ninth objective was to learn what aspect of the online activity was most interesting for our students. They had to choose between the following possibilities: easy accessibility via online platforms, diversity of digital resources, flexibility, utility, involvement and joy in using it, or nothing. Our hypothesis was that the majority of them would appreciate most the flexibility of online learning, because the process takes place in the coziness of their homes, within their comfort zones. According to Figure 9, the result was consistent with our hypothesis: 52.4% appreciate online education for its flexibility.

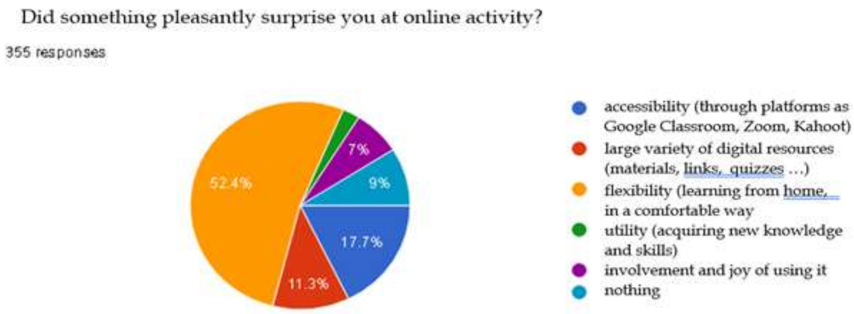

Figure 9. Responses to the nineth question

We concluded that online learning is most appealing among students due to its coziness.

The tenth objective was to find out our students' opinion about the efficiency of online learning. Considering that our students come from middle-class and upper middle-class households and attend schools able to provide them with online education, we assumed that they would assess online activity as an efficient educational method. According to Figure 10, the result was consistent with our hypothesis: 64.8% appreciated online education as effective. We concluded that the transfer of knowledge and the forming of competences in the given circumstances of forced online learning due to Covid-19 outbreak were perceived by our students as efficient.

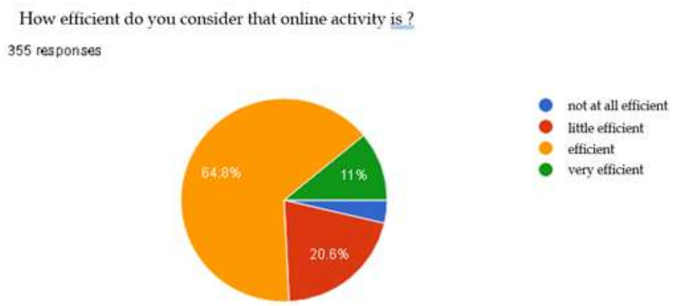

Figure 10. Responses to the tenth question

Our last objective was to learn how much time did our students spend on online learning. Our hypothesis was that the large majority spent more than 15 hours per week on online courses, but, according to Figure 11, their responses were inconsistent with our supposition: 87% spent less than 15 hours per week on online learning. We concluded that our students spent much less hours per day studying online than when doing it in-class.

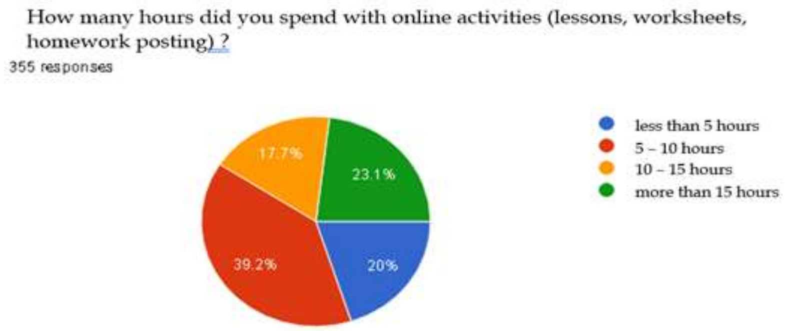

Figure 11. Responses to the eleventh question

Conclusion

Online education opens up the possibility of reaching new kinds of media resources by a larger number of students, at flexible times, at their own pace, from the coziness of their homes, no matter how far away they are. It also brings about economic and logistic advantages because it doesn't need the presence of both students and teachers in the classroom, which leads to space management issues, rigid schedules, transportation issues, time lost in traffic, environmental pollution.

Visual, dynamic explanations, built up through modern technologies, make the learning of new concepts fun and enjoyable for secondary school students, but designing effective online learning is a complex problem. Although students can benefit from Internet and almost endless digital resources, they should have nevertheless a great analytical and synthetical capacity in order to determine relevant information for problems resolution without a teacher's aide. Therefore, teachers will continue to play a central role in education, although this role will change from knowledge deliverer into learning catalyst and knowledge navigator.

One of the biggest disadvantages of online education is physical distancing. The lack of human physical contact deprives students of direct interaction with their colleagues and their teachers, of making friends, working together and competing, all situations being very stimulating. Another big disadvantage refers to disciplines involving practice, because there is almost impossible to create perfect simulations of the real-life experience. Also, real time communication is a challenge in online education, because it cannot cope with a large number of students trying simultaneously to join discussions.

In conclusion, online learning should be an extension of in-class learning. Not even the best online course can fully replace personal contact with teachers or classmates. So, in our opinion, based on the responses given by our students, traditional classes shouldn't be totally replaced by online learning.

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e-Portfolio as a Tool for Reflective Learning

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Abstract

The development of online education in the pandemic context that humanity is facing today brings to the researchers and different practitioners to focus their attention to the issue of the e-portfolio, seen as a method/instrument and also as a framework for learning. Reflection, as a process of deepening knowledge and awareness of the learning, must also be an important part in the creation and usage of the electronic portfolio. The present study examines the opinions of teachers with reference to the electronic portfolio and the use of reflection in the context of its making. The survey involved 402 teachers and was conducted using an online questionnaire, containing 35 items, completed by the teachers voluntarily. The results indicate that the respondents are not very familiar with both the digital portfolio and the practice of reflection. In fact, research participants focus on the portfolio as a product, and this product is mainly the subject of reflection. An explanation for this situation can be found in the lack of digital skills and critical reflection. However, in order to support this hypothesis, it is necessary to extend the research.
Keywords: reflection, experience, electronic portfolio, e-learning.

1. Introduction and Theoretical Background

Reflection is the process of reasoning that involves intuition, reflective thinking, emotion and passion. It gives meaning and depth to learning and life experience by creating connections between the content studied and the student's personal life and learning experience. Reflection should be integrated into any type of experiential activity, regardless of its type or location. A prerequisite for authentic reflection is that students have a variety of formats and contexts available (Bruin et al, 2012)

In daily life, reflection occurs when faced with unexpected challenges and experiences. In a school setting it must be put into practice throughout the learning process. To this end, the reflective process must be carefully designed by the teacher to develop his/her students thinking skills. In his work "How We Think" (1960), Dewey differentiates the teacher's didactic actions, characterized by routine, from those based on critical reflection. The first type of action involves the application of certain patterns of behavior while the second involves interactivity, open mindedness to accept other opinions, examining the consequences of actions, self-interrogation, introspection and metacognition. These behaviors are exercised before an activity, during it (on action and in action) and at the end of the activity (Johns, 2013).

The process of reflection is described by a series of cycles (Kolb, 1984; Gibbs, 1988; Schön, 1983, 1991; Wain, 2007). One of the best known cycles belongs to Gibbs (1988) who identifies six stages: description, feelings, evaluation, analysis, conclusion and action plan. During each phase the teacher asks questions to help students to identify and clarify general issues, and to look for information necessary to propose an action plan (Gibbs, 1988; Mulder, 2018). Also, the teacher must be a good observer being attentive to what students know, they have learned or they are willing to learn, giving them authentic working tasks which are meant to encourage reflective thinking during the learning process. The teacher's reflective thinking skills are: observation, (self) questioning, communication, judgment, decision making and (self) assessment, collaboration (Dulamă, 1996; Fariba et al, 2014).

Making and using an e-portfolio involves reflection: students reflect on what they have learned, how they have learned and how much they have learned. Step-by-step, developing their skills of reflection, metacognition and self-regulation of learning, students take control of their own way of learning.

The e-portfolio represents an instrument through which critical reflection can be put into practice and at the same time documented. It is referred to in terms of product and process. As a product, a portfolio represents a collection of materials realized by students, and it represents proofs of fulfilling work tasks, underlining the student's progress, the difficulties they encounter and the way in which these are overpassed. The e-portfolio, in contrast with the paper portfolio, offers access to digital materials, easy to use and revise and whose evolution in time can be followed.

Abrami and Barrett (2005) identify three categories of portfolios: the portfolio as an instrument to stock up information to be used in the process of learning, the portfolio of learning products (containing the learning results) and the portfolio as a process and space of work. The last type of portfolio contains artefacts of the learning process through which the process of learning with its intermediary difficulties and fulfilments are pointed out. The step-by-step evaluation of the portfolio made by the teacher may be formative, of process or progress. A product/result portfolio asks for a summative evaluation made by the teacher. Nastas (2013) classifies electronic portfolios into 3 categories. The first category, that of the learning portfolio, includes both the various materials and products done by the student during a course, semester or school year and his/her reflections on those works. The second category is assigned to the presentation portfolio that contains the most successful materials and products of the student, creating the possibility for him to form a critical vision regarding the way he accomplished his/her own work. The last category includes the evaluation portfolio that is used for appreciating the level of development of the student's competencies because it highlights the learning process and the final result. All three portfolio categories involve reflection either on the selection of portfolio components or upon them. Carleton University promotes the reflective portfolio and specify the learning objectives: to communicate accurately using scientific concepts, to relate concepts and make synthesis, to connect theory to real life applications and practice, to reorganise or revise theory, to base ideas on evidence, to critically reflect on his/her experiences and learning; to self-assess the learning process; to demonstrate critical thinking skills and creativity.

It is necessary that the students should be motivated enough to make portfolios, the environment playing an important role in this process, so that "this activity must be attractive and lay accent on active learning" (The Association for Education in Universities Initiative, The UK). Also, the stress must be put on both the quality of the materials and the learning experiences in the context they have been generated, as well as the results of learning. The moment when the e-portfolios become mere collections of photographs or other elements, they lose their educational value.

The literature identifies the essential stages after which the student can orient himself to build an electronic portfolio (Barrett, 2000; Magdas, 2012). The first step is represented by the sketching of the portfolio structure and the set up of requirements and success criteria. This approach is based on the pre-established educational objectives which are needed to select the materials that are to be inserted in the digital portfolio. The next stages imply the multimedia material gathering, out of which those that are to be used in the building of new knowledge (learning) are selected.

The penultimate stage is represented by the connection of the learning artefacts and their evaluation. The last step means the portfolio presentation in front of classmates and teacher, followed by the feed-back and the revision of the e-portfolio. Having into account that the portfolio is also a useful tool in a new learning process, this revision is obligatory. Reflection is present during every stage of building up the e-portfolio, although some authors dedicate a separate stage to it.

The assessment of students' e-portfolios, as well as their achievement, is made online. This approach is based on the objectives/aims and criteria such are: the number and the degree of complexity of the materials and their correctness, the diversity of the resources used to build the portfolio, students' skills in developing and using digital materials, the creativity and originality shown in fulfilling the tasks, etc.

2. Material and Method

The research consisted in a survey which had in view the investigation of the teacher's opinions about the e-portfolio and the role of reflection in achieving a portfolio.

The instrument used in the survey was a questionnaire (35 items), adapted by the researchers from Abrami et al. and applied online using Google. The questionnaire was structured according to three components: demographic items and items related to the e-portfolio and the role of reflection in achieving the portfolio.

The items related to the digital portfolio refer to the stages of achieving a portfolio and the portfolio components. The items referring to reflection have in view the steps in building up a portfolio in which reflection is present. To elaborate the answer to most of the items, the Likert scale with three and five levels was used. An item required a free answer from the respondents.

The Likert scale with three and five levels was used in filling in the questionnaire. The results were expressed in percentages. Regarding the answers on the five-stage Likert scale, the sums of percentages obtained at levels one and two and at levels four and five were interpreted as disagreement/ low frequency and agreement/ high frequency.

402 teachers were implied in the survey, their participation being voluntary. The great majority of the respondents (99.57%) were female. Most respondents are in the age group 30-34 years (12%) and 35-39 years (9.25%). The 18-24, 25-29 and 40-44 age groups constitute each about 8.50%. The other age groups represent under 5%. The respondents come from higher institutions all over the country. 53.98% of the respondents teach in preschool education, 23.39% in primary education and 23.63% of the respondents teach at higher levels (gymnasium, high school and university). Their teaching experience is as follows: under five years (35.57%), six to ten years (19.40%), eleven to fifteen years (13.18%), sixteen to twenty years (8.71%), twenty-one to twenty-five years (10.95%), twenty-six to thirty years (4.98%) and over thirty years (7.21%). 37.31% of the respondents teach in the urban area and 62.69% teach in the countryside.

3. Results and Discussions

According to the respondent's opinion, the stages in achieving a digital portfolio comprise: structure decision and portfolio contents (80.35% agreement); documentation and necessary material gathering to fulfil the work tasks (81.34% agreement); elaboration of the portfolio materials and establishing the connection between them (79.10% agreement); portfolio presentation, collecting the feed-back (77.11% agreement); revision of the portfolio (75.12% agreement). The highest degree of disagreement is registered referring to the last step (10.95%). The result is surprising as it leads to the idea that the respondents consider learning finished once the portfolio is made. In reality, not only the skills acquired by the students in the process of achieving the digital portfolio are transferable to a new context of learning, but also the portfolio components.

The respondents were asked to express their opinions referring to the frequency of the presence in the e-portfolio of a certain type of material of the typology suggested by the researchers. The results were divided into three categories in order to be interpreted: high/very high frequency, medium frequency and reduced or very reduced frequency. The hierarchy of the e-portfolio components, having into account their high or very high frequency in the portfolio is as follow: materials elaborated during the achieving the portfolio (64.68%), proofs of the learning process (54.23%) and reflections about the process of building the portfolio (54.23%); materials in a traditional format (53.98%); auto-evaluations of some portfolio products (52.99%); materials obtained during the documentation process (50.50%); the feed-back offered by classmates or the teacher (50.25%); electronic materials (video, audio, etc.) (47.01%). Ranking electronic materials on the last position may be attributed to a lack of high-level digital skills together with the low level of using digital means, and it makes the respondents unaware of the versatility of these materials and their efficiency during the learning process.

The respondents were asked to complete the list of portfolio materials and to justify their views (free answer item). The answers put in evidence respondents' concern for evaluation: the portfolio has to include initial and diagnostic tests, progress charts, test models, monitoring grid of each student's progress, students' self-assessments. The respondents also suggest that the digital portfolio must include book and film reviews, models of activity (problem solving, experiments), ppt's, useful link lists, photos, music recordings, movies (YouTube), books in pdf or other formats, materials having an electronic board as source, etc.

Another interesting result refers to the respondent's opinions concerning the item "My students enjoy building up an electronic portfolio". The percentage of the respondents who disagree with this statement (42.79%) is over that of the respondents who express their agreement (31.10%). However, 49.50% of the respondents agree with the statement "I encourage the students to use the portfolio in order to learn". 44.28% of the respondents agree that the student's electronic portfolios facilitate the monitoring of the student's learning process. In fact, achieving a portfolio, regardless of its nature (paper and pencil or digital) helps the students to understand how and how much they learn (41.79% agreement) and to deepen their knowledge (43.03% agreement). 50.25% of the respondents agree that building an electronic portfolio stimulates reflection.

In the respondents' opinions, reflection should be exercised on "requirements/criteria established by the teacher regarding the content and quality of materials included in the e-portfolio" (56.47% agreement), tasks given by the teacher (55.72% agreement) and learning outcomes (54.98% agreement). Equal agreement percentages (53.48%) were obtained referring to the items which mention reflection on: (1) the fulfilment of the teacher's demands about the process of achieving a portfolio; (2) the extent to which the objectives are met; (3) the (self) assessment tools and (4) the quality and usefulness of every material selected to be included in the portfolio. The respondents consider the reflection referring to the demands formulated by the teacher more valuable than that given to learning objectives (51.24% agreement). They also agree that reflection must target "the methods and resources used for reflection" (52.24%), "the feed-back received about the portfolio achievement" (51.99%) and "the revisions performed upon the portfolio materials" (50%). The results also show a difference of 5% to 10% between the answer to item "reflection targets learning results" and items "reflection targets former knowledge" (6.22% agreement), "reflection targets solving intermediary tasks" (10.20% agreement), "ways of revising the portfolio" (6.47% agreement), "reflection works upon the revision of materials in the portfolio" (4.98% agreement). Thus, in the respondents' opinions, reflection concentrates on the final outcomes, not on the intermediary results. The high percentage of undecided respondents with reference to the practice of reflection in the creation of the portfolio leads to the idea of the lack of habit of teachers to achieve reflection.

Conclusion

The results regarding both the portfolio and the reflection in the context of the development of the portfolio are around the average (50% agreement). They suggest the idea that the Romanian respondents are not familiar with digital portfolios; they see its elaboration as a linear, not cyclic process, which ends with a portfolio seen as a collection of materials which are not only digital. As a result of this view, the respondents associate reflection to the results, not to the process. Further research is necessary to establish if the results obtained in this study can be generalized.

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Carleton’s ePortfolio Faculty Learning community, https://carleton.ca/experientialeducation/reflective-portfolios-assessment/

Teachers Opinion Regarding the Use of Digital Games in Primary Education

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Abstract

Digital games are a daily present in children's and adults' lives. Researchers and practitioners have been and are oriented towards game-based learning (GBL). Recently, their interest also included gamification, defined as integration of the game elements and strategies in learning activities. This study investigates the opinions of primary school teachers on fun and educational digital games. The survey was conducted using a questionnaire adapted by researchers from the literature and applied online. Participation was voluntary. The results show that most respondents use the digital games in the classroom for the development of new knowledge and mainly as a learning method/strategy and not as a learning framework. Respondents: The lack of interest in didactic digital games has its source in the absence of good practices and training in this field and poor curricular stipulations that can encourage GBL and gamification of learning.

Keywords: digital games, gamification, game based learning, didactic games, primary school

1. Introduction and Theoretical Background

Game and play are present in human life from childhood to adulthood. The game itself is a very attractive activity that evolves between pure fiction and the reality of work. "The game allows us to pursue at the same time the multilateralism of the child in his motor, emotional, social and moral life" (Chateau, 1972). In childhood the game occupies the place of work in the adult life. The adult feels strong through his/her work, and the child feels great through his/her playful success (Chateau, 1972).

Based on literature (Juul, 2003; Salen and Zimmerman, 2004), Seaborn and Fels (2015) identifies characteristics of a game: rules; structure, quantifiable and uncertain outcomes; conflict; values; voluntariness, player effort and investment; and negotiable consequences.

There are two types of games, fun games and didactic games, both used in education. A didactic game has rules, purpose, objectives and also game elements, and it's used in lessons. Fun games also have rules and objectives and have many forms: singing, dancing, hiding and seeking, catch me if you can and games that are played outside. These types of games have a playfulness experience for kids.

Nowadays there are games that can be conducted in a physical place and in a virtual place, online games, which are very attractive to kids. "The last fifteen years have seen the rise of the digital game medium in entertainment, popular culture, and as an academic field of study" (Seaborn and Fels, 2015). There are many types of online games as well: strategy games, war, puzzle, attention, logic and lots of fun games. Online games can help children build perseverance to attain goals, build resilience and improve their communication skills so they know how to respect other people's points of view or cop with lost (Magdaș, 2014; Baranyai, 2019).

Dumitru (2020) conducted interviews with parents that are also teachers who use online games in their lessons to see their points of view about the fun games and the didactic games. They observed some qualities that emerge from playing these online games such as: children increase their tolerance for frustration, learn to accept failure and move on, develop strategic behaviour and, in addition, enrich their knowledge in various fields and sometimes learn a new language.

In addition, if these qualities can be extracted and nurtured in classroom lessons, it will be able to observe an increase in the interest in learning, the involvement of students in all activities where all the contents become attractive and not tiring and boring, stimulating the whole teaching-learning activity. So it can be said that the education is experiencing a gamification of the educational process that means: "the use of game design elements in non-game contexts" (Dixon, Khaled and Nacke cited by Erenli, 2013). Game-based learning (GBL) is practiced as a form of training in preschool and primary education (Magdaș et al., 2019). In secondary school gamification is preferred. In both situations, games are used to acquire knowledge, skills and values. Gamified learning interventions may increase student engagement and enhance learning" (Buckleyand and Doyle, 2016).

Game playing is associated with lots of terms such as creativity, motivation (intrinsic, extrinsic), failure, and success through practice, learning etc. (Magdaș and Răduț-Taciu, 2016). We can observe that "educational gamification is defined as the design strategy of using game design elements in educational contexts to support teaching and learning goals" (Saggah et al. 2015). Research on the use of gamification in education highlights the positive influence that game-based learning has on motivation, interest in study, involvement in learning and the development of student's skills.

Playing games is a sure way to engage and motivate students; these can be used as tools in teaching and may evolve in order to make games that can be just as absorbing. Game design develops a multidisciplinary field such as: art, math, geography, music, language skills, etc., but they can also offer students and teachers an opportunity to show what they know and what needs to be learned. With these tools, students will embark on creative, energizing experiences that will get them thinking in new ways, to collaborate, to trust, to have better self-esteem or to improve teamwork. At the same time, using didactic games the children have already selected relevant material by the teacher, thus aiming at achieving the learning objectives easily and more fun.

2. Material and Method

2.1. Purpose of the study

The present study aims to investigate the opinion of teachers regarding the use of games in primary education: fun digital games played by primary school students outside the school; digital educational games; frequency of digital educational games; the advantages of fun or didactic digital games, difficulties encountered by teachers with reference to the classroom implementation of didactic digital games. The research involved 127 teachers. The participation was voluntary.

2.2. Data Collecting and Procedure

The instrument used was a questionnaire adapted by researchers after Eppmann et al. (2018). The instrument was structured in two parts: 7 demographic items and 37 items related to the issue of games. The answers to the questions were given using the five-step Likert scale (1-strongly disagree, 5-strongly agree). Participation was voluntary. The questionnaire was applied online using Google forms. For the interpretation of the results, the answers of type 1 and 2, respectively, 4 and 5 were summed, the results are interpreted as disagreement and agreement.

2.3. Participants.

The number of subjects involved in the research was 127. 97.64% of the respondents were females. The subjects are aged between 18 and 64 years, most subjects belonging to the age groups: 40-44 years (22.83%), 35-39 (23.62%) and 30-34 (21.26%). 42.52% of the respondents are teachers in primary education, 23.62% in preschool education and 33.86% teach at other levels of education. Most of the respondents have teaching experience between 11-15 years (27.56%), 19.69% under 5-years and 12.60% between 21-25 years. 67.72% of the respondents work in urban areas.

3. Results and Discussions

3.1. Respondents opinion about fun and didactic digital games

Respondents consider fun games a big waste of time (72.44% agreement). At the same time, they agree that their students play daily on the computer or telephone (61.42%), for their own pleasure (70.08%).

In class, respondents use "those didactic games that are also fun" (66.93% agreement) as a learning tool / method (67.72% agreement) and less as a learning framework (55.91% agreement). The hierarchy of purposes of using didactic game places in the first position their use for the systematization of knowledge (51.18% agreement), followed by the updating of knowledge (43.31% agreement), the construction of new knowledge (39.37% agreement) and the evaluation of knowledge (37.80% agreement).

Concerning the quality of the didactic game, respondents agree that it "serves to achieve the learning objectives" (69.22% agreement); "must highlight the content of learning" (76.38% agreement) and "include the use of teaching methods" (75.59% agreement).

3.2. Respondents opinion about the frequency of use of digital educational games

The frequency of use of digital educational games is as follows: several times a week (36.59%); once a week (25.61%); bi-monthly (13.41%); once a month (12.20%); never (8.54%) and daily (3.66%)

3.3. Respondents opinion about advantages and disadvantages of fun and didactic digital games

The results obtained with reference to the advantages of games are presented in Table 1. The analysis of the difference in the percentages of agreement for the answers to the items related to didactic digital games and those related to fun digital games put in evidence next findings:

- over 25% of the respondents claim that digital games stimulate their imagination and logic;
- between 10% and 25% of the respondents claim that the quality of digital games stimulates creativity, quick decision-making and awareness that they have learned;
- less than 10% of respondents agree that didactic games require students to explore and this makes them feel active;
- between -10% and 0% of the respondents claim that didactic games involve the use of a game strategy;
- between -20% and 10% of the respondents claim that digital games make students feel autonomous and influential and require learning of quick reactions.

The biggest differences against the didactic games are registered with reference to the items "Digital games stimulate the children's adventurous spirit" (-40.94%) and "Digital games make students feel happy" (-29.13%).

Table 1. Respondents opinion on the advantages of the digital games

Items	N	Fun game	Didactic game	None fun or didactic game
Digital games stimulate students' imagination.	127	49.61%	77.17%	8.66%
Digital games stimulate creativity.	127	54.33%	70.87%	11.02%
Digital games stimulate students logic.	1	55.	81.89	3.15%

	27	91%	%	
Digital games stimulate the adventurous spirit of children.	127	79.53%	38.56%	8.66%
Digital games require making decisions.	127	64.57%	74.80%	3.15%
Digital games require quick decisions.	127	75.59%	63.78%	3.94%
Digital games involve the use of a game strategy	127	73.23%	66.93%	2.36%
Digital games make students feel happy.	127	85.83%	56.69%	3.94%
Digital games make students feel active	127	70.08%	73.23%	7.09%
Digital games make students explore various situations.	127	70.08%	77.95%	3.94%
Digital games make students feel autonomous.	127	73.23%	58.27%	14.96%
Digital games make students feel influential.	127	61.42%	45.67%	25.20%
Digital games that students like combine singular and team play.	127	75.59%	58.27%	11.81%
Digital games make students feel that they have learned something.	127	57.48%	76.38%	7.09%

Table 2 shows the disadvantages of digital games. Over 50% of the respondents do not agree that "digital didactic games are often perceived as boring by students", but agree that primary school textbooks offer didactic games that integrate the new lesson.

Table 2. Respondents opinion regarding the disadvantages of digital games

Items	**N**	**Disagree**	**Undecided**	**Agree**
Didactic digital games are often perceived as boring by students.	127	59.84%	18.11%	22.05%
Quality digital games require superior computer performance and certain devices.	127	25.20%	27.56%	47.24%
Digital games available for free on the net are deficient in performance.	127	29.92%	35.43%	34.65%
The didactic digital games proposed in the textbooks and other resources are intended only as a learning tool.	127	24.41%	27.56%	48.03%
The didactic digital games proposed in the textbook or other sources are designed to integrate the new lesson.	127	16.54%	28.35%	55.12%
Digital games sometimes make students feel frustrated, angry or hostile.	127	41.73%	15.75%	42.52%

Digital games are making students restless.	127	25.98 %	28.35%	45.67 %

Equal percentages of respondents agree / disagree with the statement "Digital games sometimes make students feel frustrated, angry or hostile", but still believe that the games are making students anxious and upset.

4. Conclusion

The obtained results show that the respondents appreciate the didactic digital games, which they consider useful in the learning process. However, less than half of the respondents use didactic games, mainly as a learning tool / method, although they agree that textbooks suggest games designed to be a learning framework. Respondents are also reluctant to agree with the majority of items. Possible explanations can be found in: the lack of information regarding the value for learning of the digital didactic games, lack of initial or continuous training in digital games, pressure due to the need to adhere to the school curriculum and (most likely!) poor digital skills. We consider it necessary to develop teachers' digital skills through professional training activities, providing models of good practice on the design and implementation of learning activities that integrate the game as a training framework. Thus, teachers can become competent users of didactic games, which become increasingly complex and varied with the development of technologies.

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E-Learning as a Mono Technology in a Pandemic

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Abstract

The paper presents an attempt for a critical analysis of e-learning as a mono-educational technology in a pandemic. The subject of the study is the impact of the critical epidemic situation caused by COVID-19 in 2020 on the theoretical university training of students-pedagogues. The indisputable possibilities, advantages, but also limitations in the course of the e-learning, realized through various forms of electronic environment, are emphasized. Based on the analysis, the following conclusions can be drawn: indisputable advantages of e-learning as an assistive technology for the theoretical university training of students pedagogues; indisputable advantages of e-learning as a mono technology for the theoretical university preparation of students pedagogues in conditions of crisis and impossibility for face-to-face training; e-learning, implemented as mono technology, is unsuitable for the theoretical university training of students pedagogues in normal conditions, due to a number of limitations and shortcomings.

Keywords: e-learning, mono technology, theoretical pedagogical training, pandemic, effectiveness

1. Introduction

The current 2020 has posed serious challenges to the world, provoked by the spread of the new COVID-19 virus and pandemic conditions. A critical epidemic situation has changed the life of every person and the activities of all spheres of society, including education. The current educational realities in 2020 necessitated changes and in the system of higher education, which are an attempt to compensate and overcome the social restrictions - physical contacts, movement of people, isolation. A way out of the current situation was offered by the various forms of distance learning and its contemporary version - e-learning. They have been present in higher education for decades. Their undeniable advantages have established them as extremely effective assistive learning technologies (Shivacheva, 2016). Over the years, their application has been perfected and expanded. In the current conditions, however, higher education institutions have been forced to use them not only as assistive technology, but as the only (mono) learning technology for a long period. It currently covers one semester (summer). A number of authors share their training experiences during the pandemic (Branekova, 2020; Delcheva, 2020; Neminska, 2020 and many others). The effectiveness of application of e-learning is determined not only by the skills of lecturers and students to work with these technologies, the quality of the connection and the available devices. The effectiveness depends to a large extent and on the nature of the educational content in a certain specialty and the specific academic disciplines. This article presents an attempt for a critical analysis of e-learning as a mono-educational technology in the conditions of a pandemic in the mainly theoretical university training of students-pedagogues.

2. Methodology of the research

2.1. Object and subject of the research

The *object* of research is the process of training students in pedagogical disciplines.

The *subject* of research is the effectiveness of training students in pedagogical disciplines through electronic form as a mono technology in pandemic conditions in 2020.

2.2. Aim of the research

The *aim* of the research is to derive (outline):

- opportunities and advantages, but also
- restrictions

in the course of e-learning as a mono technology in the pandemic in 2020, realized through various forms of electronic environment.

2.3. Methods of the research

The main method in the present study is the analysis of the aspects of the learning process of students through electronic form as mono technology.

Another research method used is a comparative analysis of the course and results of training in students trained in electronic form as a mono technology in 2020 in the pandemic, on the one hand, and in electronic form as an assistive technology in the period before 2020., on the other hand.

При отчитане на разликите в успеха на учениците в обучението лице в лице и онлайн се използват методи за *статистически анализ* за сравняване на независими откъси (групи) - *Т-тест* и метод за *сравняване на дисперсии (σ^2).*

2.4. Contingent

The contingent of the research is a total of 100 students from the Faculty of Pedagogy, with whom we worked together during the summer semester of the 2019/2020 academic year. Their distribution by specialties, educational degree and studied discipline is as follows:

Bachelor's Degree

- Programme in Social Pedagogy, 3-rd year, full-time education (courses "Andragogy" and "Working with aggressive pupils“;

Master's Degree

- Programme in Primary School Pedagogy. Information and Communication Technologies in Primary School, part-time study (course in Pedeutology);
- Programme in Special Pedagogy - module Speech Therapy, part-time study (course in Diploma Design);
- Programme in Programme in Special Pedagogy - module Resource Teacher, part-time study (course in Diploma Design);

Postgraduate qualification courses

- Additional professional qualification "English Language Teacher", part-time study (course in Pedagogy);
- Professional qualification "Teacher", part-time study (course in Theory of Upbringing).

In addition to the indicated participants in the sample, in the course of the analysis results were used from the training of students from previous semesters and years, carried out through electronic form as assistive technology.

2.5. Criteria of the research

The main criteria of the study are:

- characteristics of the communication between the subjects in the educational process (lecturer and students);
- level of current participation and preparation of students;
- independence and authorship in preparing the tasks;
- success of students.

3. Results of the survey

This analysis covers the characteristics of the process of education of students from the Faculty of Pedagogy of the Trakia University - Stara Zagora through electronic form as a mono technology in the pandemic in 2020. The results are compared with the data from the education of students through electronic form as assistive technology before the pandemic 2020.

3.1. Characteristics of the communication between the subjects in the educational process

In normal living and learning conditions before 2020, lecturer-student and student-student communication includes a variety of options and means: direct contacts; use of intermediaries - mobile phones, personal and group e-mails, electronic platform *Moodle* of the Trakia University, Facebook (personal and the group), messenger and other chats, etc. Despite the rich opportunities, the main forms of communication were realized through direct contacts during lectures, seminars, consultations and informal conversations - talks, discussions, advice and more. The advantages of the face-to-face training is in the uniqueness of the communication depending on the participants and the created situations; management of the cognitive process of students by the lecturer; management of student activity by the lecturer; the inclusion of elements of conversation and provoking students' thinking; search, sharing, reasoning and justification by students of their own experience, positions and opinions; presentation and defence of course assignments; feedback and detection of difficulties, misinterpretations, questions and their timely clarification; the accessibility and provability of the exhibition; personal perception and emotionality, etc. The other forms had a supporting function - to clarify, in case of problems, difficulties, unexpected situations, illness, etc.

The imposed social restrictions (physical contacts, movement of people, isolation) in the beginning of 2020 as a result of the pandemic caused by COVID-19 radically changed the communication between people. The typical and predominant direct face-to-face interactions were massively replaced by virtual contacts through the use of various electronic devices and environments. In the course of training this semester, communication between the subjects in the educational process was limited in terms of direct contacts. They were replaced by others which acquired basic status.

The use of asynchronous means of communication (personal and the group e-mails, electronic university learning platform, chats, etc.) retained its supporting function. However, it has expanded significantly with the inclusion of setting and submitting course assignments and works, instructions and guidelines for procedures and work with the electronic platform of the university, feedback on the implementation of tasks and assessments of procedures and more. Disadvantages of this way of communication is the possibility of frequent ambiguities, and hence mistakes and prolonging the process over time with a series of correspondences.

The place of synchronous communication via mobile phones has also expanded, and they have partly taken over the functions of face-to-face communication regarding consultations, clarification of issues and difficulties in the learning content. Direct face-to-face communication between the subjects in the educational process was replaced by organizing virtual classrooms through *Google meet* and the electronic learning platform of the Trakia University. However, its effectiveness is relative and is determined by the degree of preparation and involvement of students, by the nature of the educational content. The activity of students remains high for a short time, when the video connections are one-time and rather of an organizational nature. Spatial distance demotivates, it is difficult to maintain the attention of students for a long time, and the feedback is more difficult. The challenge for the lecturer is to be creative in selecting the accents in the educational content, to including elements of conversation and selection of questions, approach to students, ability to mobilize and organize them. This is a significantly more difficult task than face-to-face training. Virtual classrooms are particularly unsuitable for part-time study, where students have a large number of hours per day - up to 10 hours. From both a psychological and a health point of view, it is inappropriate to force students to stay in front of the computer for so long. This necessitates a reduction of classes, and hence a limitation of the professional role of the lecturer.

The summary of the nature of the communication between the subjects in the educational process in the beginning of 2020 in the conditions of the pandemic caused by COVID-19 shows that it partially compensates for the direct face-to-face communication. The deficit of direct pedagogical communication and its educational functions reflects on the students. The pedagogical guidance of the lecturer on the students is limited and their preparation is more based on their skills for self-organization and learning.

3.2. Level of current participation and preparation of students

It is a practice at the Trakia University to insist for the presence of students without going to extremes. This requirement ensures adequacy and orientation in the learning content and the organization of work in the respective discipline. The extraordinary situation caused by COVID-19 necessitated extraordinary measures in higher education. One of them is an official certification of the semester for all students. This measure is correct, but it gave the opportunity to students who have not fulfilled their obligations during the semester - do not have any attendance (virtual), completed tasks, work in the e-learning platform of the university, etc., to receive certification of the semester and appear at exam. As expected, such students could not pass their exams.

In the face-to-face training in previous years, the schedule for the presentation of individual course works during the semester(for full-time training) must be followed, because otherwise the lesson fails and students are responsible not only to the lecturer but also to their colleagues. Individual consultations with the lecturer for the preparation of course assignments were waged every week. Thus, the lecturer has the opportunity to timely direct and manage the independent work of students. They not only hand over their tasks, but also present and defend them in front of the course. As a result of such an organization, the learning content is meaningful by everyone from a different point of view, its practical application is found and the students develop skills for assessment and self-assessment. The epidemic situation during the summer semester of 2020 had a certain demobilizing and disorganizing effect on the students. It is observed that students participate in online forms without being prepared and participate formally. The analysis of their activity shows that the majority of them (both full-time and part-time) postpone the implementation of the set current tasks until the deadlines for conducting the examination procedures. This practically did not provide an opportunity for their presentation and defence front the course. Another disadvantage of the work was that the consultations were reduced to clarifying the topic of the course work, without the current possibility of the lecturer to monitor the progress of preparation, as communication with students was limited. In this sense, during the summer semester, students studying only through e-learning were deprived of these aspects of academic preparation compared to face-to-face learning.

3.3. Independence and authorship in preparing the tasks

An element of academic training is the assignment, preparation, presentation and defence of course assignments by students. One of the criteria for their evaluation is independence in the preparation and authorship. In the conditions of a pandemic in online learning due to the above circumstances (mainly limited consultations and a larger share of students' self-preparation) this requirement is not so significant. Emphasis is placed on the development of students' skills to navigate the learning content and the materials available on the network, to able to use critically available materials to perform their concrete task. For this reason, during the summer semester of 2020, the check for plagiarism of the submitted course assignments was dropped and a greater tolerance was shown towards the authorship and independence of the students.

From the mentioned specialties, which were worked with during the summer semester of 2020, course assignments were assigned to the students from: Programme in Social Pedagogy (regular education) - for current control and final assessment; Programme in Special Pedagogy (Master's degree, part-time education) - for final control; professional qualification "Teacher" and additional professional qualification "English Language Teacher" - for final control.

In the face-to-face training the course assignments in Andragogy (for the Programme in Social Pedagogy) are conducted as:

- presentation of a developed author's course for adult education on a topic related to the specialty of students,
- or by preparing and conducting a specific method of adult education on a topic related to the specialty of students.

The presentation of the course assignments, thus organized, guarantees independence, demonstration of comprehension and mastery to a certain extent of the learning content and professional skills. In online learning, the presentation of course assignments is eliminated, and emphasis is placed on the ability to enrich and expand the theoretical presentation of a particular problem in the learning content. To some extent, these types of tasks are reproductive in nature and largely allow for borrowing. The presented developments show this, as well as a lower degree of depth, criticality and precision. Formal borrowing is also a reason for mistakes, as consultations with the lecturer did not take place. From this point of view, the criteria differ, and in online training the results are definitely lower.

In the face-to-face training, the Diploma Design exam (for the Programme in Special Pedagogy) is held in person with the opportunity for students to use textbooks, but independently to construct a concept of scientific pedagogical research in the specialty and on a downloaded topic. Thus organized the exam guarantees independence, authorship and demonstration of comprehension and mastery to a certain extent of the educational content. The online exam eliminates the mandatory requirement for authorship, and focuses on the ability to be critical if using developments found on the web; to correct them and to comply with scientific requirements. Formal borrowing carries the risk of making mistakes, as there is no guarantee that the works published on the Internet are correct. From this point of view, the criteria differ, but to a certain extent guarantee an objective assessment of the formed knowledge and skills in the discipline.

In the face-to-face training, the exams in Theory of Upbringing (for the course for professional qualification "Teacher") and Pedagogy (for the course additional professional qualification "English Language Teacher") are conducted in person through tests on paper. As these students do not have access to the e-learning platform of the university, in online learning the final control is formed on the basis of a developed and submitted course assignment. It is personal depending on the specialty of the student. It is formulated in such a way as to ensure the formation of certain professional competencies and knowledge of the main components of the educational content in their integrity and practical orientation.

The construction of the course tasks puts serious challenges to the teacher to ensure the effectiveness of training and objectivity of assessment. Despite the creative intentions of the lecturer, however, in many cases in online learning as a mono technology these criteria are achieved to a lesser extent.

3.4. Success of students

The success of the students from the studied sample in the face-to-face and online learning is determined by:

- the same control and evaluation procedures for:
  - students in the Programme in *Social Pedagogy* for the discipline Andragogy - through an electronic test in the electronic platform of the university;
  - students in the Programme in *Primary School Pedagogy. Information and communication technologies in primary school* for the discipline Pedeutology;
- different control and evaluation procedures for:
  - students in the Programme in *Special Pedagogy - module Speech Therapy* for the course Diploma Design;

- the students from the additional professional qualification "*English Language Teacher*" for the discipline Pedagogy;
- the students from the Professional Qualification "*Teacher*" for the discipline Theory of Upbringing.

In Fig.1. the ratio between the average success in these groups in face-to-face and online training is presented:

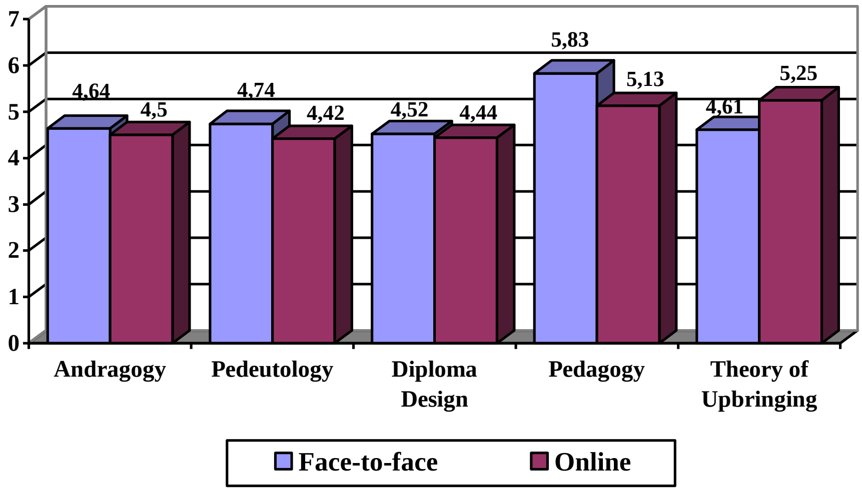

Figure 1. Ratio between average success in face-to-face and online learning

The data show that in almost all courses the average success in face-to-face training is higher than in online training. Statistical analysis by *T-test* shows that a statistically significant difference is found at $P_{(t)} = 95\%$:

- in the course in Pedagogy in face-to-face training;
- only in the Theory of Education course in favour of online learning. In this case, however, it should be taken into account that half of the students trained only through the online form did not do their coursework and in this sense did not take the exam. Assuming that their grades are low, the average success will be significantly lower than the face-to-face training. This result carries the risk of reduced motivation and dropout.

4. Conclusions

The analysis of e-learning as a mono-educational technology presented the indisputable opportunities, advantages, but also limitations in the course of e-learning, implemented through various forms of e-learning environment. Based on the analysis, the following conclusions can be drawn:

- indisputable advantages of e-learning as an assistive technology for the theoretical university training of students pedagogues;
- indisputable advantages of e-learning as a mono technology for the theoretical university preparation of students pedagogues in conditions of crisis and impossibility for face-to-face training;
- it can be assumed that the use of e-learning as a mono technology for the theoretical university training of pedagogues in Master's Degree is more appropriate and effective;
- e-learning, implemented as mono technology, is unsuitable for the theoretical university training of students pedagogues in normal conditions, due to a number of limitations and

shortcomings;

- e-learning, implemented as mono technology, is especially inappropriate and ineffective at the beginning of the training of pedagogues.

In conclusion, it can be stated categorically that e-learning is appropriate in the theoretical preparation of students in pedagogical disciplines. It corresponds to the global technological trends and preferences of the digital generation of students. However, it is recommended to use it as an assistive technology or at least not as the only educational technology according to the nature of the educational content of pedagogical disciplines and the irreplaceable importance of direct lecturer-student and students-students contact for its understanding and in-depth mastering, for formation of professional pedagogical skills and personal characteristics of future pedagogues. „Each institution and each discipline or area must find the most appropriate combination of technologies and resources to enhance the pedagogical impact, but without creating restrictions for participants and without risking the quality of training and service (Blagoeva, 2020: p. 10).“

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Education in Synthesis of the Furniture and Art

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Abstract

The education in interior decoration is part of the architecture and decorative art that deals with drawing and shaping the interior of buildings that are part of the space called the interior. Its basic division is structural and decorative design. Structural design is the basis of the space with all the functional elements without which the space cannot function, while the decorative design is the part where the ambience and artistic expression of each piece of furniture is created. For the design and drawing of the furniture, the decorative design has a strong reinforcement of the ambience, i.e. the effects achieved with all the decorative parts that give the space a completely different note, which means it is not devoid of emotions and home atmosphere.

Keywords: furniture, art, design, education, interior design

1 Introduction

East of strong emotional influence on students learning (Nedeva et al., 2013) on furniture is the participation of other arts and mainly art where there is a part of painting where on flat surfaces appear painting details or a complete painting, sculpture, i.e. the presentation of a piece of furniture in a purely sculptural form and so-called decorative monumentality. Carving is one of the basic and constant impact factor on different types of furniture (Despot et al., 2019).

This one analyzes and categorizes the arts of the small defined space with a specific function and time, which characterizes the different influences and makes the markings of creative minds that leave a mark on a certain part of the art.

The grouping of art into two main groups - simple and synthetic - is justified by the fact that some of them act synthetically (together). For example, when creating a collection of furniture inspired by an author, it can be transferred to different functional pieces of furniture or simply to a piece of furniture that will be treated in the future as a work of art worthy of representation in space as a museum exhibit.

a) cupboard b) chair

Figure 1. Synthetically, that is furniture inspired by painting

Grouping art with similar specific qualities is the question of how to use and implement it on the pure function of furniture.

The design has a mandatory nature of consumption. This feature is embedded in the sculpture that stands in the open space, and also in the decorative-monumental arts that have become part of the design and at other hand affect students creativity (Despot et al., 2017; Zlatev et al., 2017).

The mode of consumption is a characteristic of the individual, which is associated with creative responsibility. This is especially typical of furniture design and where, in addition to mandatory consumption, the issue of financial and public resources related to its realization, it accompanies human life. This is exactly the definition that draws our attention to the fact that, unlike all others, furniture as an integral part of the space is subject to constant consumption.

The path of consumption as a characteristic again connects architecture with sculpture and decorative applied arts - frescoes, mosaics, graffiti, ceramics, stained glass, wooden plastics, stone sculptures and others. And it's no coincidence that the history of the interior and furniture abounds with examples of furniture synthesis with the mentioned arts. Several conditions, prerequisites, skills and experience are required to achieve a high artistic result in the field of synthesis.

Modern furniture creativity has its own specific requirements that practice imposes. The appearance of fixed artwork in the interior depends on the meaning and genre on the furniture or work depending on its purpose, but when it is in an operating room or production space, there is obviously no place for the presence of artistic accents.

Subsequently, the question arises about the choice of thematic or decorative and abstract compositions. For example, in a children's palace the thematic composition is quite logical. In contrast, in the hotel interior decoration and abstraction should be given priority and thus the choice of furniture is made. It should be noted that, in principle, artistic abstraction is much more than purely geometric shapes, because it itself deals with abstract forms that have a precisely defined function.

Regarding some compositions and professional rules, it can be emphasized that the first condition for the appearance of plastic sculpture as a piece of furniture is dictated by the size of the space and above all, by the optimal distance of perception. It is necessary to take into account the fact that the most favorable angle of perception is 45^o. In the horizontal direction and 27^o. In the vertical.

This requirement applies to the maximum perception of students in their work of art (Shivacheva et al., 2016), including furniture. In lateral perception, this requires that the distance not be missed. With an axial approach, it is desirable to develop a composition with a center. In tangential perception occurs not serious development of the composition. This setting of the furniture as a work of art develops a sense of exposure in large spaces. An important condition in development is the placement of furniture groups and other visual barriers to overall perception. The basic condition - for the emotional impact of decorative monumental works of furniture is the presence of optimal lighting. The way of lighting is also crucial for performing art synthesis, especially for shallow relief works, and lateral lighting should be required, which emphasizes the plasticity and contributes to the look and readability of the composition. In the absence of natural light, proper artificial search must be required.

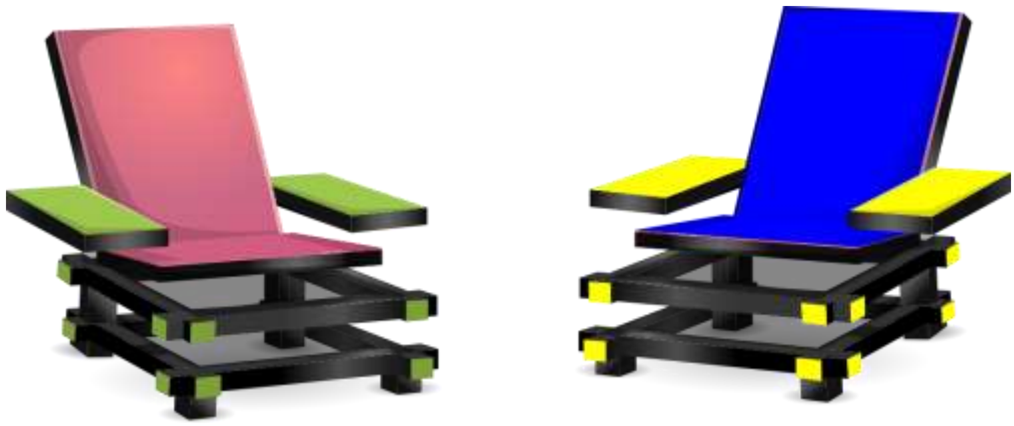

Figure 3. Geometry as a decorative element on the furniture

For the realization of synthesis it is necessary to look for kinship in the materials of the architectural environment and culture. As a first condition, it is worth noting the respect for the prestigious hierarchy arising from the nobility of the materials. At the same time, it is worth mentioning the incompatibility of some materials related to furniture and art plastic. The works of pictorial representation of the painting that occupy it completely or part of the furniture are especially successful. When it comes to free plastic or sculptural furniture in the interior, in practice this often meant the plastic design of the interior structure. It is a very delicate and debatable moment. The designer finds it difficult to require the absorption of structural pillars from their function. Perhaps the truth lies in the specific approach in each individual case. The leading point in the hierarchy in the classification of components remains reading the content and compliance with the specifics of the vital functions of the furniture. The need for a common and close professional culture should not be forgotten.

Handling skills requires talent, knowledge and experience (Sembach et al., 2002). Knowledge is absorbed, experience accumulates, and talent is quality that is possessed or not possessed.

Special consideration of furniture components that produce emotions in the perception of interior spaces is necessary given their more detailed and analytical research. In fact, they act simultaneously, they support each other, and they build the overall artifact-artistic image.

2 An artistic expression in the creation of furniture

Art has always been a central issue in aesthetics. He has his own specifics for different arts, but he also has basic positions. It should be noted that overload or playback is contraindicated and this applies to any work. Oversaturation inevitably leads to a disturbance of aesthetic integrity, of distraction, of that figurative diversity that inevitably causes doctrine and emotion. For the interior, the aesthetic measurement is crucial, because here we act on the principle of components, which have already been discussed - the shape of the interior, light, color, texture of materials and furniture.

Figure 4. Ornamentation

Where the question arises as to what is better to be in the foreground furniture as art or decorative walls to be in the foreground at the expense of the furniture to be deprived of all emotions and to stand in the background it always depends on the designer and the user. This raises the question of aesthetic precedence. At the same time, the variety of components, without which the interior space cannot, obviously the designer should carefully analyze and make a reasonable and applicable compromise, i.e. balance. Saturation with different materials on the front so-called efficiency on the furniture, which is related to the aesthetic dimension, is also determined by the genre character.

It is enough to make comparisons for their purpose, to convince the direct dependence between the aesthetic measure, the content, the color and the emotional search.

There is a determination here when we choose furniture to meet our needs we are rulers over the situation but when we start using it has a strong impact on our individual and he does not model us.

The issue of harmonious color has already been resolved, it is not a moment of discussion because such a choice is always correct and acceptable, and here it is a matter of observing the measure of the situation (Kok et al., 2016).

The furniture needs basic color and additional accents in color and texture. Errors in color selection are corrected when the material for the face is not a color carrier and the color is limited to the color only. It is not a problem of furniture articulation and plasticity saturation in the form of details, profiles or ornaments. Asked in this way, the questions themselves suggest that rich plasticity in processing can very boldly lead to a high aesthetic level. Plasticity as a design-art culmination and needs a simple background.

Excessive repetition of specific pieces of furniture very often leads to a violation of the aesthetic measure. This usually happens in the living room. People who live in their homes are gradually and imperceptibly adding furniture, especially small items, which makes the space overloaded and behind it.

Artistic elements as tools in furniture design the interpretation of the design can be seen in creating living conditions in everyday life. With the whole development of the environment, which means sociological, cultural and technological development, it is considered that buyers want the products to be a symbol of their lifestyle. Although design has the same features as art, it is different in ways it can solve problems and satisfy customers with the product.

Furniture as part of the design is subject to the creative actions of people who reflect the lifestyles, traditions, scope of development of art and technology, materials and production methods by a nation or region. Some of the structures are developed in furniture and constantly make mosaics of the correct shape. The decorative composition is rhythmically organized when similar motifs and directions of counterbalance movement are expressed in it.

Ornaments are a kind of stylization of geometric, plant or animal motifs that can be graphic, colored or sculptural. The totality of decorations, rhythm and materials are the decorations, which is a basic feature of a given style. The reasons may vary in size. The visual impression that the design leaves may be different depending on the physical, physiological and psychological characteristics.

In the broader sense of furniture design, functionality is considered a feature that can define what belongs in the field of functionality and what belongs, for example, to art. However, it has been a long time since the modernist statement that form follows function. Today, although it is still considered that the piece of furniture must have a certain function, the design of the furniture is not explained only by its functionality.

3 Artistic elements as tools in furniture design

The interpretation of the design can be seen in the creation of living conditions in everyday life. With the whole development of the environment, which means sociological, cultural and technological development, it is considered that buyers want the products to be a symbol of their lifestyle. Although design has the same features as art, it is different in ways it can solve problems and satisfy customers with the product (Zheleva et al., 2014).

Furniture as part of the design is subject to the creative actions of people who reflect lifestyles, traditions, the scope of development of art and technology, materials and the way of production by a nation or region.

Art has a lot in common with architecture, an integral part of the interior and provides comfort. Features of modern furniture are: unity of use, functionality and aesthetic performance. Some of the structures develop in the furniture and constantly make mosaics of the correct shape. The decorative composition is rhythmically organized when similar motifs and directions of counterbalance movement are expressed in it. Ornaments are a kind of stylization of geometric, plant or animal motifs that can be graphic, colored or sculptural. The totality of decorations, rhythm and materials are the decorations, which is a basic feature of a given style. As a landmark of a given style, decorativeness can be found in architecture, painting, engraving, but primarily in decorative applied art.

Various types of geometric shapes, forms, and rhythms are involved in simple compositions, resulting from a variety of motifs. The reasons may vary in size. The visual impression that the design leaves may be different depending on the physical, physiological and psychological characteristics.

Design motif in modern design with symmetry and asymmetry are analyzed different decorative forms (Tambini, 1999; Kok et al., 2016). When nature meets full symmetry, even the smallest deviations give individual characteristics to the form. All types of symmetry are a great base for creating furniture, first from a functional point of view and then on symmetrical furniture art gets its own specific expression and together they make a whole for a special exhibition.

As a rule, repeated motifs can be defined as the construction of furniture, which at regular intervals shows a repetition of the motif or motifs. Motifs can be symmetrical or asymmetrical. A symmetrical motif is an image that consists of two or more parts of the same size, shape and content. Each part is called the basic unit, a term that is also used for the smallest repeating unit or area of the overall pattern. In model synthesis, repetition can be defined as a process that allows the motive to expand at a certain distance, moving from one position to another in the plane, which at the same time allows its initial state to be retained, but very often abandoning the motif in certain parts can to emphasize the viewer, i.e. a visual gap that requires an answer, and then the goal is achieved from an artistic point of view.

There is a determination here when we choose furniture to meet our needs we are rulers over the situation but when we start using it has a strong impact on our individual and he does not model us.

4 Conclusion

Creating is an integral part of design. It has the task of determining the shape and line of a particular part, even before it starts working on a particular product. It is a transfer of an idea on paper. The meaning of creation is to follow the fashion trend that should be used at the right time.

Furniture is the subject of creative human activities that reflect the conditions of life, customs, tastes and people who created them, the level of development of art and techniques, materials and the way of production of a nation or region. The meaning of creation is to follow the fashion trend and use it at the right time. The idea that the designer has is presented with his work. The result depends on the experience of using the techniques, the available technology to develop.

Artistic design to be practical and easily sustainable; it is also necessary to know the techniques that will facilitate the permanent application of decorative elements. When the designer experiments with the techniques then the variations are endless. It all depends on the idea that the designer has and how he visually represents it.

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Relationship between colors and forms and their significance for education

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Abstract

Rapid changes in models and fashion trends, different standards and the ever-growing demands of consumers, the creation of new materials, expect manufacturers to respond quickly and offer the latest items. This reflects on the training in fabric design, where new methods of training students – future designers – are constantly sought and developed. The diverse information and computer technologies provide an opportunity to study the relationships between colors and forms in textile design. In the present work, a method and tools for forecasting consumer demand have been developed, based on features of the color and forms of folk costume elements, represented by two-dimensional contour descriptions, which is based on a certain set and relationships between them. The obtained results increase the knowledge about the connection between colors and forms and their significance for textile designers. They would help to better illustrate the materials presented and the consistency in the design of textile fabrics and will generally support the specialized training of students studying fabric design.

Keywords: Textile design, Knowledge transfer, Color and form, Data analysis, Consumer perception

1 Introduction

A problem in art and design education is that creative practice is presented as the result of research or practice-led research (Niedderer et al., 2007). This problem arises from the desire of teachers to use their creative practice, as well as to offer contributions to research. Such a problem also occurs in the analysis of the relationship between colors and forms, in the development of new textile designs and analysis of consumer demand. (Sliburyte & Skeryte, 2014). A partial solution to the problem is proposed by Georgieva (2017). The main disadvantage of her research is that it does not offer a model for forecasting consumer demand. Also, the study covers only one ethnographic area in Bulgaria.

The analysis of the definitions of form of designers, architects and theorists in the field of design shows that according to all authors form and function are interrelated (Kazlacheva, 2014; Indrie et al., 2019). When designing new patterns, the designer must take into account the color preferences of consumers. Very often the color is the first sign on which the textile consumer makes a choice, and in all other cases after the choice of a certain form, the color is the second sign determining the choice. (Elnashar & Boneva, 2016). Sharing data on the color and form of decorative elements for textiles has the potential to improve consumer demand forecasting. Such a method is proposed by Mladenov (2020). By combining data from different sources, the predictive power of the models proposed by him is increased. The use of such an approach will strengthen the desire to provide a solid basis for the further development of research in the field of art and design. (Secan et al., 2012; Stoykova, 2015; Kazlacheva, 2017). The aim of the present work is to develop a method and tools for forecasting the demand of textile elements by consumers, based on features of color and form. The main task is to enrich the knowledge in this area.

2 Material and methods

Elements of Bulgarian costumes were used. The decoration of these costumes is achieved mainly with embroidered floral, animalistic and geometric ornaments. The variety of the apron is also complemented by colorful embroidery. Data for folklore elements selected by the users were used. The data are from surveys for a total of 106 elements. As descriptors of costume ornaments, their color indices and those of their form were used.

Color indices have the look (Cermakova et al., 2019):

[1] $NEXG = \frac{2G-R-B}{G+R+B}$ [2] $GLI = \frac{2G-R-B}{2G+R+B}$ [3] $NGRDI = \frac{G-R}{G+R}$

[4] $RGBVI = \frac{G^2-RB}{G^2+RB}$ [5] $VARI = \frac{G-R}{G+R-B}$ [6] $EXG = 2G - R - B$

where R, G, B are the color components of the RGB model.

Shape indices (K_f), eccentricity (K_1), orientation (K_o), density (K_R), area ratios (K_A and K_{MR}) were used. They have the look (Elnashar & Boneva, 2016):

[7] $K_f = \frac{P^2}{A}$ [8] $K_1 = \frac{D}{d}$ [9] $K_o = \frac{P^2}{4\pi A}$

[10] $K_R = \frac{1}{K_o}$ [11] $K_A = \frac{A}{A_i}$ [12] $K_{MR} = \frac{A}{A_{MR}}$

where A is the area of the element; P - perimeter; A_i - ideal area; A_{MR} - area of a minimum rectangle.

These characteristics of the costume elements were used to construct feature vectors. The features were selected by the methods RELIEFF, SFCPP, FSNCA, FSRNCA. When processed with these methods, the data are normalized in the range [0,1]. PCA and PLSR methods were used to reduce the amount of data. Principal components (PC) and latent variables (LV) were obtained from them. Regression models by PC and LV were obtained. The second-order polynomial model, which is more often used in practice, is accepted as the main one. The models were compared by: Regression coefficient (R^2); Fisher's criterion (F); p-level; Standard error (SE); Sum of error squares (SSE); Root of the root mean square error (RMSE). The coefficients of the selected model are optimized with the means of the Curve Fitting Toolbox, in the Matlab software system (The MathWorks Inc.). 80% of the data for the costume elements were used in compiling the predictive models, and 20% in the validation of the selected model. All data were processed at a level of significance $\alpha = 0.05$.

The obtained results are demonstrated through personalized products. Digital Fabrics tools are used for this purpose (https://www.digitalfabrics.com.au/).

3 Results and discussion

Feature vectors containing color and form descriptions of costume elements are selected. After reducing the amount of data of these vectors, a comparative analysis of regression models was performed. A model has been selected that describes with sufficient accuracy the relationship between the reduced color and form data of the elements and the choice of the consumers. The adequacy of the obtained model has been proven. An example of the application of the elements more often chosen by the consumers is presented.

Table 1 shows the selected feature vectors by the different methods used.

Table 1. Selected feature vectors

Feature vector	Feature / Method	NEXG	NGRDI	RGBVI	GLI	VARI	EXG	Kf	KI	Ko	KR	KA	KMR
FV1	RELIEFF		+		+			+		+	+	+	+
FV2	SFCPP			+	+		+		+		+	+	
FV3	FSNCA		+			+		+	+	+		+	+
FV4	FSRNCA	+	+		+	+						+	+

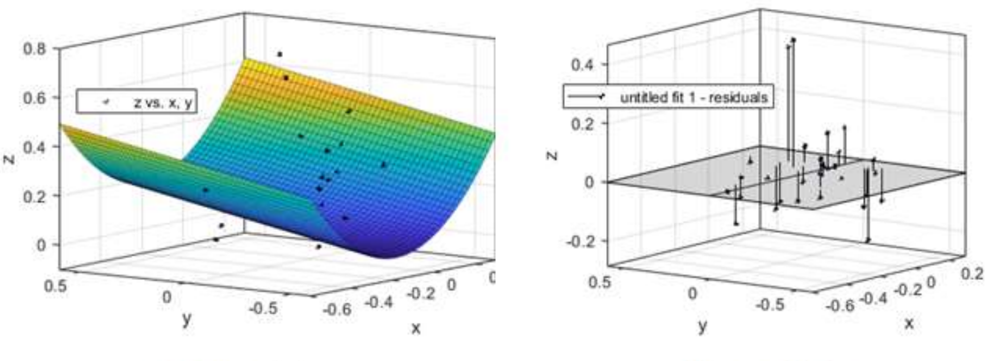
A comparative analysis of regression models obtained by principal components and latent variables is made. Their insignificant coefficients have been removed.

As a result of this analysis, a model based on FV1, selected by the RELIEFF method, by latent variables was selected. Optimization of its coefficients has been made. It was found that its regression coefficient R^2 = 0,76; SSE = 0,19; RMSE = 0,08; F (3,26) = 7,3> F_{cr} = 3,03; p <0,001; SE = 0,13.

The resulting model has the form:

$$C = 0{,}15 + 0{,}67.LV_1 + 0{,}17.LV_2 + 1{,}8.LV_1{}^2 \quad [13]$$

Figure 1 shows the resulting model and its residuals. The first latent variable is plotted on the X axis, the second is plotted on the Y axis, and the probability of selecting the elements from the consumers is plotted on the Z axis. As can be seen from the location of the residuals around the normal surface, they are close to it and it can be considered that the prerequisites of the regression analysis are fulfilled. When validating the model, low error values were obtained, SSE = 0,21 and RMSE = 0,09 were determined.



a) General view b) Residuals

Figure 1. Regression model C=f(LV1,LV2), obtained from FV1

An example of application of the more frequently chosen by the consumers elements of costumes is presented. Custom elements of interior design have been created.

Figure 2 shows examples of the application of folk motifs on curtains. A Drop iteration was used to create them. The curtains are in green and yellow range, as well as with a woven blue shade on a white background. They are placed on a dark gray wall and a window with a white frame so that they stand out smoothly in the interior of the room.

The results presented in this paper confirm and supplement those in the available literature. A model is proposed for forecasting the demand of users for elements depending on their color and shape. This complements the results of Georgieva (2017), where this connection is partially proven and the author relies more on verbal descriptions than on numerical evidence.

The joint use of data on the color and form of elements of costumes leads to an improvement of the predictive ability of the created regression models, which confirms the results of Mladenov (2020).

An example of application of user-selected elements in interior design is proposed. This complements the results reported by Kazlacheva (2017) by applying online software tools to create repeats of elements on textiles.

4 Conclusion

A method and tools for forecasting consumer demand have been developed, based on features of the color and shape of costume elements, represented by two-dimensional contour descriptions, which is based on a certain set and relationships between them.

Analytical models have been created, based on feature vectors, including characteristics of the color and form of folklore elements, reduced with principal components and latent variables. These models can be used to predict the user's choice of such elements. Models based on latent variables have been found to perform better than those using principal components.

A model is proposed by which 76% of the change in consumer desire is described by the first two latent variables obtained from a vector containing color and form descriptions of costume elements.

The obtained results increase the knowledge about the connection between colors and forms and their significance for textile designers. They would help to better illustrate the materials presented and the consistency in the design of textile fabrics and will generally support the specialized training of students studying fabric design.

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Learning of Modern Interiors with Eclectic Movements

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Abstract

Interest in training in the field of fine, applied arts and design has grown in recent years in Bulgaria. This is a prerequisite to look for new and innovative methods to be applied in this field of knowledge. The innovative method that is proposed is Eclectic in the use of elements of different periods in one piece. This makes the closed space filled with dramatic energy that closes and opens at the same time modern interior. One design to be good, he himself besides creativity, decorative, beauty and modernity should wear and functionality. Eclectic approach to thinking that one does not fully comply with the same paradigms or conclusions, and takes into account various theories to gain a comprehensive view of any phenomenon or to apply a theory. Whether in eclectic modern decor?

Keywords: eclecticism, design, interiors, furniture, architecture, color

1 Introduction

According Decree № 137 (2020), in Bulgaria, the specialties in the field of higher education, in the field of pedagogy of education in fine arts and graphic design, are exempt from semester fees for the entire course of study, by decision of the Council of Ministers. The state needs such personnel and therefore finances them fully. This raises the issue of introducing new and innovative methods in design and training in this field (Ilieva et al., 2019).

Eclecticism is the method of creation that attempts to melt the styles and opinions at the moment of occurrence, trying to rethink the differences through the selectivity of the opinions and facts that are closest to the truth to themselves. The movement emerged in the first half of the 19th century when the pink times of bourgeois prosperity and sad decades of stylistic forms came to pass. There is only one spiritual elite who dictated the forms of the past (Despot et al., 2016).Architecture and interiors begin repeating historical styles. Eclecticism, ludicrous decadence, and fake representations characterize all spheres of art after 1850. With the word eclectic, a stylistic accent is adopted by the different genres, but only when they have done the best. The persistence of using all styles and using cocktails of classic decoration forms attracts the designer.The evolved eclecticism combines an antique dowry column with the stylish features of Renaissance, Baroque or Rococo. The artist is alienated from the characteristics and essence of modern building materials and constructions (Fomina, 2003).In the spirit of eclecticism, there is a great deal of work, above all as public buildings, especially in the French cities of the 19th century, such as the Courts of Justice, theaters, parliaments etc. It is difficult to talk about an eclectic code or some common formula favored up there that turns all these options.

The eclectic trend does not limit us only to traditional materials but also to the distribution and production of industrial products. In this way it puts the printing of the structure and the possibility on the current technical production. And in the furniture during this period begins a repetition of the historical styles and with a great whirl, so it possesses true impunity. The young industry - the production of furniture has no sophisticated profile. And in that face of gut, he does not find a real breakthrough of progress (Indrie et al., 2019). They can not bend the burden of historical traditions and rely on them in the hope that only with restoration will preserve the uniqueness of the past.

This may remain the lowest step in the world of furniture styles. Indeed, some new studies characterize the ecclesia as a regular and inconspicuous stage that stops a positive transition from slow history to modernism.

Despite the great aesthetic failure, the time of eclecticism provides us with a tremendous achievement and a good historical lesson. The achievement is in the sphere of mass consumption of furniture consumption through the productive capabilities of the newly-built industry, while the lesson is distinct - the creative doom of the artificial nobility, the search with encounters, alien to the life and technical realities of its time. It is even more unpleasant when it is replayed with the forms in which the new aesthetic progress was born and dying.

2 Eclectic in the interior

The things often tell us how carefully restored antiquities are the main feature of the eclectic interior. This style is designed for people with a good taste for style, people who enjoy the interiors with objects from different cultures, people who are very passionate and people who can not overcome a single style. As shown on Figure 1, It often happens that interiors in eclectic style are interpreted as feminists, so the crazy retro color gamut and texture of space give them a touch of "femininity." But there are also such eclectic interiors that are not very colorful, and could be said to be "more masculine". The furniture and the paintings of the eclectic interior can themselves reflect and represent a work of art.

3 Modern interior design

The design of interiors is an exciting career, a fascinating profession that allows life-long personal, aesthetic and intellectual fulfillment (Litchfield, 1893; Despot et al., 2017). Engaging in this direction is an aspiration that builds up and develops our intellectual horizons, but extends aesthetic sensitivity. As shown on Figure 2, internal settlement is a living organism, filled with energy, dynamic, never static. As the world changes, life changes as well, and the internal arrangement is in line with the changes that have been made.

Figure 1. Examples of Eclectic interior


Figure 2. Examples of modern interior

Psychological and sociological needs need to be viewed with greater caution, because the interior design has a huge impact, provoking people the possibility of positive emotions.

The space, the colors, the texture, the patterns, the volume, the balance, the furniture and all the other elements and principles that make us feel and act in a certain way (Gordon, 2015; Indrie et al., 2017; Zlatev et al., 2017). Designing interior is more than collecting colorful pictures from a magazine. It is a process that results in an ultimate creative outcome.

4 Create a contemporary style in organizing space

Each time it carries certain symbols that it recognizes. It can be said that the symbol of the time we live in is the identity, both personally and professionally and visually. Modern identity represents certain characteristics that define the concept of modern furniture, and thus the current approach in the furnishing of modern interiors.

The design is presented not only in the use of new and existing new materials, but also on the demand for bold, unusual forms and expressions and a compelling connection to the styles in history and especially to the bridge called Eccletics.

The same elements correspond to facilities for different purposes - clear boundaries in combinations, no rough definitions do not exist, as some elements do not define destination, residential or commercial, but complement and intertwine in the interior where they are placed and this depends on the creativity of The designer.

New relationships in the education of treatment of architectural elements, the brave approach to furnishing and combining the interior features become synonymous with current designer achievements in the world of interior and organization (Dineva et al., 2011; Nedeva et al., 2013; Zlatev et al., 2018). In residential interiors, the zones continue with each other with emphasis on one another and emphasizes that commercial interiors have traits of interactive places where dialogue is created between the users and the space itself, public buildings get personal symbols that are recognized by them, and this motivates the emphasis of eclecticism Used in different parts of the interior makes the professional specific. Visual identity becomes synonymous with originality and attractiveness, interior awareness and internal editing is expanding, people become aware that the organization of space involves, understand how architecturally and constructively and scientifically it is that this is not just a process of arranging elements Exquisite individuality of the internal volume. Exploitation of the idea of organizing individual homes as intimate and intimate, attractive and dynamic in public catering establishments and retail outlets. The dynamics of life are conditioned by the organization of living space-office, working segments and rooms become components of family units, and comfortable seals replace the typical chairs in the premises designed for service activities. Basic principles in organizing the space with modern furniture and creating a contemporary style: Comformed, visibly moderate and harmonious space. The philosophy of contemporary interior design is based on reconciliation and the time I live in. It seeks to strike a balance between the individual's actions, duties, circumstances. The idea behind the furnishing of the interior is based on the creation of a comfortable, visually moderate and harmonious space, a pleasant atmosphere in which one can spontaneously exist.

In the field of furniture, ergonomics gains a central place, encourages and develops the thinking of functionality and emphasizes the comfortable use. One of the most typical examples is the chairs and the improvement of their characteristics, with the consideration of sitting in a position that is natural for human anatomy, as well as the fact that one spends most of the day in this state. To this end, designers strive to ease and unload a person in this situation, so we are witnessing the choice of chairs and design solutions that are growing every day. The use of materials, economics and the choice of different possibilities of the applied processing theology encourages new ideas and design of furniture.

The consciousness of ecology is also strengthened, while the materials are perceived and treated in such a way. Contemporary considerations and energy are aimed at improving the comfort, rational and flexible on the one hand, and on the other hand returning to nature And strong environmental responsibility. Space as an open whole. Contemporary style is not only about the "cold" and minimalist interior, but it is basically simple, complex, textured materials and a clear definition of the lines. It can be said that contemporary style also represents the focus of space as an open whole, not as a cluster of segments and partial elements. Focusing on such attitudes towards space, shapes and colors, modern interiors operate smoothly, nourished and bright, and the surfaces of the surfaces also choose the dimensions of the elements that are important in the furnishings: the storage and composite elements combined with the size of the space are given Harmony, the beauty of simplicity and the lack of space. The essence of the furniture is in the structure, the unification, the common function, and the final outcome is in the synthesis - aesthetic justification and visibility, not monotony. The most obvious, recognizable element of contemporary style in the design of the interior is the line. The line is a brain, a beginning, a definition, a root, from which the fruit of the design itself develops.

It is located everywhere in the architecture and architectural details and the elements of the main constructions are used as much as possible for aesthetic purposes. Separate parts of the interior no longer hide, on the contrary they are emphasized and emphasized. Clean space between given furniture positions, free or untrained surfaces of walls or ceilings also contribute to the creation of visual identity. The available totals in modern interiors are more widespread, they represent structural, available totals, the ceiling of the minimum number of most functional elements determined accessible in modern design. Every piece of furniture should be marked as a unique and individual piece, furniture and sculptures require a view from all corners, the space around them contributes to a visual impression and emphasis on its meaning.

Contemporary furniture is characterized by lines, pure geometric shapes and constructions, the beauty of the material, from the simplicity of the constructions and the functions derives aesthetics of this style. The furniture is covered in white or neutral tones with a distinctive texture, strives for an ever-increasing use of natural fibers, fabrics and cloth or the achievement of such effects, wool, cotton, jute, so that, in addition to attractive, healthy materials, Give a natural spirit to the interior. In the modern-day interior, white, black and neutral colors are common, and their combination produces sufficient results for commercial and residential spaces. Neutral tones leave room for combining with some contrasting painted segments, so neutral wall colors represent a versatile backdrop for specific furniture, and a protected wall would limit the choice of colors, but eclectic segments are therefore highly expressed, so neutral zidas are the ideal backdrop.

Furniture in modern interiors should be experienced as a puncture in the sentence - a way of apology as the equivalent of the way of the visual experience. Separate pieces and their proper distribution give the room identity and ennoble, and often emphasize, focus attention, sources of illumination in the interior, sometimes there can be found more such sources of light that are usually positioned so do not give one Another one, but to get laid.

5 Contemporary interior and contemporary design trends

The interior design today is an important topic that is being discussed and worked on in every sphere of the public domain. Yes, we have a question about designing our home, working premises, offices, shops, department stores, fashion studios and where not. When it comes to the interior of the homes, recent trends have moved into editing homes according to personal profile, needs and requirements, and within a certain style that corresponds to the character and taste of the owner. The concept of modern interior design requires creative and technical ideas embedded in the idea, structure, and possible insight into the physical aspect of design.

For a design to be good, with it, besides creativity, decoration, beauty and modernity, it must also bring functionality. Most modern interior designs have the property with bright and bright colors, well-lit and spacious rooms and the idea of maximizing the potential of space. This means consistency, clarity and clearer lines in space. In such a space, the minimalist, industrial and Art Deco style prevails. This does not mean that combinations of both styles are allowed at the same time. However, these two styles must be combined with a merger and a point of merger in order not to disrupt the idea and design of space. It is time to update the contemporary minimalist style with an eclectic style of editing. This combination combines historical styles and mystical with contemporary. The background is modern, and the decor is derived from models with historical editing elements or vice versa, but the relationship should be carefully selected. Such a combination of modern semblance with segments of eclecticism makes dramaticness in the living organism, the need to move the shapes in order not to achieve passivity. Therefore, eclectic is an accent for a particular group of users. Trends in house design change very quickly, two decades ago, one direction could last five, even seven years, but today we can expect a new trend every three years. In the economic crisis that most of us feel, the question arises as to how and when to draw a line, while the home looks stylish and functional.

6 Conclusion

Modern interior is sophisticated and elementary, and linear shapes are cleaner. The room is equally important, sometimes even more important than the furniture in it. Modern living requires the interior of the home to fulfill two basic standards - satisfaction of visual effect and maximum comfort. Most modern interior designs have the property of bright and bright colors, well-lit and spacious rooms and the idea of maximizing the potential of space. This means consistency, clarity and clearer lines of space. Modern eclectic-style interiors represent a selection of objects in space that are unrelated, while it is too colorful even feminist. Such is the purpose of having a kind of space in its entirety, like a canvas with painting, to which the eclectic segments are the brush strokes. With this style of editing the goal is space itself to be a unique work of art. Eclectic allows editing to conjure imagination and build a space that matches our character. The proposed methods and tools for training in the field of interior design have the potential to be easily applied in e-learning and distance learning systems in higher education.

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Advantages and disadvantages of virtual and classical training experience gained from COVID-19 pandemic

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Abstract

During COVID-19 pandemic restriction, the Trakia University closed and transmitted education in virtual learning environment using Moodle online platform and G Suit offered free from Google. At the beginning, that situation created shock in academic staff and students. Many professors and assistants did not know would they be capable to cope with requirements of situation or not. However, the governance of university gave immediate support as links for training, orders, definitions how is adequate to continue learning process, how should keep track with students and administration and so on. Moreover, the support and instructions were given to academic who has not been familiar with online platform to learn how to create and spread lectures, exercises, training quizzes, and how to build stable virtual channel with the students. It was needed just one-week and distant online training settled successfully in Trakia University. Because of that pandemic event, the virtual learning environment in the university enlarged and enriched with new digital information and possibilities to conduct lectures and exams through the video connections of virtual classrooms. Both academic staff and students became more familiar to work in digital environment and gain new knowledge. Furthermore, students were strongly engaged to the new situation and were supportive. The students created virtual communities as closed groups in Facebook, Messenger, e-mails, and phone calls. The lecture attendance rose due to epidemic restrictions and the recommendation «stay home, safe life». The distant learning flourished, students showed high responsibility making different homework's and tasks, they were very precise coming on time at virtual meetings, and on the end, the exam results were better. Nevertheless, the real communication was missing them; the advantages were more free time and working from any place where WiFi has.

Keywords: *online education, advantages, disadvantages, COVID-19 pandemic*

1. Introduction

The educational methodologies included *traditional classroom education* with books and blackboards, *modern classroom education* with whiteboards, projectors or audio-visual display equipment and digital boards in classrooms, *online education* using information technologies and communications. The online learning also has various types, as classical knowledgebase lectures and presentations, online support, asynchronous and synchronous training, hybrid training (Basilaia & Kvavadze 2020).

During the worldwide closure of schools and universities coming from coronavirus pandemic situation, the online education was the only acceptable and possible method to obtain education support with high quality, continued learning, diminishing the negative effects of social isolation (Basilaia & Kvavadze 2020; Frieß & Bayerl 2020; Chavarría-Bolaños et al 2020). Closure of learning institutions accelerated the development of the online learning environments (CAE Team 2020). Iwai (2020) reported that after the World Health Organization's designation of the novel coronavirus as a pandemic on March 11, universities across America are shutting down.

The pandemic affected over 114 countries, and led to chaos in university administration and students. The oldest professors cancelled classes, because of weak technical skill, trouble with

WiFi, or simply panicked teaching the full class online (Iwai 2020). The experience of paramedics' school of the City of Munich showed approximately the same result. The pandemic forced paramedic vocational school of Munich fire department and all other German schools to quit classroom teaching. The first step to cope with crisis was fast establishment of video and communication via Microsoft Skype. The virtual classroom fully replaced classroom teaching and all forms of social interactions, teaching methods and assessments were integrated into the virtual classroom. The conducted survey among students considered online homeschooling as a good alternative method of learning in emergencies, even cannot fully replace traditional classroom teaching. The academic governance concluded that perhaps the experience of this crisis could turn out to be the beginning of an innovative complementary teaching strategy (Frieß & Bayerl 2020).

After COVID-19 pandemic, the Faculty of Dentistry in Costa Rica University reported that the key elements in a e-learning environment needed a quick enhancement with virtualization' possibility to better understand, and second, teachers needed further training in the application of virtual strategies (Chavarría-Bolaños et al 2020).

2. Education in Trakia University during COVID-19 pandemic

During COVID-19 extreme situation, the Trakia University took appropriate actions followed the government recommendations, which complied with UNESCO IESALC endorsements for Higher Education Institutions encouraging students to continue learning, despite the temporary closure of educational institutions. The measures included avoiding alarmism or the spreading of false rumours or news, regularly use the website and social networks to promptly and truthfully inform the university community about COVID-19, cancel or postpone international exchange programs or trips abroad, cancel or postpone international academic meetings and conferences, and suspend face-to-face academic activities. The institution adopted remote communication system and was using the online learning platform, i.e. so called virtual learning environment. The virtual learning environment (VLE) has been creating locally in Faculty Techniques and Technology – Yambol during 2008 prior to become part of Trakia University. Hence, facing the lockdown of COVID-19 was much smoother and all students continue learning at distance having online training and support by their teachers. According to UNESCO (2020), from March 30/2020 year, over 166 countries have implemented nationwide closures, affecting over 87% of world's student population, 1.52 billion students, and about 60.2 million teachers have been no longer in the classroom (see fig.1).

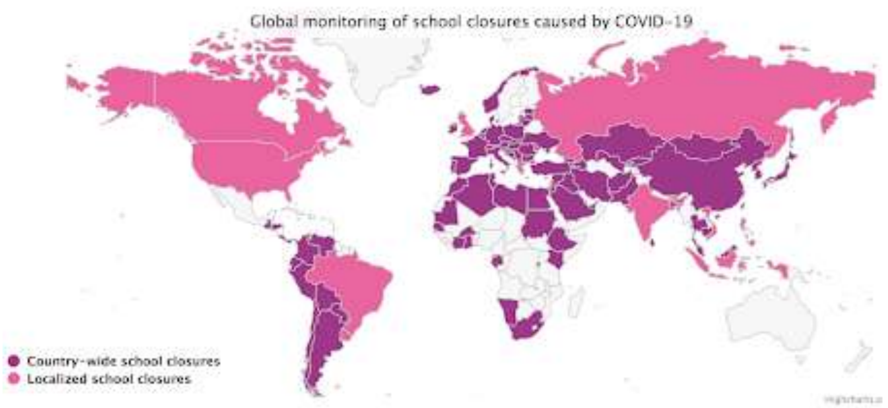

Figure 1 Countries that have shut down or localized the schools in the world (UNESCO 2020)

The instructions in connection with conducting of distance training in Faculty of Technics and Technologies (FTT) were:

1. In connection with the conducting of distance learning and forthcoming accreditation of a distance-learning environment in Thracian Electronic University (TrEU), was recommended all taught disciplines to have electronic courses in TrEU. The name of the course must correspond to the relevant discipline of the curriculum. Discrepancies to be eliminated.
2. The name of the course and the topics in the teachers' reports must correspond to that in e-learning.
3. It was recommended to replace the fully scanned materials published (book, textbook, manual, lecture notes, etc.) in the courses at TreEU with those developed by the teacher. Materials of foreign authors should not be distributed through TrEU. If a resource (book, textbook, lecture, video, etc.) is available online, a link to it can be published.
4. It was recommended that all distance-learning activities to be performed through the website of the TrEU, incl. video conferencing with BigBlueButtonBN.
5. Emailing materials to students and using other e-learning platforms was not recommended. It was desirable that teachers by 16.04.2020 to switch to the use of TreEU or to online training through Google Meet or similar video conferencing applications for conducting classes.
6. Practical and laboratory exercises that cannot be performed remotely should be replaced by others, e.g. partly with seminars, but if possible not to be postponed. A lecturer who proposes postponement of classes shall present the reasons for this in writing to the Head of the Department and the Deputy Dean for Academic Affairs.
7. The requirements of the teachers and the set tasks should not exceed the same as the load during face-to-face training. Tasks such as transcribing lectures and minutes, preparing papers after each lecture, etc. are inadmissible. A large number and volume of tasks and short deadlines should not be allowed. To take into account the fact that with the forms of asynchronous distance learning it is more difficult or not at all possible to master some topics from the taught disciplines.

Some of the working academic staff already was having experience using blended learning as methodology of teaching and learning. Nevertheless, even for them, some of the tools as for example video conferencing was new or not so often used, other just created and start to learn how to use VLE.

Results of different studies shows that the VLE is sufficient and can be successfully used in school or higher education in case of having appropriate technical environment and support (Basilaia & Kvavadze 2020). Also according to Basilaia & Kvavadze (2020), in distant teaching, teachers mainly used desktop screen to share presentation materials. We exerted the same practice, commonly was used video meeting for synchronous communication and education and as consequences of that period is the establishment of many new learning resources.

3. Advantages and disadvantages of virtual learning vs classical

Multiple differences exist between online learning compared to normal, but many authors agree that this type of teaching has more advantages, then disadvantages (Basilaia et al 2020; Ocak 2020; Almuraqab 2020). The enhancement of teaching methods in online learning classroom is one of the core advantages (Ocak 2020). There are tools, such as video conferencing systems, that can ensure the continuity of classes as effective as traditional ones and even more advantageous since they can offer a great deal of content, interaction, reinforcement, and real-time feedback during virtual sessions (CAE Team 2020). The other benefit is that the classes and assessment can be taken anywhere (Iwai 2020).

There are numerous benefits of online learning that are endorsed by many students, especially from part-time students, who have to work and study:

1. Students can acquire their knowledge and at the same time to advance in their careers by having the opportunity to participate in classes asynchronously and to work;
2. The existence of possibility for a flexible schedule for the study sessions, corresponding to their individual needs, and to choose the form of lectures - online in the virtual room offline, when they have free time;
3. Students, as in a distance-learning course, can progress at a pace that suits them, as well as to prepare at a time that is preferred according to their commitment;
4. It is not related to physical presence in the classrooms, students do not need to travel to the university to participate in classes, and i.e. they save time for travel, which gives them more time in the home environment to study or other activities;
5. Through online tuition, without leaving home, students save on transportation costs, especially if they are from a distant destination, from accommodation or dormitory rent, as well as other costs;
6. Online learning requires more skills for self-motivation and self-discipline, which is an advantage for those students who managed to adapt on time and succeed with their preparation.

There are a number of limitations and shortcomings of online learning, some of which are overcome when learning takes place in a virtual environment.

1. The traditional methods of feedback to students in the e-learning environment, but this is to some extent offset by web conferencing. The feedback from students is limited, but if desired, the teacher can achieve a maximum degree of communication to enable questions to be asked by students during lectures and exercises to bring the opportunities offered closer to the present lectures. It is true, however, that the learning process is significantly richer and more motivating in the present training for practical exercises, which depends to the maximum extent on the nature of the course;
2. The conducting of virtual online training can cause social isolation, increased stress and anxiety. This is true, but during COVID-19 it was the only possible way to conduct classes. In other circumstances, combining or alternating virtual with traditional classroom learning would be a good solution;
3. The lack of self-motivation and discipline can cause some students not to complete some courses. In the virtual environment, students have to organize themselves and there is no one to constantly encourage them to achieve their learning goals during classes. The teacher cannot monitor how they are doing, although he or she may offer to share their screen and explain if there is a problem. This requires additional measures and offering advice and assistance to students to continue successfully;
4. Lack of face-to-face communication can cause students to be unable to work effectively. They cannot develop students' communication skills, but this applies to cases where learning is entirely in distance form and not in blended learning, as in TrU.
5. In virtual learning, in some cases, teachers focus more on theoretical skills than on practical ones. The reason for this may be the virtual environment for conducting classes. This is especially true for practical exercises;
6. During the online training it is required to pay more attention to online exams because cheating prevention during online assessments is complicated. For this purpose, FTT - Yambol used secure browsers (Safe Exam Browser and LockDown Browser), video surveillance during the exams with Google Meet and BigBlueButton, various alternative forms of assessment.

The truth is, however, that there are disciplines in technical universities that cannot be taught and mastered without good practical training. For this purpose, a part of the classes at the end of the semester were held in person, in compliance with the anti-epidemic measures and with the participation of a limited number of students. There are also options for the application of virtual laboratories in technical disciplines, if any.

The complicated nature of the technology and the overdependence on technology are listed as a chief disadvantages of online training or any distance learning, because that rise the risk in case of software or hardware malfunction, then the class session will come to a standstill, or can interrupt the learning process in all. The distance learning only limits online education to students savvy to computer and tech (Brown 2017; Basilaia et al 2020; Ocak 2020).

4. Challenges for education in future

The pandemic restrictions diminished economic supply and demand, severely affecting businesses and jobs, generated disruption in educational opportunity worldwide in a generation and the will impact the livelihoods of individuals. Hence, education leaders should adopt a proactive approach contributing to the mitigation of the impact (Reimers & Schleicher 2020).

- *Preparedness of teachers and schools*;
- *Availability of technology*;
- *Adequacy of technology*;
- *Use of technology and preparedness of teachers*;
- *Access to effective online learning platforms*;
- *School practices for using digital devices effectively*;

The impact on education of pandemic is different in dependence from the economy of country under respect. The pandemic forced many countries to invest more in the online teaching delivery, but in developing countries was registered a virtual wash out of educational activities at all level since March 2020 (Yamin 2020). The humanity felt in completely new, unfamiliar situation with COVID-19 pandemic. During April 2020, more than 1.6 billion students were affected, representing over 91% of all students in the world (DeVaney et al 2020). The universities and colleges of higher education closed classical face-to-face education implementing distant, more often synchronous online. The methods of training were transformed to on an untested and unprecedented online distant education (Burgess&Sievertsen 2020). The experts classified the pandemic as a vast, new, worldwide experiment with severe influences on all sectors of life.

The shift of education from traditional classroom learning to distance learning might be one of the largest educational experiments to date because of the COVID-19 pandemic and universities lockdown. The results from 133 responses of online questionnaire showed that 55% of the students liked distance learning, 26% would like to study 100% online, while 49% favour studying through blended learning system (Almuraqab 2020).

The quick transition to the online form of education was successful and gained experience that can be applied in the future. Many other schools and universities obtained the same outcomes (Basilaia & Kvavadze 2020).

5. Conclusions

Even the results from the end of study year were successful and both students and academic staff cope well with the new situation and its challenges, the conclusion is that social isolation influence strongly on education. The classical training has its advantages and many of students need it that organized and supportive method of teaching.

The online training during COVID-19 showed that the advantages that were achieved in this period can be applied in the future. To this end, they will be studied, analyzed and improved to meet modern technology requirements and student needs. Online virtual learning was worth the effort and hard work as it is an almost revolutionary advancement in modern learning.

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Students' activity during online distant training in conditions of COVID-19

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Abstract

The pandemic situation accelerated synchronous and asynchronous online teaching, training, and assessments that enhance students' activity in the virtual learning environment (VLE). Compared with the blended learning the students' activity in the VLE amplifies due to the prohibited meetings and restricted social life replaced with the implementation of a virtual classroom. During quarantine, the students from Trakia University attended virtual classrooms created with BigBlueButtonBN in Moodle or using Google meet. They followed the announcement published online like notice on the course page or on Facebook, or in Messenger. Social isolation did not has an adverse effect on the study process in the university. Controversy, many new online resources were prepared and applied, students and teaching gain new knowledge and experience to work in VLE and communicate through audio and videoconference connections, and meetings. The Trakia e-University well coped with the pandemic situation, following the instructions of governance and using Moodle online platform with well-organized curriculum courses for departments and units, with lectures, e-books and tests for self-training. The academic staff received adequate support and efficient training to use the possible online tools for management and admit teaching.

Keywords: *on-line learning, distant learning, students' activity, COVID-19*

Introduction

The COVID-19 pandemic caused enormous tension, stress and disaster on all kinds of human social activity all over the world, but education was considered less affected, even all schools, kindergartens, colleges, universities, and other educational institutions have been closed. According to Bulgaria's Ministry of Education data, 90% of students have transferred to distance learning and online education. In Bulgaria, the special measures regarding the diminishing of virus spread were adopted on 13 March 2020, and all events involving young people were banned or postponed. People start to live in a new situation that requires them enormous changes and exerted on them a dramatic impact with consequences and still unpredictable end.

Comparing all social spheres of life activities many of which fall in deep crisis, the education remained less affected. Most schools and universities succeed to adapt fast to the novel challenges moving their lectures and courses online. Teaching and student assessments were moving on an untested and unprecedented online scale (Burgess & Sievertsen 2020). The pandemic COVID-19 fast-tracked digitalisation with all its pros and cons, distant online education starts to be applied (https://bnr.bg/en/post/ 101253673/covid-19-bulgaria-goes-online).

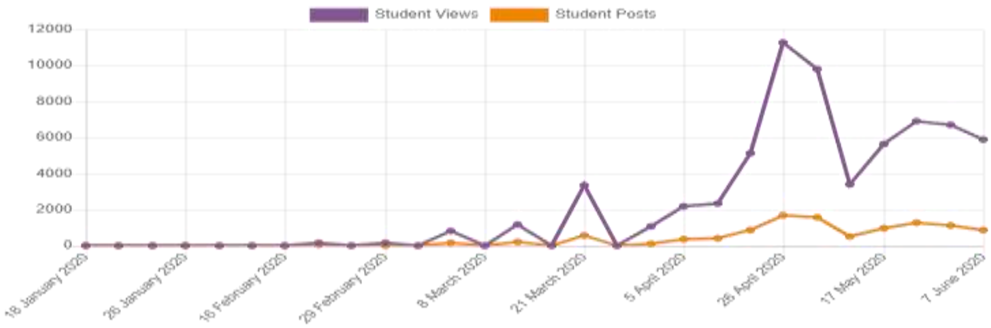
Ordinary, the universities used their existing online distance courses, while the schools created distant connections with pupils using free online education resources supplying from technology companies, for example Microsoft Teams. The recommendations of OECD (Organisation for

Economic Co-operation and Development) were followed for using the existing online distance learning platforms, developing new online teaching platforms (virtual classrooms), collaboration with private educational platforms and international existing online educational resources, using all electronic means as appropriate (streaming lessons on TV), providing teachers with digital learning opportunities (OECD 2020).

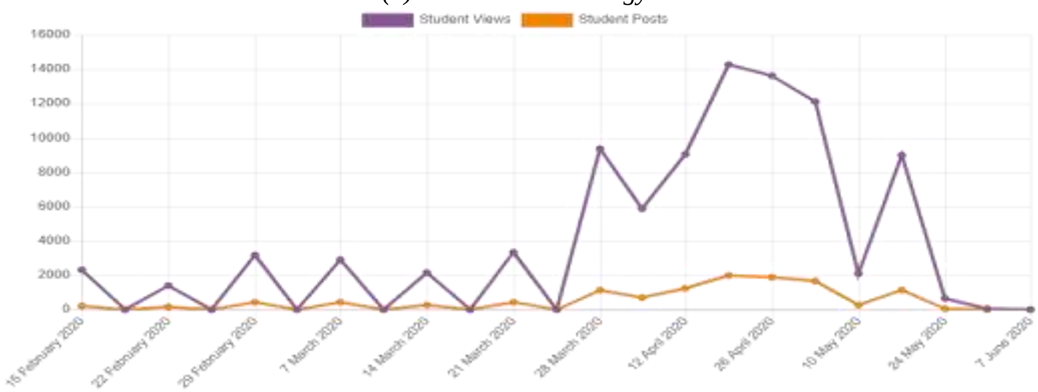
Students' activity during quarantine in VLE

The COVID-19 pandemic, threatens education progress globally, through two major shocks: schools closing and economic recession. According to the World Global Bank tutoring to cope with the crisis, the policy responses should be quickly moved to distant digital learning that mitigates the effects and turns the retrieval into a new opportunity (WBG 2020).

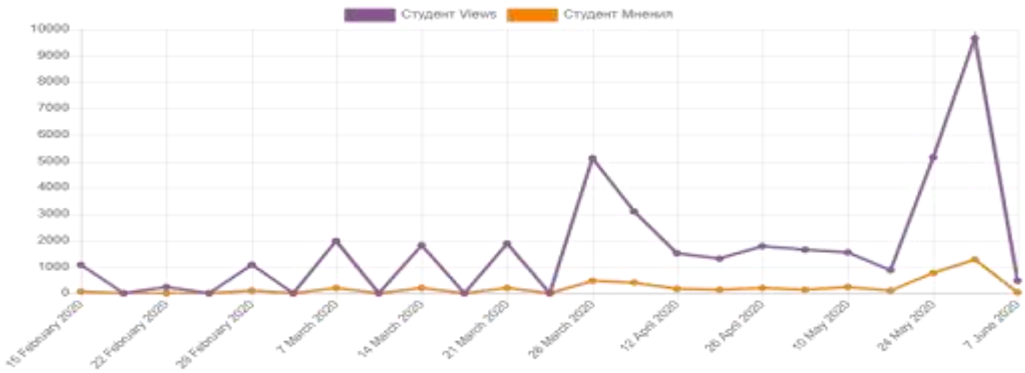
The results in the article are drawn based on the statistical approach available in Moodle for managing the study process using reports for the e-courses of Microbiology, Ecology and Biochemistry. During 60 days of quarantine, the learning process at Trakia University continued using only online teaching, support, and assessments, which correspondingly increased students' activity in VLE like views and posts (fig.1 a, b and c).



(a) Course Microbiology



(b) Course Ecology



(c) Course Biochemistry

Figure 1. Students' activity during COVID-19
(a) Microbiology; (b) Ecology; (c) Biochemistry

The students have plenty of different courses at different days and periods following their curricula, and the students' activity in VLE intensely accelerated after 13 March 2020, with picks well coincident with the appointed meeting from week schedule (fig.1, a, b and c). Mostly the students and teachers intensively start to use virtual classrooms creating through BigBlueButtonBN in Moodle or Google meet, which resulted as increased of students' viewing activity in VLE (see fig. 1a, b and c).

The activity of students using multimedia e-books during COVID-19 also increased (fig.2), it enhances approximately two times in comparison with the pre quarantine period.

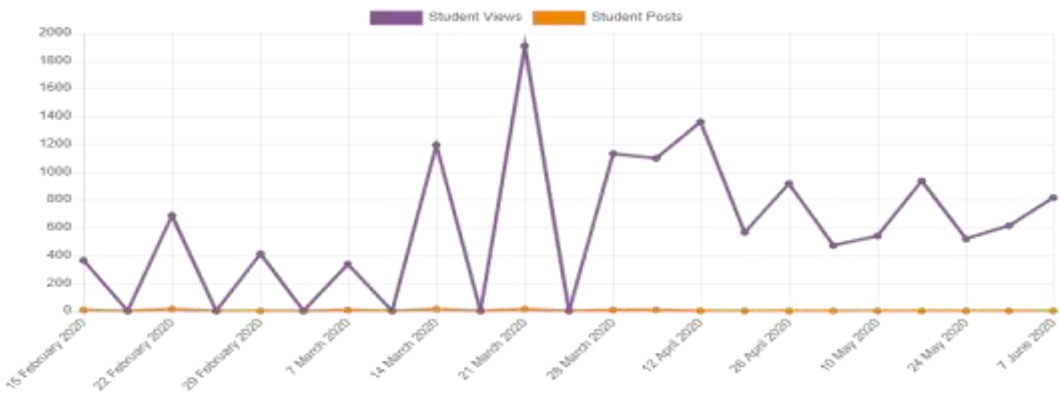


Figure 2. Students using multimedia e-books during COVID-19

According to Basilaia & Kvavadze (2020), VLE is sufficient for schools and higher education to carry the learning process. It supplies numerous forms of distant online learning as knowledgebase courses, online support, asynchronous, synchronous training, online audio and video communication used from the lectors of Trakia University provided to the novel experience.

The analysis of the student activity during the pandemic of COVID-19 in the second semester in the courses Introduction to computers and programming (C ++) and Web programming (JavaScript) in FTT - Yambol can be summarized as follows.

The lectures and workshops were held online in a virtual classroom using web-based learning platforms. The Trakia Electronic University (TrEU) based on Moodle offered additional video lectures and materials to students, visualizations of algorithms, and solved tasks. To have feedback with them, the following was done:

Activity 1: Attendance at online lectures, which were held with Google meet as part of G Suit for education - Registration of Trakia University (www.trakia-uni.bg);

Activity 2: Assignment of individual tasks for writing program code, which each student had to solve by the deadline and upload the program code and a screenshot of the solution of the task in TrEU;

Activity 3: Ongoing tests for the study material, which covers the theory and practical knowledge that students must have.

The individual C ++ programming tasks aim to increase and develop the practical results and skills for dealing with non-standard algorithms. The group of students in the course Introduction to computers and programming consists of 21 students, of which 14 (67%) have submitted their completed tasks by the deadline, which is a satisfactory result. The others were allowed to present the solutions of their tasks later to the end of the semester.

To activate and accelerate this feedback, and to increase student achievements, additional incentives were provided for those who coped successfully. Everyone's work was evaluated individually by commenting on each presented task and digital or point evaluation of the achievement. As an additional encouragement for the best decisions made on time, points are given that increase the student's chance of being released from the semester exam.

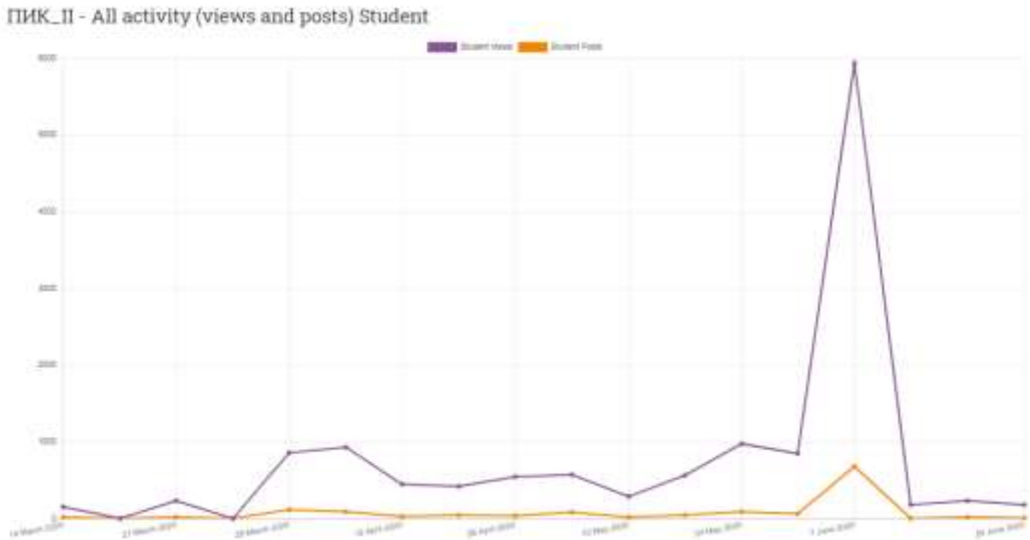


Figure 3. Student's activity in Subject Introduction to computers and programming during COVID-19

The analysis of the activity in Fig.3 shows that the greatest activity of the students was during *Activity 3*, i.e. the tests at the end of the semester 7-14.06.2020; on the second place was *Activity 1:* the online lecture attendances; and on the third place *Activity 2*. The conclusions were made during the semester and this activity was given special attention. Online visualizations of solved tasks were offered to the students through the website http://pythontutor.com/ to be able to follow the solution step by step and to cope with the tasks for independent work (Fig.4).

There is a similar situation in the Web programming course (Java Script). The tasks assigned to the students were for different periods and with different deadlines. Out of a group of 16 people, 11 submitted the JavaScript tasks in time, i.e. about 69%. To improve this result, solved sample tasks were proposed for each lecture. The approach of using examples with visualization of the solution divided into steps is also applied here (Fig.4).

In both courses to each lecture is offered solved sample of programming tasks that facilitates students' preparation, both for the practical exercises and for the semester exam. Part of sample tasks contained in addition to the program code as a block diagram of the algorithm for the solution; a video clip for a creating the program or additional explanation to the condition of the task.

In some cases, there is a visualization of the computer program presented in steps of implementation (created in the online platform http://pythontutor.com/), embedded in TrEU. Students have the opportunity to repeatedly perform the program or some steps of it by observing what happens in the Stack or Heap of memory (or Frames and Objects) at each step: e.g. how to enter the values in the individual elements of the array; how the memory cells change for the defined variables; what is printed on the console, etc. In Fig.4 can be seen that the steps for the implementation of the program are 87; the current step is 64; the console and the contents of the memory at the time.

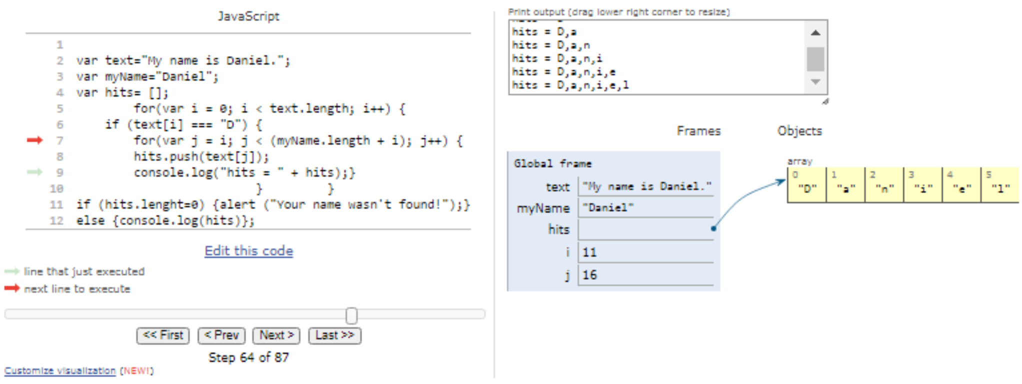


Figure 4. Visualization of the program embedded in TrEU.

Students and teachers remarked that received more homework's using online training. The tools as online schedule, Facebook, Messenger, direct phone calls, or emails have been successfully used for the organization of the study process. Attendance raised on the online virtual classes, and was approximately 90%, for the study courses.

Conclusions

The FTT– Yambol, in Trakia University well manages transitions of traditional to online education in a pandemic situation, following the instructions of governance, using Moodle online platform with well-organized courses and support materials, including lectures, e-books and tests for self-training and assessment. The academic staff and administration received adequate support and efficient training to use the possible online tools to manage and admit teaching. Therefore, the conversion of traditional to online education was successful. The social quarantine did not exert a negative impact on the learning progress. Controversy, many new online resources were prepared and applied, students and teaching gain new knowledge and experience to work and connect in

VLE through audio and videoconference connections, and meetings. Moodle's statistics revealed that pandemic situation speeded synchronous and asynchronous online teaching and increase students' activity in the virtual learning environment.

During the quarantine, all various methods of online learning have been applied, from the lectors of Trakia University, which immediately received instructions on how properly to work, attend online forums, some of the additional training. Consequently, the existing VLE in e-Trakia University enriched with new resources and novel tools. The teachers and students gained new knowledge and experience useful for the future. Students' enrolled online learning system successfully pass exams. Nevertheless, the excellence of learning online needs further examination.

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The boost of environmental study on last decades

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Abstract

The lockdown of COVID-19 has many severe influences worldwide on different spheres of social life, including education, business, economics, and the environment. Many ecologists prior to the virus pandemic disaster had warned about the high crisis levels of air and water contamination and evidence of climate changes.Immediately, after the first month of social isolation with the decreasing transport intensity and the industrial emissions, the registered results were harmful components reducing in the atmosphere, as well as in the water. The pandemic situation boostcollaboration of scientists and researchers all over the world with the common goal to reduce the negative impact of that human tragedy.The experience that was gained giving hope that with the common efforts the humankind can find the proper way to put the effort in the right direction for its development. The paper introduces and reveals the new sources base on the big Data services gathering information from satellites that are useful for researchers and further education.

Keywords: *air and water quality, Earth observations, COVID-19*

Introduction

The last decade is remarkable with the enormous attention growth to climate change and urgency appeals addressed to global warming and the importance to combat with those impacts for the protection and survival of animal species, oceans, food supply, and public health (King et al 2015). The scientists from NASA and NOAA noticed that the last five years were warmest in recorded history (Ebbs 2019a). EPA administration mentioned that the quality of water and the ocean is even in a greater environmental crisis than climate change (Ebbs 2019b). Scientists from all over the world agree that actions to prevent the threatens from climate change must be immediately taken (King et al 2015). In relation to that, the boost of environmental observations and actions toward mitigation of climate change took place and escalation of social opinion supporting government engagements was registered (Ebbs 2019b). There are also registered a growing literature on environmental technology dispersal and policies that encouraging their use (Popp 2019). For example, the Trump admin invested \$1.2B in oceans to support a "sustainable blue economy" and to slow down climate change (Finnegan & Ebbs 2019). Thus, the technology progress happening at a notable speed but still not fast enough to meet the 2˚C constraint (King et al 2015).

The Paris agreement has been adopted from almost every nation in the world, April 22, 2016 (Jacobo et al 2019), giving remarkable incitement toward the environmental observations and research, the full ecological effect is expected in 2020 (Andresen et al., 2016), that overlapping the COVID-19 pandemic effect on the environment.

Gathering data and decision making

Gathering data is an essential stage for science, policymakers, management, and economic well-being (https://www.ecoinformatics.org.au/our_data). Nowadays, huge information exist in collecting data from remote observations. Numerous web sites supply vast earth and biological data, available free for research and education. For instance, USGS is a science agency that collects, monitors, analyses, and provides science about natural resource conditions, issues, and problems to decision-makers (https://www.usgs.gov/about/about-us/who-we-are).

The validation of computer simulations includes an assessment of the predictions, estimated as a probability and ability (Borrellia et al 2020). The data and information are accessible both spatially and geographically including The National Map, Earth Explorer, GloVIS, Landsat Look, and much more (https://www.usgs.gov/products/data-and-tools/gis-data). During the last decade, the environmental science research community, with the support of NSF settled various environmental observing systems, as EarthScope, the National Ecological Observatory Network, and the Oceans Observatory Initiative (Montgomery et al 2020).

The environmental data for consumers are accessible through the global internet search services. On fig.1 are represented Google searching inclinations for documents containing words “air pollution”, “water pollution” and “global warming”, which reflect social interest.

Figure 4Google trends in gathering information about “air pollution”, “water pollution” and “global warming”

According to Anderegg and Goldsmith (2014), tools such as Google Trends can be useful and with great value for assessment of public activities toward different subjects, as they are based on big data accumulation from observations and revealed the research interest and education efforts.

The last 5 years are remarkable with picks toward air pollution and global warming (fig.1). Cellphone data, satellite imagery, and news stories may complement Internet data to address some of the limitations for forecasting and to provide additional information for researchers (Del Valle 2020).

a. Covid-19 Earth Observation Dashboard

On June 25, 2020, "Covid-19 Earth Observation Dashboard" has been released as a collaboration between NASA (the US, National Aeronautics and Space Administration), ESA (European Space Agency), and JAXA (Japanese Aerospace Exploration Agency) to unveil the global consequences of Covid-19 (Gorey 2020; IANS 2020; India Education Diary 2020). That collaboration is a notable opportunity for researchers and educators, which with the help of different economic, agriculture, and environment indicators, applying proper analytical tools can monitor air and water quality, climate changes, disasters, economic and agriculture activities by using current and historical data from satellites observations (Gorey 2020; IANS 2020). Moreover, that can directly reveal how the Covid-19 pandemic affects all areas of human life, and to serve as a tool for assessment of hypothesizes, to evaluate forecasting computer simulation models, to build and submit a proper prophesies for the future generation.

NASA and its partner space agencies have unique capabilities in different areas of science and technology. ESA contributed data from the Sentinel missions (Sentinel-1, Sentinel-2, and Sentinel-5P) in the context of the European Copernicus program with a focus on assessing the impact on climate change and greenhouse gases, as well as impacts on the economic sector. JAXA is making Earth-observing data available from its satellite missions, including ALOS-2, GOSAT, GOSAT-2, GCOM-C, GCOM-W, and GPM/DPR.

b. NASA's Earth science missionsand Space Apps COVID-19 Challenge

NASA uses airborne and ground-based monitoring, develops new ways to observe and study Earth, and shares this knowledge with the global community around the world that contribute to understanding and protecting the planet (Cole 2019).

The Space Apps COVID-19 Challenge is a special edition of NASA's annual Space Apps Challenge to examine the human and economic response to the virus. Since 2012, NASA organized every October online virtual meeting of specialists and innovators from all over the world, which have unordinary thinking and huge ideas willing to share with humanity. During a period of 48 hours, more than 15,000 participants from 150 countries created more than 2,000 virtual teams that by used Earth observations and other open data sets were proposed solutions to challenges related to the COVID-19 pandemic (https://covid19.spaceappschallenge.org; Cole et al 2020).

Space Apps 2019 included around 29,000 participants, and 225 events in 71 countries, more than 2,000 hackathon solutions were developed over one weekend (https://covid19.spaceappschallenge.org/). Space Apps 2016 had 26 challenges in the fields of Technology, Aeronautics, Space Station, Solar System, Earth, and Journey to Mars. The most popular challenges included creating a crowdsourced platform to compare environmental changes with symptoms of respiratory disease, building an educational app to help young students locate the moon, developing an app to support local drone operators (https://2017.spaceapps challenge.org/blog/nasas-international-space-apps-challenge-why-you-should-participate).

The next annual Space Apps Challenge is scheduled for October 2-4, 2020.

c. ESA and Copernicus- Global Monitoring for Environment and Security

Copernicus is a European Programme for Earth Observation for benefit of all European citizens. The Copernicus Services gather a huge amount of information for the Atmosphere; the Oceans; the Land; the Climate change; the Security; and Emergency.

Since July 2015, the Copernicus Atmosphere Monitoring Service (CAMS) provides continuous data in five main areas: air quality and atmospheric composition; ozone layer and ultra-violet radiation; emissions and surface fluxes; solar radiation; and climate forcing. In the context of the worldwide COVID-19 crisis, there was increased interest in changing air quality, and CAMS was continually monitoring air quality in Europe and around the world using satellite and ground-based observations and advanced numerical models (https://www.copernicus.eu/en/services/atmosphere).

The CAMS is a part of the Copernicus EU Programme managed by the European Commission (EC) and implemented in partnership with the Member States, the European Space Agency (ESA), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), and the EU Agencies and Mercator Océan.

The Copernicus EU Programme is a set of European information services based on satellite Earth Observation and in-situ (non-space) data. CAMS monitoring and forecast systems, global and regional (Europe), combine information from detailed numerical models of the atmosphere with satellite and ground-based (in situ) observations through a process called data assimilation. The main aim of this approach is to combine the strengths of observations and models, and to minimise the weaknesses of the information sources.

CAMS provides estimates of climate forcings separately for carbon dioxide, methane, tropospheric ozone, stratospheric ozone, interactions between anthropogenic aerosols and radiation, and interactions between anthropogenic aerosols and clouds.

d. JAXA for Earth – Earth Data Collection by JAXA Satellites

JAXA monitoring area covers Global; Around Japan; Asia; and Polar Region, with research field of observation: Land; Ocean and Sea; Atmosphere; Forest; Forest fire; Earthquake; Tsunami; Volcano; Rainfall; Typhoon Hurricane and Cyclone; Flood; Landslide; Drought; Ice and Snow; Climate; Greenhouse gases. The applications vary, as Disaster; Infrastructure; Weather; Agriculture; Fishery; Logistics; Energy; Public health; Education; Design.

AMSR Earth Environment Viewer provides global observation images and data by Advanced Microwave Scanning Radiometer (AMSR) series on-board GCOM-W etc.,available in near-real-time, visualization and download with user customize. JAXA for Earth on COVID-19 monitors the earth's surface to detect the changes on global environment and human society that related to COVID-19. This site introduces the latest observation and analysis results.

G-Portal allows users to search and download products acquired by JAXA's Earth observation satellite. JAGMAP provides environmental data for agriculture observed by using JAXA earth observation satellites. JPMAP delivers environmental data for public health observed by using JAXA earth observation satellites. JASMES for water cycle provides the images on global water cycle observed by GCOM-W etc.

Environmental impact of COVID-19 isolation

e. Improved air and water quality

Greenhouse gases in the air as carbon dioxide and nitrogen oxide (NO_2) were the first registered obvious changes after first three months of quarantine,as nearly half the world was told,"stay at home" (fig.2).The new dashboard brings together current and historical for comparison air pollution datafrom two NASA and ESA satellites (Gorey 2020).

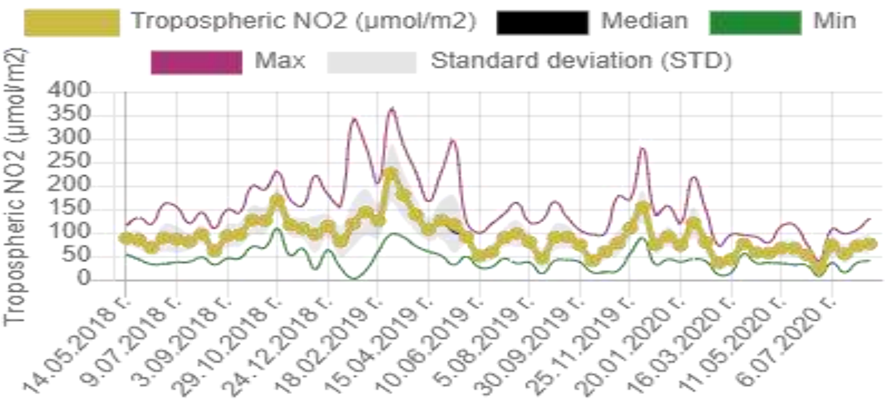

Figure 5Paris (TROPOMI), Air Quality

In Madrid, Milan, Rome, and Paris, for example, TROPOMI data show about a 50% reduction in NO2 from March 13-April 13, 2020 compared to the same months the year before. These reductions coincide with the implementation of strict quarantine measures across Europe. According to Le Quéré et al 2020, daily global CO_2 emissions decreased by –17% (–11 to –25% for $\pm 1\sigma$) by early April 2020 compared with the mean levels of 2019, and mostly from registered surface transport pattern changes, as well as, at their peak, the emissions in different countries reduced by –26% on average (Le Quéré et al 2020). Sulphur dioxide concentrations in India have been decreased by around 40% between April 2019 and April 2020, according to data from the Copernicus Sentinel-5P satellite (https://maps.s5p-pal.com/cases/).

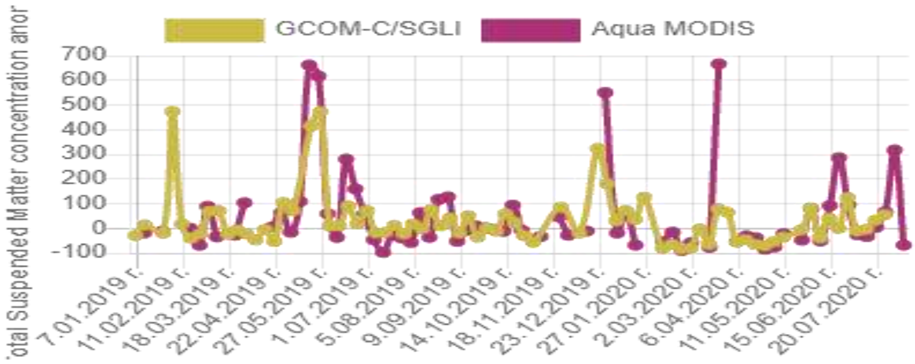

Figure 6 Total Suspended Matter concentration anomaly - Venice, TSM, Water Quality Time Series

The Water Quality Index (fig.3) are designed to assess the effect of the lockdown and the subsequent recovery on inland and coastal waters by monitoring the Total Suspended Matter concentration measured from optical sensors onboard the three agency's satellites, namely Sentinel-3 (ESA), GCOM-C (JAXA) and Aqua (NASA). Water quality changes are associated mainly with human activities, such as industry and tourism. The dashboard presents targeted satellite observations from all three agencies of total suspended matter and chlorophyll concentrations (Gorey 2020).

Conclusions

Humanity faced the global ecological crisis and many researchers alarmed that we are very close to the "point non-return". Many innovations and technologies took placed in education, collection of data, monitoring the ecological systems and in the decision-making process. Hence, the last decade those circumstances boost the environmental observations, executing the innovative technologies to diminish the consequences of long-scale improper use nature and arrogant politics.

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Organizing virtual training- experience gained from COVID-19 pandemic

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Abstract

During the COVID-19 pandemic,the Trakia University gained enormous experience in how to organize and conduct virtual training.The university was closedlike most universities all over the world and education wastransmitted through the virtual learning environment using the possibilities of Moodle online platform, Google Meet, and BigBlueButton. This report presented the organization of student education during COVID-19. The special attention is paid on Google Meet and BigBlueButtonapplications, which were applied in distance learning foronline video meetings.A comparison is made between the two applications with an emphasis on their specific use: the similarities of Google Meet and BigBlueButton are indicated; functionalities that are common to both applications but performed differently; the advantages of Google Meet in comparison to BigBlueButton for FTT - Yambol; the advantages of BigBlueButton. In connection with the way of conducting the training, the advantages and disadvantages of virtual learning vs classical are analysed. The results of the students' opinionsneed to be analysed with a view of further improvement and successfully applying the form of distance learning in FTT - Yambol.

Keywords: *online education, advantages, disadvantages, COVID-19 pandemic,Google Meet, and BigBlueButton*

Introduction

During COVID-19 quarantine, the Trakia University took appropriate actions followed the government recommendations, which complied with UNESCO IESALC endorsements for Higher Education Institutions encouraging students to continue learning, despite the temporary closure of educational institutions. The institution adopted remote communication system and was using virtual learning environment. Trakia University governance encouraged faculty members to use all conceivable distant delivering of lectures and training support, synchronous and asynchronous, using Google meet, Microsoft Teams, BigBlueButtonBN, e-mails, social set of communication as messenger, Facebook and phone calls. One of the biggest challenges and new experience for faculty members were perhaps the examinations on the end of academic year.

Organization of the online learning process during COVID-19

During the period of required social isolation, the OECD published a framework to guide education responses to the COVID-19 pandemic. The guidance aims to support education leaders to accept the right choices and implement effective education responses. The plans and strategy for applying alternate modalities and mitigate the impact of a pandemic should be developed very quickly from the governance of education to prevent severe learning damages for students and protect the opportunity to study during this period (Reimers & Schleicher 2020). The main points to guide the development of an education strategy during the pandemic included:

- establish a task force or steering committee that will have the responsibility to develop and implement the education response;

- develop a schedule and means of frequent and regular communication among task force members;
- describe the principles which will guide the strategy;
- re-prioritize curriculum goals and define what should be learned during the period of social distancing;
- categorize the feasibility of pursuing options to recover learning time once the social distancing period is over;
- recognize means of education delivery that should include online learning or other secure variants;
- undoubtedly define roles and expectations for teachers to effectively steer and support students' learning in the new situation;
- boost communication and collaboration among students to foster mutual learning and wellbeing;
- define appropriate mechanisms of student assessment during the exigency;
- develop a communications plan and key messages to support the execution of the education strategy (Reimers & Schleicher 2020).

On 13 March 2020, Trakia University closed doors and quickly transformed all communications and learning processes to all possible distant forms.In the beginning, that situation created a shock in academic staff and students. Many professors and assistants did not know will be capable to cope with the requirements of the situation or not. The governance of the university gave immediate support as links to virtual connections, orders, definitions of how is adequate to continue the learning process, how should keep track ofstudents and administration, and so on.Moreover, the support and instructions were given to people who havenot been familiar with the online platform to learn how to create and spread lectures, exercises, training quizzes, and how to build a stable virtual channel with auditory. It was just one-week need and distant online training settled successfully atTrakia University. Because of that pandemic event, the virtual learning environment in the university enlarges and enriches with new study digital information and the possibility to conduct lectures and exams virtually through video connections of virtual classrooms. Both academic staff and students became more familiar to work in a digital environment and gain new knowledge. Furthermore, students were strongly engagedinthe new situation and were supportive. Students created virtual connection as closed groupson Facebook for communication, used Messenger, e-mails, phone calls. The attendance to lectures rose due to banned movements and the recommendation «stay home safe life». The distancelearning flourished, students showed high responsibility for making different homework and tasks, they were very precise coming on time at virtual meetings, and exam results were better atthe end. Nevertheless, the real communication was missing for them; the main mentioned advantages were more free time and work from any place where WiFi has.

Application of Google Meet and BigBlueButton in distance learning through online video meetings

Upon the outbreak of the COVID-19 pandemic, Faculty of Technics and Technology (FTT) – Yambol atthe Trakia University of Stara Zagora, quickly and in an organized manner took measures to conduct online distance learning. To this end, a series of online seminars with teachers were held.Moreover, written instructions were prepared and spread with all possible ways of conducting the classes. A special video was developed and distributed on how teachers can use Google Meet for their learning purposes, organize their students, and invite them to lectures with various Google applications from the G Suite for Education with www.trakia-uni.bg. In FTT - Yambol students have their lectures, available asynchronously through http://edu.uni-sz.bg

(TrEU. Some lectures are supported by additional videos and visualizations. During the pandemic, students were studiedwith synchronous meetings; they were able to ask questions; they can discuss and comment on the answers of the teacher and their colleagues.

In some cases, it is practiced to record the online lecture and make it available to students for re-viewing if necessary or to make it available offline to students who were unable to attend in person.

FTT focuses on the use of Google Meet and BigBlueButton because on the one hand Google Meet with its maximum capabilities is provided free of charge to the university through G Suite for Education. On the other hand, TrEU, based on Moodle, has a BigBlueButton plugin installed, which allows its use built into the Moodle environment.

f. Google Meet of G Suite

Google Hangouts is Google's longest-running messaging and video chat service, from June 2020 this service will only be offered to consumer accounts, anyone with an @gmail.com or @googlemail.com email address. Google Meet, previously named Google Hangouts Meet, is Google's premium video conferencing software, provided as part of G Suite. There is also a free version of Meet. Google Meet is similar to the video chat service provided in the consumer Hangouts but supports far more participants (Justin Pot 2020).

Due to the COVID-19 pandemic, Google provided enterprise-grade video conferencing available to everyone. Each user with a Google account was able to create an online meeting with up to 100 participants and meet for up to 60 minutes per meeting (up to 24 hours per meeting to Sept. 30, 2020). Businesses, schools, and other organizations took advantage of advanced features, including meetings with up to 250 internal or external participants and live streaming to up to 100,000 views within a domain (Javier Soltero, 2020).Hangouts support only up to 25 participants' video calls. Google users head to meet.google.com can start an appointment, or appointments can be booked in advance using Google Chat or Google Calendar. As of April 2020, G Suite had 6 million paying businesses, (Jordan Novet 2020) and 120 million G Suite for Education users (Zach Yeskel 2020).Google Meet offers collaboration anywhere, because documents, spreadsheets, and presentations could be co-edit, in real-time by using Docs, Slides, Sheets, Drive, Jamboard. The communication we can apply by your way with Gmail, Meets, and Chat. When we use the classroom of G Suite we can connect our classroom with email, chat, and video. For classroom management, were created classes, made assignments, givequizzes, and save time grading using Classroom, Assignment, and Forms. For organizing the tasks, the users can build to-do lists, create task reminders, and schedule meetings using KeepandCalendar. With administrative software Admin,the users can scale confidently - manage students, devices, and security so data stood safe and scaled as needed.

g. BigBlueButton

BigBlueButton is an open-source video conferencing system for online learning. This project started in 2007 and reached a high level of maturity, as the code has been completely rewritten. BigBlueButton supported advanced virtual board capabilities and allows the maintenance of multiple audiences and the exchange of video with the ability to present.

Students participating in the virtual room can "raise their hands", use emoticons, participate in surveys. Many other features make the app attractive for a virtual classroom. Integration with Moodle is one of the very valuable features in addition to online education.

From a business perspective, using a video conferencing tool, BigBlueButton allows improving internal operations, mixed education, customer and provider support services by making all communications flexible and accelerated.

h. Similarities on Google Meet and BigBlueButton

Google Meet and BigBlieButtonhave quite common features that make them useful for online web conferencing:

- They work on Operating Systems Windows, Mac, and Linux;
- Audio and Video support;
- Desktop Sharing;
- Cloud-based;
- Host Meeting from Mobile.

This makes them especially useful and preferred by schools and businesses during COVID-19.

i. Functionalities that are common to both applications but are implemented differently:

• *Recording capabilities* - Google meet provides the ability to record a video lecture without the user to fear about a server outage or other technical problems that would disrupt it.Therefore, Google meet works independently of the server on which the e-learning platform ofTrEU is uploaded.When BigBlueButton is installed on a university platform as in Trakia University, then problems may arise and it may work at some point - neither for communication nor for recording the online lecture.If synchronous sessions are used and recorded they should be downloadable so students with slower Internet speed or no reliable method for connection to be able to download them where they can find good connections and watch these videos later.

• *Breakdown rooms* - the moderator in BigBlueButton can select and redirect users to a new room to divide into smaller discussion groups.Themaximumnumberofroomsis 8. This can also be done in Google Meet and Jamboard of Google app by inviting some of the participants to a new virtual room and mute the microphone to them.

• *Cloud Storage* - unlimited storage for Google Meet of G Suite.

• *BigBlueButton* - features for the enterprise-level plan include up to 200 meeting participants and unlimited cloud storage.

j. The advantages of Google Meet compared to BigBlueButton for FTT - Yambol:

Comparing Google meet and BigBlueButton we find that most of the academic staff of FTT have used Google meet. The reasons for this can be summarized as follows:

• Students can be invited for a video conference call via Chat or Google Calendar. This allows pre-booking a room with an ID or code. Thus, it is not necessary to send an invitation to the participants at the last moment, but to plan well before the beginning of the session;

• All participants have equal rights to share the screen or application window they want to present to their colleagues. Everyone can do this simultaneously and each participant can pin some of the others they want to watch. Users do not need to have rights from a Moderator, as with BigBlueButton;

• Each participant in the virtual meeting can control the look and layout of their screen differently from the others;

• The initiator of the virtual meeting can control the microphones only to turn them off, but cannot turn them on again - only the participant in the meeting does this;

• Video conferencing can run in parallel with the secure Safe Exam and LockDown Browser, which are used to conduct online exams.

k. The advantages of BigBlueButton over Google Meet:

The advantages of using the BigblueButton are also important, which is why they are preferred in some cases to Google Meet:

•Third Party Integration like Canvas, Drupal, Moodle, WordPress etc.(https://bigbluebutton.org/integrations/2020);

• Whiteboard and Multi-user Whiteboard - BigBlueButton supports many users to use Whiteboard at the same time. The management and the deletion arein the functions of the moderator that is performed for all participants. The user can only delete his notes. The recording format allows all users' notes to be recorded and played back;

• Shared Notes and Text Formatting - to make learning more effective, it is possible to keep "shared notes" during the online session, which are available to all participants. The shared windows allow users to apply formatting changes (font, font size, and style) to any of the text in the shared notes;

• Download Shared Notes - users can download the shared notes as plain text or HTML, which will be available to them later;

• Enable Presentation Download - the presenter can allow users to download the presentation;

• Promote Viewer to Moderator - moderators may additionally grant moderation rights to other participants in the video conference call.

Conclusions

The conclusion is that both applications, Google Meet and BigBlueButton are equally good for organizing virtual conferencing in FTT - Yambol and were effectively used. They were implemented along with TrEU (http://edu.uni-sz.bg), based on Moodle, with all its resources and activities for students. Google Meet and BigBlueButton were used for video surveillance when online tests were conducted; the semester and state exams were performed in Moodle with secure browsers - Safe Exam Browser and LockDown Browser.A survey and interviews for performed online classes were conducted. The results of the students' opinionsneed to be analyzed with a view of organizationimprovement and better conducting the form of distance virtual learning in FTT - Yambol.

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Application of Mobile Devices in Distance Learning

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Abstract

The possibilities for using mobile devices, such as tablets and mobile phones, for the analysis of the condition of food products, are a prerequisite for the development of methods, technical means and methodologies for their use in educational activities. This article proposes methods and tools for obtaining, processing and analyzing data on the condition of eggs using mobile devices. Spectral characteristics of hen eggs, as well as of quail eggs were obtained. Examples of the results application of the present elaboration in distance learning of students are presented. In case the proposed methods and tools are used, the whole process of obtaining, processing and analyzing spectral characteristics can be monitored and shared with learners – it is enough just to have a mobile device with Internet access.

Keywords: M-Learning, Distance learning, Spectral characteristics, egg yolks, mobile devices

1 Introduction

The training, formal or informal, is realized using mobile devices. It is essential that educational technologies are focused and adapted to the needs of the present times (Govindasamy et al., 2019; Liu & Zhang, 2019). In the context of a complicated epidemiological situation in 2020, this form of learning has been imposed in a number of countries (Gómez-García et al., 2020; Liu, 2020). More and more pupils and students who take part in the distant form of learning use their mobile devices (Zlatev & Baycheva, 2018).

A growing interest in the application of mobile technologies is observed in the field of obtaining, processing and analyzing data in regard of the condition, composition and properties of food products. Using a “measuring” tool, which is always at hand, is of interest to mobile users (Zlatev & Baycheva, 2017). Through the mobile applications developed in recent years, an express analysis of the color, spectral characteristics, and product type recognition can be performed, using the video camera of the device as a data source (Gábor & Péter, 2015; Gómez-García et al., 2020).

The possibilities for using mobile devices, such as tablets and mobile phones, in the analysis of the condition of food products, require the development of methods, technical means and methodologies for their usage in educational activities, either in technically oriented specialties in the field of engineering or in the training of food technology, animal husbandry, plant growing, and ornithology specialists.

One of the products for which mobile applications for analysis have been developed is bird eggs. They are the subject of research and training of specialists in the field of food technology, poultry farming, and ornithology.

The application of mobile devices is among the other, already traditional, methods for obtaining basic eggs characteristics. During the training of specialists for analysing these products it is necessary to develop methodological models, software applications, use methods for data processing and analysis and their introduction into the curriculum in order to increase students' interest in the subject area, their technical culture, literacy, knowledge and competence in terms of recognition, implementation, perception of information received, product recognition condition and building skills for independent work.

The purpose of this paper is to propose methods and tools for obtaining, processing and analyzing data on the eggs' condition, using mobile devices.

2 Exposition

In the present study, the object of research on the possible usage of mobile devices in the analysis of eggs and training in this area is the egg yolk.

The properties of egg's yolk are an element of the trading eggs' grading. The main indicators of the yolk are color and its index, related to its geometric dimensions (Lukanov et al., 2019).

Table 1 shows data from a study on the importance of egg yolk color in various fields of science and practice. Significance for consumers and that for food technology, poultry and ornithology is included.

Table 1. Importance of egg yolk color

From the point of view of	**Importance**	**Source**
Consumer	Preferences depend on the country in which the eggs are traded. The color of the yolk is a key indicator of its quality, according to consumers	(Alikhanov et al., 2017)
Food technologies	Nutrient content. Application as a raw material in food products	(Titova et al., 2015)
Poultry farming	Influence of bird nutrition on the external and internal characteristics of the yolk	(Lukanov et al., 2019)
Ornitholog y	Influence of the region and living conditions of birds on the yolk composition and properties	(Alikhanov et al., 2017)

The yolk color is determined by comparison with a standard. Different color scales have been created, with Roche and DCM being more commonly used (Titova et al., 2015).

Technical software that can be used in mobile devices such as a phone or tablet is divided into the following groups:

- ✓ Specialized. They use a model of the standards for the yolk color and the obtained values for the color are compared with it;
- ✓ With general purpose. Such are colorimeters that measure color in a specific color model.

Each of the two groups contains two subgroups:

- ✓ Software based. It uses the video camera of the mobile device as a source of color data input;
- ✓ Using an external color sensor. The sensor uses a wireless connection to the mobile device, for example via WiFi or Bluetooth.

The advantage of yolk color measurement systems that use an external sensor over those using a mobile device's camcorder is that the measurement becomes more accurate due to the lower degree of influence of ambient light and the measurement distance on the received data. The disadvantage is that a separate device is used outside the mobile phone.

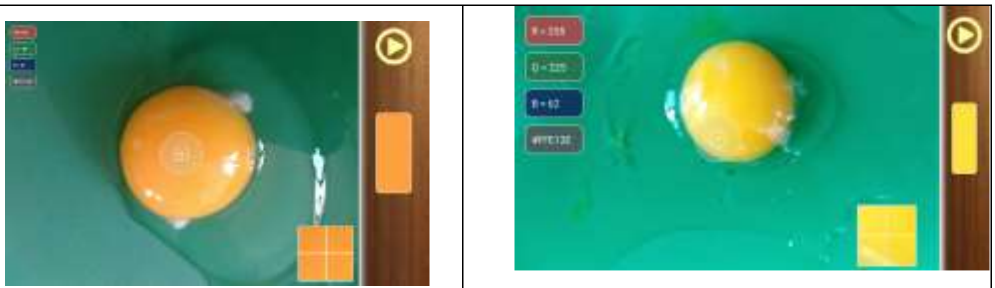
The color of the yolk depends very much on the type of bird food. Using the color of the yolk to determine its composition and nutritional properties is not enough. For example, xanthophyll, which makes the color more saturated, have no nutritional value. On the other hand, the carotenoids that impart a dark yellow color to the yolk act as provitamin A (Titova et al., 2015).

3 Material and methods

A total of 90 hens and 90 quail eggs from three producers were used for the purposes of the present study. 30 hen eggs and 30 quail eggs per producer. The eggs were purchased from the trade network of the town of Yambol, Bulgaria.

A video sensor of an LG mobile phone, model L70 (LG Electronics, Inc., Seoul, Korea) was used to obtain the yolk images. The video sensor is VB6955CM (STMicroelectronics International N.V.). Resolution 2600x1952 pixels. Pixel size 1.4 μm x 1.4 μm. It has a built-in autofocus mechanism.

Color digital images of hen eggs yolks and quail eggs yolks were obtained using the ColorMeter Free - color picker application (VisTech.Projects Inc.) for the Android operating system. Figure 1 shows an example of obtaining images of yolks. The yolks are placed on a field that contrasts with their color. The shooting distance is 10 cm.



a) hen eggs *b) quail eggs*

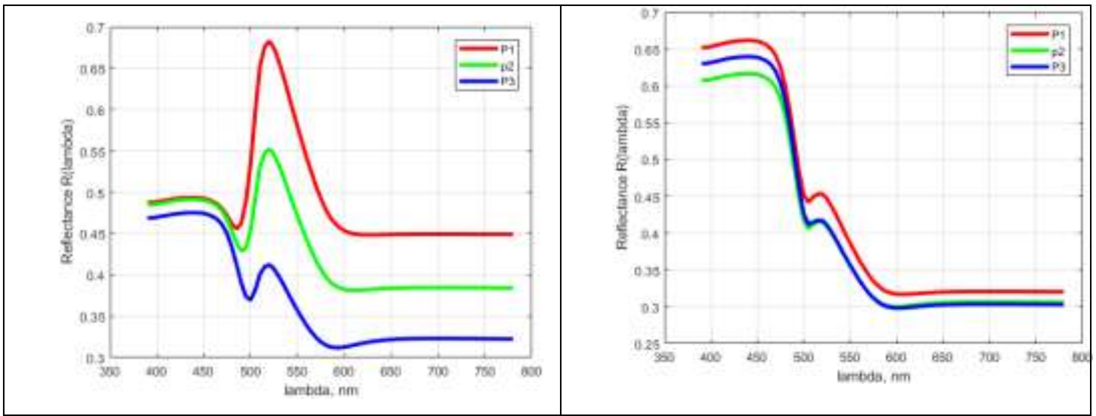
Figure 1. Examples of measuring the color and spectrum of yolks

The conversion of values from RGB to XYZ and LMS models in reflection spectra in the VIS region, in the range 380-780 nm is done by mathematical dependences and the conversion is possible in both directions of equality (Glassner, 1989). The matrices used to convert color components to spectrum are available in (Spectral and XYZ Color Functions) for the VIS range.

4 Results and discussion

The proposed methods and tools were used to obtain spectral characteristics of the products in this survey through the camera of a mobile phone. An example of the application of these online learning tools has been presented. The general purpose software product mentioned above is used, which uses the built-in camera of a mobile phone. Thus, the proposed method for obtaining spectral characteristics of egg yolks is available to a larger group of students (including outside the university laboratories) than when using specialized equipment and external telephone sensors.

As can be seen from Figure 2, the obtained spectral characteristics of the hen eggs yolks and quail eggs yolks show a visible difference between the different producers. In the case of hen eggs in the range 500-780 nm, and in the case of quail eggs in the range 380-480 nm when comparing the three producers, while in the range 500-780 nm the spectral characteristics of eggs from producer 1 are clearly distinguished, while those of the second and third producers overlap. The overlap is due to the similarity in the region of rearing and feeding of the birds, as well as the period for which they were kept before the measurement. This is also confirmed by the results reported in the available literature (Titova et al., 2015; Lukanov et al., 2019).



a) hen eggs	b) quail eggs

Figure 2. Presentation of egg yolks from different producers by their spectral characteristics

The whole process of obtaining and processing the spectral characteristics, carried out with the mobile device, as well as the work with the Matlab software system, can be observed by all students from the screen of their mobile phones. This is done with online video conference software.

Figure 3 shows video conference screens via Google Meet (Google Inc.). On this screen, the teacher shows the main errors that are made in the calculation and visualization of spectral characteristics obtained through the camera of the mobile device. The demonstration is in Matlab (The MathWorks Inc.) environment, but other software products, such as GNU Octave, can be used for this purpose.

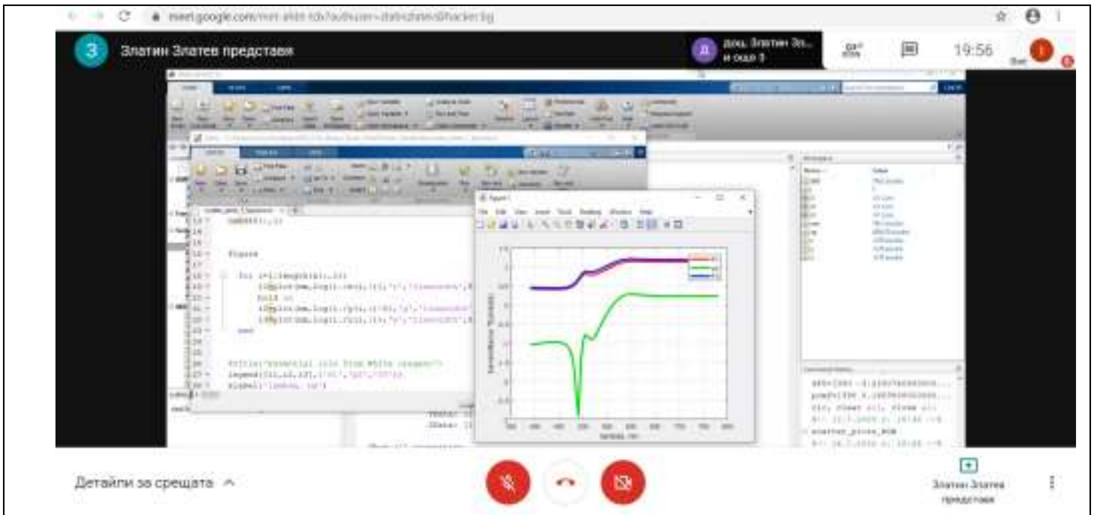


Figure 3. Online meeting using data obtained with a mobile device

After eliminating the measurement errors and removing the spectral characteristics, which have a significant deviation from the others for the respective manufacturer, students can move on to the next stage - processing and analysing these characteristics.

Figure 4 shows a block diagram of the process of learning for receiving, processing and analyzing data using a mobile phone. The objects visualized on the diagram are free to use by PIXABAY (https://pixabay.com).

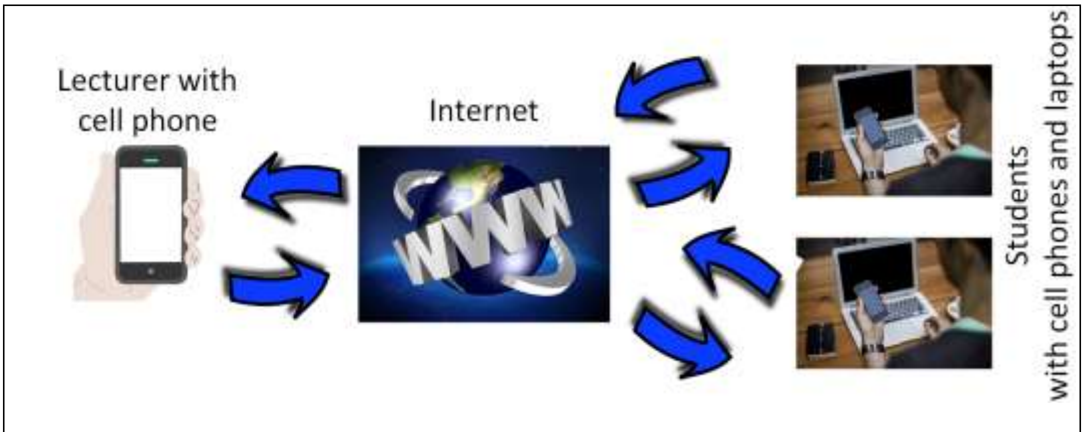


Figure 4. Block diagram of the learning process using a mobile phone

Taking photos of the analyzed object, in this case eggs can be done both by the teacher and after a short instruction to the students, with the help of the camera on their own mobile phones - of the object located near them. Object data, whether a list of values from an RGB color model or a color digital image, can be shared with other participants in the training, for example via email, or directly through Google Meet. The teacher demonstrates online how to process the measured data, using his/her personal computer or by providing a pre-recorded video. Students independently process the data on their personal computers. In case of questions or incorrect execution of the exercise, students can share their screens and discuss with the teacher the issues they have when processing the experimental data.

Supported by the proposed methods and tools, the whole process of obtaining and working with spectral characteristics can be observed and shared with the learners, with random placement and access to the Internet. On the other hand, the accessibility, comprehensibility and responsibility, when disseminating these mobile services, to each student as their user must be taken into account.

The proposed methods and tools can be used in the training of students in disciplines in the field of Artificial Intelligence, Machine Learning, Obtaining, processing and analysis of spectral characteristics and certainly, due to the use of well-known devices and technologies from their daily routines, will enhance their interest and desire to work.

Conclusion

Methods and tools for analyzing products of biological origin that are suitable for use in distance learning are proposed.

It has been proven that the camera of mobile devices can be used as a sensor to obtain spectral characteristics of products of biological origin and in particular the yolk of hen and quail eggs. The obtained measurement accuracy is sufficient for the application of the proposed methods in the training of students.

The comparative analysis showed that the results obtained with the camera of a mobile device are as close as possible to the spectrophotometers established in the research practice, having the advantage that with its accessibility it can be applied in the educational activity in training for work with specialized laboratory equipment which is not publicly available.

The use of mobile devices (phones and tablets) can improve the quality of the learning process, but only when students are active participants and not passive observers of what they see on their screens. The presented methodology creates conditions for active participation of students. The use of tools and digital technologies from their everyday life makes the training interesting, attractive and motivates for active participation in the learning process.

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Application of Mobile Device as a Tool for Early Diagnosis of Diseases on Vine Leaves

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Abstract

The search for new methods and technical tools for early diagnosis of diseases in vineyards, in order to adequately apply plant protection products, requires new knowledge and supplementation of existing solutions in this area. In the present work the possibility for early diagnosis of diseases on vineyards by using a built-in video sensor on mobile devices is tested. Spectral characteristics from the adaxial and abaxial sides of the leaves were used. From the comparative analyzes it was found that suitable for early diagnosis of diseases of vine plants are spectral characteristics obtained from the abaxial part of the leaves, reduced with latent variables and classified by nonlinear separating functions of the used classifiers.

Keywords: Disease management, Disease detection, Biophysical parameters, Spectral characteristics, Classification

1 Introduction

Collecting and processing the necessary information for decision-making for plant protection activities of vineyards is a complex and time-consuming process. To remain competitive, the modern farmer often seeks the help of agricultural specialists and consultants in order to provide information for decision-making (Nedeva et al., 2012; Zlatev, 2016; Albetis et al., 2018). Unfortunately, the agricultural help of the specialist is not always available to the farmer. These circumstances lead to the need to introduce and apply information technology in the field of plant protection.

The forecasting of diseases on agricultural crops is fundamental for the successful implementation of plant protection. In general, for the time being, the prognosis of the diseases is carried out sparingly by relevant specialists by visiting the agricultural lands. However, this is not enough to reliably detect diseases in their early stages. The late detection of diseases is often associated with the impossibility of their eradication.

The analyzes of the development of diseases on the vineyards are context-based, which means that additional research is needed to refine the developed advisory systems and applications for mobile devices in specific geographical regions. (Pichon et al., 2020).

In recent years, a number of mobile applications have been developed to determine the condition of vineyards (https://play.google.com).

From the review of the scientific literature and the developed mobile applications, it was found that there are few publications related to the early diagnosis of diseases in vineyards, using mobile phones (Pongnumkul et al., 2015).

The aim of the present work is to test the possibility for early diagnosis of diseases in vineyards by using a built-in video sensor on mobile devices.

2 Material and methods

An analysis of diseases of vineyards grown in the region of the village of Hadjidimitrovo, Tundzha municipality, Yambol district, the southeastern part of Bulgaria was made.

2.1 Technological measurements

Planar chromatography. The method presented in Priyadarshini et al. (2016), with some modifications.

Measuring instruments used: Active acidity pH, pH meter PH-108 (Hangzhou Lohand Biological Co., Ltd); Electrical conductivity EC, µS/cm, Conductivity Meter AP-2 (HM Digital, Inc); Total amount of solutes TDS, ppm, TDS-3 measuring instrument (HM Digital, Inc.); Oxidation-reduction potential ORP, mV, Measuring Instrument Model ORP-2069 (Shanghai Longway Optical Instruments Co., Ltd).

2.2 Measurements with non-contact technical tools

In the present work, a video sensor of a Samsung Galaxy J7 SM-J727P (SAMSUNG Inc.) mobile phone is used. The video sensor of the rear camera used is HERO_12M_2PD (Sony Corp., Japan). 12MP resolution (OIS driver). Dimensions of the module 12.07 x 12 x 5.5 mm (WxLxH). Pixel size 1,4 µm x 1,4 µm. It has a built-in autofocus mechanism.

The homogeneous lighting of the captured scene was obtained with a light source, which consists of a domed part, the inner part of which is covered with glossy paint, with pure white color RAL 9010, and the outer part is covered with black acrylic paint RAL 9005.

White LEDs with a maximum intensity of emitted light at 450nm are mounted in the domed part. The lighting of the captured stage is provided by diode lighting SMD3528-120/1, 6500K white IP65 (V-TAC Innovative LED Lighting), mounted in a domed part in two rows, with a distance between them of 10 cm.

The lighting system is supplied with a switching source of constant voltage, with nominal output voltage and current U = 12V, I = 2,5A.

The full spectrum of the images was used. The transformation is made according to the mathematical dependencies presented in (Glassner, 1989). Conversion functions for observer 2^o (Stiles and Burch 2^o, RGB (1955)) and D65 illumination (average daylight with UV component (6500K)) are applied, according to mathematical dependences, in which the conversion is possible in both directions of equality (Wyman et al., 2013).

Reduction of spectral characteristics data. The methods used (Mladenov et al., 2015; Zlatev et al., 2019):

- ✓ Latent variables (LV) obtained by the method of partial regression of least squares;
- ✓ Linear variant of principal components (PC) obtained by the principal components analysis method.

The following classification methods were used (Vasilev, 2016):

- ✓ Discriminant analysis (DA) with five separating functions: linear (L), diagonal linear (DL), quadratic (Q), diagonal quadratic (DQ) and Mahalanobis (M);
- ✓ Support vector machines method (SVM), with four separating functions: linear (L), quadratic (Q), polynomial (P) and radial basis element (RBF).

The assessment of the separability of object areas by vine leaves, with these classifiers is made by a general classification error which is conditionally marked with e_m,%.

Matlab 2013 software product (The Mathworks Inc.) was used to process the experimental data.

The measurements were made at a room temperature of 20±2 ^{o}C and a relative humidity of 45% RH. All data were processed at a level of significance α = 0,05.

3 Results and discussion

Physico-chemical characteristics of healthy and infected with powdery mildew and vine scab vine leaves were obtained.Tables 1 and 2 show the results of these measurements. It can be seen that the obtained data have similar values and they partially overlap.

Compared to healthy, infected leaves have lower values of active acidity, higher values of electrical conductivity, TDS and ORP.

According to planar chromatography, it is difficult to distinguish healthy from infected leaves by the content of chlorophyll, xanthophyll and carotene. Powdery mildew leaves have elevated values of these characteristics, while those with vine scab have characteristics close to healthy leaves.

Table 1. Parameters of studied vine leaves (mean±SD)

Parameter / Disease	pH	EC, μS	TDS, ppm	ORP, mV
Healthy	6,67±0,36	345±1	151±0,6	211±13,1
Mildew	6,52±0,35	361±2	155±1	216±12,3
Scab	6,02±0,41	394±2	166±1	215±9

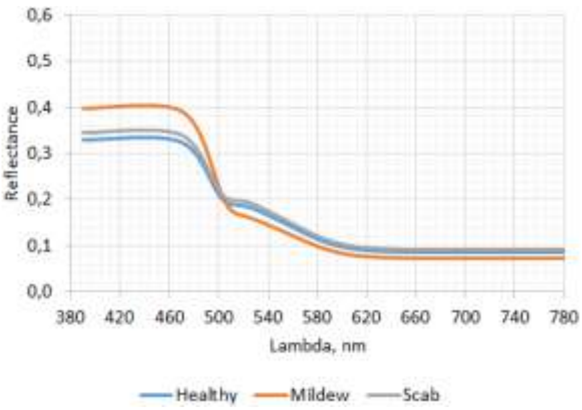
Table 2. Results from planar chromatography (mean±SD)

Disease / Content	Healthy	Mildew	Scab
Carotene	0,84±0,08	0,97±0,22	0,87±0,35
Xantophyll	0,71±0,04	0,81±0,18	0,73±0,31
Cholophyll a	0,55±0,08	0,59±0,15	0,49±0,13
Chlorophyll b	0,32±0,06	0,38±0,09	0,31±0,05
Anthocyanin	0,07±0,05	0,06±0,01	0,08±0,03

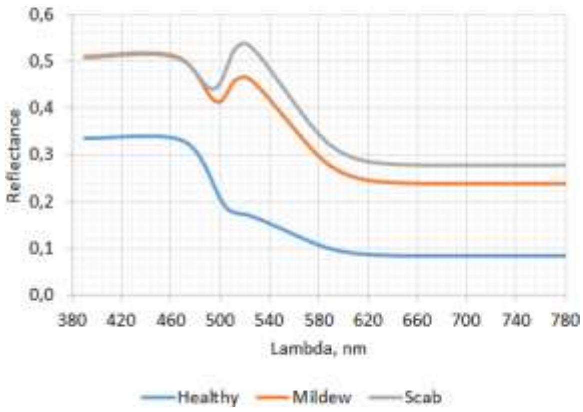
Figure 1 shows the obtained spectral characteristics of healthy and infected vine leaves in the early stages of disease development. It can be seen that at the adaxial side of the leaves there is a strong overlap of spectral characteristics. Like their physicochemical parameters, the spectra of healthy leaves are very close to those with vine scab. In the initial range of the spectrum (380-480nm) a resolution of these characteristics is observed. In the spectral characteristics obtained from the abaxial part of the leaves, a separation is observed between healthy and infected leaves. Separation between the two types of analyzed diseases is seen in a narrow spectral range (500-580nm).

The results of processing the obtained experimental data with discriminant analysis, reduced by latent variables and principal components, are shown in Table 3. It can be seen that when using latent variables, regardless of the type of separation function, low values of the total error of classification. These results are obtained regardless of whether the spectral characteristics of the adaxial or abaxial part of the vine leaves are used.

When using principal components, significantly higher values of the total classification error are observed. When using this method to reduce the amount of data, lower error values are obtained by using spectral characteristics from the abaxial part of the leaf. The type of the separating function is also important in this case. The total classification error is significantly lower (2-5%) when using nonlinear separation functions than linear ones.



a) Adaxial part



b) Abaxial part

Figure 1. Spectral characteristics of vine leaves in early stage of disease development

Table 3. Total classification error (e_m,%) using Discriminant analysis

DRM	Class / Part / DF	H-M Adaxial	H-M Abaxial	H-S Adaxial	H-S Abaxial	M-S Adaxial	M-S Abaxial
LV	L	1%	1%	1%	1%	1%	1%
	DL	1%	1%	1%	1%	1%	1%
	Q	1%	1%	1%	1%	1%	1%
	DQ	1%	1%	1%	1%	1%	1%
	M	1%	1%	1%	1%	1%	1%
	e_m, %	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**
PC	L	15%	13%	15%	15%	14%	13%
	DL	15%	13%	15%	15%	14%	13%
	Q	2%	2%	5%	3%	3%	1%
	DQ	2%	2%	5%	3%	2%	1%
	M	31%	29%	37%	25%	27%	16%
	e_m, %	**13%**	**12%**	**15%**	**12%**	**12%**	**9%**

DRM-data reduction method; DF-discriminant function; LV-latent variables; PC-principal components; L-linear; DL-diagonal-linear; Q-quadratic; DQ-diagonal-guadratic; M-Mahalanobis; H-healthy; M-powldery mildew; S-vine scab

Table 4 shows the results of processing the experimental data by the Support vector machines method. When using latent variables, low values of the total classification error (up to 1%) are obtained. The use of principal components leads to an increase in the total classification error. When using linear separation functions, high error values are obtained compared to non-linear ones. Whether adaxial or abaxial leaf data is used, the errors are similar.

Table 4. Total classification error (e_m,%) when using the Support Vector Machines method

DRM	Class / Part / DF	H-M Adaxial	H-M Abaxial	H-S Adaxial	H-S Abaxial	M-S Adaxial	M-S Abaxial

LV	**L**	1%	1%	1%	1%	1%	1%
	Q	1%	1%	1%	1%	1%	1%
	P	1%	1%	1%	1%	1%	1%
	RBF	1%	1%	1%	1%	1%	1%
	e_m, %	**1%**	**1%**	**1%**	**1%**	**1%**	**1%**
PC	**L**	13%	12%	14%	11%	13%	7%
	Q	10%	9%	9%	5%	9%	4%
	P	1%	2%	1%	3%	2%	2%
	RBF	1%	2%	1%	2%	2%	2%
	e_m, %	**6%**	**6%**	**6%**	**5%**	**6%**	**4%**
DRM-data reduction method; DF-discriminant function; LV-latent variables; PC-principal components; L-linear; Q-quadratic; RBF-radial basis function; H-healthy; M-powldery mildew; S-vine scab							

Analyzes show that the separation of healthy and infected vine leaves is possible using spectral characteristics reduced by latent variables. The use of a linear variant of the principal components is inexpedient because it leads to high values of the total classification error (over 15%). Regardless of the classifier used, the application of linear separation functions results in high values of the total classification error.

The obtained results complement those of the available literature. AL-Saddik et al. (2017) used only the SVM classifier and achieved low values of the total classification error (up to 1%) after reducing the experimental data by spectral indices. The data used by the authors are for already visibly developed signs of the studied diseases, according to data from the adaxial part of the vine leaves. In the present work, in the analysis of the early stage of the development of diseases on the vine leaves, such an error is achieved by reducing the amount of data with latent variables and using nonlinear separating functions of a classifier.

Albetis et al. (2018) receive a low classification error (again up to 1%), but with already clearly distinguishable signs of vine leaf disease.

Bendel et al., (2020), in the early diagnosis of diseases on vine leaves reach a total classification error of 5-30%, using spectral characteristics in the visible region obtained from the upper part of the leaves. This is confirmed by the results obtained in this paper.

4 Conclusion

Spectral analysis, which is one of the main tools of artificial intelligence, can be used to make an assessment of early diagnosis of the degree of infestation of the plant object with diseases.

The system for obtaining, processing and analysis of spectral characteristics is offered as a tool of obtaining initial data for the tested sample and thus allows on the basis of the measured information by using a database and knowledge base of the computer system to automatically determine the disease of a plant which symptom is a change in its spectral characteristics.

It has been found that the use of linear separation functions to distinguish healthy from infected vine leaves, as well as the early detection of various diseases, is inappropriate because high values of classification errors are obtained, regardless of the classifier used. Similarly, an unsuitable tool for reducing the amount of data is the linear version of the principal components.

The comparative analysis shows that a higher degree of recognition of diseases in vineyards is achieved by using spectral data from the abaxial part of the leaves. This necessitates the search for new methods and technical tools for early diagnosis of diseases in vineyards, in order to adequately apply plant protection products.

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Methods for Distance Learning in Technical Courses

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Abstract

In the beginning of 2020 the humanity was struck by an unprecedented pandemic. The universities stopped conducting face-to-face classes and they had to switch very quickly to distance learning and assessment. The report presents the results of a study among students studying in various technical programs at Trakia University – Stara Zagora, Bulgaria. The aim of the study is to determine the most appropriate technologies and methods for distance learning and assessment in technical courses in times of crisis - in the absence of pre-prepared materials, using only available means - the Internet and available free resources, e-learning system Moodle and etc.The results show that the majority of students prefer the lecturers to provide them video recordings of the lectures, of the conducted experiments from the laboratory exercises, of solved sample tasks, etc. The reasons for this are the ability to watch the videos as many times as necessary to master the learning content and inability to attend at the time of the scheduled classes. As for the exams, the most preferred form is the test conducted in the e-learning system. After analyzing the attitudes of the students, appropriate techniques for conducting online teaching in the technical courses are proposed.

Keywords: Distance learning, e-learning, e-assessment

1. Introduction

The emergency situation that arose in early 2020, due to the rapid spread of COVID-19, posed a major challenge to education systems. All universities were forced to stop face-to-face classes and very quickly move to distance learning and assessment. This happened so unexpectedly that most universities and lecturers did not have pre-prepared materials suitable for distance learning. Many of them considered that distance exams were not suitable for higher education.

The emergency situation helped to “the majority of people working in academia and higher education not only to complete their personal transition to the fully functional and operational online tuition, but also to understand that online defences, online entrance and final exams, as well as online academic jobs are as effective and meaningful as those conducted “in real life”. Due to the crisis induced by the coronavirus epidemic, innovations in academia and higher education that would have normally taken several years due to the various contradictory administrative regulations are now introduced promptly in a matter of days.” (Strielkowski, 2020)

The students adapted more quickly to online forms of learning than lecturers, because this is their way of communicating. Very good results were obtained and the training kept its quality. One reason for this is the fact that new methods bring diversity to training, and each diversity leads to better efficiency.

Because with modern technologies modern things must be taught, this naturally stimulates lecturers to update the educational content.

Distance learning is not just adaptation of traditional teaching methods to new technologies. Under normal circumstances, students who were born and raised with new technologies expect them to be used in other ways.

“Distance education has evolved to the point where technology is no longer a major concern to distance educators and students. For the most part, technology used in the delivery of distance courses is stable and reliable. Ironically, it is the human factors that most greatly influence distance teaching and learning thus, the importance of appropriate pedagogy and course design." (Dehler, 2004)

"Meeting students' learning needs, through creative and innovative teaching/learning pedagogical processes, is the goal of any educator. Being able to have an active presence, guide students through the learning process, and enhance their comprehension of the content while fostering a sense of proactive and student-centered learning is the true essence of teaching." (Sharoff, 2019)

Researches in the scientific literature on distance learning can be divided into two groups - research methods in distance learning and teaching methods in order to obtain greater effectiveness of learning. Naturally, all of them refer to moments in which the lecturers have enough time and resources to prepare and conduct the courses.

A detailed overview of research in the field of distance education is made in (Kline, 2020; Saba, 2014). Researches are discussed, which refers to the effectiveness of distance education compared to the traditional, the shortcomings and gaps in the research of distance education and others.

(Koper, 2014) presents a new educational model in which predesigned materials have a smaller role, and the role of dialogue between teachers and students, due to the possibilities of new synchronous and asynchronous communication technologies is strengthened. "The perception of online and distance education as an integral part of powerful teaching and learning, and not as a poor mans variant that is only preferred by people who are not able to follow regular ('good') education" is changing.

The selection of educational methods must take into account the specifics of the courses taught. The purpose of training in technical courses is not only to learn the definitions and dependencies and master the rules for their application. Students should acquire more complex skills related to comparing research data, explaining situations, forecasting events according to current conditions, formulating and proposing their own solutions in a given situation, summarizing results, planning and implementing ideas and more. To achieve this goal, it is not enough for students to have a presentation or lecture on the topic and the teacher to introduce their content. It is necessary to derive complex dependencies, to explain complex schemes, to develop projects and software products. This requires the application of complex distance learning techniques.

Another important element that must be taken into account when choosing a method and technology for training are the characteristics of the learners - age, work experience, educational level, demographic characteristics, individual differences and attitudes.

No method can meet all the requirements for learning and teaching. If possible, more methods should be applied (Kline, 2020).

In the conditions of state of emergency and need for a quick response, finding the best form of teaching, which will be most effective, coordinated and adapted to the level of students is a great challenge.

In order to determine the most appropriate technologies and methods for online training for the conditions of the Faculty of Technics and Technologies - Yambol and the most preferred by students studying in technical programs, a survey was conducted among students from different programs and years of training.

The aim of the paper is to find the most effective technologies and methods for distance learning in technical courses in times of crisis - in the absence of pre-prepared materials, lack of sufficient equipment for each lecturer, using only available means - the Internet and available free resources, Moodle e-learning system, telephones, emails and other means of communication.

2. Methods

A survey was conducted with 83 first and second year students from the Faculty of Technics and Technologies - Yambol, studying in different technical programs. The survey was located in 2 electronic courses - "Electrical Engineering and Electronics" and "Theoretical Electrical Engineering" in the learning management system Moodle of the Trakia University - Stara Zagora. In these courses, different tools have already been used and different methods for conducting distance learning have been applied. Thus, students have the opportunity to competently express their opinions and preferences.

The survey includes 13 questions. They refer to the methods for remote lectures, seminars, laboratory and practical exercises in the technical courses. The attitude of the students was also studied on the issues of providing feedback to the students and making a final grade in the disciplines. In addition to the questions with answers for selection, open questions were included, in which students could add their opinion.

3. Results

Trakia University has a learning management system Moodle and therefore the first distance learning classes were conducted using this system. However, the materials available so far in the system were not sufficiently detailed and suitable for independent preparation of students. They were provided in addition to the face-to-face lectures.

Some lecturers chose to implement a live connection with the students and thus lead their lectures. However, not all students had enough quality personal computer equipment at home and not all students had ability to attend at the time of the scheduled classes. In addition, in the teaching of technical disciplines, the lecturer must derive formulas and draw diagrams at the moment, which requires specialized software.

The other method of distance learning, which was preferred by some lecturers, was the provision of audio and video recordings with lectures in the e-learning system. However, this required time to prepare the recordings. In addition, due to the specifics of the technical courses related to deriving complex dependencies and explaining complex schemes, the use of presentations with ready results is not always appropriate. It is necessary to invent a variant in which the formulas are derived and the schemes are drawn simultaneously with the explanations. This could be achieved using appropriate equipment - document camera, interactive whiteboard and more.

The problem with conducting seminars, laboratories and practical exercises, which are typical for technical courses, is even bigger. When conducting them, lecturers can use video link, provide recordings or use simulation software.

The preferences of the lecturers for the proposed options are different, but the most important thing is that they correspond to the wishes of the students. Therefore, at the very beginning of the state of emergency, I conducted a survey of students' opinions on distance learning methods during the crisis. The results obtained for student preferences can be used after the end of the crisis.

It was studied the students' opinion on "Which of the following ways of conducting remote lectures achieves the highest quality of teaching in the technical courses?".

The largest percentage of respondents believe that this is obtained by using video recordings of lectures (a total of 55.74%). Most of them, however (36.07%) think that the lecturer at the moment of the lecture should draw diagrams and derive formulas so as to maximally imitate conducting a lecture in present form.

There is also a large percentage of students (34.43%) who consider the use of a live video link to be the most appropriate method. The use of written materials is considered appropriate by only 8.2%.

Those who indicated another answer prefer to be applied a combination of the listed methods. This refers for all questions from the survey.

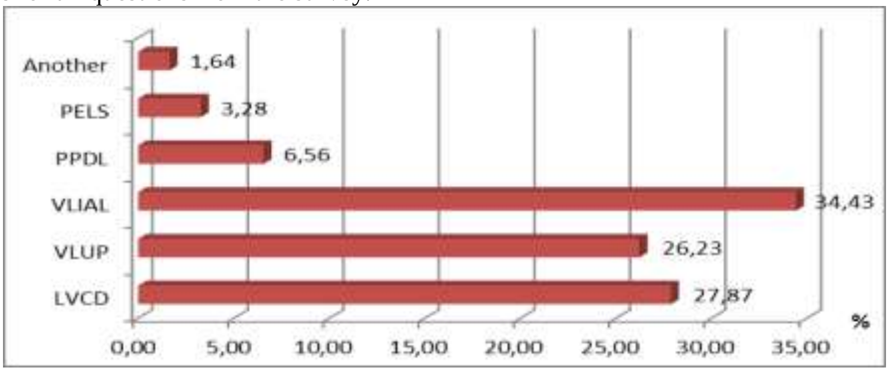

Figure 1. Distribution of the Answers to the Question Regarding the Lectures

In Figure 1, the abbreviations are used: LVCD - Live video communication with written or oral discussion (using the capabilities of e-learning system, Google and more); VLUP - Video lectures using presentations with pre-drawn diagrams and derived formulas available in e-learning system; VLIAL - Video where the lecturer draws diagrams and formulas at the moment of the lecture so that he maximally imitates an attendance lecture; PPDL - Preliminary provision of detailed lectures in the e-learning system; PELS - Presentations in e-learning system.

Students do not always prefer these teaching methods, which they believe will achieve the highest quality. The percentage of those who prefer to use videos is 60.67%. The share of preferred videos and detailed written materials increases at the expense of those who prefer video connection (Figure 1).

The reasons for this are different. The most common reason is inability to attend at the time of the scheduled classes - 66.67% of those who answered the first 2 questions differently. And 22.22% have problems with equipment at home.

The students also added that the provision of videos and detailed written materials allowed them to view them repeatedly at a time convenient to them.

The purpose of distance learning is not only to provide the necessary materials. Students should be able to give feedback to teachers to ask questions and have discussions with lecturers and other students. Lecturers no less need feedback to monitor student progress. It should include solving tests, tasks and developing projects. If necessary, the lecturers should provide additional materials and instructions.

Feedback can be done synchronously (orally, via video and audio connection or in writing, via chat at a pre-arranged time) or asynchronously (using email, chat, forums, etc.).

The largest percentage (44%) of the respondents prefer the feedback to be provided through a video link and discussion of the learning content. Different forms of written questions are preferred by 25% of students.

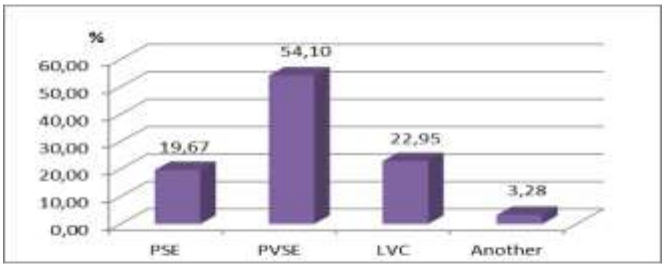

Figure 2. Distribution of the Answers to the Question Regarding the Seminars

The possibilities for conducting seminars are more limited. Possible options for this are direct video connection, providing solved examples and videos with solving sample tasks. More than half of the respondents 54.1% prefer to get videos with solving sample tasks and tasks for self-execution, which lecturers should check timely (Figure 2).

The main reason for this is again the inability to attend at the time of the scheduled classes and the ability to view the videos repeatedly. Here the trend is even more pronounced.

In Figure 2, the abbreviations are used: PSE - Providing solved examples through the e-learning system. Setting tasks for self-performance; PVSE - Providing in the e-learning system videos with solving examples. Setting tasks for self-performance; LVC - Live video and chat. Discussion of tasks that have been solved in advance.

The biggest challenge for lecturers is the remote conduct of laboratory and practical exercises. In this case, the methods are reduced to (Figure 3):

- Live video from a laboratory where the lecturer demonstrates the exercise - LVD;
- Video of the exercise, available in the e-learning system - VE
- Use of simulations (virtual laboratories), with the help of which the lecturer sets tasks and students complete the tasks - US
- Providing detailed theoretical part and written instructions for the exercise and setting tasks that do not require equipment - DIT

54.1% of the respondents prefer to have a video of the exercise. A surprisingly small percentage prefers the use of simulations and virtual laboratories (6.56%).

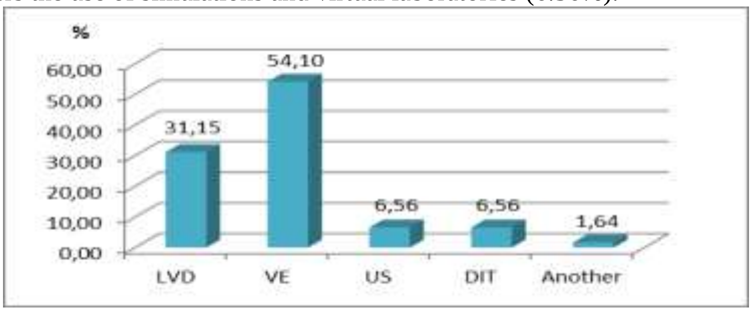

Figure 3. Distribution of the Answers to the Question Regarding the Laboratory and Practical Exercises

The other challenge in distance learning in technical disciplines is testing. The main danger in distance assessment is the possibility of fraud on the part of dishonest students. Here the students are almost unanimous. 77.05% of them prefer the assessment to be conducted through a quiz in the e-learning system (Figure 4). The probable reason for this is that students find this way of assessment easier - the quizzes do not require memorizing a large amount of learning content, there are questions with answers for selection from which unprepared students can choose at random and last but not least is the opportunity for the use of unallowed materials. Methods for prevention of cheatings when using quizzes in Moodle are discussed in (Pehlivanova, 2019).

None of the respondents prefers an oral discussion conducted via video or audio connection. Few students prefer to develop projects.

When solving tests remotely, students have a greater opportunity to use additional materials. Therefore, teachers must be very careful in composing the questions. Questions aimed at reproducing the learning content should not be used, but preference should be given to those aimed at verifying a higher level of content assimilation.

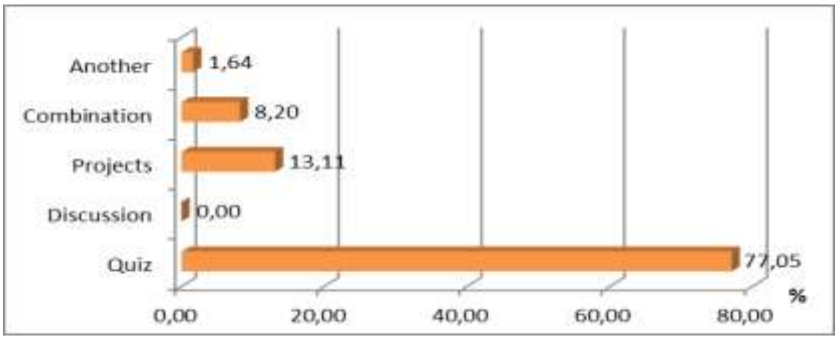

Figure 4. Student Preferences for Conducting Semester Exams

Due to the specifics of technical disciplines, when conducting tests from home, it is recommended to use test questions that: are focused on the student's ability to synthesize information; require multi-stage considerations to arrive at an answer; check knowledge that cannot be found online (eg interpretation of images / data).

After analyzing the attitudes of students, the following techniques for improving the conduct of online training in technical disciplines can be defined and suggested:

1. Video recordings of the lectures - The provision of video recordings of lectures is more preferred by students than the live broadcast of lectures. This way, students can watch them at a suitable time. In addition, they can watch them as many times as they need to assimilate the content.

2. Video duration - Videos longer than 15-20 minutes can cause problems with slow downloading and distraction for learners. It is better to record two or three short videos for each lecture.

3. Use of existing resources - It is unrealistic to expect that high quality videos can be produced in a short time. It is possible to provide students with pre-designed resources available online. Only open access ones should be selected.

4. Interactive activities - The higher level of assimilation of the material is achieved with more active forms - Development of projects, case studies, discussions, use of simulations, demonstrations, etc.

5. Setting reasonable tasks - Tasks such as: summarize the lecture or video are not appropriate. This engages many students and does not develop their thinking. When creating tests, questions must be asked that can be answered using the learning resources provided. However, they should not be aimed at reproducing the learning content.

6. Use of group communication - Group communication is not best suited for direct teaching. It is preferred as a form of communication with students. Through it, discussions, consultations, etc. can be held. This can be a great way to collect student feedback on online teaching.

7. Flipped Classroom - In the traditional classroom, the teacher presents the lesson during class and can ask questions to students to make sure they understand it. In the Flipped Classroom, students are provided with materials and encouraged to prepare before class (to read certain material or even to solve certain tasks). The time of the class is used to discuss the lesson, share ideas and interact in a dynamic environment.

8. Mixing different forms of training and ways of providing information - In order to engage students, the course should not include long lectures, but should consist of short portions. Change the forms of training. Mix discussions, videos and audio clips, practical exercises, individual or collaborative work.

9. Organization of the course - Courses should be organized so that students can easily and quickly access the necessary materials. When students use a lot of cognitive resources, videos,

discussions or quizzes, they find it difficult to understand where and what to read, are discouraged and have difficulty perceiving the learning content.

10. Checking the attendance and effectiveness of the course - Attendance and effectiveness of the course can be checked by setting tasks (tests, projects, etc.). If it is not possible to check the set tasks manually, the automatic checking and ranking functions in the learning management systems can be used. When students know that their presence is controlled, they begin to comply with the requirements.

4. Conclusion

Due to the COVID-19 pandemic, universities were forced to stop face-to-face classes and move very quickly to distance learning and assessment. They were not prepared for such a rapid transition. However, the academic year ended successfully without reducing the quality of education. The students welcomed with interest the new teaching methods.

The report presents the results of a study among students related to the methods for distance lectures, exercises and exams in technical disciplines.

The results show that in terms of lectures, the largest number of students prefer lecturers to provide them with a video of the lecture, in which the lecturer draws diagrams and formulas at the moment of the lecture so that he maximally imitates an attendance lecture. When conducting exercises online, more than 50% of the respondents prefer to prepare from videos of the conducted experiments, solved sample tasks, etc. The reasons for this are inability to attend at the time of the scheduled classes and the ability to view the videos as many times as necessary to master the content.

77% of the respondents prefer the exams to be conducted as a test in the e-learning system. When using this form of assessment, lecturers must take all possible measures to prevent the possibility of cheating (Pehlivanova, 2019). Questions should be used whose answers cannot be easily and quickly found on the Internet, but those that require reflection and test students' ability to synthesize information.

The report also makes recommendations for improving the conduct of online training in technical courses. They relate to teaching methods and the organization of courses.

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Data Privacy Aspects of E-learning

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Abstract

In today's world distance learning is increasingly used. Web-based tools are used to implement it. In order to function properly, they must store information about their users. This paper goes through the issue of data confidentiality when using e-learning. A study among students from Trakia University - Stara Zagora, Bulgaria is presented. It aims to check whether students are aware of how their personal data is used and what is their sense of security for personal data while using e-learning platforms. The students' attitude to the personal information that they are predisposed to share with the other participants in the e-learning courses is studied. It was concluded that a large number of students are not aware of the problems that can arise from sharing personal data and how they and the lecturers can protect their data. In addition, confidentiality recommendations have been proposed that should be taken into account when using e-learning.

Keywords: Data privacy, e-learning, Distance learning, Personal data

1. Introduction

A trend in modern education is the growing role of distance learning. Distance learning provides a unique opportunity to acquire education, without the physical limitations associated with the location of the educational institution, the lecturers and the learners. It can be used independently, but it can also be a complementary training to traditional forms of training.

Modern distance learning uses web-based learning management systems (LMS). Often it is done asynchronously by providing digital materials for reading, video and audio recordings for watching or listening in the student's free time, discussion forums and chats. With the development of technology, synchronous technologies are increasingly being used, including live video or audio connections.

LMS are the tools with which distance learning is carried out. They have indisputable advantages, such as: saving time aond money for travel, 24-hour access to training materials, one-time creation of courses that can be used and improved at any time, rich opportunities for creating tests and assessment, etc.

Distance learning became especially relevant during the pandemic with COVID-19, due to which all pupils and students were forced to switch to online training.

In order to function properly, LMS needs to store information about their users. Since they are information systems that manage personal information, they must comply with the requirements of Regulation (EU) 2016/679 of the European Parliament and of the Council GDPR.

GDPR is an EU regulation on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (Regulation (EU), 2016). It was adopted in April 2016 and is applicable from May 2018. This Regulation protects the fundamental rights and freedoms of individuals and in particular their right to the protection of personal data.

The personal information that is entered in the LMS includes name, surname, email address, profile image along with others. In addition, LMS store personal information about students' progress, such as students' grades for each course and activities they have taken online.

LMS registers every action of students, logging in and out of the system, length of their session, read materials, posts in forums and chats.

Much of this information is available not only to system administrators and course instructors, but also to students enrolled in the course. In many online courses they can see a list of all enrolled in the course students, information from their profile - photo, email, etc., links to their profiles on social networks, the activity of students in the course, records from forums and chats and last but not least course grades.

The design of the LMS in terms of data privacy protection can lead to cyber harassment, among other inappropriate behaviors (Kambourakis, 2013; Mayes et al, 2015; Amo et al, 2020) .

In order to use an e-learning platform, the student is obliged to accept its conditions, in which the policy for personal data processing should be described. He has no right to refuse, as this would mean that he would lose access to the desired training.

To protect students' identity from other students, various technological measures have been proposed. For example, (Anwar and Greer, 2015; Amo et al, 2020) propose solutions by introducing anonymity to participants.

Another problem that arises when using LMS is insufficient confidentiality on the part of the leading lecturers in the course. They often use the e-learning system to communicate with students, to provide information, messages to students in which they unintentionally disclose sensitive students information. For example: uploading lists with grades from exams and course assignments that have not been conducted in e-learning, lists of students who have not completed assignments, attendance sheets, etc. Sometimes in these lists are used identification numbers of the students instead of their names. However, this is not enough. The identification (faculty) numbers can be easily learned by all students, especially in universities where training is carried out in groups with a small number of students. Most often this happens from lists in the LMS containing the names together with the numbers of the students.

Often, to carry out distance learning platforms are used, with the help of which a video connection with students is made (Zoom, Google Meet). Most of these platforms require at least the name and email addresses of students and lecturers. This is necessary for the platform to manage identification, accounts and logins. Platforms may also collect data through cookies or other online identifiers. This information may be obtained by third parties and used for innocent purposes, such as targeted marketing, but may be resold or used by malicious persons to obtain personal information about users or even identity theft.

Most articles related to data confidentiality when using e-learning are aimed at reviewing existing technological solutions to ensure data confidentiality and offering new solutions (Jerman-Blažič, 2005). There are also publications that examine the satisfaction of students and lecturers with the privacy of data in the LMS.

In (Ivanović et al, 2013) it is said that „Regarding possible privacy issues, the majority of students are satisfied with the privacy level offered by Moodle, though they gave specific remarks and expressed their general opinion that access to their private data should be limited. Teachers, on the other hand, seem to have no privacy concerns whatsoever. When asked which parts of the information from the user accounts should be hidden, expected answers were received such as e-mail addresses, telephone numbers, identification numbers, etc. Some students also mention hiding first/last access times and activity diaries of course participants.

The answers to the questions „What kind of privacy data is enough for educators to manage a successful learning process?“ and „What kind of data the students are predisposed to share in order to successfully accomplish their learning activities?“ were found in (Ivanova, 2015). A model for protection of users' privacy combining components of different measures and actions - technical, institutional, legal, educational, social and economic model is proposed there.

The technological measures related to the collection of personal data necessary for the qualitatively conducting the training, as well as for the security of the information used are discussed in (Jerman-Blažič, 2005; Romansky, 2019). This paper examines only the attitude of students to the personal information they are predisposed to share with other participants in e-learning courses.

The aim of the paper is to examine whether students are familiar with how their personal data is used and what is their sense of security about personal data while using e-learning platforms. In addition, privacy recommendations have been proposed, which should be taken into account when using e-learning.

2. Methods

To achieve the goals of the paper, a survey was conducted with 94 first and second year students from the Faculty of Technics and Technologies-Yambol, studying in technical programs. The survey was published in two electronic courses - "Electrical Engineering and Electronics" and "Theoretical Electrical Engineering" in the learning management system Moodle. The surveyed students have experience with the use of courses in the e-learning system and can express a competent opinion.

The survey includes fourteen questions. They are related to the risks of leakage of personal information when using the e-learning system. It examines what personal information students are prone to share with administrators and other course participants. Are they concerned that other students might have access to their personal information such as email, enrolled courses and activities, grades, opinions posted in chats, forums, video recordings of lectures or exams , in which they participated, etc.

3. Results

The majority of surveyed students (56.38%) believe that they are aware of the risks of leakage of personal information when using the e-learning system or other platforms for distance learning. Approximately the same number of students claim that they know what personal data the other participants in the courses have access to.

At the same time, 41.49% admit that they do not know this (Figure 1).

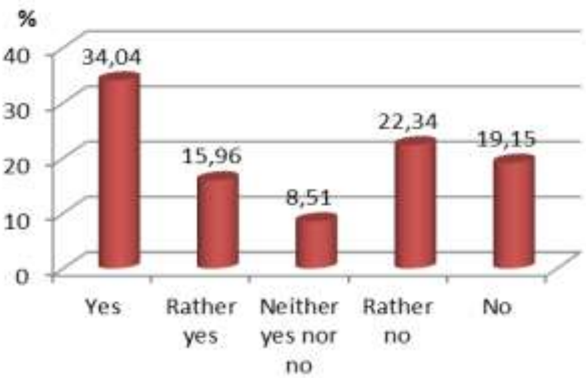

Figure 1. Are the respondents aware of what personal data the other participants in the courses have access to?

Only 23.4% of the respondents do not feel secure about their personal data while using the e-learning system or other platforms for conducting distance learning (Figure 2).

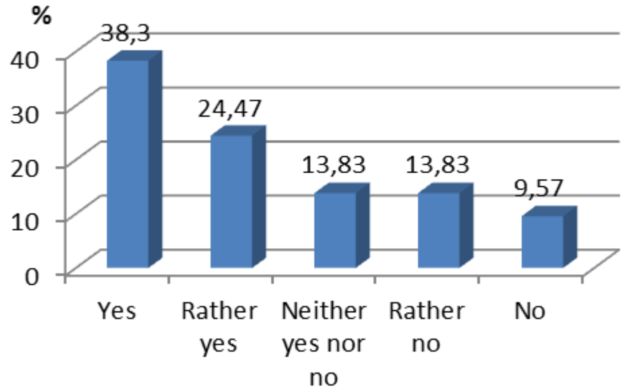

Figure 2. Sense of security for personal data at conducting e-learning

The predisposition to share different types of personal data has been studied - grades, emails, enrolled courses and activities in them, posts in forums and videos in which students participate.

About two-thirds of respondents are not worried about the fact that other students may have access to their grades, their participation in forums, and videos with their participation. Slightly smaller is the percentage of those who do not worry about sharing information about enrolled courses and actions in them and their emails (Figure 3).

A similar result regarding the sharing of assessments was obtained in (Ivanović et al, 2013). Some Serbian students even want to see their colleagues' grades as a way to improve the transparency of grades.

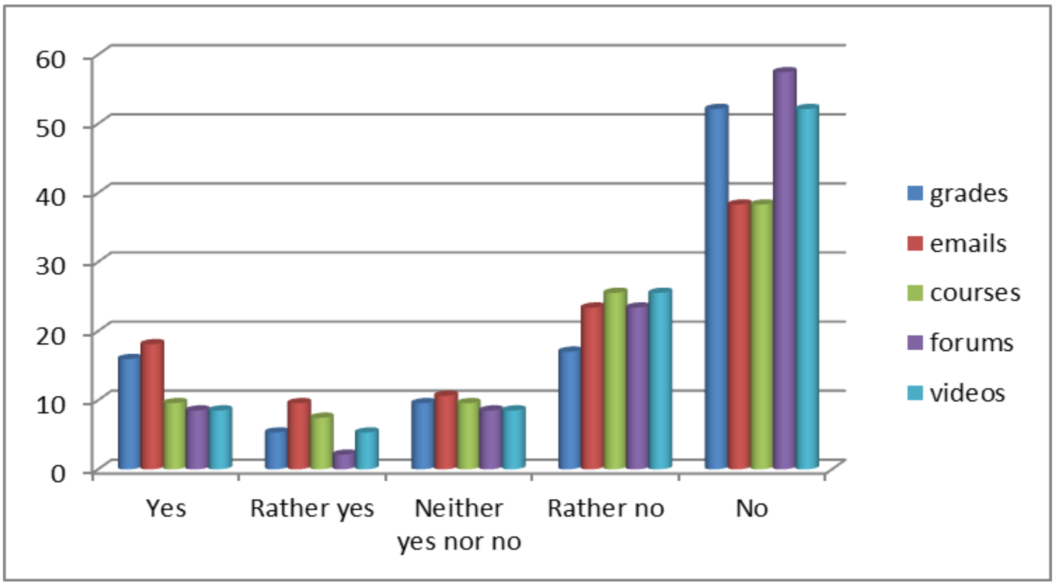

Figure 3. Predisposition to share different types of personal data

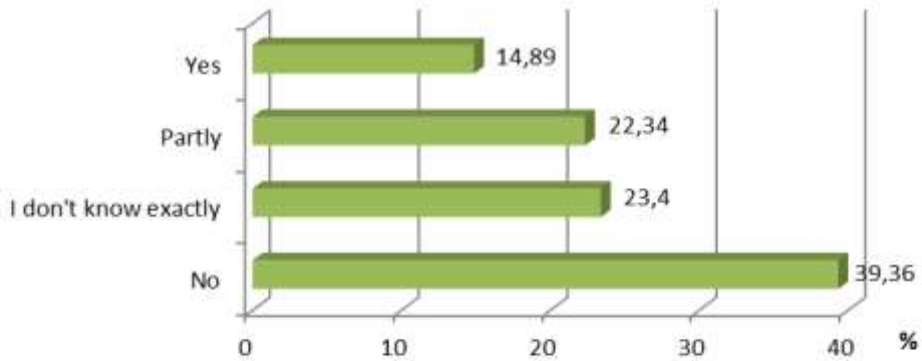

Figure 4. Are students familiar with the European regulation on personal data protection?

The probable reason for the high sense of security and predisposition to share personal information is that a large number of students are not sufficiently aware of which data is personal and which data they have the right not to share. They are not familiar with EU legislation on the protection of individuals with regard to the processing of personal data. To the question "Do you know what GDPR is?" Only 14.89% answered positively. 22.34% are partially familiar, and 39.36% - answered negatively (Figure 4).

This explains the high percentage of respondents who do not think that they themselves should determine what data they can share with other participants in e-learning courses. 85% are convinced that the University does what is necessary to protect their personal data.

After analyzing the most common ways to access personal data when using e-learning, the following non-technological measures to preserve the privacy of student data are formulated:

- The courses should be re-created every year so that students do not have access to information about the old participants and documents published for / by them;
- The access of already graduated / dropped out students to LMS should be suspended;
- Students should use institutional email addresses, instead of personal ones;
- When sending mass emails and messages to a larger group of students, the blind carbon copy (Bcc) option should be used for listing the recipients so that information about grades, course participation, etc. cannot be retrieved from the address list. If possible, pre-created email groups should be used;
- Files containing general information about the students in the course should not be published;
- Video recordings should be made only with the consent of the students and they should be allowed to work without using cameras, if this is not necessary for the purposes of the course or as a security measure during the exam / current control;
- The lecturers to explain to students the risks of excessive sharing of personal data;
- To give students the opportunity to request deletion (hiding) of information published by or about them in already completed courses;
- When publishing papers by previous course participants, as an example of a task, data such as identity numbers, emails and grades / reviews must be hidden, unless if the students have not agreed their data to be distributed in this way;

- When conducting a videoconference, use the options of the system used to approve the participants in the videoconference in order to avoid the participation of unauthorized persons in it, which in turn may lead to leakage of personal information;
- The latest versions installed from authorized sources on all software systems used, both LMS and videoconferencing to protect against data leakage through vulnerabilities in the software must be used.
- When conducting a videoconference, the microphones and the camers of the participants should not be enabled by default. If this is necessary, the students should be clearly informed in the invite for the meeting.

4. Conclusion

This paper presents the results of a survey among students from the Trakia University - Stara Zagora, Faculty Technics and Technologies-Yambol on issues related to the privacy of personal data in the application of distance learning.

The results show that almost all students feel secure about their personal data in e-learning. They are convinced that the University is doing what is necessary to protect their personal data. Most of them, however, do not know what personal data the other participants in the e-learning courses have access to and are not aware of the problems that may arise from sharing personal data in them.

The attitude of students to the personal information that they are predisposed to share with other participants in e-learning courses was studied. About two-thirds of respondents are not worried about the fact that other students may have access to their grades, their participation in forums, and videos with their participation. Slightly lower is the percentage of those who don't worry to share information about enrolled courses and actions in them and their emails.

The paper also makes privacy recommendations that should be taken into account when using distance learning.

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Training in Electrical Machines by Adaptation of Educational Technologies

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Abstract:
Harmonization and integration within the European Education Area is needed for training in the field of electrical machines. For this purpose, the curricula and programs, providing fundamental, general technical, specialized engineering training, must correspond to the level of development of modern theory and practice in the specific subject area. The article presents an analysis of the adaptation of digital teaching materials and technical tools in the engineering-laboratory courses in the training of electrical machines. A methodology has been proposed through which these teaching materials and technical tools become a useful apparatus for achieving better student engagement in the learning process. This will require continuous additional efforts on the part of the teaching staff and constant updating of their specific digital competencies.
Keywords: Electric drives, Interactive tools, Electrical machines, Experimental equipment

1 Introduction

Modern education is reduced to the acquisition of a number of knowledge gained from practical and laboratory exercises (Zlatev et al., 2018; Georgieva et al., 2018). With the development of science and technology, the requirements for the technical and technological tools necessary to obtain this knowledge also increase. (Pehlivanova et al., 2011; Nedeva et al., 2013; Georgieva et al., 2015). For this purpose, the training must be carried out according to specially created curricula and programs. They provide the necessary fundamental, general technical and special engineering training. Purposefully, they must correspond to the level of development of modern theory and practice in the specific subject area (Mladenov et al., 2008; Pehlivanova, 2015). This statement was confirmed in the comparative analysis between the disciplines set in the curriculum of the specialty "Electrical Engineering" at the Faculty of Technics and Technology, Yambol, Bulgaria (FTT). The comparative analysis was made with technical universities in Bulgaria, Greece, Australia, Germany, Great Britain.

Figure 1 presents the results in the search for coincidence of disciplines studied in FTT with those from other universities in Bulgaria and abroad. It can be seen that the coincidence of the studied disciplines is over 60% for the universities in Bulgaria. This is because the curricula in FTT are in line with the requirements of business in the city of Yambol and the region. As can be seen from the graph, the results are similar compared to universities outside Bulgaria (over 50%). The main coincidences are in the studied technical disciplines.

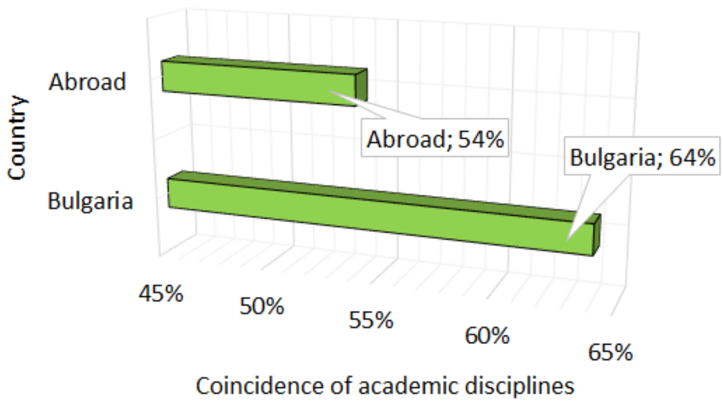

Figure 1. Coincidence of disciplines studied at FTT with those from other Universities in Bulgaria and abroad

Both abroad and in Bulgaria, the main place in the training is occupied by the practically oriented disciplines. Active forms of education have a significant relative share in the education in the specialty "Electrical Engineering" and in particular in electrical machines and enable students to independently solve individual problems of practice. For this reason, it is necessary to provide modern technical tools for students to work with.

Under European programs, experimental productions have been acquired at Bulgarian universities, mainly from producers in EU countries.

Bulgarian technical Universities have a tradition in training in the use of electrical machines. For effective use of the experimental productions it is necessary for them to be adapted to the teaching methods in Bulgaria (Zlatev, 2017; Doncheva et al., 2018).

The purpose of the report is to propose a methodology for adapting experimental setups to the needs of training in electrical engineering in Bulgaria, which will be suitable for e-learning and distance learning.

2 Material and methods

Lucas Nuelle training systems (Lucas-Nuelle, Inc., Germany), delivered under project BG161PO003-1.2.04.0081-C001 are used during the training in the discipline "Electrical Machines" at the Thrakia University (TrU), Faculty of Engineering and Technology, Yambol, Bulgaria. "Development of research and development capacity of TrU through renovation and modernization of applied research equipment".

Each of the studied machines is attached to a circuit board, which is placed on the laboratory installation and connected via a USB connection to a computer and the LabSoft multimedia interactive environment (Lucas-Nuelle, Inc., Germany). This software product provides virtual measuring instruments, and each of the measured values in real time can be checked for correct reading. The work window is divided into two parts.

In the left part is presented the studied course in the form of a short theoretical part and exercises, and in the right part their visualization, including scheme and way of connecting the experimental setup, setting of the used virtual tools, tables for filling, questions related to the specific exercise. There are laboratory exercises studying the following electrical machines: single-phase and three-phase transformer, autotransformer - Three-phase transformer SO4204-7Y; three-phase asynchronous motor with short-circuited rotor - Asynchronus mashines SO4204-7T; three-phase asynchronous motor with wound rotor - Slip-ring machines SO4204-7U; DC motor, universal collector motor - DC machines SO4204-7S; synchronous motor Slip-ring machines

SO4204-7U; stepper motor- Stepping motor SO4204-7W. A strobe for measuring the speed is provided for each of the considered electric motors.

Also, a laboratory stand is used for energy efficiency testing in electric drives, consisting of the following separate modules - power supply unit CO3212-5U, frequency inverter for control of asynchronous motors from Lenze (Lenze SE, Aerzen, Germany) CO3636-5G, CO3636-5V, test system with servomotor-CO3636-6V, multimeter with the ability to measure active, reactive, full power, current, phase voltage of the studied induction motor, cosφ; asynchronous motors-energy inefficient-SE2673-1K and energy efficient IEE 3-SE2673-1N.

3 Results and discussion

The individual stands used in the training are adapted to the study curriculum in the discipline of Electrical Machines, in order to effectively apply them and obtain specific knowledge, skills and competencies from students.

This is possible due to the accurate and clear visualization of each specific exercise, the simplified setup of the used virtual instruments for measurement and monitoring, the ability to check the measured values and the observed dependencies. In this way, the trained students acquire skills with a practical focus, giving them the opportunity to form the right behavior in real working conditions.

Table 1 presents the topics of the curriculum in electrical machines and appropriate experimental settings for the implementation of exercises.

The laboratory unit examining the characteristics of a single-phase transformer allows the operation of a single-phase transformer to be monitored in idle mode, measured by a virtual ampmeter and a voltmeter-idle current of the primary coil, voltage of the secondary coil terminals. A virtual oscilloscope visualizes the spurious form of idle current. The single phase transformer is tested both in load mode and in case of short circuit. Important characteristics such as nominal short-circuit voltage are identified, the influence of the type of load on its operation is monitored.

The three-phase transformer study involves tracking its operation on different circuits and groups of primary and secondary winding. The tests are carried out in a symmetrical and asymmetrical load.

When studying the operation of an autotransformer, it is monitored the decreasing and increasing voltage transformation without load and the load of the autotransformer.

The study of a three-phase asynchronous motor with a squirrel-cage rotor is accomplished by two laboratory installations - UniTrain INTERFace, together with Asynchronous machines and an energy efficiency testing stand in electric drives. An asynchronous motor is captured by the stand. Also, on the basis of the laboratory installations, knowledge of the types of stator winding of an asynchronous electric motor, reversing, use of variable frequency drive (VFD) and adjustment is obtained.

Table 1. Curriculum topics and appropriate experimental setups

Subject	Laboratory equipment
Exploring the characteristics of a single phase transformer	Three-phase transformer SO4204-7Y
Exploring the characteristics of a three-phase transformer	Three-phase transformer SO4204-7Y
Exploring of autotransformer	Three-phase transformer SO4204-7Y
Examination of the characteristics of a three phase asynchronous motor with a squirrel-cage rotor	Asynchronous machines SO4204-7T Laboratory stand - CO3212-5U,CO3636-5G,CO3636-5V,C03636-6V,CO5127-1Z,SE2673-1K,SE2673-1N

Examination of the characteristics of the three-phase asynchronous electric motor with wound rotor	Slip-ring machines SO4204-7U
Insertion of a three phase asynchronous motor with squirrel-cage rotor to a single phase network	Asynchronous machines SO4204-7T
Exploration of a DC motor	DC machines SO4204-7S
Exploration of a universal collector electric motor	DC machines SO4204-7S
An asynchronous electric motor study	Slip-ring machines SO4204-7U
Examining a stepper motor	Stepper motor SO4204-7W

An asynchronous wound rotor motor test involves starting the asynchronous electric motor by engaging resistors in the motor rotor circuit and setting the shunt time. The sliding and rotational speed of the asynchronous electric motor is calculated, the measured and calculated quantities checked.

An example of realization of a practical exercise, in which the dependence of the the stator winding parameters current and impedance of phase, at different voltage frequencies is monitored and the elements of the equivalent circuit of the induction motor are determined.

The tasks that students have to perform include connecting the scheme, measuring, recording and analyzing the results obtained.

The scheme of the experimental staging is gradually connected, in a way set in the exercise in the form of animation.

Initially, the tested phase of the stator winding is connected to a DC source, which is adjusted according to the instructions. The measuring instruments - Voltmeter A and Ammeter B are also switched on and adjusted.

The voltage of one phase of the stator winding and the current through it is measured. Using the obtained values, the active resistance of the stator winding phase is calculated.

The next measurement is made at a power supply of alternating voltage and adjustable frequency. The results are recorded in a table. The dependence of the current and impedance of one phase of the stator winding on the frequency is monitored. Based on the values obtained at a frequency of 50 Hz, the inductance of the respective phase of the stator winding is also calculated.

a) Laboratory setup – general view b) Screen of exercise realization

Figure 2. Stage of an exercise to study a three-phase induction motor with a wound rotor

When studying the connection of a three-phase asynchronous motor to a single-phase network, the start-up is done by pre-connecting the stator winding in a triangle and the motor being switched on as a single-phase capacitor motor.

In the DC motor test, a sequential, parallel, mixed coupling of the excitation coil to the anchor winding is carried out, measuring the speed of rotation. Laboratory setup and paced exercises allow you to adjust the rotational speed of a DC motor by: changing the supply voltage, adding additional resistance to the boiler circuit, and changing the excitation current. Through a virtual oscilloscope, the starting current is monitored and reported when the DC motor is started directly and by means of resistors in its anchor chain. Reversing the DC motor by changing the direction of the current in the excitation or anchor coil is also realized.

The universal collector motor study is performed by determining the useful moment of the rotor shaft, taking the losses from the rotor steel in rotation and the mechanical losses at the respective speed from the electromagnetic power.

The study of a synchronous motor through the laboratory setup gives a clear understanding of the start-up process of these engines and the lack of starting momentum in them. The release is realized through frequency feed. Determine the cos φ of the engine studied.

When studying a stepper motor, determine the maximum frequency of the stepper motor in which it can be actuated and reaches each position. The control signals are examined in full-pitch mode. Reversing the stepper motor is realized.

The adaptation and implementation of new training stands ensures independent performance of practical tasks by students as main learners. Affordable hardware is used, which reduces equipment and maintenance costs. Students are given the opportunity to work independently, which leads to the improvement of skills that are defined in the learning objectives.

When adapting practical exercises, it was found that the experimental setups are suitable for solving various practical tasks close to working in real production conditions. Through them, students acquire skills in using electrical machines in real production processes. Based on the realized examples in the present work, the adapted exercises are added to the existing course for electrical machines of the students in FTT Yambol.

4 Conclusion

The use of modern teaching tools requires constant additional efforts on the part of the teaching staff and constant updating of their specific and digital competencies.

The curriculum in Electrical Machines at the Faculty of Technics and Technology is harmonized with those of related specialties in other Bulgarian and foreign universities in terms of content and basic parameters. This is an important condition both for the realization of student mobility and for integration into the European educational area.

From the management point of view, there will have to be additional funds and infrastructure.

The developed methodology and support tasks will be applied in a number of exercises on electrical machines. Educational goals were set for the respective curriculum, which the learners must achieve.

The research can be continued by conducting a survey among students in order to evaluate the effectiveness of the use of the proposed methodology.

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Survey of students' opinions on the effectiveness of e-learning and distance learning during a pandemic

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Abstract

The article analyzes the opinion of students in two high schools in the town of Yambol, Bulgaria, in connection with the effectiveness of distance learning during the second school year of the 2019/2020. In conducting the survey, gender and the school in which the students are educated were taken into account. The questions from the survey are related to the successful acquisition of knowledge, the independent work of the students, the influence of their social contacts, as well as the time for self-preparation. The obtained results confirm and supplement those from the available literature. Methods and tools for detailed analysis of student performance using e-learning and distance learning methods are proposed.

Keywords: education, students acceptance, information-technology, service quality, distance learning, data analysis

1 Introduction

In a complex epidemiological situation in 2020, distance learning has been imposed in a number of countries (Gómez-García et al., 2020; Liu, 2020). Bulgaria is no exception during the Covid-19 pandemic, where remote sensing methods have been used as the main way to present teaching material. Teaching is carried out synchronously and asynchronously with the help of online platforms, means of Internet communication with shared chats, audio virtual conference rooms, electronic textbooks and others (Shivacheva & Nedeva, 2016).

After numerous tests by teachers of open applications for online learning with a wide range and strong user base, the most used during the pandemic in Bulgarian schools are Microsoft Teams and Zoom (Digital, 2020). Although Microsoft's application is more labor-intensive, it is most used due to support from the Ministry of Education and Science (MES) in Bulgaria (MES, 2020). The platform is implemented by the Ministry of Education and Science to the users in edu.mon.bg, as the student accounts are connected to the teachers' accounts automatically.

The specifics of the application of distance learning in the Balkan countries are summarized (Gábor & Péter (2015). According to the authors, the use of such teaching methods in the specified geographical region, for the study period until 2015, has gone through stages of complete rejection , until acceptance as an additional and in some cases as a basic form of preparation.

In Bulgaria, the use of electronic and distance forms of teaching provokes wide discussion (Shivacheva et al., 2016; Stoykova et al., 2016). The main advantages are possible savings, active participation of students, who are often absent from the classrooms, and last but not least, the opportunity for training to take place wherever there is an Internet connection. For their part, skeptics of online forms of teaching have no less arguments. They point to the need for technical availability and literacy, the emergence of problems with students' vision due to prolonged staring at monitors, social isolation and the need for continuous parental control during training.

In order to receive feedback from students on the effectiveness of distance learning during the Covid-19 pandemic, schools in Bulgaria are initiating anonymous online surveys in their school community.

An online survey (Tonchev, 2020) shows that 38% of respondents indicated that distance learning in 2020 was ineffective and should not be conducted in the next school year. On the other hand, 28% of the respondents indicate that the distance form is suitable as a supplementary, but not as a basic form of education.

Another survey conducted in the city of Sofia, Bulgaria (ELS, 2020) shows that over 50% of the surveyed students believe that the problem with distance learning is the lack of social contacts. The same percentage of participants answered that they needed more time for self-preparation due to the larger volume of homework.

Opposite results were obtained in a survey in the city of Vratsa, Bulgaria. Only 15% of respondents (Vratsa, 2020) indicated that it took them longer than usual to prepare on their own.

In addition to schools in major cities, surveys have been conducted by companies offering online supplementary education for students as a service. According to the surveyed survey in the distance form of education the time for independent work of students increases by 22% (Namama, 2020).

The results of the research, reflected in the presented review of the available literature, show that the assessment of students for the use of e-learning and distance learning is not unambiguous. This necessitates more research in this regard. The survey surveys in schools were conducted mainly in the big cities of Bulgaria, while in the smaller ones there are none. Another disadvantage of the presented is that they are mainly expressed as a percentage of the total number of respondents. It is necessary to propose a methodology for relatively more accurate analysis, using a statistical calculator.

Such studies conducted in the town of Yambol, Bulgaria are few and concern schools offering primary education. No surveys have been conducted on the opinion of upper secondary students.

The aim of the present work is to make a survey and comparative analysis of the effectiveness of e-learning and distance learning in a pandemic.

2 Material and methods

The survey was conducted in two of the most elite high schools in the city of Yambol, Bulgaria: Profiled High School “Atanas Radev” (PHS); Natural and Mathematical High School “Vasil Levski” (NMHS).

The answers to the questions in the survey are 98 students from 11th grade, from all 11 grades. The survey was conducted immediately after the end of the school year.

Based on a study of literature sources, questions were selected for a survey, in connection with e-learning and distance learning. After consultation with an expert, questions were selected that are suitable for obtaining informative data on students' opinions.

The students surveyed would not like to answer too many questions, but are willing to fill out a short questionnaire with a small number of questions after a kind request. For this reason, the developed survey contains a small number of accurate, easy and clear questions.

Table 1 shows the selected questions that are included in the survey.

Table 1. Survey questions and possible answers

№	**Question**	**Possible answers**
Q1	Your gender?	Male; Female
Q2	High school where you study?	Name of high school
Q3	Do you think that with e-distance learning, the acquisition of knowledge is more successful for you?	Yes; No
Q4	Do you think that the independent development of topics (presentations) helps to better acquisition of knowledge?	Yes; No
Q5	Do you think that the lack of direct social contact and	Yes; No

	communication in the school environment leads to poorer learning of the material?	
Q6	Do you think that e-distance learning requires more time for self-preparation than the present form of learning?	Yes; No

The survey was prepared and conducted with the help of Google Forms (Google Inc.). This online tool was chosen because it is convenient to use and fill out questionnaires on mobile phones, which are preferred by students to work in the Internet environment.

Google Forms also offers a summary graph, as well as a download of the answers received in the form of a spreadsheet. In this table are available the individual answers of each of the respondents, which makes them suitable for processing with the methods used in the present work for data processing and analysis. The questions are arranged one below the other and the possible answers are marked with a "checkbox" element.

Data were processed at significance level $\alpha = 0.05$, using the chi-square analysis method (χ^2) in the software product Statistica 12 (Stat Soft Inc.). "Chi-square" is a non-parametric method for testing hypotheses, which hides its main advantage, namely that it does not require knowledge of the law of stochastic distribution. The method is based on the comparison of two distributions, one empirical and the other theoretical. From the comparison of the indicated distributions a criterion is drawn up with the help of which the existence of a presumed connection between the studied factors is checked.

3 Results and discussion

It was checked whether there is a statistically significant relationship between gender and the high school where students study, and the answers to the question: do you think that with e-distance learning, the acquisition of knowledge is more successful for you (Q3)? From this analysis it was found that there were almost equal numbers between men and women who gave a positive answer and with about twice the predominance of women gave a negative answer to question Q3.

The hypothesis for connection between the gender factor of the student and the factor whether with the e-distance learning, the acquisition of knowledge is more successful for the students is tested.

The χ^2 analysis of the respective answers shows that the level of significance $p=0{,}093>0{,}05$, which means that the factor does not affect the response or there is no statistically significant relationship between gender and the given answer to question Q3. From these analyzes it was found that no statistically significant dependence on the gender of the students and their opinion on this issue was found.

An analysis was made of the relationship between questions Q2 and Q3. It was found that there is a strong predominance of those who gave a positive answer to the question to students from NMHS, and the majority of students from PHS gave a negative answer to question Q3.

The hypothesis for connection between the student's school factor and the factor was made, whether with the e-distance learning, the acquisition of knowledge is more successful for the students?

The χ^2 analysis of the respective answers shows that the level of significance $p=0{,}0001<0{,}05$, which means that the factor affects the response or there is a statistically significant relationship between the high school and the given answer to the question whether the electronic distance learning, the acquisition of knowledge is more successful for students. From this analysis a statistically significant dependence on the NMHS where the student studies and their opinion on this issue was established. In PHS students strongly believe that with e-distance learning, the acquisition of knowledge is more unsuccessful for them.

An analysis was made of the relationship between questions Q1 and Q4. Women who gave answers have an almost double advantage, but this is due to the larger number of participants in the survey.

The hypothesis of a connection between the gender factor of the student and the factor is tested. Do you think that the independent development of topics (presentations) helps for the better assimilation of knowledge?

The chi-square analysis of the respective answers shows that the level of significance p=0,43>0,05, which means that the factor does not affect the response or there is no statistically significant relationship between gender and the answer to the question whether self-development of topics (presentations), helps to better acquisition of knowledge. It was found that there is no statistically significant dependence on the gender and response factors – the independent development of topics (presentations) helps to better acquisition of knowledge.

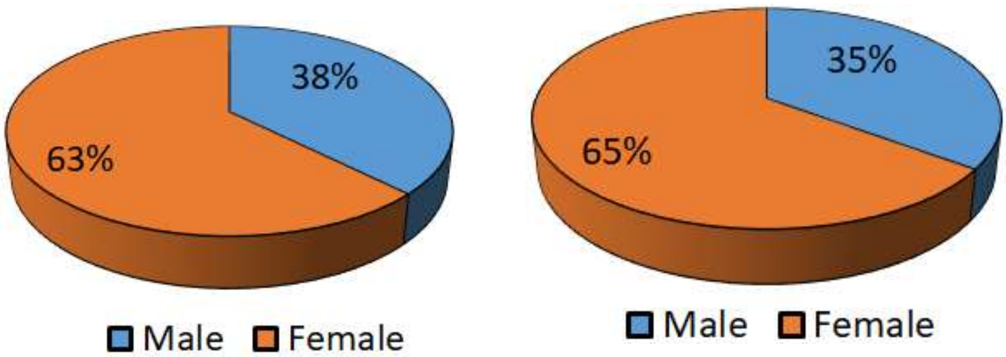
An analysis was made of the relationship between questions Q2 and Q4. There was a slight difference in the answers of the students depending on the school in which they study, as for the first a slight advantage have the students in NMHS, and for the second from PHS.

The χ^2 analysis confirms that there is no statistically significant relationship between the school factor and the factor – the independent development of topics (presentations), helps to better assimilate knowledge, p=0,52>0,05.

From the analysis it was found that there is no statistically significant dependence on the school factor and the response – the independent development of topics (presentations) helps to better assimilate of knowledge.

An analysis of question Q5 was made. It was found that 75,5% of students believe that the lack of direct social contact and communication in the school environment leads to poorer learning, and the remaining 24,5% that it is more successful.

It was checked whether there is a statistically significant relationship between gender and the high school where students study, and the answers given to this question (Q1 and Q5). Figure 1 shows a diagram of the impact of these issues.



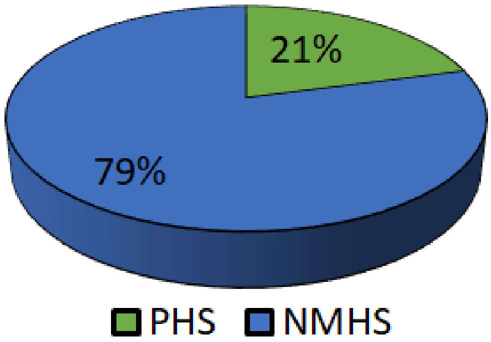
a) No b) Yes

Figure 1. Categorized diagram of influence of questions Q1 and Q5, according to gender

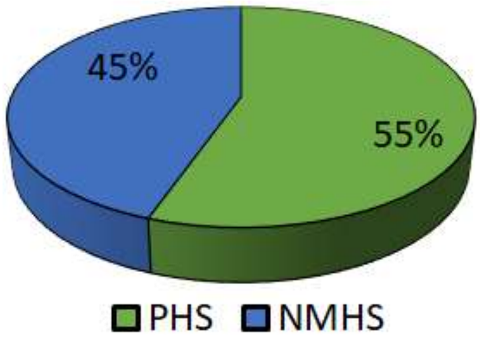
The performed χ^2 analysis confirms that there is no statistically significant relationship between gender and that the lack of direct social contact and communication in the school environment leads to poorer learning of the learning material, p=0,83>0,05. It was found that there is no statistically significant dependence on the gender factor and the response that the lack of direct social contact and communication in the school environment leads to poorer learning of the material.

An analysis was made of the relationship between questions Q2 and Q5. There is a significant difference in the answers of the students depending on the school in which they study, as for the first significant advantage have the students in NMHS, and for the second insignificant – PHS. Figure 2 shows a diagram of the impact of these issues.

The performed χ^2 analysis confirms that there is a statistically significant relationship between the school and that the lack of direct social contact and communication in the school environment leads to poorer learning of the learning material, p=0,03<0,05. There is a statistically significant dependence on the school factor and the response that the lack of direct social contact and communication in the school environment leads to poorer learning of the material. NMHS students do not believe that the lack of direct social contact and communication in the school environment leads to poorer learning of the material, while PHS students believe the opposite.



a) No



b) Yes

Figure 2. Categorized diagram of influence of questions Q1 and Q5, according to high school

An analysis of question Q6 was made. It was found that 56,1% of students believe that e-distance learning requires more time for self-preparation than the present form of learning, and 43,9% do not think so. There is a difference in students' responses depending on gender, we will check how statistically significant it is. Table 2 shows the empirical and theoretical frequencies of the answers to question Q6, depending on the gender of the respondents.

Table 2. Empirical and theoretical frequencies of answers of Q6, according to gender

Frequencies	Empirical frequencies			Theoretical frequencies		
Answer / Gender	No	Yes	Total	No	Yes	Total
Male	19	16	35	15	20	35
Female	24	39	63	28	35	63
All groups	43	55	98	43	55	98

An analysis was made of the relationship between questions Q2 and Q6. The χ^2 analysis confirms that there is no statistically significant relationship between the student's gender and that e-distance learning requires more time for self-preparation than the present form of learning, p=0,12>0,05. There is no statistically significant dependence on the gender factor and the response that e-distance learning requires more time for self-preparation than the present form of learning.

Table 3 shows the empirical and theoretical frequencies of the answers to question Q6, depending on the school in which the respondents study.

The χ^2 analysis confirms that there is no statistically significant relationship between the school in which the student studies and that e-distance learning requires more time for self-preparation than the present form of learning, p=0,08>0,05. There is no statistically significant dependence on the factor the school in which the student studies and responds that e-distance learning requires more time for self-preparation than the present form of learning.

Table 3. Empirical and theoretical frequencies of answers of Q6, according to High school

Frequencies	Empirical frequencies			Theoretical frequencies		
Answer / High school	No	Yes	Total	No	Yes	Total
PHS	16	30	46	20	26	46
NMHS	27	25	52	23	29	52
All groups	43	55	98	43	55	98

The results obtained in this paper confirm and supplement those of other surveys related to the effectiveness of e-learning and distance learning in Bulgaria in a pandemic. The lack of social contacts of children is defined as a shortcoming mentioned in the available literature (over 70% of the respondents) (Kandeva, 2020). This is confirmed and supplemented by the results obtained in the present study, which found that this lack of social contact has a statistically significant difference in the assimilation of learning material by students. A survey similar to the one presented in this paper was conducted at a high school in Sofia, Bulgaria (ELS, 2020). The results are convenient for comparison between those obtained in a larger city and those presented here for the city of Yambol. According to the results of the survey in the city of Sofia, 56% of the surveyed students point out as a disadvantage the lack of social contacts in the distance form of education. The time for independent work is increasing by 32% of the respondents. Also, 54% believe that the volume of homework has increased. These results are confirmed and supplemented in the present work, a statistically significant difference was found between the different schools and there is an increase in the time for self-preparation of students.

4 Conclusion

In the present work, a survey and comparative analysis is made to assess the effectiveness of e-learning and distance learning in a pandemic. Methods and tools have been proposed that can be used to improve the analysis of survey data in schools. From the analyzes it was found that the gender factor does not have a statistically significant impact on the successful acquisition of knowledge, increasing the time for self-preparation and social contacts in e-learning and distance learning. It was found that in the analysis of the factor educational institution, there is a statistically significant difference in these factors.

The results obtained in the present work confirm and supplement those of the available literature. There is a statistically significant difference between the different schools and there is an increase in the time for self-preparation of students using e-learning and distance learning.

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Design of a System to Improve Technical Training Equipment Performance

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Abstract

When using automatic bread machines for research and practical exercises in the field of automation and food technology, there is no complete compliance of the obtained results with those in real production conditions, as well as meeting the technological requirements laid down in the normative documents for bread production. In the present work, through the analysis of the technological object - a baking chamber in an automatic bread machine – a precise control system is proposed, replacing the relay controller, which is more commonly used by the manufacturers.

Keywords: Process control, Feedback control, PI-control, Integrating Process, Bread machine

1 Introduction

Automatic bread machines are used in the field of research (Nachev et al., 2016; Trih et al., 2016) as small automatic laboratory devices for examining different indicators of bread quality and reducing electricity consumption.

Indicators that are mainly monitored in test laboratory tests and in production laboratories include: taste, color, odor, crust thickness. The physicochemical parameters to be determined are: mass, volume, humidity of the crumb, total moisture, porosity of the crumb. These indicators are to varying degrees influenced by the regimes of final fermentation and baking. The errors in the modes of preparation, final fermentation and baking have a significant influence on the finished product. The intense mechanical impact of the processing of weak and defective flours gives bread with serious defects in quality. These defects stem from the quality of the raw materials.

The poorly selected regimes of final fermentation and baking strongly influence the quality of the product. Therefore, proper temperature control is required as a basic indicator characterizing the effect of the automatic bread machine operation on a particular operating mode. Another application is in teaching (Hesketh et al., 2001; Dineva et al., 2011) as laboratory facilities for training in technical disciplines. Comparative analyzes of automatic bakeries have been reported (Hamlet et al., 2001), which found that the incorrect application of technological operations and the inaccurate regulation of temperature in bakeries lead to the creation of an environment for the development of pathogens in the resulting bread. It is incomplete to say that inaccurate temperature regulation leads to microbial contamination.

After baking, the bread is sterile with respect to molds and yeasts. Bacterial spores remain viable in the bakery environment of *Bac. subtilis, Bac. mesentericus*. They cause potato disease when stored because their spores are heat resistant. Therefore, the baking temperature indirectly influences the microbiological status of the bread, which is mainly influenced by the microbiological contamination of the raw materials and the manner and conditions of storage of the bread.

From the analysis of the literature, it can be considered necessary to: Improve the technological process of making bread in an automatic bread machine, as close as possible to that used in industrial production. The improvement of the technological process consists in the pre-activation of the yeast, the use of specialized lactic acid starters, the inclusion in the formulation of fats, sugars, which directly affect the firing regimes. Refine the processes of temperature regulation during fermentation and baking.

A method for improving temperature regulation is offered by Nikolova et al. (2017), by combining a relay and PID (proportional-integral-differential) controller.

The purpose of the article is to design a system for improving the performance of an automatic bread machine through a combination of relay and proportional-integral (PI) controller.

2 Material and methods

In the present work were used object approximation methods, basic PI (proportional-integral) control laws, and relay regulators described in (Astrom et al., 2006; Petrov et al., 2017).

The baking chamber of the automatic bread machine Elite BM-001 (E-Elite Bulgaria Ltd.) was used as the control object, with the main characteristics according to the manufacturer: Capacity 450g; Power 480-580W. The object is approximated to a first-order process with a time delay of the type:

[1] $$G(s) = \frac{k_o}{T_o s+1} e^{-\tau_o s}$$

A basic PI (proportional-integral) control law was used:

[2] $$y_{pi} = k_p e(t) + k_i \int_0^{100} e(t)dt$$

where y_{pi} is the calculated impact of the regulator on the object; k_p, k_i - adjustment factors; t - time, s; e - adjustment error.

A basic relay law is used:

[3] $$y_r = \begin{cases} 1, if\ y_o < y_{ref-\delta} \\ 0, if\ y_o > y_{ref+\delta} \end{cases}$$

where y_r is the calculated impact of the regulator on the object; y_0 - value of the regulated parameter; y_{ref} - setpoint of the regulated quantity; δ - hysteresis of the relay controller.

Figure 1 shows a block diagram of a control system with a combination of relay and PID controller. The switching between relay and PID (proportional-integral-derivative) controller is made by means of a comparison block. This block has a Threshold set to a value greater than or equal to k than the setpoint of the setpoint. It is necessary to determine the value of this coefficient, depending on the application of the management system and the specific site.

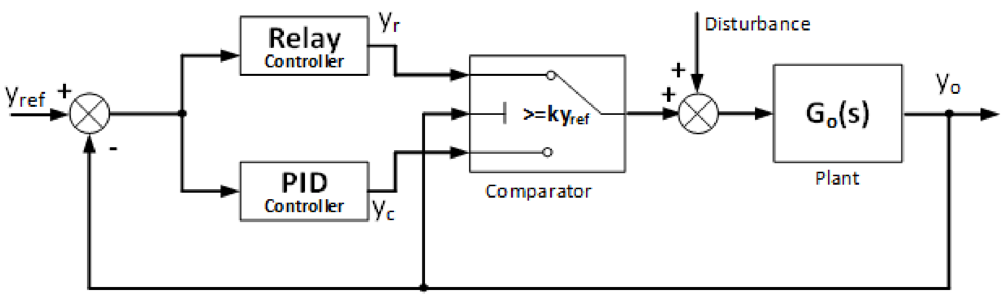

Figure 1 shows an electrical diagram of the control system used.

The system is built from a single-board computer Itead nano (Itead Inc.), type K thermocouple, Analog Output K-Type Thermocouple Amplifier - AD8495 Breakout (Adafruit Industries Inc.), SSR-25DA triac switch the input to which a 10 kΩ resistor is connected. The system controls the heating element of the household bakery. A program has been compiled in the Arduino IDE programming environment that implements the proposed combined control scheme with relay and PI regulators.

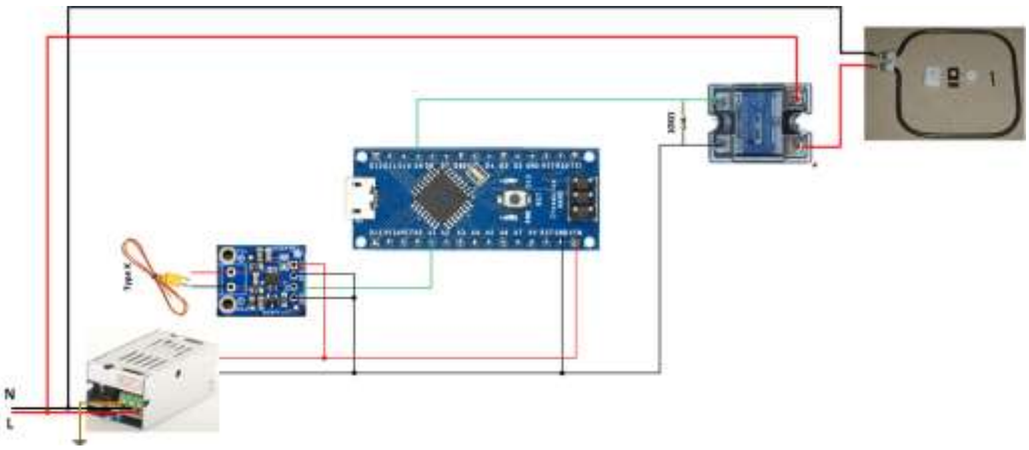

Figure 2. Schematic diagram of the control system used

3 Results and discussion

After approximation according to data obtained with the relay controller, the object is approximated to a first-order process with time delay. The object coefficient, time constant and its delay are determined:

$$[4] \quad W(s) = \frac{1{,}68}{192s+1} e^{-25s}$$

The value of the coefficient k at which the system switches between relay control and PI controller is determined depending on the time taken to reach the reference and the maximum dynamic deviation. In this work, a PI controller was used because the D component of the PID control law had a negative impact on the operation of the control system.

Figure 3 shows the relationships between the value of coefficient k, the time to reach the job, and the maximum dynamic deviation. It can be seen from the figure that at k=0.75 (at 75% of the desired process value), a switching between relay and PI control law can be made, because in this case a fast reaching of the reference is obtained and low values of maximum dynamic deviation.

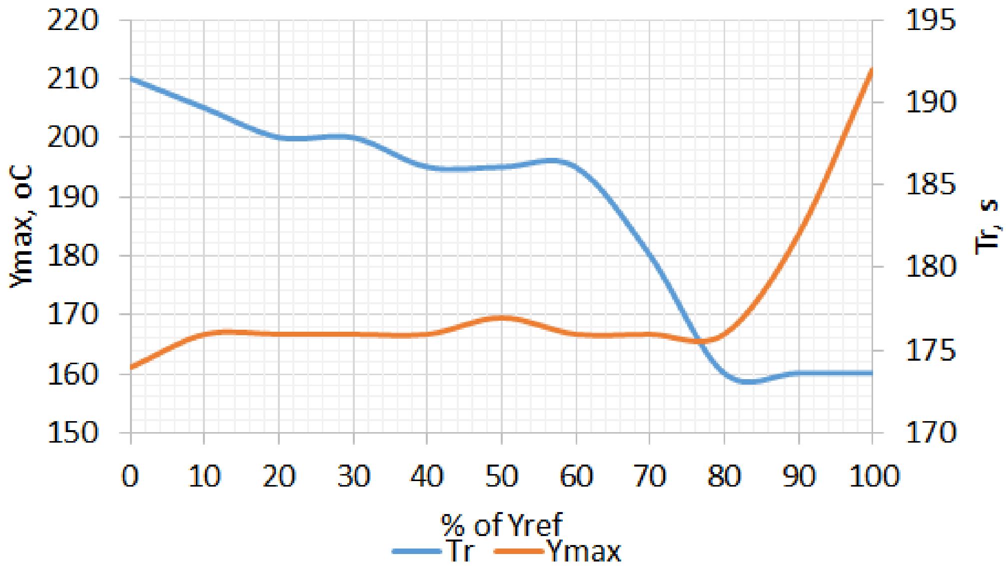

Figure 3. Relationship between k (% of Yref) and time to reach the reference temperature and maximum dynamic deviation from the set point

Figure 4 shows the performance of the proposed combined controller. The PI controller settings are kp = 1.69 and ki = 0.006125. The coefficient k = 0.75, therefore the switching between relay and PI controller is at a temperature of 131.5°C. The graph shows that there is an improvement in the operation of the site using a combined controller.

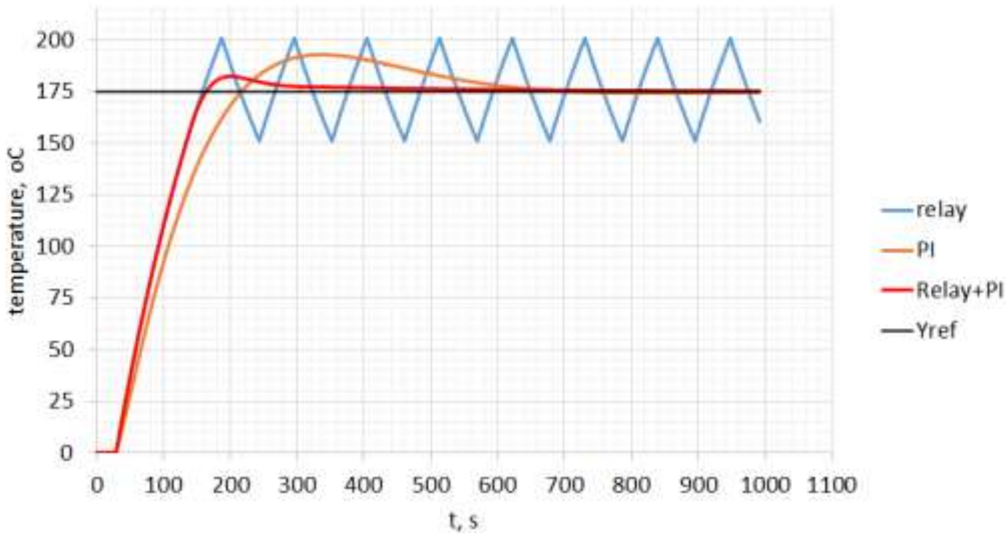

Figure 4. Operation of temperature regulators for an automatic bread machine

Table 1 presents parameters of system responses when working with different regulators. The presented temperature control system for bread baking in an automatic machine has its advantages and disadvantages. By using a relay controller, the setpoint is reached faster than the PID controller. The PID controller, for its part, precisely regulates the temperature, but reaches the set point much slower.

Table 1. Parameters of system responses when working with different regulators

Regulator	T_r, s	Y_{max}, oC	T_s, s
Relay	160	201	-
PI	220	192	690
Relay+PI	160	182	630
T_r-time to reach reference; Y_{max}-maximal temperature value; T_s-settling time			

The presented temperature control system for bread baking in an automatic machine has its advantages and disadvantages. By using a relay controller, the setpoint is reached faster than the PID controller. The PID controller, for its part, precisely regulates the temperature, but reaches the set point much slower.

In the system under consideration, it was found that the use of a PID controller containing the D (derivative) component was not appropriate. Here, its major drawback is that it exacerbates interference, leading to higher levels of overregulation. It may be recommended to use a PI regulation law when using the method of combining regulators.

Nikolova et al. (2017) make such recommendations, which indicate that with such a combination between a relay and a PID controller, the D component may have a negative impact on the effective operation of the control system. This statement is true of the management system considered here.

4 Conclusion

In this work, software and hardware tools have been adapted to improve the performance of an automatic bread machine, which can be used to meet the requirements set out in the regulatory documents.

From the measurements, calculations and analyzes made, the authors believe that:

- ✓ It is necessary to generalize the methodology for determining the value of coefficient k, which switches between relay control and PID control. This question remains unresolved;
- ✓ The use of a control law containing a differential component when combining relay and PID controllers is strictly dependent on the control object and the interference available.

Acknowledgements

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Color as One of the Supporting Elements of Training in Minimalism

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Abstract

Minimalism is a style that suggests a method of reduction, where all design elements are reduced to their necessary size and shape. In addition to the mentioned feature, it is important to understand how effective color is in minimalist spaces and what kind of a role color plays in those interior spaces. The study also explored minimalist interiors, and performed a statistical analysis of minimalist interiors in the Republic of Northern Macedonia. This specific study, at first explains minimalism, beginning with its relation to design, interior design, art and color. Color is an important element of design and has a special role in interior design. Therefore, literature has been reviewed, in order to analyze these minimalist interiors, color, design and interior design.

Keywords: Minimalism, Design, Simplicity, Interior, Color

1 Introduction

The word minimalism means least in quantity, and if we scale, minimalism would be the lowest level. What minimalism seeks to achieve is the simplification of aspects of modernism, and it is often identified as a reaction against abstract expressionism and its connection with post-modern art. The term minimalism, when it comes to architecture and design, is used to describe a style of design that is characterized by simplicity and functionality (Bueno, 2003; Indrie et al., 2017). Color plays a specific role in the design, and is one of the primary features of design elements. It is used in various design disciplines and creates the uniqueness of the design itself. The study discusses about the application, role and meaning of color in different design disciplines and the use of color in interior design, with particular reference to the minimalism in the interior (Rossel, 2005). The goal is to find similarities and differences in the use of different colors in minimalist interior spaces, because each color has a different effect and function in the interior. In other words, the final goal is to find out what is the use of color in interior minimalist spaces, in different regions of the world.

2 The history of the appearance of style

Minimalism has emerged as a design reaction to the abundance of contemporary trends. The basics of minimalism are taken from Japanese culture. Japanese minimalism in the interior is more of a void, there is not so much furniture and decorations. European minimalism is less radical. The simplicity in Europe is combined with functionality.

3 Minimalism and design

Design minimalism can be defined by the artist's non-dramatic expression and the simplicity of the form and shape of the elements. Minimalism is a movement that first rises through the arts, music, paintings, theater and the movie industry, where the artists send their message through a small number of simple and essential creations. This movement begins with the sudden development of art, after World War II and trace their roots in western arts and visual arts within the United States, between 1960 and 1970.

4 Minimalism in interior design

The minimalist approach can be used in various design disciplines. Many modern architects have implemented purity and rigor in their designs, so we can call these designs minimalist. Bruno Munari, a professional graphic designer, once quoted: “To complicate is easy, to simplify is difficult” (Lleonart, 2019). He says that to complicate something, you only need to add things to it. On the other hand, in order to get something done, you need to recognize the essential features of the element, so that its basic function can be preserved. Simplification is a reflection of intelligence. As noted in an old Chinese proverb: "What cannot be said in a few words cannot be said, even in a lot of words." What everyone has been trying to say is that it is easy to design a complicated space, for example through a combination of five cubes, but it is difficult to use just one cube, which will perform the same function as all five. Famous Italian designer, AG Fronzoni, claims that a cube is a cube. Fronzoni wanted to say that materials and forms cannot and shouldn’t be considered secondary elements in the domination of the human figure. Also, the shapes and colors of nature should not be considered as subordinate elements. This Italian designer is known for emphasizing the possibility of incorporating abstraction into everyday life. This philosophy is supported by other renowned minimalist architects, such as Louis Bargan, Claudio Silverstein, Peter Zumtor and Tadao Ando. Baragan is known for his geometric purity and sharp colors, which he uses in his paintings, sculptures and architecture (Grimley, 2018).

5 Minimalism and color in interior design

Color is the basis of everything related to art. It helps define the elements and plays a dominant role in the basic aesthetics of artistic creations. Color is often the only characteristic of design and design elements, and is also present in minimalist style because it is a symbol of purity and simplicity. Herbert Ipma points out, in his book, “London Minimum”, that color plays a different role in shaping visual culture, it represents one of the oldest forms of communication and attracting people. The color is simple and clean. Color is a feature of minimalism and helps in defining the space (Zlatev et al., 2017; Layne, 2019). Leonart points out in his book, Minimalism and Color, that minimalism is not style, but it is absolute simplicity. Because the whiteness itself, in the minimalist space, reminds us that white light is the basis of the whole spectrum of colors. Another color accent is needed to capture the power of white. The decorations in minimalism are actually the colors themselves, because their combination adorns the space and makes it harmonious. As we know, color perception comes from different types of retinal cells that we have in our eyes and goes to different parts of the spectrum, colors can be defined and measured to the degree that they stimulate these cells. These physical or psychological quantifications of color, however, do not fully explain the psychophysical perception of color. Light from certain rays, is energy that comes from a source of light, such as the sun, moon, etc. The globe is illuminated by this energy. Although light is invisible, when a particle illuminates the atmosphere, some wavelengths are absorbed and others are reflected. The sky is blue because the moisture or dust that exists in the atmosphere absorbs short, blue wavelengths, and red wavelengths that pass through it. For example, people can sometimes see a rainbow because the light is refracted and reflected by stains of moisture or dust in the air. In addition, ambient light is the one that illuminates the day and makes surfaces and objects visible to the human eye (Fiell et al., 2012; Secan et al., 2012; Taschen, 2015). Without light, the world would be the same as the black moonless sky, and all surfaces that are visible to us and receive direct light, would be burned with the frozen shadow. To sum up, the color in our environment is characterized by light and shade. Color is a general term that encompasses both light and shade, though we often use shade as a synonym for color. Lighting is determined by the amount of light emitted by a light source and reflected on the surface. The hue is determined by the type of light-specific wavelengths in the light emitted by the source and reflected on the surface. (Minimalist, 2019).

6 The role of color in interior design

Color plays a strong role in changing the perception and feeling we get when perceiving it. For example, it can make a room without sunlight look cooler than it is, or a room illuminated by the sun, even brighter. As Mandelberg said: "If we use cold blue in a room that is not touched by sunlight, we will get a feeling of extreme coldness in the perception of the room. Conversely, if we use warm-white color in a room that is illuminated by the sun, it will awaken a feeling of unnecessary heat." Miller said that the color in the interiors can enhance a sense of belonging in that space, or it may be the reason for creating some kind of illusion. The color would be stronger and more striking if:

- ✓ Its value has decreased;
- ✓ Its saturation has increased;
- ✓ And it's warmer in terms of hue.

The color can also contain both advanced and retractable features. It depends on the features that are present in its interior, some are dominant and others subordinate. The darkness or lightness of the color, its saturation, the grayness it contains, sometimes can be more important features of the color, than its hue. When we are already talking about colors and their characteristics, we will say a word about the contrast that appears in them.

a) Warm space b) Cold space

Figure 1. Example of warm and cold interior spaces

The contrast can be achieved by using a light color along with dark, where the light color makes the dark look even darker and conversely. Also, complementary colors increase their intensity if they are used together. The use of strong, eye-catching colors, along with the gray shades, will make the gray look even lighter than they are (Cumberbatch, 2016; Gordon et al., 2019). Effective, vibrant colors, along with textures and eye-catching designs, can be used to add vibrancy to the space. However, when using them, care should be taken not to overfill the space (Ilieva et al., 2019). There is one way to avoid this problem, and that is to use contrasts of the complementary color scheme. For example, orange tones contrasted with blue tones, resulting in achieving a soft pale blue. State of harmony, is a general principle of design and is known as the law of the arrangement of things, where elements and structures have a visual connection and appear to form a whole together. The whole of art means that everything we see in a work of art belongs right there. Whole as such, it is achieved through balance, repetition and harmony in design. If we use two complementary colors for the floor, or the same color, we will achieve the unification of two rooms, for example a living room and a dining room. Whole helps piece of furniture look as if they belong together. Similar objects, with similar components or attributes, can be more easily combined with one another and look as if they complement each other. Repeating colors, shapes, textures or lines to create a visual connection between the elements makes exactly the whole space, because it creates a consistency and wholeness. By repeating colors, volume, layout, texture, shape, we can design elements that will be similar to each other. Suppose all the elements in the room are blue and highlighted. The elements send a clear message to the observer that they are connected and harmonized as a whole. To create dominance in their work, designers create attention by setting triumphant elements. Every design should have its primary purpose, which serves as a guide for the designers themselves. Once the primary, dominant element is created, the designers continue to create less dominant elements. The best way to achieve dominance is to use contrasts, because without contrasts, it would probably be the same. Imagine two cubes, one of which is larger than the other, which one would dominate? Of course, the bigger cube, it doesn't matter how big it is, it will dominate.

Conclusion

In minimalist interior design simple elements are always used, the most necessary elements, the color plays a big role in achieving the width and openness of the space and so on. But there are similarities and differences between the rooms themselves. The similarities are the use of cold colors for the main elements such as ceiling, floor, wall, basic pieces of furniture etc. The rooms differ due to the use of warm colors to achieve a focal point. No matter how many traditions, cultures, periods exist in the world, the minimalist interior design was the same everywhere. This research is analyzed in the study and is devoted to only a few cases of interior design, which are characterized by a minimalist style. Research can be further developed, with a more detailed approach, to a wider field of study.

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The role of digital technologies in development of 4cs competencies of learners

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Abstract

In today's digital world, people need new competencies that will allow them to be active and successful members of society. The key competencies of the 21st century, known as 4Cs – creativity, critical thinking, communication and collaboration, should be formed and developed in adolescents in schools and universities. They will help them integrate into a society characterized by the ubiquitous use of technologies. Information and communication technologies can support the development of these competencies, being used in training to stimulate students' creative and critical thinking, and to assist the process of collaboration and communication. The aim of the current work is to reveal the key role of technologies in the development of 4Cs competencies of digital generation learners.

Keywords: 4Cs competencies, Information and communication technologies, Digital learners

1 Introduction

Modern society, based on information and communication technologies and connected network of smart devices, strives to become a smart society. This direction of its development imposes new requirements on the education of adolescents so they can be fully integrated into it. The traditional approaches of memorizing content and known algorithms for solving problems are not enough today. There is a need to develop skills and competences to analyze and evaluate information, creative and critical thinking, ability to use the acquired knowledge in solving practical tasks and problems in real life. The basic competencies that must be mastered by learners, known as 3Rs (reading, writing, arithmetic), date from the early 19th century. The modern global community, the information society and the digital economy, dominated by technologies, are forming new basic competencies that people need to have in order to be successful. To be citizens of such a society, learners must also master the key competencies of the 21st century, known as 4Cs – critical thinking, creativity, collaboration and communication. Creativity and critical thinking are a prerequisite for generating innovative ideas in solving problems. Communication and collaboration ensure effective connectivity with other people. The four basic competencies can be formed and improved in classrooms, contrary to the common understanding that they are traits of human nature and it is not possible to be the subject of teaching and learning. The aim of the current work is to reveal the key role of information and communication technologies in the development of 4Cs competencies of digital generation learners.

2 4Cs Competences

The key competencies of the 21st century are critical thinking, creativity, collaboration and communication and they are known as 4Cs.

Critical thinking requires people to acquire, interpret, evaluate, and critically analyze large volumes of often contradictory information. It helps them solve problems by making informed and reasoned decisions and taking timely action based on evidence, knowledge and experience and using a variety of tools and resources (D'Addario, n.d.).

Creativity is the ability to think outside the generally accepted standards and frameworks. Creativity is to consider theories and concepts from different points of view, without imposing restrictions on existing norms. It is often associated with innovative ideas, approaches, and solutions. Without them, progress and development are not possible in any field (Kivunja, 2015).

Collaboration is the ability to work in teams to achieve a common goal, to learn from others and to contribute to the enrichment of their knowledge and development. To work with people from different cultures, resolve conflicts and make compromises has a crucial role. It is also includes taking responsibility for one's own and common actions. Collaboration expresses the role and strength of the collective intellect in the generation of ideas, content and knowledge.

Communication is the ability to express and convey ideas and thoughts so others can understand and perceive them (Stauffer, 2020). Communication also includes active listening, asking questions, and expressing opinions on discussed topics. Modern communication technologies guarantee the connection of people regardless of geographical location and time differences. To have effective communication with others, people have to know the features, advantages and limitations of the communication means and how to use them to present their ideas.

3 Development of 4Cs competencies of students

The potential of modern digital technologies has to be fully used to acquire the new basic competencies of the 21st century. The widespread integration of information and communication technologies in education and positioning students at the center of the learning activities, where they actively participate, cause positive changes in learning. Mobile and smart devices, smart technologies are an essential part of the everyday life of digital learners and should be incorporated into the educational process. Technologies provide innovative opportunities for educational organizations in terms of implementing new approaches and strategies in teaching and learning (Shoikova et al., 2017). They enable the necessary tools for creating an innovative and smart learning environment in which the development of 4Cs competencies is supported.

3.1 Critical thinking

The web space is a huge repository of information available to any learner. Students use the global information network when they are working on individual or group projects. Often they are tempted by the technique Copy/Paste, but the result is simply a way to present facts and information found on the web (Tech4Learning, n.d.). Learners need to be taught how to understand its meaning and interpret it in the context of the problem or task they are working on. Plagiarism checker software is a tool that can prevent the misconception of directly copying the information and indicating the source from which it was taken. The availability of many resources on the Internet is a great advantage, because on any topic can be found information. On the other hand, learners face problems related to the correctness and reliability of the information. Usually, students choose the first resource that comes out when searching in Google - in many cases Wikipedia. Learners should be informed that Wikipedia is a reliable source since the content is created as a result of the collective intelligence, but is not the only one that can be used. It is desirable to look for sources among articles in scientific and specialized journals, libraries and others. An important moment during the searching is the use of the accurate keywords, through which learners can find those sources that best match their information needs. Learners need to develop the ability to evaluate the information sources, to subject them to critical analysis, to synthesize and extract the important details. To do this, they need skills to build a system of criteria and use it to select the appropriate sources.

The next step after selecting the sources is to compare and evaluate facts and opinions, discover the links between them, extract the essential and important, summarize the common and different, play alternatives before making a final decision or taking concrete action (Tech4Learning, n.d.).

To develop critical thinking, learners have to be encouraged to design their own creation that solves a problem or task (Tech4Learning, n.d.). The process of creation demonstrates the application of acquired knowledge and skills in different contexts. The freedom to choose the tools to create and provide their own products is also a prerequisite for the formation and development of critical thinking. The variety of software tools will test learners' ability to choose the one that will strengthen the expression of their ideas and decisions. For example, the case of creating a presentation on a given topic. The learners can be provoked to create the presentation using cloud office package or web-based tools such as Prezi, Canva and others, not well known PowerPoint. Students should be encouraged to work with new and different tools, rather than relying on the comfort of the familiar. They have to use unfamiliar tools, so they need to explore and compare their features and capabilities to decide which one is more appropriate in the given case to express their ideas and to create a different and distinctive product. Practicing such an approach will give learners confidence that they are able to make the correct decisions and take the proper actions. The role of digital technologies in this process is as an object and at the same time tool to develop critical thinking.

3.2 Creativity

An important feature of any learning environment is to create conditions and prerequisites for active participation of students in the generation of new ideas, their improvement and subsequent implementation (Smit, 2016). Again, to successful development of creativity learners should be encouraged to produce their own creations – presentations, videos, projects, essays, lessons, stories, applications and others, not to copy good models and practices. This is the way to be actively involved in the learning process and turn from consumers of knowledge into creators of content. The manifestation of creativity in learners' products often excludes the precise instructions from teachers how to do something. Teachers should encourage diversity (Tech4Learning, n.d.) – the more diverse the learners' work, the more creativity they have shown. If all products are the same, it means too many instructions, directions, requirements and restrictions given by the teachers.

Modern infromation and communication technologies can support the realization of creative ideas of students. There are various tools for creating products in different forms and presenting and providing them to the others.Let's look again at the example of creating a presentation on a given topic or problem – one of the most commonly used approaches that teachers practice to observe students' work. Students can integrate multimedia elements and links to external sources; create effects, animation, and interactivity with all presentation products. These enriched possibilities of software support the realization of learners' creative ideas. Students can get the most out of the benefits of one or another tool and creatively use them. The tools can provoke innovative concepts and help students develop projects and assignments. Original ideas should guide the choice of presentation software, not its functionality. The lack or limited capabilities of a technology should not deter learners from realizing their ideas. They should be encouraged to look for ways to express their thoughts. Another technological mean for provoking the inventive performances of the learners and developing creativity is the use of Digital storytelling applications. The learners have the opportunity to tell a story that is a product of their imagination or reflects real situations. There are many tools for creating stories on the web, such as StoryKit, Story Creator, Storybird, Storyboard That, Tellagami, UtellStory and others. To enrich stories and reinforce them with facts, learners can search for information on the Internet, select the proper resources and synthesize the information they need. The presentation of story requires learners to choose approaches that are related to their communication skills, because storytelling is another way of communicating and transmitting ideas (Robin, 2006).

3.3 Collaboration

Collaboration includes teamwork, interaction with other team members, acquiring knowledge and skills from them, contributing to their training and development, giving their share to the collective creation of content and knowledge (D'Addario, n.d.). The distribution of tasks and activities between the participants in team working is important. It should allow each of them to show his strengths and at the same time to give the opportunity to improve weaknesses by interacting with others (Tech4Learning, n.d.). The allocation of tasks should not be imposed by the teachers. Learners are responsible to do this and during this process they are able to demonstrate their communication skills, critical appraisal and self-assessment. One significant problem in team working is the risk of not appreciating the contribution of each individual learner. It is possible one of the participants to hide behind the activities and achievements of others and to be without a real contribution to the final product. Such a situation affects the motivation of other learners. Digital technologies can help avoid such situations. There are many software tools that support and facilitate collaboration. Their most prominent representatives are the Wiki systems – the content and knowledge are created as a result of team working. Blogs, discussion forums, web conferencing tools, cloud office suites and services offer opportunities to create content collaboratively. They support also different means for synchronous and asynchronous communication. The advantage of the Social Web tools is the reporting of the individual contribution. The presence of a history of changes, versions of the created documents/pages/posts, comments and discussions on various issues ensures fair consideration of the contribution of each participant, which motivates learners to be active and creative.

Web conferencing software as a tool for synchronous communication, allow students to cooperate in real time. They enable participants to show presentations or other documents and use them to work together. It is possible to create shared notes on the presented documents, share screens and mutual assistance. Some of the software solutions provide additional opportunities for teamwork within the conferencing session through Breakout rooms. Small groups of learners can be formed to act as a team on a given task and then present the results to everyone. Cloud-based office suites provide shared spaces for collaboration on common projects in real-time and various connectivity channels. Each learner can perform his individual tasks on a group project, and the results are summarized in a common document. While working together, learners can appraise and edit the work of their colleagues, thus developing critical thinking, ability to analyze and evaluate, justify opinions, etc. Real-time work stimulates them to actively participate in executing tasks, since their actions and results are visible to others. The option to follow the work process on shared documents and establish the participation and contribution of each learner helps to impartially assess their knowledge and skills.

3.4 Communication

In the age of Internet of Things, all digital devices are connected and exchange data with each other. The next stage in the development of the global network is Internet of Everything where people and devices are connected. Digital smart devices can be used to ensure people's continuous connectivity. In a globalizing society, communication and work in international teams is common. Communication skills are of great importance for students. Learners have to be prepared to collaborate with people of different nationalities, with different views, ethnic and religious affiliations. They have to find the proper way to say, present and share their ideas, views or solutions to problems with others. Otherwise, no matter how creative and unique the ideas and solutions are, they will not be realized, especially in the case of team projects (Stauffer, 2020; Tech4Learning, n.d.). Communication, mediated by modern technologies, is possible and takes place through various channels. Connecting with other people is easier and faster than ever. To be effective and productive, students need to know the different tools and channels and make the most of their advantages in order to strengthen the presentation of their ideas. They should feel confident while using technologies as a communicating tool, because this will reflect on the presentation of their thoughts. Software communication tools include audio-, video-, web conferencing, virtual classrooms, discussion forums, email, chat. They enable synchronous and asynchronous communication and some of them provide tools for collaboration. Preferred tools for collaboration in the learning process that support synchronous communication are web conferencing tools and virtual classrooms. They combine different types of communication channels. The combination of communication and collaborative tools allows the realization of the learning goals and support the development of relevant skills and competencies.

4 Examples of use of digital technologies for development of 4Cs competencies

This paper presents the practical implementation of the presented ideas for developing 4Cs competencies with the help of modern information and communication technologies. It is aimed at students of pedagogical specialties, who will work as teachers of information technologies after their graduation. In their future work as teachers, students will have to follow the curriculum provided by the Ministry of Education and Science and work on established and approved textbooks and manuals. Despite the imposed requirements, future teachers have the opportunity to show creativity and critical thinking in presenting learning content, preparing individual tasks, additional exercises, assignments for assessing pupils’ knowledge and skills. They have to be able to apply their creative ideas even when there are limitations by the requirements of formal learning. Communication with students, collaborative work with them and other teachers are extremely important for creating a positive learning and work environment.

The example under consideration includes the following: Students are tasked to develop a lesson on a specific topic from IT courses. They can use a variety of resources – from textbooks and manuals to online video tutorials. Their choice is the result of careful study of available resources and the programs established by the Ministry of Education and Science. Their preliminary work includes researching the audience for which they are preparing the lesson. They need to take into account the needs and level of knowledge of pupils they will work with. Since there are many different learning materials, students have to extract, summarize or even change them according to the learning goals. They can create their own exercises, tasks, examples in different formats – text, graphics, audio, video. Students have to decide and choose the appropriate forms and tools for providing the learning content to pupils – presentation, video material, game, paper or electronic document, oral presentation, etc.

There are many software tools for the development of educational applications, including those with elements of gamification (for example, Learning Apps, Kahoot and others). They allow students to create projects for assessment of knowledge and skills. Despite the limitations of software tools to available templates, students can create projects that allows them to assess pupils’ knowledge and at the same time assess their own teaching approaches and whether learning goals have been achieved.

Teachers have to limit the instructions given to students how to prepare the lesson in order to create conditions for developing of competencies such as creativity and critical thinking. The option of giving very precise instructions ensures that the learners will create the lesson properly, observing all the requirements. But the result is that all lessons are similar, because students do not have the opportunity to implement creative ideas if they follow precise and specific instructions to achieve the desired result. The advantage of this approach is that they will learn how to create a lesson according to the rules. The second option for completing the task is without giving detailed instructions, but only general guidelines. In this case, it is possible learners to skip some elements of the lesson, not to apply the proper approaches, go beyond the proper frameworks. But in this case, they will have the freedom to be creative. The teacher can discuss omissions or mistakes later with all students, demonstrate how it should be done to achieve the desired goals and results. The students will learn from the mistakes they had made.

Digital technologies assist students in completing the assignment and cover all developing stages – from providing new knowledge to assessing pupils' achievements. It is a matter of students' personal opinion and consideration which of them to use, how to implement them in a learning process to effectively realize their ideas. Technologies support the formation and improvement of competencies such as creativity and critical thinking.

Another example of practical implementation of digital technologies for development of 4Cs competencies is the collaborative work of students on a group project, the result of which is presented in a wiki system. Students create linked pages in a wiki system that summarize the results of team work. The collaborative work of students involves the distribution of tasks and discussions on the possible solution of each of them to avoid the duplication of content or present materials that are not related to the rest. Collaboration and communication in the entire process of completing the task have the crucial importance. Each student has to guarantee the quality of both the results of his own performance and a critical assessment of the work of the other members of the team. The final performance depends on the quality of all components. The contribution of each learner is clearly distinguishable, since wiki systems offer tools to report the personal participation of everyone – the content he has added, editions and comments he has made, a chronology of changes is also kept. Each student is evaluated on the basis of individual performance and contribution to the overall performance.

These two practical examples illustrate the potential of modern technologies in developing the competencies of the 21st century of digital learners.

5 Conclusion

Technologies are used in all spheres of life and today's society is being transformed into a digital society. It requires new competencies and skills in people. To be successful in their professional activities in both real and digital environments in the technological world, learners need its key competencies – critical thinking, creativity, collaboration and communication. Critical thinking and creativity are personal competencies, whose development can be enhanced by digital technologies. Communication and collaboration are competencies that help individuals integrate into society. They can be evolved in the digital environment and are vital for the inclusion of the individual in the society. 21st century competences can be develop through the whole life, but their formation in adolescents has to start in classrooms. Information and communication technologies help create favorable learning environment where the necessary skills and competencies can be developed.

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Reliable and secure online exams during the COVID-19 pandemic

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Abstract

The paper aims to present the authors' experience in choosing software tools and suitable methods for reliable and secure online exams in organizing and conducting entrance, final and state exams at the Trakia University - Stara Zagora during the COVID-19 pandemic. To achieve this goal, literature sources related to the topic are analyzed, the prerequisites are presented and the conditions in Trakia University for conducting online exams are clarified. A comparison of existing secure browsers is made, from which Safe Exam Browser and LockDown Browser are selected and used. Emphasis is placed on the planning, organization and conduct of online exams and how reliability and security are achieved. There is a separate place for the problems that have arisen and the possible solutions for overcoming them.

Keywords: online exams, Safe Exam Browsers, LockDown Browser, student assessment,

1 Introduction

The spread of the new coronavirus COVID-19 has led to profound changes in social interaction and the organization of the education sector. In just a few days, universities switched to e-learning. This required a rapid adaptation of lecturers and students. One of the main problems of online learning was conducting exams. It had to ensure the reliability, security and fairness of the assessments. Many lecturers and students thought that distance exams were not suitable for higher education. The coronavirus pandemic became a major factor that helped "everyone to better understand that all the attributes of higher education such as online defenses, online entrance and final exams, as well as online academic jobs are as good as those conducted "in real life". (Strielkowski, 2020) Immediately after arising of the emergency, the management of the Trakia University - Stara Zagora decided to conduct all exams (entrance, final and state) online. The examination process for each of the listed types of exams includes - organization of exams, preparation of exam materials, conducting exams and assessment. This paper focuses on conducting entrance online exams and, in particular, the measures taken to make them reliable and secure.

2 Related work

COVID-19 pandemic and the rapid development of the Internet and information technologies are making the questions, related to the online exams an important problem for a growing number of researchers. Most often, researches relate to methods for detecting cheating during the exam and identifying students. „Academic dishonesty is nothing new, but an online testing environment requires different strategies and tactics from what we have had to consider in the past“ (Michael and Williams, 2013). According to (Grünigen et al, 2018) “One of the most important aspects is to prevent access of students to unallowed external help (humans) or resources (teaching material, internet) during the exam (cheating prevention)” “since access to the Internet allows for new ways of dishonest behavior in comparison to pen-and-paper exams. Preventing cheating requires extensive technical and organizational measures”. A basic measure of protection is indicated “combining a lock-down browser with recordings by physical cameras. The lock-down browser drastically raises the amount of effort a student must exert in order to cheat, while the cameras are a strong threat that cheating might even be detected after the exam.” In (Grajek, 2020) four most commonly used ways of proctoring are listed: “Passive monitoring of software on students' computers (by tracking application[s] students are running on their computers and whether they switch to another application while taking an exam); Active restriction of software on students' computers (by using a "lockdown browser" application that blocks access to other applications during exams or course activities); Passive video surveillance of students (by using software that accesses a student's webcam to directly monitor them) and Active video surveillance of students (by using a method similar to passive video surveillance software but adding real-time monitoring by live proctors)”; Results of a survey among institutions from the US, Australia, Canada and others show that “Active restriction of software and passive video surveillance is the most widespread. Most institutions that adopt online proctoring use more than one type.” Most institutions use Respondus Monitor products and / or the LockDown browser. ProctorU is the next preferred online tracking tool. Some institutions use Zoom to actively conduct video exams.

Some studies examine the attitude of both parties (evaluated and evaluators) to electronic evaluation. In (Kocdar et al, 2018) a study is presented that aims “to identify students’ perceptions on cheating and plagiarism and trust in e-assessment according to their assessment experience and mode of learning as well as exploring their concerns in e-assessment”. It is concluded that although “most of the students are willing to accept e-assessment practices, some have concerns about cheating and plagiarism and a low degree of trust in e-assessment, which should not be ignored”. (Mellar et al, 2018) examines the “higher education teachers’ perceptions of the prevalence and types of cheating in their courses with a focus on the possible changes that might come about as a result of increased use of e-assessment, ways of addressing cheating, and how the use of student authentication and authorship checking systems might impact on assessment practice”. Most lecturers expected cheating to become a greater problem with the increased use of e-assessment. Student authentication was not seen as a major problem. The paper aims to present the authors' experience in choosing software tools and suitable methods for reliable and secure online exams in organizing and conducting entrance, final, and state exams at the Trakia University - Stara Zagora during the COVID-19 pandemic.

3 Prerequisites for secure and successful conduction of online exams

To be held successfully online exams some several prerequisites and conditions must be met in advance. First of all, must be selected a software application or online exam platform that must meet certain requirements. They relate to both the security and the reliability of the tools and technologies used. At Trakia University (TrU) we accent the following basic requirements for online exam platform: To allow administration and service of a sufficiently large number of students simultaneously; to be web-based, work in cloud to allow conducting exams remotely for students who do not have the opportunity to participate in person or do not participate in person due to various circumstances (for example COVID-19); The user should not install additional applications besides the secure browser; To allow personalization of the choice for conducting the exam; To work in different languages, for which is expected to be needed, but obligatorily in Bulgarian and English; To allow constant updating by the server part; Easy to be configured and integrated with other applications as needed; To maintain a high level of security of the environment by allowing a level of security depending on the functions of the staff - only authorized staff to have access to the tests before, during and after the exam, incl. and for the results; To allow tracking and reporting of all attempts to access the e-learning environment.

Conducting online exams implies that a platform or environment for e-learning and distance learning has already been created. It maintains materials and resources for the courses. To conduct online exams, we must have a rich library of questions based on the theoretical knowledge or skills that students need to demonstrate. The paper does not discuss the topic of creating test questions, their types, etc., but considers them only as a prerequisite for online exams. Part of the requirements for the libraries with questions and the functionalities of the virtual learning environment (VLE) are as follows: The questions should be distributed thematically with the possibility to choose a certain number at random from each topic for the individual courses; They should be well thought out, formulated in an understandable way, with different levels of complexity and weight of the assessment; In case of more than one correct answer, points should be formulated for each correct answer to the question; To allow the possibility of fixing the time for performing the test; To allow the possibility of penalty points for incorrect answers; To allow the possibility to change the operating modes - adaptive with review of errors in self-preparation; or a test mode in which only the final result of solving the test is shown; To offer additional help and instructions through the menus that could be useful before the start of the test. It is especially important in online tests to predict all possible situations to prevent cheating during the exam.

The second prerequisite for secure and successful conduction of online exams is the provision of a secure browser. The secure browser ensures: Prevention of Question Copying; Prevention of screen sharing programs; Prevention from opening any other window of applications; Live Streaming of remote candidate; Unable to use shortcuts or function keys to access some applications; Student couldn't quit browser during online test; The time for the exam is limited. "SEB quits (and/or unlock the device) automatically after the exam was submitted." (ETH Zurich, 2020)

4 Conditions for the realization of the online exams in TrU

The conditions offered by TrU for the realization of the online exams comply with the above-mentioned prerequisites. Trakia University has a VLE, which is called Trakia Electronic University (TrEU), available at http://edu.uni-sz.bg. The electronic platform of the Trakia University is based on Moodle 3.6.5. It offers functionalities and features that are required for online exams, namely: it is user-friendly; It is familiar to students from previous exams or pre-test using; has a responsive design - can be applied to various devices - desktop, laptops, tablets, mobile devices; Offers 16 types of questions (multiple-choice, calculation, true/false, embedded answers, drag and drop into text, essay, matching, etc.), incl. use of mathematical formulas and graphical objects in the questions, as well as the addition of new third-party question types; offers quiz analysis, feedback analysis, question analysis, log analysis, etc.

Electronic courses have been created in the platform of TrU, which contain multimedia teaching materials (multimedia textbooks, presentations, lectures in various formats, video lectures, audio recordings, etc.), assignments for students with opportunities for collective work and tests for the courses in which online exams are taken. There are modern technological tools introduced through Moodle plugins such as Virtual Programming Laboratory, a flowchart of programming algorithms, plugins for games and gamification, visualizations of program code created with www.pythontutor.com modern forms of training with simulations in engineering and some natural sciences and others.

The second basic requirement for conducting secure and reliable exams is the use of secure browsers. TrU uses two browsers: Safe Exam Browser 2.4.6 (SEB) and LockDown Browser (LDB) with Respondus Monitor (RM). The first browser is free, and the second has a paid one-year TrU license. They allow easy and quick incorporation into TrEU. When conducting online exams, both browsers are applied depending on the nature of the exam: whether it has to be conducted with quaestors or with auto-proctoring. SEB and LDB require the installation of a secure browser on the user's device. They run on Windows and Mac (LDB also works on iOS for iPad). Both browsers are integrated into the learning management systems of TrU.

The features of the browsers are the following:

SEB: "SEB consists of three components: a kiosk-application, a portable firefox with the seb-plugin and extensions to divers learning-management-system" (ETH Zurich, 2020); Requires test setup by entering code generated by SEB; A key-file can be generated and sent to the user to run the test – it can be encrypted; It does not allow active processes for video sharing and remote intervention on the client computer; Allows to add other restrictions using a configuration tool. Another form of protection is to implement a checksum in the key-file which would be changed if the file was manipulated by the user in an attempt to overcome some of the imposed restrictions. If the checksum is not correct the SEB brower wouldn't start.

LDB: Automatically triggers stop of the process for applications that allow screen sharing or messaging - Skype, Viber, Facebook, etc. Add-on application Respondus Monitor (RM) provides live automated proctoring and video archiving; Possibility to observe and conduct the exam without the presence of a quaestor; Requires the student to record a video of the environment in which the exam is conducted; Verifies students' Identification; Keeps a video of the exam; Allows based on the recorded video to make an assessment and analysis of the problems encountered during the exam.

Online exams save money and time for students and lecturers, do not require the use of paper, create greater security. As a disadvantage can be reported that an online exam system is a little bit more susceptible to fraud.

When using both browsers, additional protection from simultaneous sessions to the e-university server was used via a Moodle module called Onesession.

For observation, during the exams, web conferencing with students is used via Google Meet. It is mainly used for online exams due to the following advantages: Unlimited hardware resources in terms of CPU load, session recording functionality. Google Meet supports access to a variety of hardware and software configurations used by prospective students; It does not interfere with the work of SEB and allows video surveillance of participants. LockDown Browser requires Google Meet to be stopped, but Respondus Monitor supports video recording of the exam.

5 Organizing and conducting online exams

The overall organization and conduct of entrance examinations include submission of documents, development of examination materials, preliminary work with the applicants (acquaintance with the rules for conducting the examination, the type of questions and the grading system) and conducting the examination. Only issues related to ensuring the security and reliability of online exams are discussed here.

Before the beginning of the entrance exams, the following main activities are performed in TrU: Training and instructing of the quaestors - lecturers and employees; Development of detailed written and video instructions for applicants and quaestors; Creating virtual rooms in Google Meet; Creating e-mails for each applicant and quaestor with domain trakia-uni.bg; Registration of the applicants in TrEU with a username and password; Sending names and passwords to the already created e-mails; Conducting preliminary online meetings of the quaestors with the applicants, divided into groups at different hours on the day before the exam; Execution of a trial test in the presence and after instructions from the quaestor. The first version of online entrance exams conducted at TrU was using Safe Exam Browser and video surveillance via Google Meet. The groups were small, 5-6 people with one quaestor for each group. The following steps were performed sequentially during the exam: Informed consent of the persons that a video is being recorded; Starting a video recording of the exam; Identification of the person by a copy of his / her identity card, which was sent by him / her and shared with the quaestor; Inspection by the quaestor of each computer of the participants in the exam for shared monitors and unauthorized software - all installed programs on the computer are inspected by name, regardless of the OS - Windows or Mac; Video inspection of the environment / space around the desk and in the room - there should be no other persons and unauthorized materials that may tempt the applicant for cheating; Instructing the applicants on the manner of conducting the test, on the permitted and impermissible actions; Selection of the variant of the test by a random applicant in a randomly selected virtual room - online with video surveillance of the selection of the variant by several or all groups of applicants; Sending by e-mail a key for the test to the applicants - separately for each exam because many exams are held at the same time; Sending the test password by e-mail to the quaestors; Beginning of the exam; Video surveillance of the prospective students with camera and microphone on; Instructions if the camera stops. The exam does not count if the camera is turned off. A backup option is for the person to join the virtual room via a mobile device; At the end of the exam, the candidate turns off the secure browser and this returns it to the place from where it was started, ie. his e-mail; When all the applicants are finished, the video is stopped. It is available for viewing if necessary. More than 3000 entrance exams were held at TrU with over 2100 candidates for the academic year 2020-2021. For all the applicants who study in Bulgarian, they were conducted in the described way. Some of the lecturers used SEB to conduct their mid-term and final exams also.

The second option for conducting exams is with the application of LockDown Browser. Thus, the final exams at the Faculty Technics and Technologies-Yambol were held, as well as some of the exams at other faculties. LockDown Browser with Respondus Monitor was applied during the entrance exams with the students who will study in English. In this case, the day before the exam, the applicants are instructed and they take a trial test using LockDown Browser with Respondus Monitor to install the software and get acquainted with the VLE of TrU. During the entrance exams and final exams, the conservators and technical specialists remain online for support and consultation in case of problems. „Respondus Monitor® builds upon the power of the LockDown Browser, using a student’s webcam and industry-leading video analytics to prevent cheating during non-proctored exams.“ (Respondus, Inc. 2020) Respondus Monitor offers a fully automated proctoring solution that enables students to take online exams. It is integrated into Moodle, the platform on which TrEU is based. „At the heart of Respondus Monitor is a powerful artificial intelligence engine (AI), Monitor AI TM that performs a second-by-second analysis of the exam session. The first layer of Monitor AI includes advanced algorithms for facial detection, motion, and lighting to analyze the student and examination environment. The next layer uses data from the computing device (keyboard activity, mouse movements, hardware changes, etc.) to identify patterns and anomalies associated with cheating.“ (Respondus, Inc. 2020) The third option for conducting exams at TrU was in a virtual room of Google Meet scheduled through Google Calendar, through which all participants are invited. Thus, some final exams, State exams for students from certain programs of Faculty of Technics and Technologies and thesis defenses were held. The State Examination Commissions are also included in the invitations for the virtual meetings for these examinations.

6 Identified problems from the exams and ways to overcome them

During the exams, some difficulties arose due to technical problems and insufficient technical literacy of the applicants. The technical difficulties are caused mainly by computer hardware problems or power outages. In case of disconnection of the Internet connection on the computer, if the applicant fails to turn on the web conferencing software via mobile device in time, then for objective reasons for these applicants the examination session is considered unsuccessful. Another common problem is the use of a camera with low resolution and low lighting, which does not allow the quaestor to assess whether there is an attempt for cheating. Difficulties also arose from insufficient technical literacy of the applicants and insufficient preparation for the day of the exam. Many of the applicants had not been acquainted with the training materials for passing the exam. Some of them did not understand basic things like the terms "Static IP" and constant uninterrupted "Internet connectivity". Subsequently, the ability to check the IP and whether it changes over time was added, which was useful for those who were not sure if they met this condition.

Conclusions

A very good preliminary preparation and organization was created for conducting the online exams during COVID-19 at TrU. Therefore, the level of security and reliability was high enough because of the level of technical literacy of the applicants. The possibility of using another person to solve the test was prevented by adding a password to access the test, which is told to the applicants through an audio channel immediately before the start of the exam and only if they are present in the video chat connection. The possibility of using unauthorized materials was prevented by using security browsers.To achieve an even higher level of reliability and security, the following recommendations can be made:

- ✓ To be imposed stricter requirements regarding the quality of webcams and the lighting of the premises, which due to the extreme conditions could not be met;
- ✓ To be added a step before the exam in which the candidate visits a web page to be recorded his IP and to be prevented the possibility of another person to take the test while the candidate is present only in the video chat;
- ✓ It would be good if each applicant was present with more than one camera in the chat - one that captures him and a second that captures the environment around him.
- ✓ To be conducted more training for quaestors to be prepared for any challenges;
- ✓ To be done a separate video of each applicant instead of a total video for 5 applicants or to be used LockDown Browser with Respondus Monitor, which records each applicant individually.

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Motivation for learning and choosing a professional field among students at Faculty of Economics in Trakia University

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Abstract

Motivation plays an important role in the development of the individual and the society and has an impact in every area of modern life. Research on the influence of motivation and the achievement of educational goals dates back decades and is based on basic theories in psychology and behavioral sciences. Creating an appropriate learning environment tailored to the learners' needs and requirements, applying innovative educational methods, competitiveness stimulates learners and strengthens their motivation to express and acquire basic skills suitable for their professional realization. The main goal of the present work is to determine the main factors for choosing a professional field and achieving better motivation for learning and acquiring professional skills and competencies in economics. A survey is conducted among students from the Faculty of Economics at Trakia University, Bulgaria, which provides feedback on their opinion and the need for transformation in learning environment in order to meet the students' needs.

Keywords: Motivation, Education, Learning environment, Professional competences

1 Introduction

In the modern digital society, particularly in the field of education, the low students' motivation for learning is more and more tangible. Increasingly, the teacher faces the problem of learners' indifference or confidence that everything can be read on the Internet and there is no need for all these lessons and tasks. It is an indisputable fact that there is a strong relationship between motivation for learning and the achievement of educational goals at each stage - from schools to universities and then in the workplace. This raises the need to find those key factors that would increase the motivation to learn and to acquire professional realization in a chosen specialty. When a person knows what he wants, he will find ways to achieve it and to develop himself.

1.1 Motivation theories

For decades, many scientists have studied motivation, and as a result, different points of view have been presented, shaped into variety of theories. Some of these theories as well as basic terms in this area are synthesized by Stirling (Stirling, 2014).

Motivation is a driving force, which is mainly divided into intrinsic (internal) and extrinsic (external). Intrinsic motivation is this one that comes from the individual and is not influenced by external incentives, while concerning extrinsic motivation, factors that are external to the learner (such as grades, rewards or potential benefits), affect his behavior and way of acting. Quite often these actions are not pleasant and interesting, unlike those that provoke intrinsic motivation and the learner enjoys performing them.

Other terms introduced by Murphy and Alexander's analysis are goal, interest, and self-schema (Murphy and Alexander, 2000). Based on their research, they believe that motivation is a state of mind in a specific context or within a specific domain, rather than a personality trait, and in Maslow's theory, behavior is determined by various factors, where one of them is motivation and the others factors are environmental forces. In this case, if the motivation is determined by the specific situation, then it is possible to build an educational environment that motivates students to learn (Maslow, 1987).

1.2 Motivation in education

According to (Tohidi and Jabbari, 2012), motivation in education can have a positive impact on the way students behave towards subjects and disciplines and their actions to achieve certain goals. It can increase initiative and perseverance in activities, improve cognitive processing, help determine consistency that increases motivation and improves performance.

This is a challenge for educational institutions and teachers, who should transform the system, curricula and learning materials so that young people become more motivated, continuing to improve themselves and acquire the necessary knowledge and competencies.

One of the external factors that influence motivation is the rewards or grades in the educational process. It has been studied that when they have a controlling effect, intrinsic motivation is transformed into extrinsic and learners begin to choose the easiest way to receive a grade or reward.

The problem with assessment is that it does not always give a real feedback of the learners' progress and distorts the focus on the reward rather than the motivation to learn. Studies show that the same task can be assessed with different grades when it is submitted at different times or if it is assessed by different teachers. In this case a positive effect on the motivation could be the constant support from the teacher and the comments on the assignments in order to make learners feel more engaged in the process

The intrinsic desire to learn, according to the Self-Determination Theory, is stimulated by the basic psychological needs for autonomy, competence and relatedness (Stirling, 2014; Tranquillo and Stecker, 2016).

The study of motivation for learning and choice of professional development among students aims to identify the main factors and educational methods that have a stimulating effect on achieving the main educational goals.

2 Educational environment at Trakia university and motivation

Technologies are useless if they are not combined and integrated with appropriate teaching methods. Therefore, building an educational environment that motivates students is essential.

Trakia university has been using an e-learning platform since 2004, but in 2013 the platform was expanded and became official for the whole university. It is based on LMS Moodle where pedagogical principles and teaching strategies are well designed and performed. The integration of different modules aims to provide the necessary educational environment that motivates students and creates long-lasting interest in the relevant disciplines. There are elements of gamification, activities for individual and group work, personal learning path and conditional activities, tools for communication and many more. All the teachers and students from all faculties in the university took the advantages of online learning during the pandemic situation COVID-19.

Yordanova (Yordanova, 2017) explores the possibilities of the Moodle environment and describes the use of different modules and strategies for their application so that they cover the six principles to increase motivation to learn: **positive attitude**, **pleasure and joy**, **sense of significance**, **success**, **personal benefit**, **clarity**. Her examples could be an inspiration for other teachers and could give them ideas how to implement these modules in order to increase students' motivation and achieve better learning results.

3 Research questions and principles for motivation in education

The issue of motivation is discussed by other teachers and researchers who study the factors influencing the choice of profession and the elements of the educational environment that motivates them to study (Ilcheva and Dimitrov, 2012; Proshenska at al, 2017).

The survey, conducted among the students from the Faculty of Economics, includes issues related to the basic principles for building training programs and guaranteeing the quality of the training process. Some of the principles that need to be implemented to motivate students to learn and included in the survey are:

- Trainees must be motivated to actively participate in the learning process and to learn;
- Using new interactive methods to put the learner at the center of the learning process ensures active participation;
- Receiving feedback on how well they have mastered the material and coped with the relevant tasks. This motivates learners because it stimulates their effort and work. The relationship between the teacher and the learner has a beneficial effect on the effectiveness of the process;
- Well-structured teaching material, without ambiguities and contradictions;
- Conducting systematic repetitions and doing practical tasks contributes to maintaining motivation in learners;
- Practical applicability of the study material;
- The content of the study material and curricula should be in accordance with the individual characteristics of the learners (gender, age, qualification, position, learning style, etc.).

4 Results and discussion

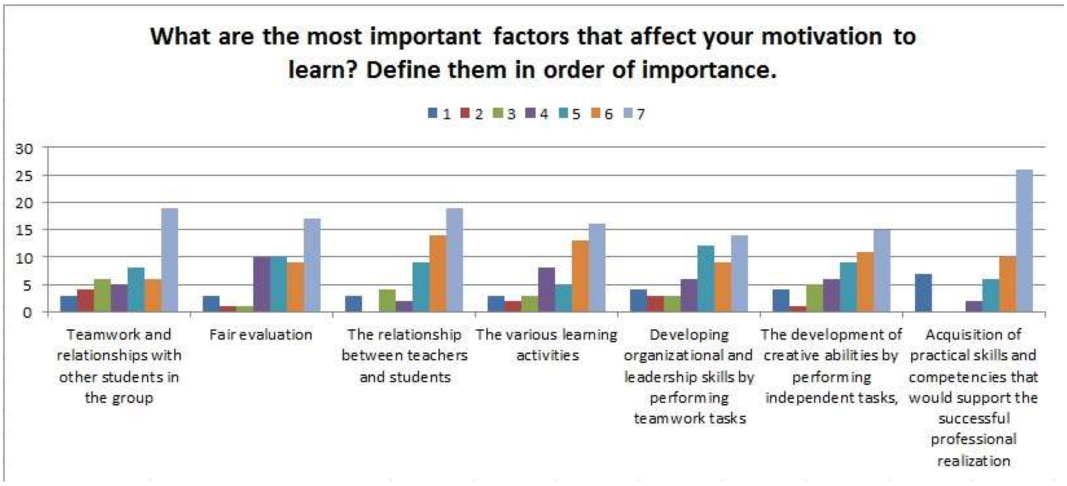
The aim of the study is to identify the factors that influence the motivation for learning and professional training among students at the Faculty of Economics in Trakia university, Bulgaria. The survey was conducted in June 2019 with part-time students and during winter semester 2019 with full-time students. There are 51 respondents that took part in the survey.

The first research question determines the reasons people decide to continue their education. The results indicate that 44 (86.27%) of the respondents have decided to continue their education at a higher education institution in order to acquire new knowledge and skills. Factors such as receiving a higher salary and greater self-confidence and prestige remain in the background by 17 (33.33%) and 22 (43.14%), respectively.

There is a balance between the expectations of the learners regarding the acquisition of theoretical knowledge 34 (66.67%) and practical skills 34 (66.67%), as well as the subsequent successful realization - 32 (62.75%). Expectations for contacts with business during the training are almost twice less -18 (35.29%). Only 1 of the respondents indicated the expectation to include businessmen from practice as teachers.

Among the factors that most influence the students' motivation, are presented in Figure 1:

- Acquisition of practical skills and competencies that would support the successful professional realization;
- Teamwork and relationships with other students in the group;
- The relationship between teachers and students;
- Fair evaluation;
- The various learning activities;
- Developing organizational and leadership skills by performing teamwork tasks;
- The development of creative abilities by performing independent tasks.

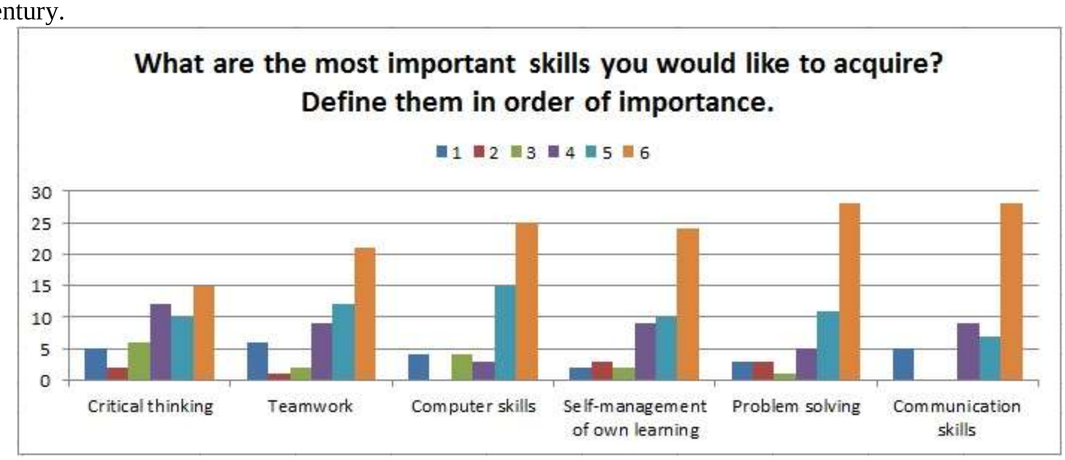


"Figure 1. The most important factors that affect motivation to learn"

According to the answers of the students shown on Figure 2., the skills they want to acquire during their studies, are ranked as follows:

- Problem solving;
- Communication skills;
- Computer skills;
- Self-management of own learning;
- Teamwork;
- Critical thinking.

These students' expectations lead to the conclusion that applied forms of training should be based on problem solving and case studies, use of informal forms of teaching, placing the learner at the center of training and assigning new roles that involve high degree of commitment and responsibility for own learning. There is less emphasis on teamwork and critical thinking, which requires a focus on presenting these two competencies that are considered basic in the 21st century.

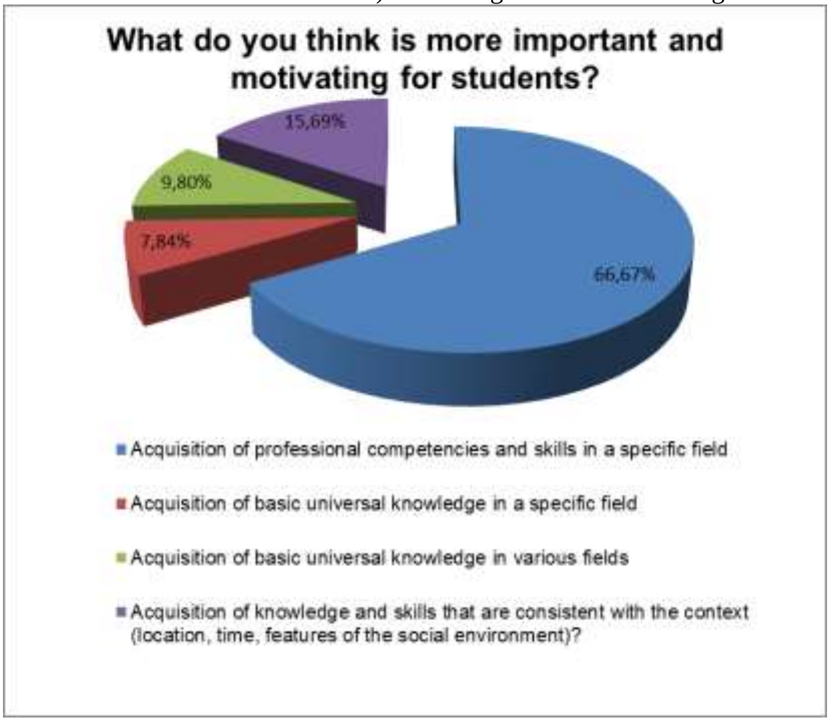


"Figure 2. The most important skills for acquiring"

Competition at the university is a determining factor on the motivation for learning of 52.94% of the respondents. For 43.14% of them, their motivation to learn is not influenced by external factors (such as competition between students), which puts teachers in the difficult task of motivating students through various learning activities and content to actively participate in the learning process and complete their education.

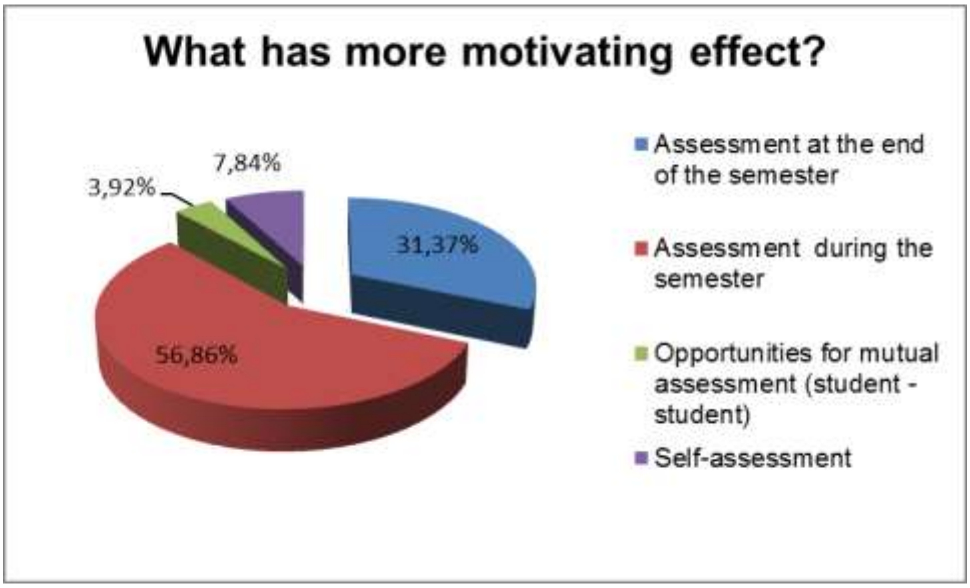
The opportunity to receive additional help from teachers in terms of preparation is one of the leading factors that keep students at the university – 29 (56.86%). Opportunity for change in a positive direction exists with regard to the application of innovative teaching methods, as there is a relatively low percentage -20 (39.22%). The result is an indication that innovative forms of learning process are still not considered as a factor that can affect the motivation to continue learning.

According to 66.67% of students more important and motivating for them is to acquire professional competencies and skills in a particular field, while the acquisition of basic universal knowledge in various fields or knowledge and skills that are relevant to the context (location, time, peculiarities of the social environment) are among the less determining factors of motivation.



"Figure 3. Motivation and acquisition of professional skills and competences"

Assessment of knowledge and skills also has its motivating effect as the results show that 31.37% of students prefer the traditional assessment of knowledge and skills at the end of the semester (Figure 4.). For 56.86% the assessment of knowledge and skills during the semester is highly motivating and only 11.76% believe that opportunities for mutual assessment (student - student) and self-assessment can have a positive effect on motivation to learn. This result corresponds to the low percentage of students who want to acquire teamwork and critical thinking skills during their studies.



"Figure 4. Motivation and assessment"

It is encouraging that the majority of respondents believe that after graduating from university they should continue to acquire new knowledge and competencies mainly through participation in qualification courses organized by educational institutions (70.59%) and non-formal forms of education - courses, offered by non-educational institutions (43.14%). This result shows that students are aware of the need for lifelong learning, which is largely realized through various innovative forms for online and distance learning, possessing opportunities to combine work and study.

5 Conclusions

The main role of educational institutions such as universities is to provide knowledge and train good professionals in different professional fields. The learning process is mutual and cannot be done unilaterally, and the choice of specialty is determined by various factors - desire for realization, social status, location of the university, etc.

In order to attract students and achieve good educational results, it is important to create a good motivating learning environment, because motivation is the first step to success.

According to a study conducted among students from the Faculty of Economics at Trakia university, the main reason for continuing education is the **desire to acquire new knowledge and skills for professional realization**.

The **competitive environment** and the **need to acquire more practical skills in the specific professional field** are important for students' motivation. Learners prefer application of **innovative teaching methods**, combining theory and practice that teach them how to deal with real situations. The **ability to work in groups and incorporate collaborative technologies** would improve their communication and computer skills.

Fair assessment during the semester is another factor that increases the motivation to learn, as well as the **relationship between students and teachers**. The various learning activities, individual and group assignments create organizational and leadership skills.

The main role of teachers is to transform and flip the traditional classroom model, creating learning resources that put the learners at the center of learning process and give them opportunities to manage their own learning. Using tools that are familiar and close to the new digital generation of learners will place them in an environment they are used to and can easily handle. The Moodle platform used for e-learning in Trakia university is an option, offering various digital learning resources and activities that support gamification and enables personalized learning paths tailored to the students' needs.

Achieving the set learning goals is a stimulating factor and increases the motivation for work and study not only for the students, but also for their teachers. This requires constant communication and receiving feedback during the learning process in order to improve it when needed..

The pandemic situation COVID-19 has put the educational system in Bulgaria to the test and now all participants are better prepared and more experienced, ready for new challenges. The research will help the academic staff of Faculty of Economics to increase the students' motivation for learning and to prepare specialists with the skills of 21st century.

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A Comparative Study of Students' Performance and Perception in Asynchronous and Blended Language Learning Environments (A Case Study of a Russian University)

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Abstract

Nowadays, with the rapid development of technology, online learning is becoming an inevitable educational method and educational alternative to face-to-face classes, especially for those who cannot attend classes on a regular basis. Online learning environments trend can be categorized into asynchronous, synchronous and hybrid/blended-learning environments. The paper presents a comparative study of two e-learning experiments for English as a Foreign language (EFL) study in a Russian university. One course (Eng1) provided real-time offline student-teacher interaction followed by asynchronous activities. During the pandemics lockdown, faced with some technical problems such as lack of powerful computers, microphones, headphones and stable internet connection to provide synchronous e-learning, the university had to resort to asynchronous-only activities. It became obvious that Eng1 didn't cover the EFL syllabus. Collaborative work resulted in a course designed on university Moodle platform (Eng2). Research methods were observation, students' performance analysis and a survey questionnaire administered to 510 students total in three groups: Eng1, Eng2 and both. The courses were evaluated and compared in terms of interactivity, variability, audio content quality, time consumption, technical support, etc. The findings revealed that asynchronous-only language learning was quite beneficial for foreign language learners, especially to improve grammatical and lexical competence, receptive skills such as reading and listening with some limitations on productive skills training. The main advantage of asynchronous-only environment is that it is not time bound and a learner can work on his own pace. On the other hand, these limitations could be scaffolded by synchronous sessions.

Keywords: Online learning, Blended-learning, Asynchronous learning, EFL

1 Introduction and Literature Review

The development of Web 2.0 technology introduced the affordance of the Internet and generated a special interest in distance education, and renewed research in heutagogy, the term being described back in 2000 by Stewart Hase and Chris Kenyon, 2001. All submissions must be original, not presented at other conferences, published elsewhere or submitted for publication. The official language of the submissions is English, and spelling must be consistent with the Concise Oxford Dictionary or a corresponding dictionary.

In fact, heutagogy further extends the andragogical approach and has the potential to become a theory of distance education. Distant education brings about new concerns regarding the management of the online environment such as the necessity to adopt new teaching methods, the issue of learners' engagement, motivation, self-discipline and autonomy and the problem of interaction in three dimensions (learner-instructor, learner-learner, learner-content) which is undoubtedly the most critical one (Cicillini and Salusso, 2019). A heutagogical learning environment facilitates development of capable learners and emphasizes both the development of learner competencies as well as development of the learner's capability and capacity to learn, that is active and autonomous learner-content interaction. Distance education and heutagogy have the same target audience in common: mature adult learners (Blaschke, 2012). The current COVID-19 crisis has witnessed the situation when many universities came up with distant language learning solutions. It's necessary to distinguish the two approaches: one is emergency remote teaching to compound the deficiency in many language instructors' preparation and support to teach online which allowed teachers and students to just stay connected and engaged while they work from their homes, the other is online courses which have the benefit of being designed and developed in advance, with dedicated structure and support in place (Russell, 2010). Depending on the form of interaction there are three types of organization. The five key ingredients in a blended/hybrid learning program include live events (tutor-led instruction), self-paced learning and assessment, collaboration, and performance support materials (Rezaee and Ahmadzadeh, 2012). Some of the disadvantages of synchronous education can be the need of the availability of students at a given time and the necessary availability of a good bandwidth Internet (Perveen, 2016).

Asynchronous learning is the most adopted method for online education because learners can learn anywhere, anytime, whatever they need, adjusting their individual achievement.. Asynchronous online learning happens when students take instructions from and complete tasks in learning programs that are not delivered in real time or by a person. Asynchronous environments can provide students with readily available input in the form of audio/video lectures, Powerpoint presentations, articles, external links but are not limited to these. Asynchronous e-learning can be challenging as only a carefully devised set of strategies can keep students engaged and interested in this sort of learning environment to facilitate motivation, confidence, participation, problem solving, analytical and higher order thinking skills (Perveen, 2016). When it comes to second or foreign language learning, an indispensable component in the acquisition process is the opportunity for spontaneous exchange. Therefore, it is critical to explore ways of incorporating the benefits of all that is online education without compromising the vital aspects of quality language education (Farina and Selmo, 2018). Asynchronous tools have been viewed as affording greater opportunity for reflection on one's own ideas, as well as on comments made by others. It has been suggested that bulletin boards and forums promote the production of more syntactically complex language and more words (Rezaee, 2012) to develop writing skills. The challenge is to organize polite unmoderated communication in an online asynchronous untutored university course and incorporate speaking activities. The idea of present paper is to compare two university courses: one - blended learning environment, the other is asynchronous course based on some factors, such as construct students' learning materials and environment to target particular students; and interact with their students by monitoring the online presence of them and supplying them with continuous feedback (El-Seoud et al., 2014). The main criteria in assessing two courses was learner satisfaction. Learner satisfaction refers to attitudes, perceptions and expectation of learners toward a specific mode of learning. Researchers have stated that learners tend to be satisfied when their expectations of the learning environment, design of a course, teaching practices and learner achievement are met (Gyamfi and Sukseemuang, 2018).

2 Methods and Setting

The setting for this comparative research was a university in Russia. Over 1500 first- and second-year students were required to use Eng1 program as a part of an English as a foreign language course for the 2019/20 academic year. The students had to take a placement test outside the program to know their proficiency level. The program falls into blended-learning environments category because it requires one face-to-face lesson a week followed by asynchronous activities ranging from vocabulary, grammar, reading, writing, pronunciation, listening to other tasks. The material was positioned as methodologically verified and copyright. The program designers reported exposing students to over 100 hours of learning content at each English language proficiency level. The students did some progress tests on the course and had a computer-based centralized achievement test at the end of semester.

Eng2 program was piloted on over 8 000 first- and second-year students for three months during pandemic lockdown period of 2019/20 academic year. The course appeared spontaneously when faced with some technical problems such as lack of powerful computers, microphones, headphones and stable internet connection to provide synchronous e-learning, the university had to resort to asynchronous-only activities. It became obvious that Eng1 didn't cover the EFL syllabus. Collaborative work resulted in a spontaneous course designed on university Moodle platform. The course was based on the concentric principle to smoothly improve grammatical and lexical competence, reading, listening skills to guarantee a student's achievement success on each proficiency level. The variety of tasks was limited to the technical limitations of the Moodle platform, but the number of tasks was calculated to meet the curriculum needs to expose students to 8 hours of learning content weekly. At the end of the semester a survey questionnaire (with some Likert-scale evaluation questions and open questions) was administered to the students of two departments who are sure to fall into one of three groups: Eng1-only students, Eng2-only students and Eng1/Eng2 students to compare. We received 510 random answers with 60% being Eng2-only, 38% - Eng1/Eng2 students and 2% belonging to Eng1-only group. The range of A1 (37,5%), A2 (26,7%), B1 (25,9%), B2+ (10%) proficiency levels was representative. The students belonged to approximately the same age group 18-19-year-olds who can be called digital natives. Sex differences didn't contribute much to learning content evaluation. Both programs didn't contain any sensitive content, so this parameter wasn't taken into account.

3 Results and Discussion

The perceptions of 11 teachers who used Eng1 for six months indicated that the teachers had a moderate to low satisfaction with the usefulness, interest and effectiveness to improve students' communicative skills, grammatical and lexical competence. However, the users appreciated the course from satisfactory to good. Among the positive sides they marked an opportunity to have face-to-face classes once a week, interactivity (4 out of 5), little exposure time to online activities on the platform (1-60+ minutes a week), the system of rewards (such as medals and statuses).

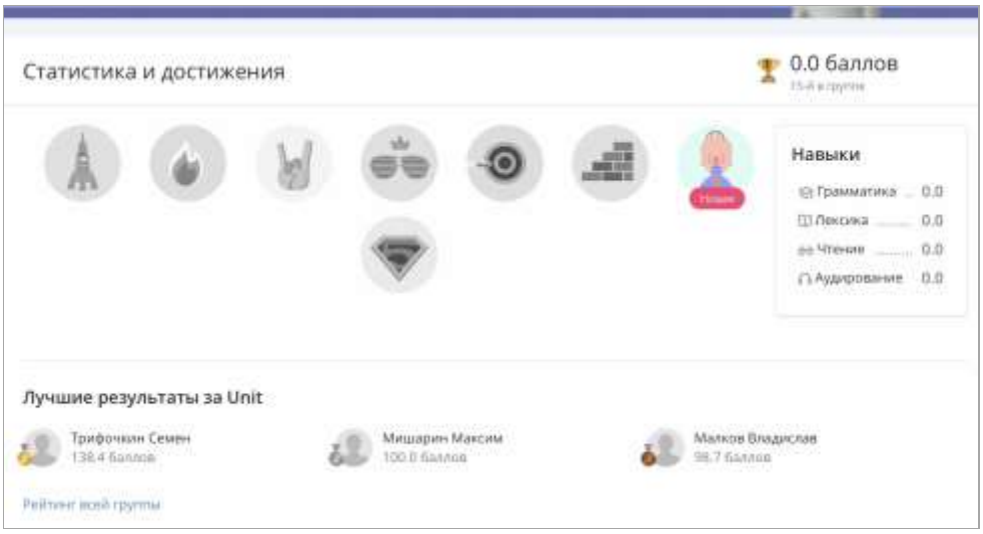

Figure 1. The interface of Eng1 platform showing statistics, skills and best results for a unit

The problems can be summed up as follows: poor audio quality (3 out of 5), slow and reluctant technical support, no input materials, ignorance of distinction between A1 and A2 proficiency levels of Common European Framework of Reference, A0 materials are missing.

A significant part of students' complaints was connected to mistakes in the tasks which then resulted in total low score. Some students unwilling to get low scores sent feedback with screenshots to the teachers and tech support, but the limitations of platform End1 would not allow to correct the task and improve the score, so that after the update teachers had to assign the same task and students completed it one more time which affected students' motivation. Among common mistakes: the correct answer didn't count, but it was presented in key suggestions; with the first letter given the correct answer included it; for some tasks it was impossible to predict the word choice; the platform would not recognize the answer if the cursor was left in the middle of the sentence; some tasks didn't show the right statistics even if fully completed. Despite such a drawback as the presence of mistakes, students noted that it is important for them to see where the mistake was made and to be able to see the answers after completing the task.

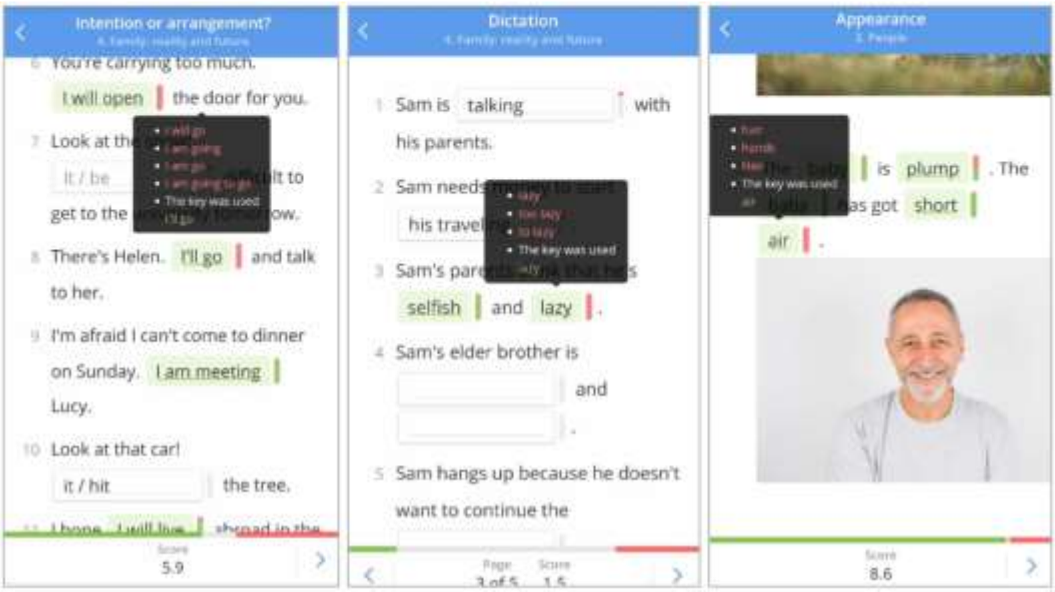

Figure 2. Mistakes on Eng1 platform found by students

It is noteworthy that what is highly appreciated by the students is regarded as a problem by a teacher. It became obvious that the students' exposure on the platform didn't correspond to English as a foreign language university curriculum plan. Since this program belonged to third-party developers the teachers couldn't control and interfere with the content. The information was reported to the developers for consideration without feedback.

Eng2 course was a response to remedy the drawbacks of Eng1: guarantee the clear distinction of levels, design the tasks according to vocabulary and grammar level profiles, develop and improve receptive skills because elimination of a tutor from assessing asynchronous activities restricts the opportunities for productive skills tasks. The figures to compare are given in Table 1.

There is obvious preference for Eng1 rather than Eng2 which can be accounted for by the time the learners spend on the platform and visual presentation and perception of the platform pictures. Among the things to improve in Eng2 are strategies to solve technical problems because the percentage of system failures is rather high. Next, we worked out a set of instructions to prepare and unify the organization of input materials in the form of Word documents and short videos. On the other hand, searching for an explanation is also a part of learning which is close to heutagogy.

Table 1. The comparison of Eng1 and Eng2 platforms

	Eng1	Eng2
Logged in with a computer	61,50%	79%
Logged in with a mobile device	7,70%	0,50%
Didn't have any problems	61,50%	49,20%
Had to study a lot on their own	50,80%	63,10%
Time exposure:		
1-30 minutes a week	13,80%	5,10%
31-60 minutes	39%	16,40%
1 hour+	27,70%	25,10%
2 hours+	14,40%	28,70%
3 hours+	5,10%	24,60%
Tasks were useful for the final computer-based test:		
Yes	12,80%	19,50%
Rather yes than no	47,70%	55,40%
Interactivity (out of 5)	4	1
Quality of audio files (out of 5)	3	4
Which would you prefer		
Yes	30,8%	13,3%
Rather yes than no	24,1%	20%

Unfortunately, the interactivity can’t be enhanced due to the platform capabilities and features.

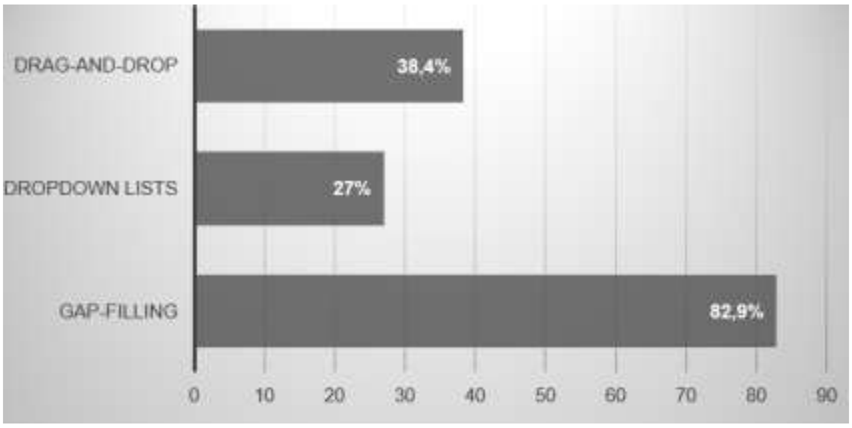

Figure 3. The most inconvenient types of tasks mentioned by students

We asked students which task they found the most poorly adapted to use. Students had both types of tasks: open gap-filling and banked gap-filling. However, while in an open gap task students are not given any words to choose from, in banked gap-filling tasks, the words removed from the text can be found before or after the text, and they simply needed to decide which word in the list of words after the text is suitable for which gap in the text, 82,9% of students reported any gap-filling tasks as the most uncomfortable ones. Students explained their frustration by incomprehensibility of instructions for given tasks as it wasn't clear enough what word form must be used for an answer. But we can state here that gap-filling being one of the most difficult tasks is an unwanted one at the same time. Also, 38,4% of students mentioned drag-and-drop type of tasks as uncomfortable. Here we may consider some technical problems, based on the incompleteness of the platform which doesn't allow to complete this type of task from mobile devices.

A positive achievement of Eng2 is its extended student exposure to English language content up to three hours a week. Despite the numerous complaints from the students we managed to design an extensive English as a foreign language course. The percentage of learners who admitted the role of Eng2 in their preparation outweighs that of Eng1. Objective results of the final computer-based test show a 17,6% -increase of students' performance after Eng2 completion in the end of the year.

On the whole, open question on Eng2 quality produced controversial answers from words of gratitude to strongly negative evaluations. The conclusion is for a distant language course to be beneficial it must have a mature adult learner with inner motivation, self-discipline and prospective goal.

We asked students to describe in a few words their feelings and moods during the pandemic lockdown and distance education and if they are willing to continue the education in online form. The results are presented in fig. 4. As can be seen 30,2% of students described the time during distance education as convenient, but the majority of students were not optimistic - the time appeared to be boring, useless, hard for them. Among others students used the words: unusual, depressively, unpleasant, uncomfortable, bearably, drearily, tediously, amorphic. As a result, 42,1% of students said no to distance education and 25,1% said rather no than yes.

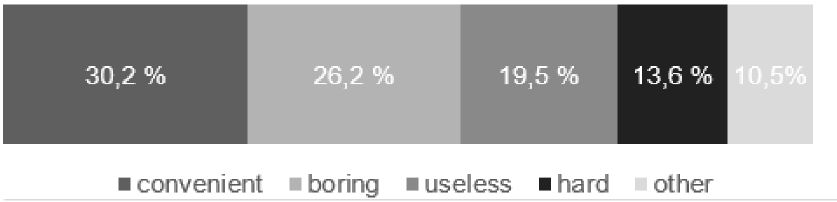

Figure 4. Moods and feelings during distance education

4 Conclusion

Online education is here to stay, and only through monitoring, evaluation and constant improvements, educational institutions will be able to ensure that they maintain and expand online offers for foreign language courses of high quality. The fact that students performed well during the final test is a good indicator of satisfaction. The results can be seen as an opportunity for necessary improvements, further development and important changes for courses to offer more effective online solutions.

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The usage of remote technologies in teaching children with motor diseases

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Abstract

The problem of teaching children with musculoskeletal disorders remains open today. This is primarily due to the fact that the birth rate of children with this type of pathology continues to increase. Among children with motor impairment, the category of children with cerebral palsy stands out (from 3 to 7 per 1000 births). The pathological syndromes of infantile cerebral palsy affect not only the motor, but also the mental sphere. Taking into account that many children with cerebral pathology have potentially intact prerequisites for the development of intelligence, it is necessary to form cognitive activity in babies, develop activities, various interests and motivation for learning. Distance learning has a number of features that make it quite effective in working with people with disabilities and, in particular, with children with cerebral palsy. The use of distance learning for children with motor pathology allows to take into account the needs, interests and capabilities of each child and to conduct classes at a convenient and suitable time for him. In addition, it allows an individual pace of advancement in the process of mastering the educational material.

Keywords: distance learning, children with motor diseases, teaching

1 Introduction

The relevance of our research is determined by the requirements of the modern stage of socio-economic development of society to the quality of education. Currently, fundamental changes are taking place in the education system, caused by a new understanding of the goals and values of education, the development and implementation of new education technologies at its various levels. The problem is of particular relevance and practical importance in connection with the change in the social services commissioning in the field of education - the creation of a sufficiently flexible educational system that takes into account the individual needs of the individual, providing equal access for "all Russian citizens to education at different levels, regardless of place of residence and family income level" [4].

The problem of teaching children with musculoskeletal disorders remains open today. This is primarily due to the fact that the birth rate of children with this type of pathology continues to increase. Among children with motor impairment, the category of children with cerebral palsy stands out (from 3 to 7 per 1000 births). The pathological syndromes of infantile cerebral palsy affect not only the motor, but also the mental sphere.

Taking into account that many children with cerebral pathology have potentially intact prerequisites for the development of intelligence, it is necessary to form cognitive activity in babies, develop activities, various interests and motivation for learning [3].

2 Children with motor pathology as participants of the educational process

One of the areas of activity that can contribute to the transformation of children with developmental disabilities into full and useful members of society is the creation of conditions for their rehabilitation with the help of the potential of education, which this category of children is in desperate need of.

The rehabilitation potential of education is realized subject to the maximum inclusion of children with developmental disabilities in a variety of feasible types of educational, labor, cultural, physical and social activities aimed at understanding and realizing physical and spiritual capabilities and social ties, teamplay and cooperation both with other disabled people and with healthy people.

However, the majority of children with disabilities, provided that they have educational or vocational training opportunities, require limited rehabilitation. The point is that many of them are deprived of equal opportunities to receive a broad education, as a result they find themselves somehow “pushed out” into secondary roles in the labor market. Thus, one of the most important tasks in solving the problems of people with disabilities is related to finding ways to include as many people with disabilities as possible in the education system. Solving this problem will facilitate the process of their further integration into society.

Accordingly, the rehabilitation of children presupposes the following organizational and pedagogical conditions and means: adaptation of the learning environment of educational institutions, taking into account the needs of disabled children; creation of a barrier-free environment for an educational institution: variability of education through the use of multilevel educational programs, variability of teaching rates, variability and organizational flexibility: organization of the activities of disabled people, taking into account their interests and capabilities; organization of opportunities for the provision of social, psychological and pedagogical assistance.

It can be noted that it is distance education, which is currently beginning to be most actively used in Russia, that really meets most of the organizational and pedagogical conditions listed [1].

3 The use of distance technologies in teaching children with physical disabilities

In Russia, distance education appeared with the opening of the "i-School" in Moscow in 2003. Training takes place using video communication, the Internet telephony, chats, forums, etc. The school is attended by children with cerebral palsy, diabetes, oncological, nervous diseases, kidney and heart diseases, etc [2].

In the Krasnodar Territory, the project "Development of distance learning for children with disabilities" began in 2010. In accordance with the order of the Department of Education and Science of the Krasnodar Territory dated 16.10.2009 No. 3255, in the structure of the State Educational Institution of the Krasnodar Territory, the Regional Institute of Additional Pedagogical Professional Education created the Center for Distance Education for Disabled Children. By order of the Department of Education and Science of the Krasnodar Territory No. 3892 of 20.07.2011 "On the modernization of educational institutions by organizing distance learning for students" in Krasnodar, four basic schools which organize distance learning were approved. The education process takes place using distance educational technologies for programs of primary general, basic general and secondary (complete) general and additional education, as well as for educational programs of special (correctional) educational institutions.

The model for organizing distance learning for children with disabilities implemented in the region assumes:

1. Voluntary participation of children in the project (based on the application of parents or poeple replacing them).

2. Transfering of computer equipment to families of disabled children under an agreement with the regional operator of the project, net connection.

3. Teaching students, their parents, teachers who carry out home education, the basics of computer literacy in adapted programs of basic ICT - competence.

4. Choice by students and their parents of training courses from the list of recommended ones for mastering in a distance form.

5. Continuation of a child`s studies in a municipal educational institution in accordance with federal and regional documents regulating the organization of home education for sick children, taking into account the additional possibilities of distance learning technologies.

6. Fulfillment of the role of teacher-curators in the development of educational material by students on the basis of the Internet resources by teachers of municipal educational institutions who teach a child at home.

Distance learning for children with disabilities contributes to the solution of such socially significant problems as:

- stiffening the level of education of society and the quality of education;
- realization of the need for educational services;
- meeting the country's needs for high-quality trained specialists;
- increasing social and professional mobility of the population, its entrepreneurial and social activity, the level of self-awareness, broadening the horizons;
- preservation and augmentation of knowledge, human and material potential accumulated by the domestic higher education;
- development of a unified educational space within Russia, implying the provision of the possibility to obtain a standardized education at any point in the educational space.

The teacher's activities are carried out in several stages:

1. Planning and preparation. At this stage, there is a diagnosis of the needs of students for accompaniment and support; determination of the initial level of their knowledge and skills; preparation of a package of methodological support materials.
2. Accompanying training. It implies deepening knowledge, developing the skills and abilities of students; counseling on specific problems, testing; information and analytical support; organization of information exchange and contacts between students; actualization of their internal forces and reserve capabilities.
3. Use of learning outcomes and summary analysis. This stage assumes the consolidation of the acquired knowledge, skills and abilities.

4 Conclusion

So, distance learning has a number of specific qualities that make it very effective when working with children with disabilities:

- individualization of training. The child can study the discipline as much as he personally needs to master it; studies according to a convenient schedule for him;
- psychologically and technologically comfortable education of children in a family setting.
- drawing up individual programs for each student, taking into account his individual characteristics, that is, in each case, the teacher works with a specific educational request and a real educational situation.

Distance learning has a number of features that make it quite effective in working with people with disabilities and, in particular, with children with cerebral palsy. In this case, it means that each child can work according to a convenient schedule. The pace of the lessons is also selected individually and everyone can do exactly as much as it is required personally for him to master any subject. The usage of interactive elements makes it possible to carry out a dialogue not only with the teacher, but also with other children - participants in the training. Completing assignments and tests stimulates children's independent work and self-control skills. Using the feedback allows learners to analyze and correct mistakes which were made. In a number of programs the computer allows to record the result without scoring, delicately pointing out wrong answers and providing the necessary help. Thus, a situation of learning success and motivation for further learning is created.

The use of distance learning for children with motor pathology allows to take into account the needs, interests and capabilities of each child and to conduct classes at a convenient and suitable time for him. In addition, it allows an individual pace of advancement in the process of mastering the educational material.

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Training in the Use of Elements and Details for the Design of Women's Jackets

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Abstract

The purpose of this report is to trace the trends of the elements and details used in the design of women's jackets in the period 2017-2020 by examining the collections of world-famous designers and fashion houses. The results show that during the study period the use of decorative elements and those that shape the details of women's jackets has increased. New elements and unusual shapes appear, which create a new and different vision of the women's jacket from the one known so far. The results of the research can be applied in the training in the field of fashion and textile design.

Keywords: Fashion design, Latest trends, Women’s jackets, Elements, Details

1 Introduction

The study of fashion trends in the design of women's clothing is necessary, as the development of textile production provides opportunities for new design of shapes, elements and details (Smal & Lavelle, 2011). Design research will create a need to study design and modeling approaches as well as fabrication technologies (Kazlacheva & Ilieva, 2018). The elements and details involved in the construction of the composition and its style play a significant role in the women's jacket.

This report presents a study of the design of women's jackets in the collections of world-famous designers and fashion houses during the fashion seasons for the period 2017-2020. In search of a new, modern and unconventional style of women's jackets, designers develop their models using different structures, fabrics, design techniques, mixing styles, unusual elements and details, creating a completely new look of the classic jacket. It is important to include results in fashion design education (Stoykova et al., 2016; Indrie et al., 2019). The elements used in geometric and plastic style make a strong impression, which build voluminous, abstract and avant-garde forms, exaggerated volumes, some of which shift the focus from the human figure (Secan et al., 2012; Ilieva & Milusheva, 2019). Constructions in unusual shapes of sleeves, lapels, fasteners, as well as asymmetries of shapes and lengths are noticed.

2 Material and Methods

In present work studied 50 collections from the seasons Spring Summer and Fall Winter of leading designers and fashion houses in which there are women's jackets for the period 2017-2020, Pret-a_Porter, Ready-to-Wear and Haute couture included in the database of Vogue magazine (2020).

The aim is to explore as many elements and details as possible designed by the designers. The sample includes a large number of models of jackets from the collections of: Alexander McQueen, Alexander Vauthier, Armani Prive, Antonio Grimaldi, Balmain, Chanel, Christian Dior, Giorgio Armani, Valentino, Viktor and Rolf, Givenshi, Issey Miyake, Tierry Mugler, Max Mara, Maison Margiela, Michael Kors, Stella McCartney.

The results were measured in percentages, presenting the elements used in the design of women's jackets, and their location in detail.

The method used, Correspondence Analysis, presents the strong interrelationships between them (Kazlacheva, 2010). It is based on a multidimensional approach, allowing the study of data in tabular form, using qualitative weights (Zlatev & Baycheva, 2017). The results are presented by a map of the correspondences between the individual representatives of the studied groups.

Statistica 8 (Stat Soft Inc.) and MS Excel 2016 (Microsoft Corp.) software products were used for data processing.

All data were processed at a level of significance α=0,05.

3 Results and discussion

The results of the study show that in 2017 the designers have used 8 types of elements in the design of women's jackets, followed by 9 types for 2018, 7 in 2019 and 11 different elements in 2020, and a new element appears – bias ribbons.

Figure 1 shows the highest application rate in 2017 of fringes was 24%, followed by pleats and sets with 18%, in 2018, with 16% are used sets, knot and fold, for 2019 ruffles with 39% followed by fringes with 22%. Used in 2020 in the design of women's jackets elements are 17% folds, 13% for fringe, ruffles and flounces, 8% pleats, applications, tucks, paired details, 4% sets, knot and bias ribbons. During the period the least used in the design of women's jackets were bilateral pleats in 2017.

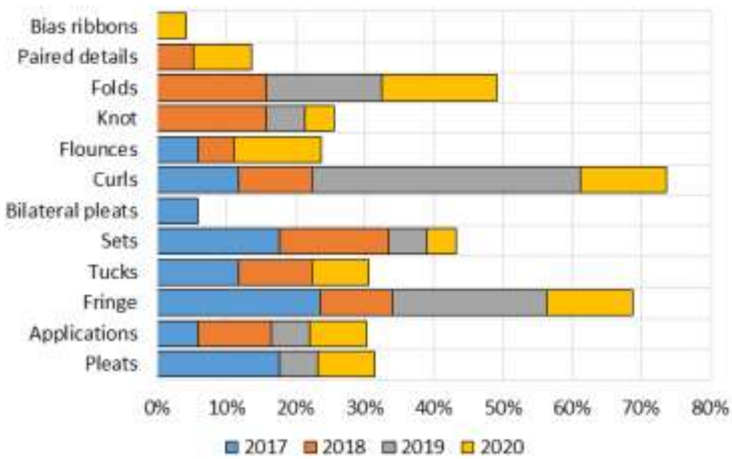


Figure 1. Graphics of the elements used in the design of women's jackets for 2017-2020.

The choice of location of the elements in women's jackets is presented in Figure 2 and the results show for 2017 the elements with location of front parts and back with 25% are most often used, across all of the details 19%. In 2018 the location of the elements is 30% for collars and lapels and 25% for front parts and back. Significantly high application of the elements in 2019 is on the sleeves with 50%, and in 2020 by 25% on front parts and back followed by sleeves by 20%.

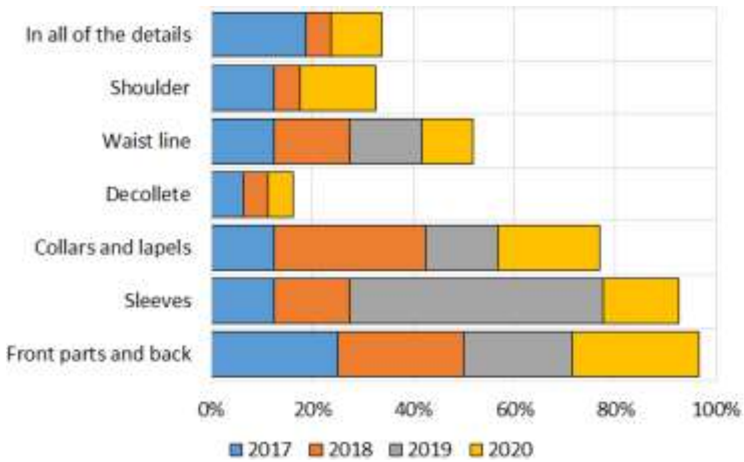


Figure 2. Graphics of the location of the elements in women's jackets for 2017-2020

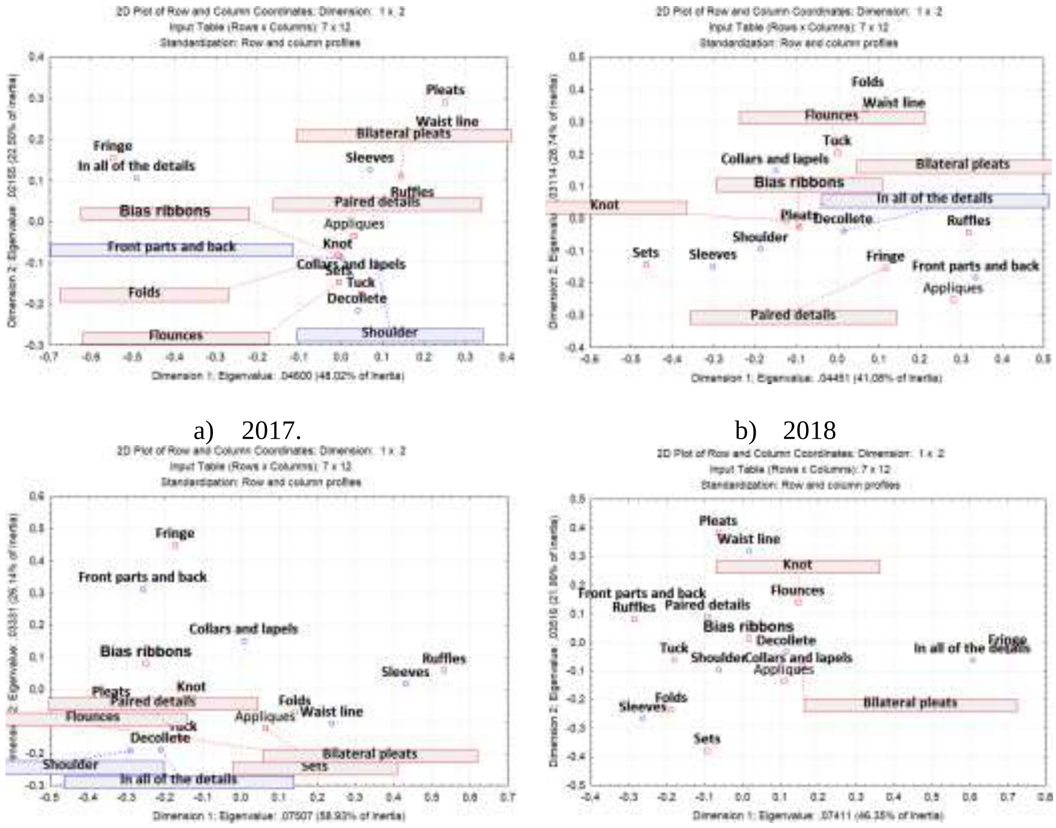
The results of the Correspondence Analysis present the trends of the relationship between the elements and their location, which will allow the design of new models of women's jackets. These relationships are shown in Figure 3.

The graph in Figure 3 (a) shows that in the fashion trends for the season, the interrelationships between the front and the back are strong with elements of sets, folds and frills, pleats and a waist line. The interconnection of the fringe element with a location in all details is also strong. The location of the elements is important not only because of their decorative role in the construction of the composition, but also often because of their purely decorative-constructive function.

The graph of Figure 3 (b) shows that in the fashion trends for 2018 are very strong relationships between the element folds and their positioning in the waist area in the formation of peplums. The element sets most often are located on the sleeves, as well as between the front and back with applications involved in the construction of the composition. The application of the knot element positioned on collars and lapels stands out.

In 2019 strong interrelations between the elements of curls with the location of the sleeves and the waist area stand out. The use of the fringe element is great and their location on the front and back, collars and lapels is preferred. This is shown in Figure 3 (c).

The outstanding interrelations for 2020 are between the element fringe and their location on all details, curls positioned on the front and back, shoulder, sleeves and waist line, the use of folds on the sleeves, paired details in the area of lapels and collars. The use of bias ribbons in the compositions of women's jackets has increased in recent years with their application on the front and back. This is shown in Figure 3 (d).



a) 2017. b) 2018

c) 2019 d) 2020

Figure 3. Results of the analysis of the correspondence between element type and location

A design of women's jackets with the application of the analysis of the fashion trends is proposed. These designs are presented on Figure 4.

The model of Figure 4 (a) is designed with tucks and asymmetrical folds in the front parts. The bias ribbons on the front parts of the model from Figure 4 (b) are located asymmetrically. Folds form the collar of Figure 4 (c) and asymmetrically arranged curls form the lateral peplums.

In Figure 4 (d) the front parts and the collar are shaped by folds in asymmetry of lengths, and the sleeves form volumetric geometric shapes. The model of Figure 4 (e) is designed with a lapel of curls, which continues in the steering wheel, ending the front parts and back. Curls form the width of the sleeves of the model of Figure 4 (f), as well as the attached steering wheels at the waist of the front and back.

Figure 4. Designs of women's jackets

4 Conclusion

From the analysis can be made some conclusions determining the fashion trends in the design of women's jackets.

There is an increase in the type of elements in women's jackets, as well as their location on the details.

The highest application rate is seen in 2017 with 24% use of fringes and the relationship with their location in all details is also the strongest.

In 2018, the greatest is the application of the elements sets, knots and folds with the same number of percentages of 16%, as the sets are in the strongest interrelation with the sleeves, the element knot of lapels and collars and folds in the waist area.

Leading element of application in women's jackets in 2019 are flounces with 39%, the strongest being their relationship with the sleeves and the waist area.

In 2020, designers require the use of folds by 17% and the location of the sleeves is the strongest interconnection, paired elements are most often used in the field of lapels and collars. Tucks and bias ribbons are used for building compositions in plastic style. Their strong interconnections are with the front and back.

The application of asymmetry of shapes and volumes is great, as well as the guiding lines of the elements and their role in the compositions.

The application of the results of the research leads to a facilitated creative process and diversity in the design of new models of women's jackets. They are suitable for the training of new designers.

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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**

Towards Building a Collaborative Learning Environment in Software Testing Classes

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Abstract

Hard and soft skills are mainly acquired by students while being engaged in team activities, with an emphasis on communication and collaboration. Software tool integration in teaching software testing helps to build a learning community. This promotes collaboration principles in teams, participants being allowed to accomplish specific tasks along with valuable competencies gain. The paper details teaching activities specifically designed for students that work in teams. Benefits, challenges, and teaching experience are presented, as activities were held face to face and then online, because of COVID-19 pandemic circumstances.

Keywords: communication and collaboration tools, gamification, soft skills

1 Introduction

Designing tasks focused of hard and soft skills acquisition for face to face or online activities is a demanding task for educators. Software tool adoption and harmonization in teaching can be successfully carried out considering competencies to be grasped. This needs to be complemented with actions that support a collaborative learning environment.

Software Systems Verification and Validation course (VVSS) (Chisalita-Cretu, 2020) at Babeş-Bolyai University of Cluj-Napoca is currently a compulsory course held during the last year in computer science (CS) bachelor degree.

The paper addresses the seminar learning activities that needs to be rigorously developed in order to support communication and collaboration between participants. Tasks that engage students are usually execises that challenge them to provide adequate solutions. Teachers can promote healthy competition among teams that brings immediat goal accomplishment and knowledge acquisition, through collaboration and team spirit. Such course activities ensure the competency advancement for the entire learning group.

The paper is structured as follows: *Section 2* details the VVSS course, its activities and the participants' details. *Section 3* shortly presents the tools integrated in software testing teaching that helped building a collaborative learning environment. The designed tasks for the seminar activities focused on collaboration and goals achievement are presented together with the students' feedback in *Section 4*. Lessons learned on designing seminar tasks are noted in *Section 5*. The paper ends with conclusions and future work.

2. VVSS Course Design

This section details the educational objectives and the assessment rules stated for VVSS course, together with the activities attended by students.

2.1 Educational Objectives

VVSS course takes 12 weeks and provides 5 credit points (ECTS) that requires a total of 125 hours (=5*25 hours) of study. The course follows the guidelines of ACM Curricula

Recommendations (ACM, 2013) for CS. It covers a wide range of topics, from concepts extensively used in practical software testing to the more abstract ones, like formal methods used for program specification and verification. The course is designed as a two hours lecture each week, supported by two hours seminar and lab activities every two weeks. Students can attend a non-mandatory project activity that allows them to deepen their knowledge in software verification topics at their choice.

Assessment. The final grade is obtained by using the following formula: *FinalGrade* = 0.50 * *LabGrade* + 0.10 * *SeminarGrade* + 0.40 * *WrittenExam* + *ProjectGrade*. The *ProjectGrade* helps the students to increase their final grade up to 2 points. The following subsection details the course activities.

2.2 Course Learning Activities

VVSS course consists of activities organized as seminars and laboratories.

Seminar activities. The course covers various topics in the six allocated seminar activities. The main goal is to detail, to experiment and to reflect on the concepts approached during lectures. Students are allowed to further investigate testing related concepts during lab activities, while other notions, concerning correctness and program refinement are approached during seminars only. The topics covered by the seminars are:

- **Sem01:** different types of inspection, from formal ones (Fagan inspection) to less formal and informal reviews, on various types of documents (requirements, architectures, diagrams, source code);
- **Sem02:** investigate black-box test design techniques as equivalence class partitioning (ECP), boundary value analysis (BVA), best representative (BR) and domain testing (DT) on specific problems, at unit testing level; use of testing frameworks (`JUnit`) and test management tools (`Testlink`);
- **Sem03:** investigate white-box coverage criteria by building the control flow graph (CFG), computing the cyclomatic complexity (CC) and studying code coverage criteria (statement/ decision/ condition/ decision and condition/ multiple conditions/ loop coverage);
- **Sem04:** study the integration strategies and apply them according to some specific application development context; use of mocking frameworks (`mockito`), continuous integration/ continuous delivery (CI/CD) tools (`Jenkins`) and report the test results in test management tools (`Testlink`); improving bug reports by using RIMGEA strategy (Kaner and Bach, 2008);
- **Sem05:** apply Floyd's method to assess the partial correctness, termination and total correctness of small already developed programs;
- **Sem06:** apply refinement rules to develop correct programs based on given specifications; investigate formal static and dynamic analysis tools based on Java Modeling Language (`JML`), as `ESC2Java` and `jmlc` and `jmlrac` tools.

Lab activities. There are five lab activities designed for this course. Each of them focuses on different verification tasks employed during software development, having different weights in the *LabGrade*. The tasks of each assignment are applied to an already existing software product. Specific task requirements, tutorials and guidelines prepared by teachers were available for students for each assignment. The aim of elaborating such tutorials was to help participants achieve the tasks on their own pace, without the pressure of taking notes and not paying attention during the live demo sessions.

2.3 Participant Details

The data and the analysis refer to students enrolled in VVSS course during 2019-2020 academic year. All of them were young adults studying for their first university diploma.

While attending activities they were organized in groups of 25 to 30 participants for seminar activities and teams of 3 students for the lab assignment.

3. Technology Integration in VVSS Classes

Throughput VVSS classes a plethora of tools and frameworks required to perform software testing is used. In addition to these tools, communication and collaboration software are largely employed for seminar and laboratory activities.

Slack platform (Slack, 2020) is a communication platform that is used by a wide range of teams that collaborate in various types of projects. Over 3,000 higher education institutions use Slack platform to keep their classes and administrative activities online.

Basically, Slack allows building an environment focused on communication and collaboration, by relying on the *workspace* concept that represents the team (group) that works together. Workspace members can send messages on *channels* or as direct messages to designated collaborators. Further discussion on a specific topic can be achieved by creating *threads* for already sent messages.

Skype platform (Skype, 2020) was mainly used to achieve synchronous communication during lectures, seminars and laboratories. This tool allowed organizing smoothly the live teaching and learning sessions by creating id-based *meets* for different groups of study. Still, students were instructed to use Slack platform as the main communication tool, even if during live activities it was recommended to use Skype's chat features. The students were able to keep the chat as a content archive of the previous online activities.

In order to prepare challenging quizzes during activities, **Kahoot!** game-based learning platform (Kahoot, 2020) was employed. Students were invited during live sessions to join quizzes by using given entry codes. Competition among participants was stimulated by the gamification characteristics that Kahoot! presents to its users. Reports and analytics features were actively used by the teachers to rank the players, i.e., students.

Menti application (Mentimeter, 2020) was used to get feedback on spot from the students during face to face and online activities. Teachers designed various types of questions offered by the free version of the platform. Students were able to answer the quizzes after accessing presentations from their mobile phones and entering a unique identification code for the specific interactive presentation.

4. Collaborative Learning Activities for VVSS Course

This section presents several seminar activities developed for face to face and online activities. The student feedback based on Menti quizzes together with the teacher's perception on the deployed activity are reported and analysed. The first seminar was held for all groups as face to face activity, while for others seminars the switch to online activity was made. This situation was caused by the COVID-19 pandemic circumstances that started at Cluj-Napoca on 10 March 2020. From this moment onward all activities were carried out online.

4.1 Activity Details

The topics addressed during seminar activities were carefully selected such that students acquire knowledge required for laboratories tasks. For the online activities the asynchronous communication used Slack and for synchronous communication during online activities Skype was employed. Students were able to use private Slack channels while providing solutions on tasks or other tools at their choice.

Sem01. This seminar introduced several verification activities that referred to: formal inspection (Fagan inspection, walkthroughs, technical review) and informal review (peer review, buddy review, e-mail pass around, pairing).

For a deeper understanding of similarities and differences between these verification tasks, the teacher designed a game that required students to walk in the classroom and assign characteristics to designated verification activities.

After discussing the obtained results, actual inspection activities were proposed to the students. Therefore, context-based inspection solutions were developed by participants for different types of documents elaborated during software lifecycle. Sem01 was held as face to face activity for all students enrolled in VVSS course.

Sem02. The black-box testing seminar focused on working with specific test design techniques (ECP, BVA, BR, DT) for particular problems starting from specifications (pre-condition and post-condition). A team task was designed to allow students to further exercise the test design on several given contexts and reporting the results between teams.

Sem03. This activity was aimed to understand how CFG is built CC is computed together with various code coverage criteria in white-box testing, e.g., statements, decisions, conditions, multiple conditions, loops, Various practical problems related to white-box testing were discussed with the online participants aiming to understand the difference between *decision* and *condition* concepts while addressing code coverage criteria. Besides a proper learning of the particularities of each criterion, actual test case design is essential. The teacher designed a quiz Kahoot! that allowed students to learn over a consistent number of problem contexts issues frequently encountered by developers.

Sem04. A collaborative assignment was designed to acquire knowledge on testing levels. It was focused mainly on integration testing applied to a particular architecture of software modules. Students were required to work in teams and apply a studied integration strategy. The choice needed to consider project development requirements details provided by the teacher. This information was represented by the integration context that guided the integration strategy to be used. The students selected from the followings: big-bang, incremental top-down depth first, incremental top-down breadth first, incremental bottom-up, and sandwich strategies.

Sem05. The collaborative tasks designed required students to build a cross-word game based on concepts previously discussed during lectures. The task aimed to challenge the students to revisit course content and to help other colleagues to check their knowledge on software verification. Therefore, the cross-word games created by teams of three students needed to be solved by other teams (or by individual students) while the initial team was requested to grade the provided solution.

Sem06. One of the most challenging tasks in testing is the delivery of good bug reports that encourage the developer to allocate resources to investigate the reported issue. Students organized in teams were asked to build a bug report that emphasized the RIMGEA strategy (Kaner and Fiedler, 2008). At the same time, colleagues were able to vote for the best bug report in their opinion, as potential users that exposed the addressed issue.

4.2 Student Feedback Analysis

For each particular seminar activity a specific feedback quiz was created by the teacher, aiming to immediately assess discussed content. Due to the space limitations we present in the following some of the obtained results to indicate the analysis outcomes.

Sem01. The Menti quiz created consisted of three questions that addressed both the topics addressed during the seminar and the learning experience students perceived. *Figure 7* shows the word cloud provided by one seminar group that performed tasks of Sem01. All seven groups provided similar word clouds, formed of relevant terms associated to the concepts in human-based verification activities, applied to different types of documents throughout the development process.

Figure 7. Word cloud for concepts discussed in Sem01

Students reported their opinions on the performed activities when they were asked: *What did you like? What did you not like?*. From the 192 students that provided answers, 69% of them liked the activities, indicating high level of interaction, team based-tasks, not being required to keep their place all times, or being able to learn theoretical aspects in a pleasant manner in group, not by individuals. Other 31% reported they did not liked the activity, claiming several issues as: not being able to read details from the table or cards placed far from them, too many concepts being discussed at once, not enough time to solve the tasks.

Sem02. One of the questions of the Menti quiz referred to the applicability of ECP and BVA techniques. From the 59 students that answered the question, 80% of them were correct, saying they apply to variables' domain of values. Still, many of them choose to not respond even if they were present in the classroom or had joined the web conference on Skype. Further, we have studied the answer on the questions *What was easy to understand? What was hard to understand?* We got a better understanding of the small number of students that offered a response to the first question. Aspects discussed referred to theoretical concepts, while some students did not grasp the differences between ECP and BVA techniques.

Sem03. Students were excited about answering to the quiz on the white-box topics. Still, for some of them it was hard to finish as the quiz was time limited. The CC importance and the difference between a *decision* and a *condition* concepts were the main aspects addressed in the Menti quiz. When asked about them 30% of the students answered that a condition is part of a decision, while 70% responded the other way around. This issue was confirmed by several Kahoot! quiz questions that required to identify the correct number of test cases to achieve condition or decision coverage.

Sem04. Team communication and collaboration based on public/private Slack channels and *meets* on Skype allowed students to prepare the integration solutions following a specific application and architecture context. Students reported to be very useful for them these platforms, as they were able to ask questions while elaborating their solution. All the teams could see the addressed questions and teacher's answers, creating a learning environment that encouraged them to provide an acceptable solution that met the context constraints. In the end, students were able to share their solutions. They stated that it was relevant for their learning experience to see other teams' work and debate upon the integration strategies and the bug types easy to spot. Students noticed that the application context information was essential to uniquely identify the integration strategy.

Sem05. Students enjoyed the task, 30 student teams being enrolled for this group assignment. They felt empowered by creating challenging and diverse questions for their colleagues and were stimulated to provide the correct solution for other teams' quizzes.

Sem06. For the bug report race seven teams enrolled to compete. Students were challenged to find a bug and provide a proper description such that a possible developer is motivated to fix it. Teams reported various bug found in web browsers, operating systems, MS Word application, or team project already developed. Students voted the preferred bug story on the Slack platform by using emoticons and providing feedback on their colleagues' work.

4.3 Teacher Perception Analysis

For each seminar activity the teacher made notes on how the designed seminar activities were carried out.

During **Sem01** teacher noticed that students expected a classical seminar, where they are invited to involve in blackboard-based problem solving. Some of them did not expected from their teacher to ask them to go around the classroom and discuss with their colleagues to solve the assigned tasks. Teacher easily spotted students having leader and task management skills, organizing the actions to be performed by the group. The main intent of the first seminar task was to engage all students, regardless of the learning styles (visual, auditory, kinesthetic). Therefore, during the first task all types of learners were able to get involved.

For **Sem02** the teacher expected to have a consistent engagement of students during stated tasks. This expectation was not fulfilled as many students were struggling to remind formal concepts discussed in a previous year. More, while student team aimed to collaborate in teams to test design test cases bad on ECP and BVA, their answers were different from one team to another. Students considered the problems hard to understand, by once understood, the solution was easy to provide. The teacher noticed that more emphasis on mathematical concepts is required before being able to solve easy problems.

Sem03 tasks were the only ones that required to work as individuals not in teams. During the actual seminars, teacher noticed that some students very active compared to others. More, participants seemed to be overwhelmed by the number of coverage criteria to be discussed during a single seminar.

Improvements in team management while achieving assigned tasks were noticed for **Sem04**. Students quickly formed teams, worked on the solution and sent to the teacher the strategy-based integration results following the recommended file format. Students carefully analysed the application contexts and observed several small variations that suggested a certain integration strategy. The cross-word game quickly engaged students during **Sem05**. Many teams tried and succeeded to solve more than one puzzle, even if only solution was finally considered to be graded. Students were stimulated to conceive and deliver puzzles formed of compounded words and thus, having increased complexity level. The collaborative task assigned for **Sem06** granted students the freedom of being creative while building an appealing bug description that helped to fix it. While elaborating the bug story, participants reflected on the relevance of choosing the right details that may motivate someone else, e.g., developer, to investigate the issue. While reading someone else's bug description, students had the opportunity to understand the bug impact from some one's perspective that embodies a certain user profile.

5. Lessons Learned

During the 2019-2020 session of VVSS course that required both face to face and online interaction during activities, teachers were challenged to design tasks that easily engage students. Game-based activities, were successfully accepted by students, helping them to overcome the everlasting question *why do we learn this?* on many undergraduate CS-based classes. The knowledge was perceived like a gift nicely packed, students being curious to find out more about it. Still, from the teachers' perspective, the effort to prepare the working materials cannot be neglected. The educators need to have clear goals about the concepts students should learn during some specific activity. Then, the focus is turned to choose the right software that helps gaining competencies, while creating a relevant learning experience. The instructor's endeavour in creating meaningful task was fully repaid by the feedback that students provided at the end of the activity. For example, Menti features that allowed students to provide answers to a specific question while dynamically building the word cloud (see *Figure 7*) helped them to have a group reflection moment during the class.

Students were stimulated to actively engage during classes even in some theoretical and abstract parts of the assigned tasks. Each time students were told about what follows and what is expected from them to achieve. Clear directions made easy each task they were involved in.

6. Conclusions

The paper addresses the hard and soft skill acquirement during seminar activities for the VVSS course by engaging students in collaborative tasks. Software integration in software testing education like Slack, Skype, Kahoot and Menti allows creating a learning environment that promotes communication, creativity, competition and goal achievement.

Specifically designed tasks were analysed from students' perspective considering the formative provided feedback. The results show an increased commitment for activities that allow idea sharing and team work. Educator's perception while guiding activities indicates the students require clear directions, interactivity and sometimes support to accomplish the assignments.

Future work in this domain includes communication and collaboration software tools analysis, with focus on the integration opportunity in Slack. A more narrow research will be focused on the design of critical thinking-based tasks for testing education using these tools.

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The 3D Virtual Prototype- A Sustainable Solution For The Clothing Industry

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Abstract

Textile and clothing industries are in a new point of development: digitalization and forward to industry 4.0. Digitalisation brings essential changes of the production process in the clothing industry: it offers the possibility of producing individualised/personalised models, it reduces the time between the design stage, in which digital CAD patternmaking and grading solutions are employed, and the production stage, which is usually carried out by digital machinery or robots. In this case, designers will be able to make faster decisions, subject their collections to simulations in the market (to identify the customer's needs), reduce the quantity of waste resulting from the manufacturing process (to the possible extent), and involve the consumer in the design process of the new product model (co-design). The virtual prototype of a model is a virtual representation of the new item which enables one to assess the extent to which it matches the model sketch/ photo, see whether the design method was adequately chosen and if the process was carried out correctly, to evaluate the fitting degree of the garment (dimensions, proportions, position on the virtual body/ dummy), and to decide if it fulfils the customer's requirements. In this paper, the authors present a tutorial about how to obtain a 3D prototype and to virtually try it on a virtual body/ dummy, by using a Lectra software solution. This tutorial is suitable for any person who is working in the field of clothing design, and who has got access to this advanced Lectra module.

Keywords: Virtual prototype; Clothing design; Patternmaking; Customer

1 Introduction

"Fashion" is a unique word, which suggests beauty, originality, emotions, used not only for clothing but also for lifestyle, accessories, jewellery, make-up, soft goods, body proportions, etc. This word is magic, captures the attention of any person, but the way they perceive it is influenced by their age, the society they live in, their level of education, financial resources, cultural heritage, the geographical area where they live, etc. The meaning of this concept is changing at a fast pace, and many consumers are willing to buy goods that they do not necessarily need for the sole purpose of being "fashionable". From time to time, new items are created from either already existent materials or new ones, created explicitly for this purpose. The demand for garment products has increased dramatically over the past two decades. Unfortunately, a significant fraction of these items end up either not being worn or used only for short periods before being eventually thrown away, and if they are not properly disposed of.

Climate change and air and water pollution are critical problems, which affect the balance of ecosystems, the lives of the animals, and the behaviour of the human society as well. To successfully deal with them, one has to determine the necessary changes, how they can be implemented, and to make sure that they withstand the test of time in a society dominated by consumerism.

In order to turn the concept of “clean, friendly and green” clothing industry into a reality, it is vital to reduce the consumption of raw materials (all types of materials and accessories), energy and water, to cut down on the levels of air, water, and pollution, and waste, while extending the life cycle of the product, and educating the consumer to use the garment product to the maximal extent and to recycle it in the end.

In order to stay competitive and creative in launching and manufacturing new collections, a clothing company must employ cutting edge equipment and IT applications in producing diverse and complicated models, in a personalised/customised manner to fulfil the client requirements. Under these circumstances, the first step that must be taken is to design the new collection in a virtual environment, as this allows the designer to carry out the process in an interactive, efficient, fast, and creative way. By taking this approach, the designer can explore a combination of different materials, styles, and lines in new shapes and structures of models, while simultaneously testing the fitting degree of the garment on a virtual dummy (e-prototyping). The virtual environment offers the possibility of exploring new ideas without consuming physical materials.

This paper presents a gradual e-learning tutorial of how to obtain a virtual prototype of a garment model using the 3D module developed by Lectra. This module enables the user to verify if the adopted design solution leads to the desired result: a correctly sized model (as it is shown in the sketch) that fits well on the human body. By carefully following the instructions, the student/ learner will be able to test various design features, to identify issues as early as possible during the design stage, and to provide a virtual model for company stakeholders that they can use in order to obtain a greater understanding of the characteristics of the product.

2 Work method

There is a great diversity of CAD’s with a 3D module that allows one to test and validate a design solution by obtaining the virtual prototype of a garment model. This module offers the possibility to import the 2D patterns and virtual seams besides the virtual mannequin or to directly design the 3D patterns on the virtual mannequin (suitable for fitted garments, placed very close to the surface of the human body, without pleats or folds) and then to export them as 2D pieces. Designers usually take the first approach, which consists of importing 2D patterns into a 3D environment, because these modules offer the possibility to design diverse category of garments, with complicated styles and layers at affordable prices.

In order to obtain a virtual prototype of a garment by importing the 2D patterns, the user (learner) must:

-prepare the patterns for virtual sewing process (design the variant of the model, figure 1). The patterns are designed using the Modaris module developed by Lectra, by taking into account the style of the model and the size of the human body. The user declares the garment sewing lines (figure 2). In the end, the user selects the button "Check 3D fitting", and the software verifies the model (if everything is OK) and then automatically launches the 3D module.

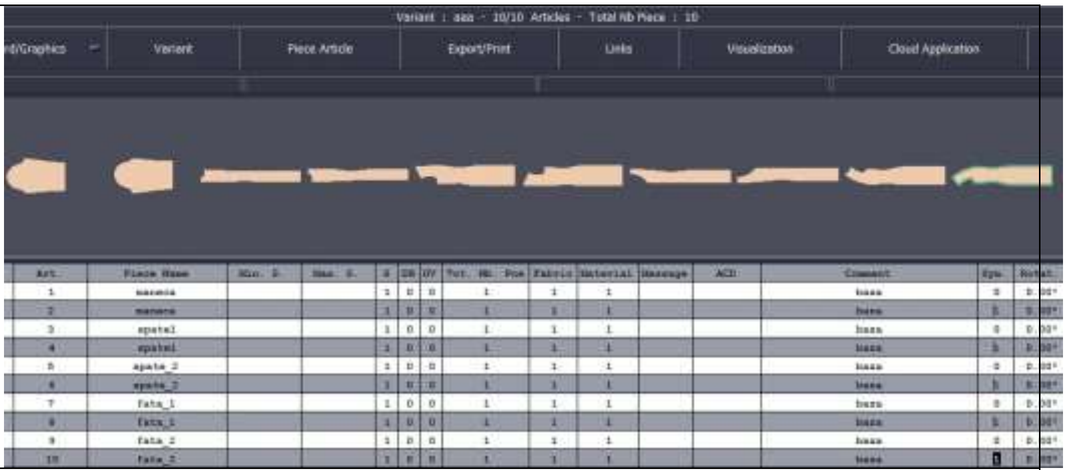

Figure 1. Design the model variant

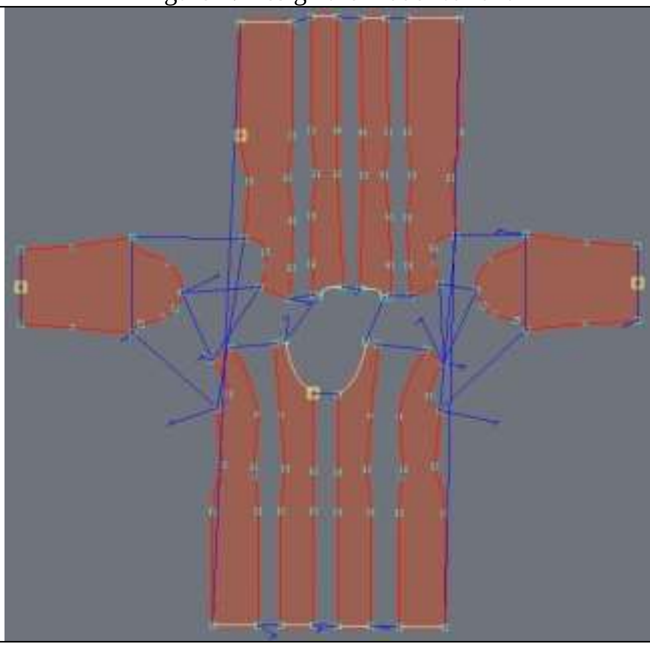

Figure 2 Declare the seam lines

-resize and re-shape the dummy from the CAD’s database. The user can use a 3D scanned body, but one must verify its surface, in order to eliminate the holes or other imperfections. The most frequently adopted solution is to select a suitable virtual body from the database of the CAD and to change it according to the size and the shape of the customer’s body. The virtual bodies have a particular position to allow the positioning of the garment pieces around the human body.

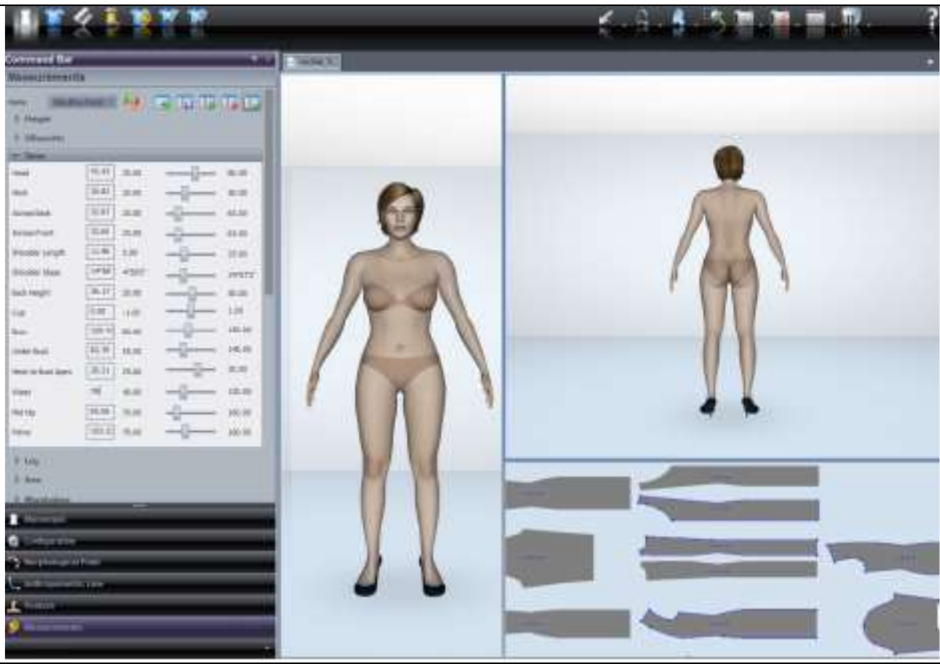

Figure 3. Re-size the dummy

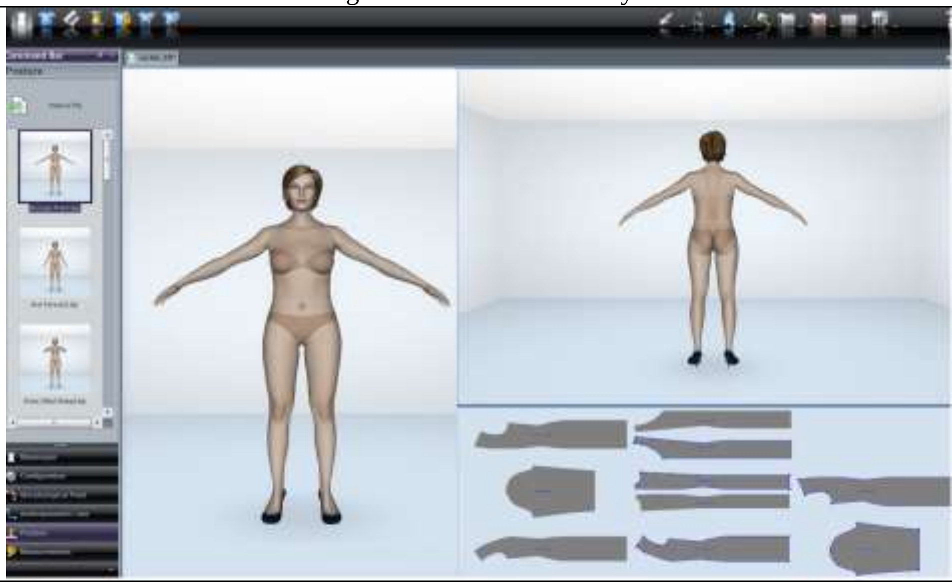

Figure 4. Select the suitable dummy position

-the user declares contacts point between the garment and the human body (figure 5), and select the type of material from which the model is made. Optional he/she can select to visualise the sewing lines between the garment parts (by activating the button Seams/ All Seams), (figure 6).

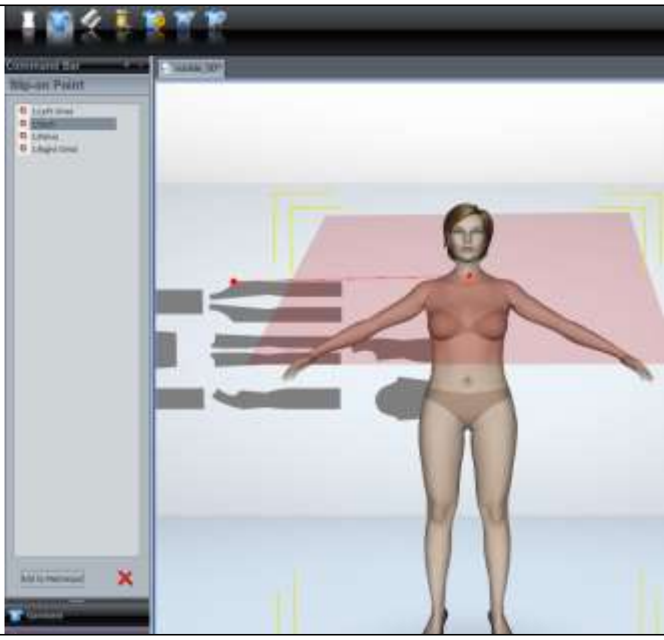

Figure 5. Declare the contact points between the garment and the human body

Figure 6. Visualise the sewing lines

- carry out the virtual sewing process. During this stage, the patterns are sewn around the human body (figure 7). The users can stop the sewing process, change the product position on the human body and then restart the sewing process (figure 8).

Figure 7. Simulation of the sewing process

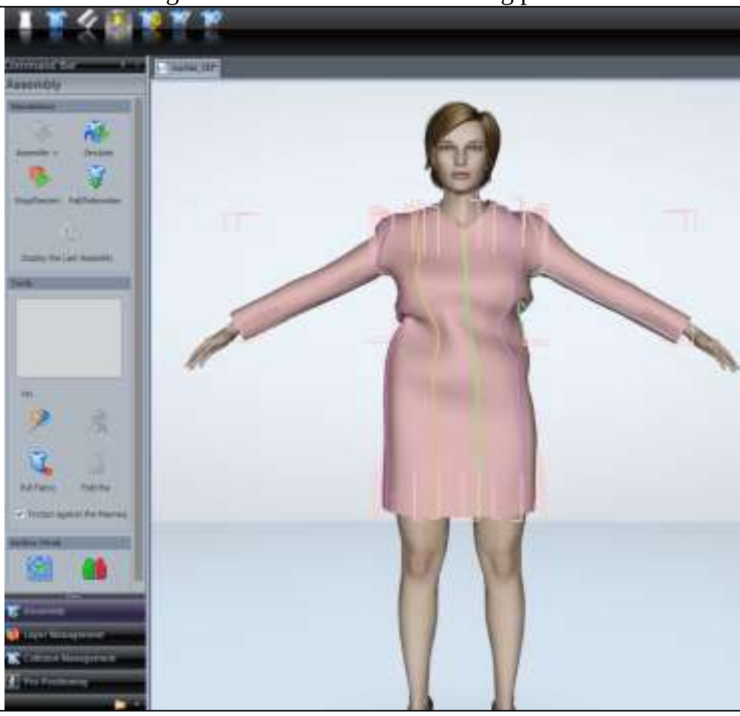

Figure 8. Arranging the garment on the surface of the human body

-the user analyses the appearance of the model, its balance and style details and decides if the virtual prototype accurately reflects the model sketch or not (the user analyses the tension map). At this stage, the designer decides what modifications are necessary to apply in order to eliminate the identified problems (if in the tension map the designers see red areas, they must increase the size and the shape of the pattern, and if they see blue areas, the shape and size of the pattern have to be reduced).

Figure 9. Final virtual prototype

Figure 10. Test the model appearance with a different combination of materials

These final patterns are used for obtaining markers, determining consumption, obtaining production patterns and the first physical prototype.

3 Conclusions

The virtual simulation of the first prototype offers the possibility to analyse and validate the design solution, test new materials, add new elements in order to obtain a new style, without using raw materials, energy, water or any other chemical substances. By working in a virtual environment, the user/learner can:

-explore sophisticated and diverse design solutions for atypical conformations or postures in order to verify the balance of the product when it is fitted on the surface of the human body;

-check if the materials were chosen in accordance with the category of the product (for summer, winter or spring/ autumn), and the behaviour of these materials during the virtual sewing process;

-test different colours or types of print for the materials on the selected model.

The design process of a garment model in a virtual environment requires a comprehensive study of the interaction between materials (number of layers, structure, and volumes) and the human body.

These e-learning lessons are suitable to can be easily followed by any person who is working in a design department, and who has to obtain the production patterns of a model in a timely manner. This virtual approach is environmentally friendly because it enables the user/designer to cut down on the amount of raw materials, water, or chemicals used in the production process.

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Learning to use new technology for the elderly

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Abstract

The outbreak of Covid-2019 and the subsequent quarantine reminded us that new technologies make a real difference to people's lives and help them lead a better, healthier, self-satisfying life at home. This article aims to explore how learning to use new technology for the elderly can be helpful in order to encourage them to stay healthy at home and safe when going out. Are the elderly ready to become more familiar with new technologies and use them in daily activities?We present here the IOANNA application that helps senior users feel safe to walk around the city, find an interesting temporary job or community service, and continue being active citizens. Besides, IOANNA provides a friendly interface for finding stores close to their location, organize their shopping, and find special offers. The results from the pilot tests we deployed have shown us that people over 65 years old, with different IT literacy and with/without previous experiences with technology, have a great interest in using the app features and functionalities because they are aware of the real benefits of using it in their everyday lives. Sometimes, they need help setting up and learning to use the app. But this is not an insurmountable barrier for the elderly if they are self-motivated, and the perceived usefulness is high. If IOANNA app is to be adopted on a large scale, then we have to focus on showing the benefit gained from using the app. Also, training instructions have to be customized to elderly needsThis document provides you with detailed guidelines for producing and submitting your print ready proof for the proceedings. The document is written in accordance with the instructions, which should be followed carefully.

Keywords: ICT's for the elderly, healthy aging, learning to use

1 Background: Using ICT's in a post-pandemic world

Worldwide, the ICT's industry was playing a key role in fighting against the pandemic. The post-pandemic world will be different and the barriers that had previously slowed the mass using ICT's in education, working, health, etc. will be removed. People of all ages will rapidly integrate technologies in their daily lives, from staying in touch with friends and family members, or daily activities to satisfying vital needs such as health, consumption, and education.

The COVID-19 pandemic has a negative impact, especially on the elderly defined as people aged 60 or 65 years and over (ECDC, 2020). This applies especially to those whom were compelled to stay at home and endure serious constraints due to the major health risks of infection. Social distancing and isolation can have a negative effect on their physical and mental health.

…what about ICT's for Healthy Aging

There are 101.1 million people aged 65 years or more living in the EU-28. During the next three decades, the number of older people in the European Union (EU) is projected to follow an upward path, peaking at 149.2 million inhabitants in 2050; their relative share of the total population will also gradually increase and is projected to reach 28.5 % in 2050. (Eurostat, 2019).

It is undeniable that the ICT's has the potential to be of considerable use to older people, innovative products are developed for the elderly like health and wellness apps, safety services, apps that educate elderly, etc. Many ICT solutions supporting active, safer and healthy ageing are implemented. The ICT's use can be beneficial to the elderly (or seniors) in many ways. For example, "Livewell" project (Boulos, M. N. et al, 2017) attempts to address this issue, and also adds a component of social networking and peer support to its educational provision to help patients and their family combat social isolation and depression. Research evidence also shows that Internet use and online social engagement can protect against health literacy decline during aging (and hence result in better health outcomes), independent of cognitive decline.

Moreover, there are many benefits of continuing learning something new. Studies show that when seniors learn a new skill, such as learning how to use new technology, it reinforces the healthy brain and it keeps dementia away. It is very beneficial for the elderly to continue to acquire new skills or to do new things. Learning is an important aspect of aging productively (Gillian M, Boulton-Lewis, 2006) and mental stimulation.

Despite the benefits of using ICT's, there are also constraints and challenges seniors face when using new technology. Previous E.U projects (The Home Sweet Home project, 2014) shown that from the perspective of older users of ICT's, the main difficulties of usage are listed under five main items: the need and understanding the benefits of technology using, the usage and accessibility, the trust in technology if they do not understand, the affordance in terms of the cost, and the perceived usefulness or "how will it change my life"? Also, iterative testing, using tutorial and training also, of the devices for some time before adopting them, allows older persons to experience the benefits of technologies that can help them gain confidence in using and start adopting them.

Also, the understanding of the elderly user experience is paramount to enhance their acceptance and adoption of the new technologies (Spiru L. et al, 2019). So, the elderly need to learn to adapt to the new digital challenges and learn how to use and share information. Even if, some of them are learning and using technologies for the first time.

Research (Paul C. at all, 2019) about factors affecting seniors' acceptance or rejection of newly technologies found that gerontographics segmentation can tremendously inform on the openness of the seniors towards certain products or services. Seniors who are independent and socially active, namely the categories of healthy indulgers and ailing outgoers, are open only towards new technologies and avoid age stigmatized gerontechnologies and health-oriented products and services, while the categories of frail recluses and healthy hermits, who are more self-isolated and dependent, are more open towards new technologies and gerontechnologies alike.

1.1 Paper Contributions

In this article, we intend to see how the elderly learn technology by using it, if this can be helpful in order to encourage them to stay healthy at home and safe when going out. For people with no experience with technology, learning how to use is paramont in order to better turn knowledge into a real-valued product.

This article aims to explore how learning to use new technology for the elderly can be helpful in order to encourage them to stay healthy at home and safe when going out. Are the elderly ready to become more familiar with new technologies and use them in daily activities?

We present here empirical evidences we received through experimentation with the IOANNA application. The main findings we obtained during pilots/ field trials, concerning the above-mentioned problems are detailed. The primary objective is to assess the readiness of seniors to accept the app, if do they need it? As a secondary objective, we intended to see if there are any difficulties the participants might experience while interacting with the app. It is learning to use a difficulty for them? What can we do?

2 The IOANNA apps - facilitating mobility and social engagement of elderly

The integrated solution IOANNA is developed under the AAL project Integration of all stores Network & Navigation Assistant (http://www.ioanna-project.eu/) as a platform and mobile phone/tablet application for facilitating mobility and social engagement of the elderly. The project's services are based on the following pillars, as follows: a) Search for commercial offers, stores, stores categories, and specific products of services near the user's location b) Offer community service in paid or volunteer basis for experienced senior adults.

IOANNA will collect all the information needed from local professionals, to create a database that will be dynamically updated to build a network of almost all stores in town, with product and services details whenever possible. Local professionals will be able to sign-in to the application and upload any offers they may currently have, so that the users can arrange their shopping lists. That way the users will be able to see if there are any good offers nearby this week that they would miss had it not been for IOANNA. From the seniors' perspective, while finding the optimum price compared to how far the shop is, may not be their main concern, they do care for being able to wander around the town feeling safer in case something unexpected happens to them. A panic button is available that automatically calls their family if pressed and a fall detector will do the same if the user falls down. In addition, users will know if there are any interesting jobs or community services, they can offer their services and they would appreciate the fact that they can now be independent, giving them self-confidence for the small every-day challenges. On the other hand, seniors are familiar with some few places in the neighborhood, but their 'known area' tends to be smaller and smaller. IOANNA's challenge is to help them stay up-to-date, engage them in local activities, help them to have a larger window on the world and bring them in contact with other people in a safe and secure way.

Local stores, would greatly benefit from IOANNA, as they may become known, or even advertise themselves through the platform by posting their offers and prices. That way, even smaller stores may shine in the competitive market, despite their low budget cycle of work, especially during the pandemic times that it's more difficult to visit the actual stores.

Moreover, the public sector and other local professionals (companies etc) may take advantage of IOANNA platform and post openings in places that need the labor or expertise of senior adults or other citizens, for limited time, as a volunteer or paid work. Those offers will be presented in a different way than the product or services offers and the platform will support the interface through which the two parts will come in contact. This way, people with enough free time will have the chance to offer their valuable experience and remain active citizens in the case of seniors, or maybe acquire some valuable experiences through those offers an enrich their CV in the case of other citizens. At the same time, the public sector or other professionals will greatly benefit from that particular service, as they will have their offers seen by a big network of people, being able to choose the right person for the job. Engaging community services will offer "community credits" to be reimbursed through IOANNA.

3. The methodology, results and discussion

Before implementing the mobile app on a larger scale, we want to see how elder users interact with the prototype. The involvement of the end-users is an important factor to develop a mobile app that is user-friendly, easy to use, and easy to learn to use. Also, elder users' feedback will be used to manage the difficulties and facilitators to learning to use technology (i.e. mobile application). We present here selected conclusions on requirements and field trials of the first prototype.

Users' requirements. In September–October 2018, we invited seniors from Cyprus and Romania to express their opinion. The inclusion criteria for seniors is age over 55 years, with low or minimum/high IT literacy levels, living in urban or rural areas, also being interested in using the opportunities of IOANNA and its services. Method. We applied semi-structured questionnaires (collecting responses from 47 seniors) and deep-interviews with 10 seniors We presented them a short description of the IOANNA concept and its services and a mock-up and ask their opinion. The results show us that seniors feel comfortable using IOANNA app and would be happy to use it daily if they are aware of its benefits. Easy to use interface with friendly images and good visibility even is necessary. A step by step tutorial with learning instructions would be highly appreciated. The safety is the main practical barrier that people perceive it to prevent the daily use it.

Real-life trials. In January-February 2020, the first prototype was tested with seniors involvement, in two countries, Cyprus and Romania. For the investigation, we asked seniors to test the prototype and give us their feedback, comments, and suggestions on how to improve the IOANNA system to respond to their needs. A total of 30 participants was involved in both end-user countries; 15 in Romania and 15 in Cyprus. The inclusion criteria are age over 55 years with special attention for those 75+ years and different levels of IT literacy, i.e. no, low, or minimum/high. The method: The participants were guided through one experiential learning scenario and their respective tasks to navigate through all the functions of the mobile application. Experiential learning is the practice of learning by doing. It encourages people to use technology, even if they do not have previous experiences or how to use a computer. The tools: observation, semi-structured interviews, and questionnaires. The results: Most of the older adults in Cyprus and Romania said they had a good experience and found the application interesting and useful, with some particularities. The willingness to use it is dependent on many factors and parameters like age, IT literacy level, and area of residence. In Cyprus, many adults of older age (75+) liked the application but found it hard to use it and/or did not want to use it. However, as the researchers observed, older adults of more than 75+ years of age in Romania showed little interest in learning how to use IOANNA and its functions.The IT literacy level of older adults highly affected their opinions. For example, the majority of the older adults in Cyprus stated that they found the application difficult to navigate. This point is related to the need of some kind of training material. In Romania, older adults with no IT literacy are not interested in the application at all. Older adults living in remote areas in Romania were more negative towards the IOANNA application. By contrast, older adults in rural areas in Cyprus have more acceptance towards the application than those living in semi-urban areas.The results from the 30 participants also highlighted the most important areas for improvement for the application. Some notable examples included: a. some kind of training and tutorial on the application, b. to include a voice recognition function, c. bigger fonts and icons, d. options for communication between the users and e. a function to compare the prices of the stores in the application.

4. Conclusion and future work

We consider that the readiness of seniors to use ICTs is a complex process, highly dependent on other reasons. There are important influential factors we cannot adjust, as demographic factors, geographical factors, and factors we can influence like psychological factors (e.g. motivation, perception, etc.). While the readiness to use the app is essential, one prerequisite to its use by the elderly is that the system is easy to use and matches the needs of older adults. The process of development of new technology for the elderly has to involve the elder users to confirm that products are addressing the real needs of the elders. They can learn technology by using it. The issues are not about the willingness to use it in everyday lives, but lack of practical experience. If they feel confident, they will be more likely to view the beneficial and accept to learn how to use the technology. We consider that using the app for some time and seeing its benefits first hand might change elderly opinion. This is why we will proceed with the longitudinal study, in subsequent stages of development. We assume that elderly learn to use and become more confident with technology simply because they used to use it in their daily activities. Also, there are some concerns in terms of privacy and ethical issues that required a particular approach. This is essential to protect the elderly, their rights and data privacy, throughout the complete cycle of development, from creation to market launch and implementing the mobile app on a larger scale.

ACKNOWLEDGMENT

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Home Alarm System with Arduino and LabVIEW

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Abstract

The purpose of this paper is to create a functional system in terms of hardware and software, to create a home alarm system. The system can monitor the following parameters: temperature, possible gas emissions, the presence of smoke as a result of a fire, as well as the audible warning of exceeding normal values and also the ventilation of the house. This system will be built using the Arduino Mega 2560 development platform, and programming will be done using the LabVIEW graphical programming. Hardware resources that will be used in the paper are: Arduino Mega 2560, two LM35 Precision Centigrade Temperature Sensors, the MQ-2 smoke sensor that is sensitive to smoke and to the flammable gases, the MQ-135 Air Quality Sensor, the MQ-5 Gas Sensor sensitive for LPG, natural gas, coal gas,the DC 12V Brushless Cooling Fan, a breadboard, a buzzer, 2 LEDS with 2 x suitable resistors for to limit the current through LEDs (220 Ohms is fine) and connecting wires. The results will be displayed through the serial interface on the computer, in the LabVIEW program.

Keywords: Temperature Sensors, Smoke Sensor, Air Quality Sensor, Gas Sensor, Arduino, LabVIEW, LINX.

1 Introduction

With the development of new electronic technologies and their integration with older, traditional building technologies, smart house is at last becoming a real possibility. Smart House is not a new term for science society but is still far more away from people's vision and audition. This is because although recent various works has been done in designing the general overview of the possible remote access approaches for controlling devices (Hamed, 2012).

Data Acquisition (DAQ) is the principle of conversion using I/O signal interface from one device into another (e.g. Analog to Digital) using the appropriate channel of conversion. Data acquisition systems have evolved over time from electromechanical recorders containing typically from one to four channels to all-electronic systems capable of measuring hundreds of variables simultaneously (Data Acquisition Handbook, 2012)

LabView VI uses USB cable to connect the port for data acquisition board (Arduino), while another side of the cable connects to the port of PC which shows the COM Port communication number when tested to the LabVIEW connection port block.

The components required for this technical project are: LM35 temperature sensor, MQ-2, MQ-135 and MQ-5 gas sensors, a fan commanded by 5VDC Relay Module, 5V piezoelectric buzzer, 2 LEDs with 2 suitable resistors for to limit the current through LEDs, and an Arduino MEGA2560 development board.

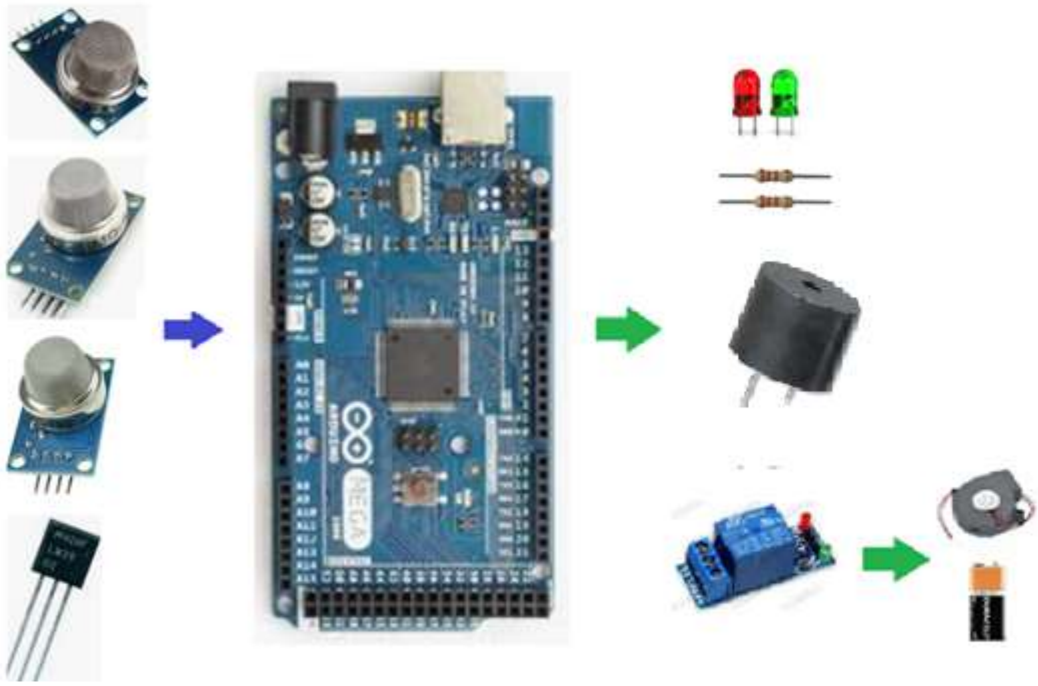

Figure 1.The components necessary for the elaboration of the technical project

LM35 temperature sensor, which are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. It can measure temperature from -55 degree Celsius to +150 degree Celsius. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. Thus, at 0°C it will have an output voltage of 0V and increases by 10mV when raising the temperature by 1°C.

LM35 can be operated from a 5V supply and the standby current is less than 60uA (http://www.ti.com/product/LM35).

The gas sensors of the MQ series are analog sensors, designed to detect the presence of different chemical components in the air. We can connect these devices with any microcontroller, like Arduino. There is a wide variety of MQ sensors. Each model is designed to detect one or more substances, designed for a specific use, such as flammable gas detection, air quality or detection of alcohol in breathed air (Bogdan M., 2018).

The MQ sensors use small heater inside with an electro-chemical sensor that changes resistance in contact with the various substances. They are sensitive to a range of gasses and are used indoors at room temperature. The output is an analog signal and can be read with an analog input of the Arduino (https://playground.arduino.cc/Main/MQGas Sensors).

2 Hardware Description

The following figure shows the block diagram of the alarm system to better express how the components communicate with the microcontroller. All sensors send data to the microcontroller, which in turn will send instructions to the sensors, and then the output will be controlled.

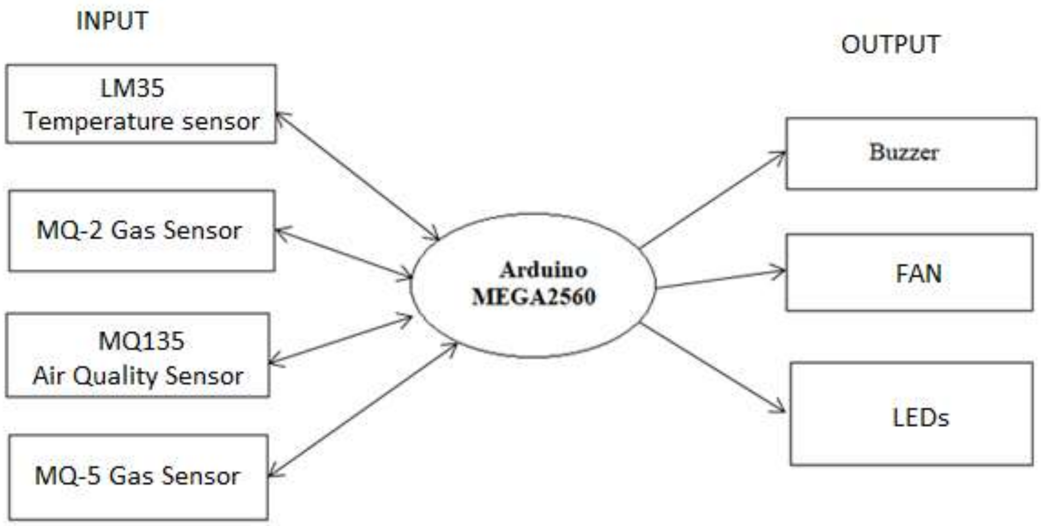

Figure 2.Block diagram of the alarm system

The following figure shows the wiring diagram of the alarm system to better express how the components communicate with the microcontroller.

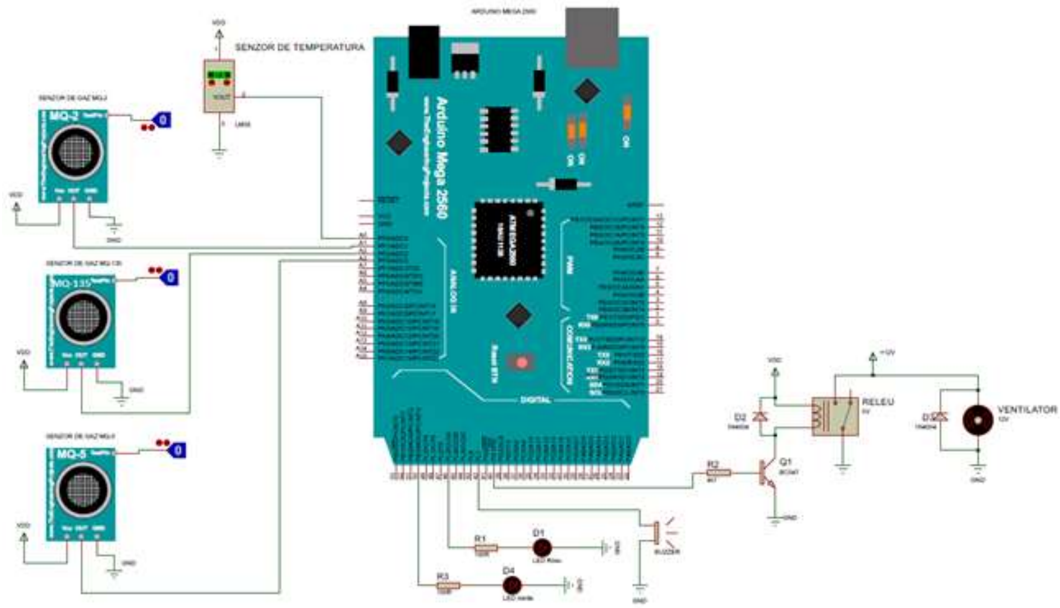

Figure 3.The Wiring diagram of the project, made in Proteus

Arduino plays a key role in the project, being its brain. All sensors transmit data to the Arduino MEGA2560 microcontroller, which is based on the Atmega2560 chip and an oscillator operating at 16 [MHz].

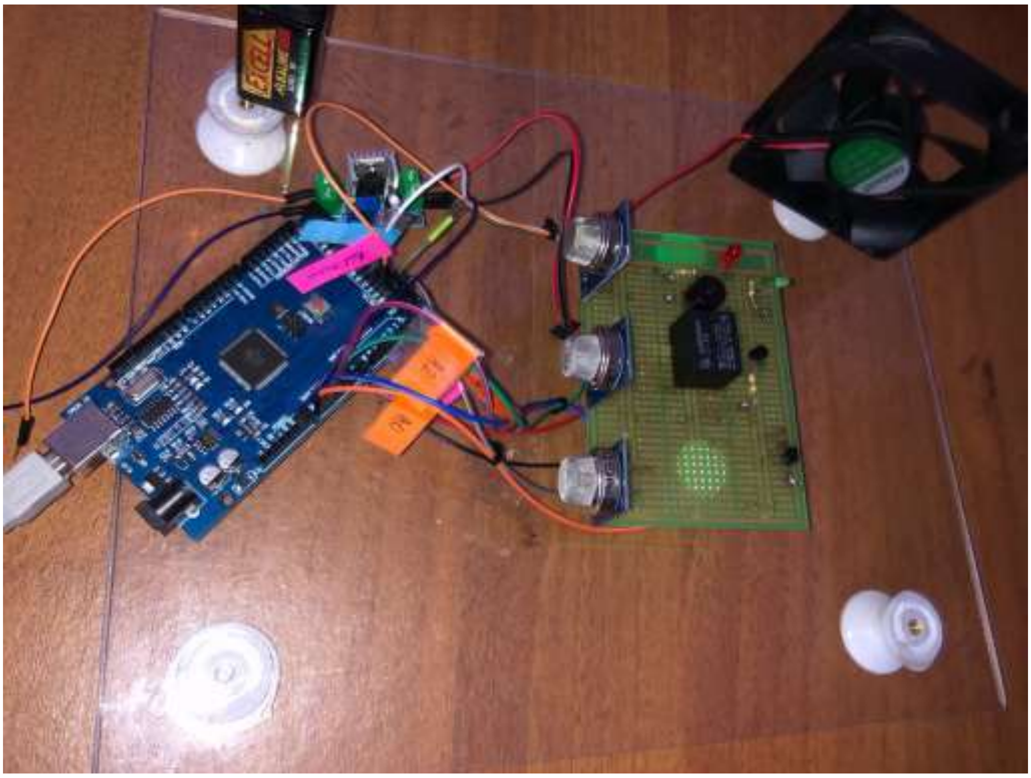

Figure 4.The image of the project

3 Software Description

In the figure 5 you can see which are the steps that the application must follow. Figure 6 shows the front panel of the VI, that contains the controls and indicators, and figure 7 shows the Block Diagram.

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 (Bogdan 2017).

After establishing the elements and the appearance of the front panel (with various decorative elements), I made the Block Diagram of VI.

The Block Diagram of VI contains the controls and indicators terminals of the Front Panel, the various nodes, constants and the wires. The nodes in LabVIEW are different functions, subVIs and programming structures (Bogdan, 2019).

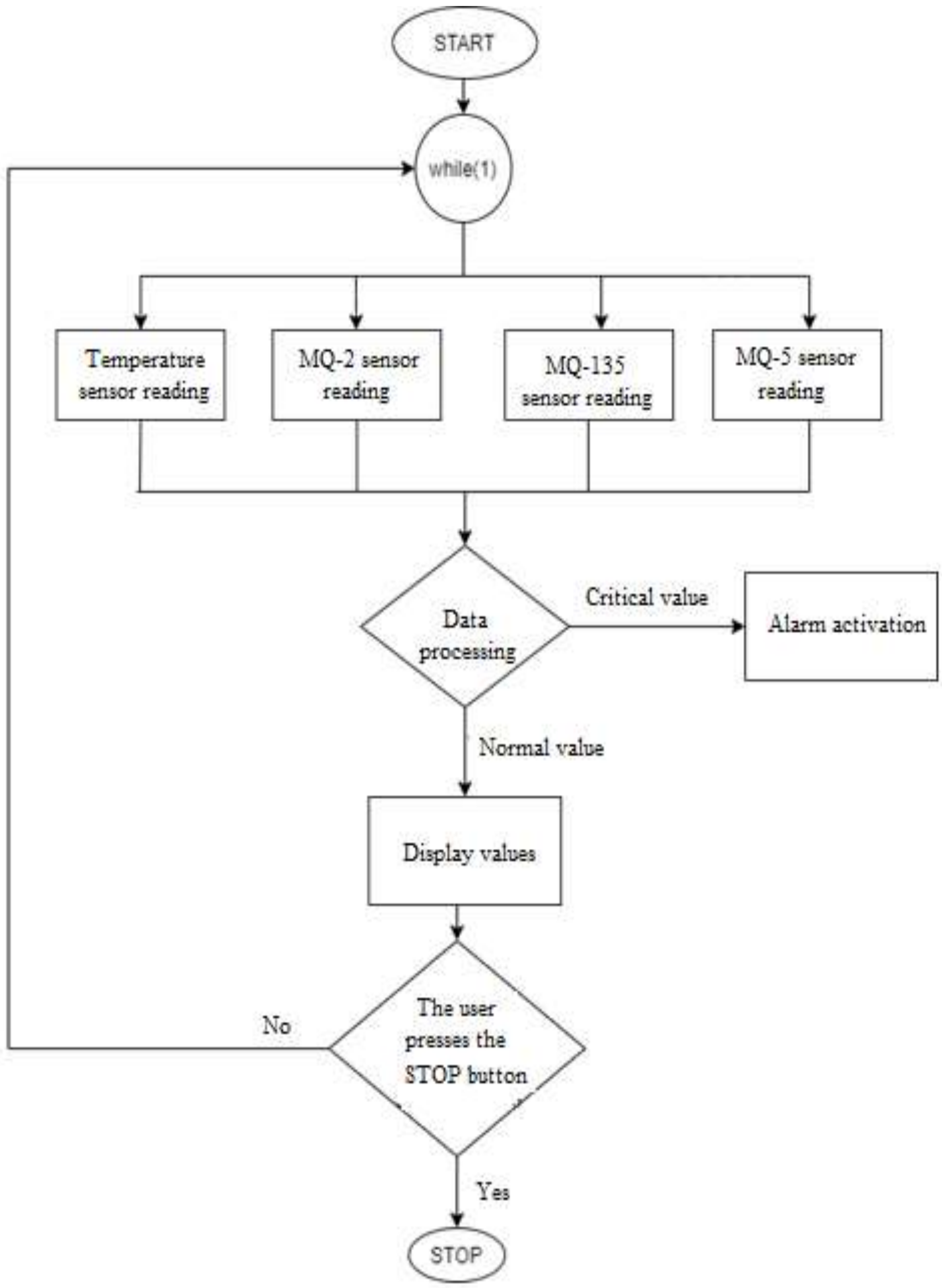

Figure 5.Software architecture of the application

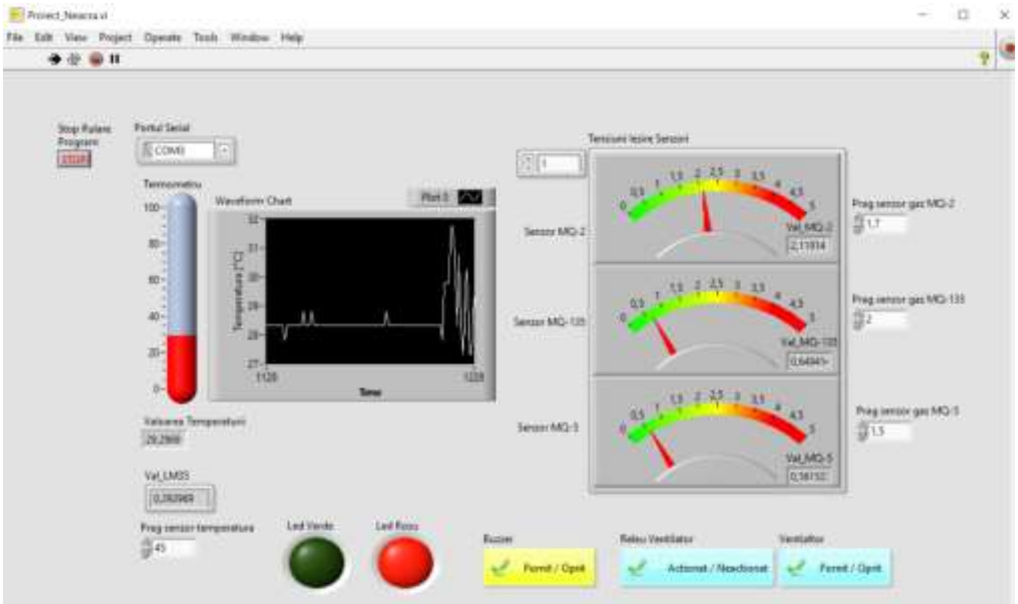

Figure 6. The Front Panel of the VI

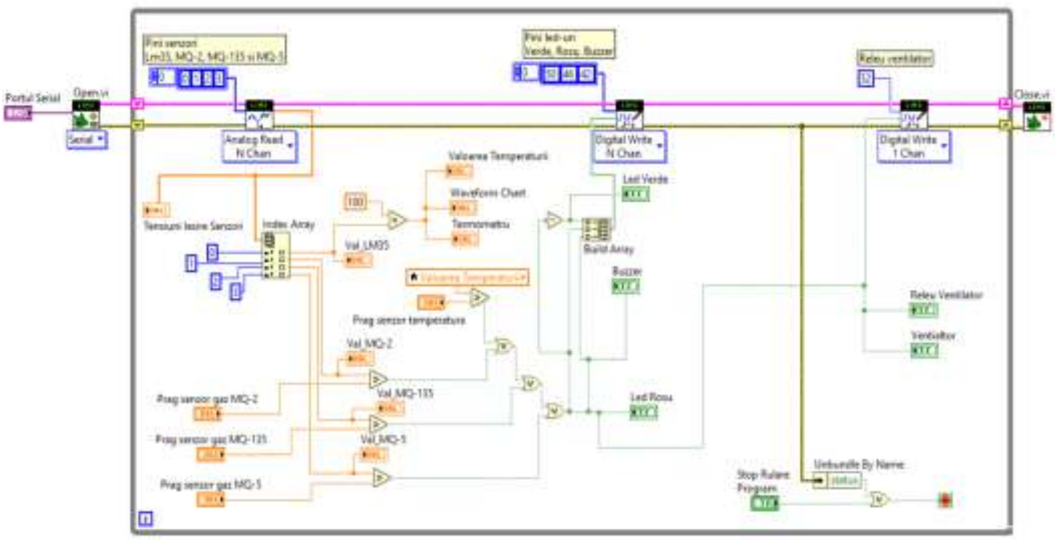

Figure 7. The Block Diagram of the VI

3 Conclusion

The purpose of this project is to introduce an electronic alarm system that monitors the temperature and possible gas emissions in a room and the audible warning in case of exceeding normal values. The software was made in the LabVIEW graphical programming environment with the help of the Arduino development board, which has the possibility to both read the data and control the elements. The solution presented has a low cost and can make this system easily integrable into a overall more complex. In addition to these aspects, as further developments I mention the use of a GSM module to be able to receive messages on the phone when a fire or gas leak is detected.

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Heating and Ventilation System with Arduino and LabVIEW

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Abstract

This system aims to control the heating and ventilation system of the home, using the LabVIEW graphical programming environment. The system consists of a temperature sensor, 2 control circuits, and the Arduino mega 2560 platform, which will control the entire system. The first control circuit is used to start a fan for cooling the house, and the second control circuit is used to operate a relay of the boiler for heating the house. This system works like a thermostat, so it will keep the house at the set (desired) temperature.The temperature sensor measures the temperature inside the house and if the temperature is lower than the set one, Arduino activates the boiler relay to start heating the house. After reaching the set temperature, the heating of the house is stopped. The same thing happens if the temperature of the room is higher than the set temperature, Arduino controls the fan to cool the room.

Keywords: LM 35 DZ, Cooling Fan, Arduino, LabVIEW, LINX.

1 Introduction

Home automation ensures increased comfort through various functions offered by automation, such as: measuring and improving the air quality inside the home, adjusting the lighting according to the light level, or automating the heating system so that the temperature is always right for the user. A thermostat is a component of a control system which senses the temperature of a system so that the system's temperature is maintained near a desired set point. The thermostat does this by switching heating or cooling devices on or off or regulating the flow of a heat transfer fluid as needed, to maintain the correct temperature. A thermostat can often be the main control unit for a heating or cooling system, in applications ranging from ambient air control to automotive coolant control. Thermostats are used in any device or system that heats or cools to a setpoint temperature, examples include building heating, central heating, air conditioners, as well as kitchen equipment including ovens and refrigerators and medical and scientific incubators (https://en.wikipedia.org/wiki/ Thermostat).

The system for controlling the heating and ventilation of a room, contains a temperature sensor LM 35 DZ, a circuit for controlling the boiler relay and respectively a circuit for controlling the fan.

The LM35 series is an integrated circuit for the temperature measurement. Corresponding to each degree Celsius (°C) it gives 10 mV as output. It can sense temperature in the range of −55°C–+150°C.

The temperature sensor is connected to the A0analog input of the Arduino mega 2560. The control circuit of the ventilation system is connected to the 40-digital pin, of the Arduino mega 2560, and the control circuit of the boiler relay is connected to the 42digital pin number. To see if the boiler relay is activated, we mounted an LED to indicate this (Figure 1).

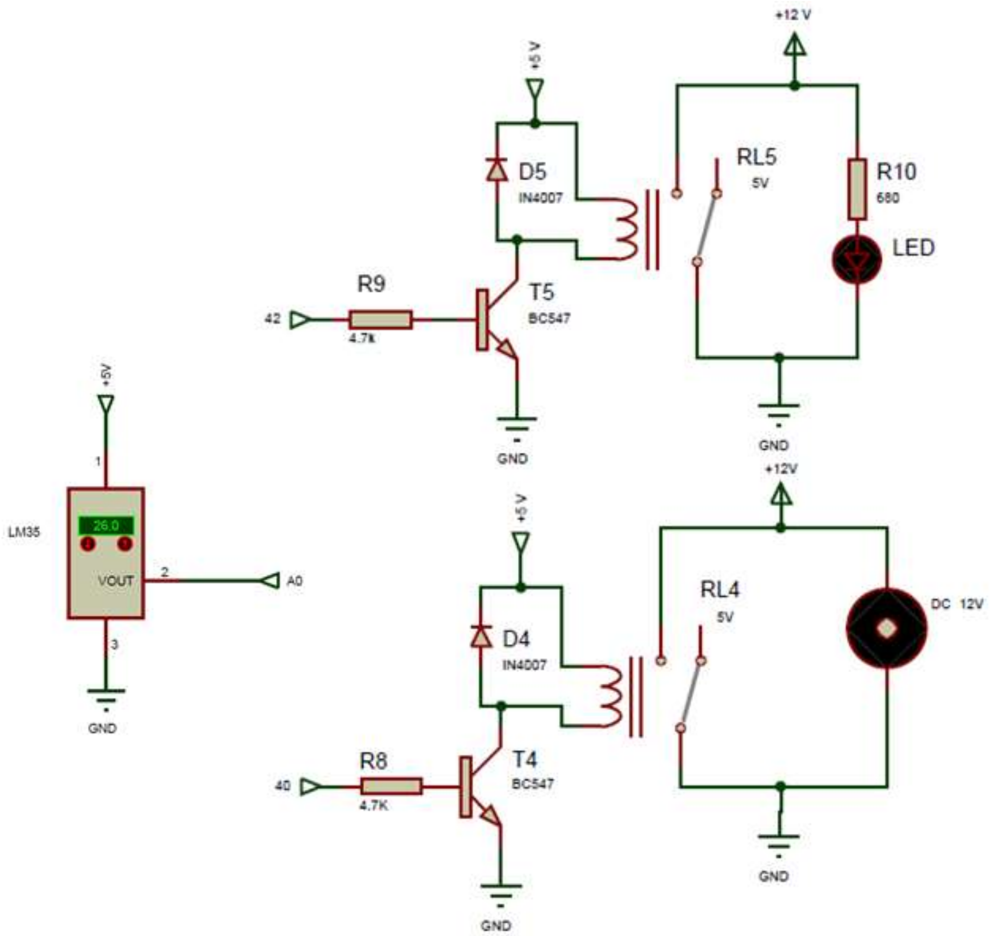


Figure 1.System Hardware Wiring Diagram

The resistance for limiting the current through the LED, we calculated it with the relation:

$$R_{LED} = \frac{U_{AI} - U_{LED}}{I_{LED}} = \frac{12 - 2}{15 \cdot 10^{-3}} = 666.6\Omega => R_{10} = 680\Omega$$

2 System Software Design

To create the interface between LabVIEW and Arduino, you need the following software:

- LabVIEW;
- NI VISA;
- VIPM;
- LINX

NI VISA - National Instruments Virtual Instrument Software Architecture is an API that provides a programming interface to control Ethernet/LXI, GPIB, serial, USB, PXI, and VXI instruments in National Instruments application development environments like LabVIEW, The API is installed through the NI-VISA driver (https://www.ni.com/ro-ro/support/documentation/supplemental/06/ni-visa-overview.html).

VIPM - VI Package Manager reduces project costs by helping you implement a code reuse process in your organization. VIPM makes it easy to manage and share reusable VIs across multiple projects, computers, and teams of developers (http://sine.ni.com/nips/cds/view/p/lang/ro/nid/209002.

LINX - LabVIEW for X (LINX) is designed to replace LabVIEW Interfaces for Arduino and to provide a LabVIEW generic protocol for the interface with any programmable device, but specifically targeting Microcontrollers and SoCs (System on a Chip). LINX will provide a high level of programming that allows users to communicate with several devices, including Arduino (https://www.labviewmakerhub.com/).

After installing all the necessary software, the LabVIEW program will open, in which I will make virtual instruments necessary for programming the Arduino MEGA 2560 boards, then select Tools >>Makerhub>> LINX >> LINX Firmware wizard.

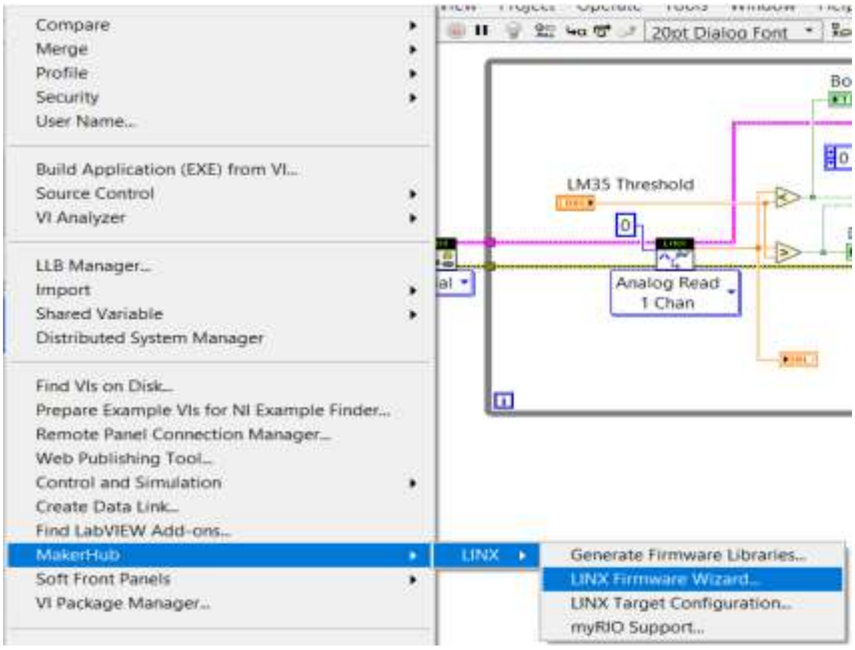


Figure 2.LINX Configuration

Represented in Figure 3 is the Front Panel of the VI. It contains the following controls and indicators:

- a control (Serial Port) for setting the serial port to which Arduino is connected;

- a boolean control (Stop Program) to stop running the virtual instrument;

- a numerical control (LM35 Threshold) for setting the voltage level, from which the relay of the boiler for heating the house or the fan for cooling the house is operated;

- a numerical indicator (LM35 Output Voltage) for displaying voltage values at the output of the LM35 temperature sensor;

-two Boolean indicators (Boiler Relay and DC Fan) to indicate the status of the boiler relay and DC fan.

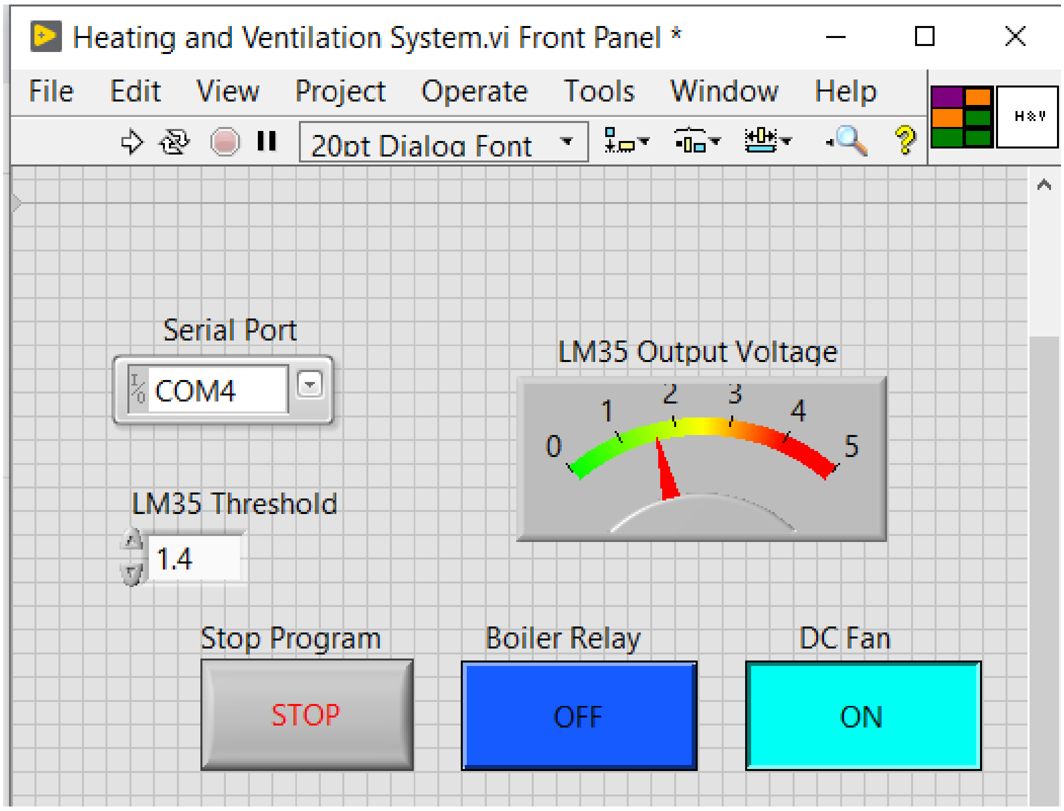
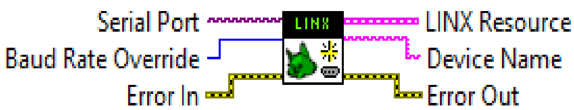


Figure 3. The Front Panel of the VI

The Block Diagram of VI contains the controls and indicators terminals of the Front Panel, the various nodes, constants, and the wires. The nodes in LabVIEW are different functions, subVIs, and programming structures (Bogdan, 2018).

In the block diagram, the following functions and programming structures were used:

- The **Open Serial** Function: this function opens a serial connection with the Arduino platform. Each different program starts with the Open function.



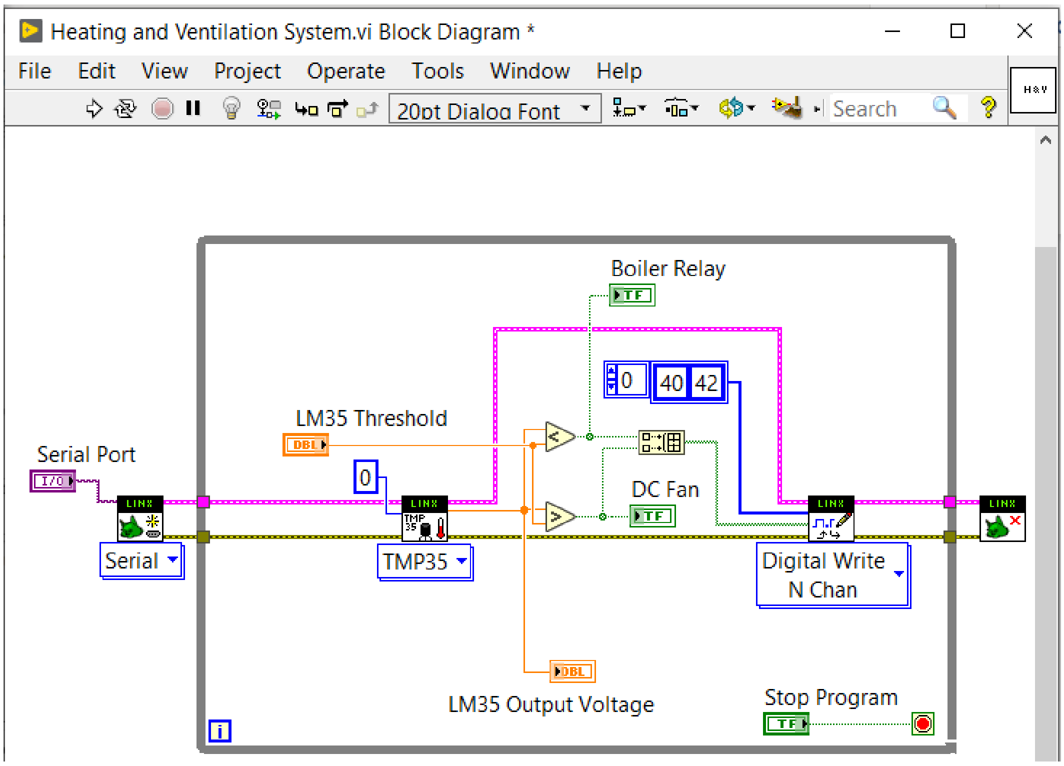
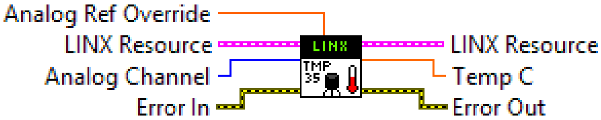
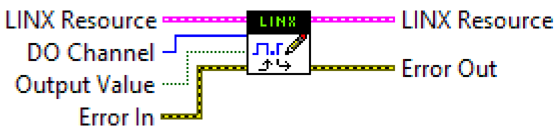


Figure 6. The Block Diagram of the VI

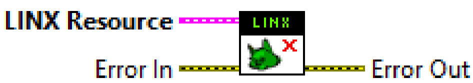
- The **TMP35** Function: Read temperature from LM35 sensor.

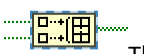


- The **Digital Write N Chan** Function: Write the digital values (high or low) to the specified digital output channel.



- The **Close** Function controls the end of the program. This function closes the connection to the remote LINX device and free any local I/O resources. We must finish each different program with Close function;



-  The **Build Array** Function - this function adds the two boolean values to the input, in a two-element array, which will be applied to the input of the Digital Write N Chan Function which will write these values to pins 40 and 42.

-  The **While Loop** structure: that will continuously execute the functions inside it until the conditions for termination are reached.

3 Conclusion

The two major heating and ventilation functions for a home, offer thermal comfort and acceptable indoor air quality at reasonable installation, operation, and maintenance costs.

I opted to write the application code in LabVIEW Graphical Programming and not in a classic text-based programming language.

The advantages of programming using the LabVIEW graphical programming language over the classic text-based programming language are:

- It offers a multitude of libraries and virtual tools specific to programming embedded systems;
- The graphical interface of the LabVIEW program is very friendly with the programmer;
- Higher productivity of graphic language compared to classical languages of programming;
- The LabVIEW language features interactive debugging tools.

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S7-1200 Siemens PLC based industrial automation educational platform

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Abstract

Industrial automation competences are in great demand by several industries worldwide. The 2020 academic year had its unique challenges that nobody in the community expected. The apparition and world wide spread of COVID-19 forced the educational institutions to adjust to conditions and requirements never encountered. In this context, the University of Pitesti developed an educational platform for industrial automation course. Even before COVID-19, industrial automation was a career in very high demand worldwide in general, and in Romania in particular. Now, with the implementation of robotic applications, companies active in a wide range of industrial activities demand this career more. This article presents a S7-1200 Siemens PLC based industrial automation educational station developed at the University of Pitesti for regular laboratories. By remotely accessing one PC, the platform can be use as support for remote laboratory applications.

Keywords: PLC, Tia Portal, electrical installations, industrial automation

1. Introduction

The 2020 academic year had its unique challenges that nobody in the community expected. The apparition and world wide spread of COVID-19 forced the educational institutions to adjust to conditions and requirements never encountered. In this context, the University of Pitesti developed an educational platform for industrial automation course.

Even before COVID-19, industrial automation was a career in very high demand worldwide in general, and in Romania in particular. Now, with the implementation of robotic applications, companies active in a wide range of industrial activities demand this career more.

In order to provide the specialists the industry demand, the universities around the world prepared different means to teach online or hands-on the required courses to equip students with the necessary competencies.

Thus, in (Garduno-Aparicio et al., 2018) the authors present a robot prototype for an undergraduate laboratory. The purpose of the prototype is to help students to learn basic concepts of robotics and apply them in practice applications. This application allows the students and teachers to modify the software and hardware units. The paper presents six practical applications. The authors present an analysis of student performance in digital systems that indicates sensible improvements during 2014 – 2016.

A different approach consists in using Power-Hardware-in-the-Loop system (PHIL) (Kotsampopoulos et al., 2017). This system allows the connection of a physical power component to a real-time simulated network. In the paper, the authors present the increased integration of distributed generation, voltage control with on load tap changer, short circuits with inverter-based distributed generation and microgrid operation. The beneficiaries of the system appreciated positively and appreciated real-time simulation. Another solution (Abichandani et al., 2019) of virtual laboratory was developed using Google Cloud Platform. This contained self-guided laboratory modules that covered the fundamentals of solar cells and parallel solar cell connections.

Automatic control laboratories could be offered as virtual or remote access as presented in (Saenz et al., 2015). The system is developed using low-cost solution for developing the laboratories based on Easy Java/Javascript Simulations. The laboratories are integrated in the Moodle system for maintenance and management. The authors make a distinction between virtual and remote laboratories. The virtual laboratories are the ones based on computer simulations that offers similar behavior with the real systems. The remote laboratories are the ones operated at distance. The remote laboratory (August et al., 2016) thematic is in the attention of the academic community since more than two decades ago and the continuous interest is proven by the publications in the field.

A new approach of laboratory development is to appeal to games and gamification. There are several publications (Abichandani et al., 2019), (Lopez-Pernas et al., 2019a) , (Lopez-Pernas et al., 2019b), (Morlovea et al., 2019) that present game related approaches for teaching important engineering concepts. After all, computer simulation of engineering installations or concepts are quite similar to present day computer games. Visual pick and place programs (Moreno-Leon and Robles, 2016), (Moros et al., 2020), (Kaučič and Asič, n.d.), etc. transforms the way of implementing complex algorithms.

2. Industrial automation platform

In this paper, we would like to present a S7-1200 Siemens PLC based industrial automation educational platform that helps the users to acquire basic competences required in the automation engineering. Various topics are covered by the use of the platform:

- Basic electrical installations (Beloiu, 2015a)
- Basic automation experiments cabled logic based (Beloiu, 2015b)
- Basic automation experiments programmed logic based (Beloiu, 2017)
- Remote connection to the platform (Saenz et al., 2015), (Hu et al., 2017)

Figure 8. Automation station

Figure 8 contains the picture of the implemented automation station. The main elements of the station are:

- Automation elements:
  - PLC: Siemens S7-1200
  - HMI: Siemens KTP-700
  - Profinet Switch: XB005
- Electrical elements:
  - Power supply

- Protection elements
- Buttons, lamps and numerical indicators
- Safety button

The station will be programmed and monitored with the Siemens developed programming software Tia Portal.

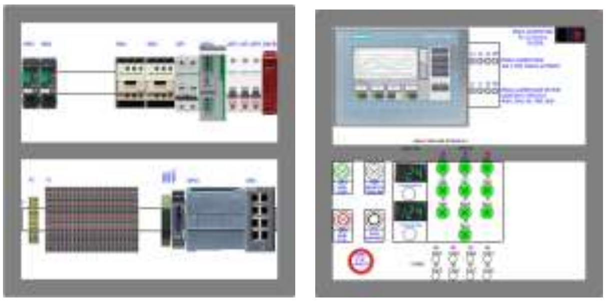

Figure 9. Automation station distribution

Figure 9 displays the distribution of the elements of the automation station in the electric panel.

2.1. Basic electrical installations

Figure 10 displays the input-output PLC electrical connections. Analyzing these schematics the students can accomplish two very important practical tasks:

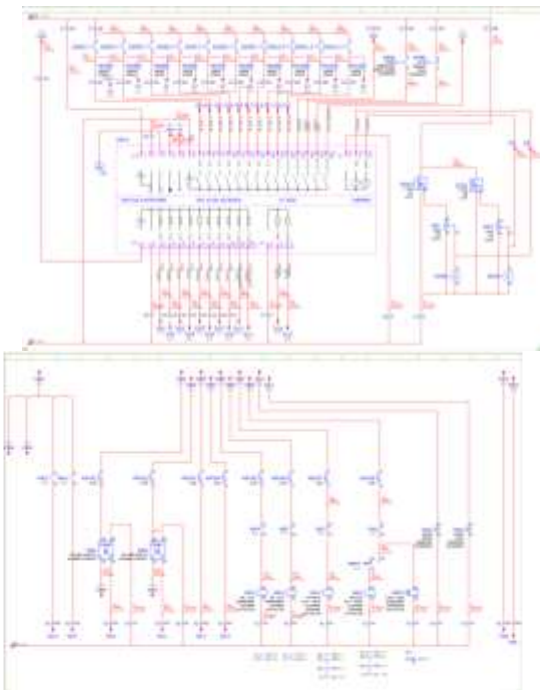

Figure 10. Input-output PLC electrical connections

- Identify the electrical elements that needs to be connected to both inputs and outputs of the PLC
- Identify the electrical connections between the PLC and the rest of the electrical elements: relays, lamps, buttons, etc.
- Understand how electrical schematics have to be made
- Failures can be induced as part of the educational process and students have to diagnose and fix them using the schematics
- Learn how to read a real electrical schematic

2.2. Basic automation experiments cabled logic based

Using the automation station (Figure 8) the implementation of cabled logic based applications is up to the user imagination. There are practical limitless possibilities of exercises that can be simulated.

For exemplification reasons, we chose to implement a conveyor application. Conveyors are used in industry on a very large scale to move products from one place to another. Many industries use conveyors to move a wide variety of products from one point to another in order to be sorted, processed, packed, etc.

A conveyor consists of an electric motor, start and stop buttons and limit starting and ending sensors, as indicated in Figure 11.

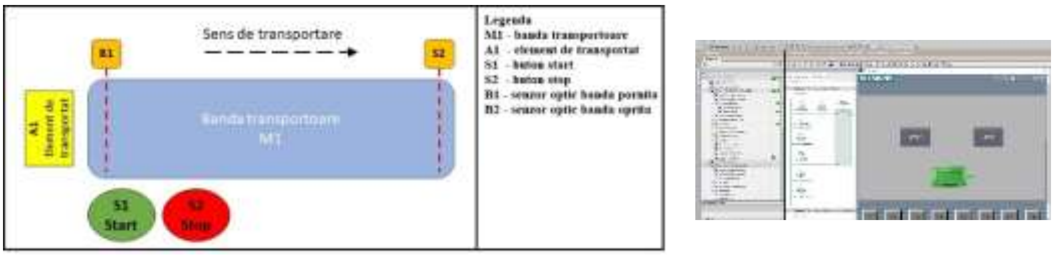

Figure 11. Conveyor application simulation

For this application, the process starts with the push of the S1-start button and stops with the push of S2-stop button. The S1 and S2 sensors send information to the PLC to be processed: to start and stop the moving process. In this application, the motor simply starts and stops according the commands received from the PLC. The most common configuration of the commanding schematics of the motor is either direct or wye-star connection (Beloiu, 2015a). The analysis of these schematics is not the purpose of this article.

2.3. Basic automation experiments programmed logic based

As far as programmed logic based application, we meant applications that use electronic converters to control the electric motor. In this case we focused on a Siemens PM240-2 FSA-IP20 U400V 0,75 kW converter. The programming environment Tia Portal allows the configuration of both control and power module of the converter.

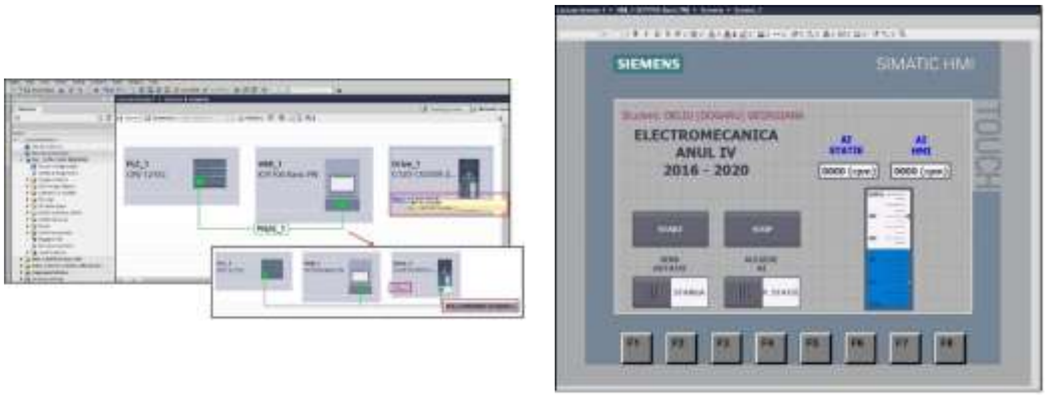

Figure 12. Basic programming logic based application

These converters are widely used in different industries. The configuration of the converter is not an easy task. Therefore, by using this platform and the associated programs, the students can get used with the implementation, configuration and monitoring complex applications.

2.4. Remote laboratory configuration

Another advantage of the developed platform is that in can be remotely accessed. The platform is connected to a regular computer via network port.

All the elements of the platform communicate between them using Profinet protocol. Thus, the platform contains a very simple industrial network switch. In this switch is connected the controlling and programming PC. A free port of the switch is connected to the Internet connection of the laboratory.

Using any kind of remote access application the main computer can be accessed from distance. During the setup of the platform we obtained very good results using Google application: Chrome Remote Desktop. In order to use this application, the user has to configure both the accessing PC as well as the accessed PC in the same network via a single google user account. By using this possibility, this complex laboratory can be done remotely, which proves to be very advantageous in the COVID-19 context.

At the same time, using this configuration, the physical resources can be shared with other laboratories. Thus, it is encouraged communication and collaboration between laboratories from different universities both national as international.

3. Conclusions

In this article, we presented the implementation of a S7-1200 Siemens PLC based industrial automation educational platfrom. The implementation of the station follows industrial specifications for these applications.

Industrial automation competencies were, are and will be required by many industries. Therefore, the University of Pitesti, as being concerned of the necessity, developed a practical laboratory application.

Using this implementation, we identified several advantages for the students that uses it:

- Learn about electrical connection of industrial equipment
- Reading and understanding an electrical schematic

- Programming PLCs
- Diagnosis of industrial electrical panel
- Profinet configuration

The platform can be used directly in the laboratory in classical application industrial automation classes. At the same time, due to the present day condition, the platform can be used remotely using remote access computer applications. Once the programming PC could be accessed remotely, the automation platform can be used too.

Acknowledgements

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Identification of cultural dimensions specific to pre-university education

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Abstract

This paper aims to present the importance of the existence of training management in pre-university education. The paper presents a case study based on the application and interpretation of a questionnaire that aims to establish the cultural dimensions of pre-university education.The paper aims to develop a material that can serve better information on the cultural dimensions of teachers, developing the possibility of developing training programs specific to Romanian education.

1. Motivation of research

Due to the evolution of technology in this knowledge-based society, the educational system has undergone several changes, implying the adaptation of teaching methods that train the higher-level thinking competencies in pupils to better prepare them for life and work in a global world. Teachers are motivated to actively participate in a training program if they are provided with the opportunity to define the problems they face in their schools, and thus express their professional development needs and participate in a program of training that is not imposed by others, and primarily responds to their needs. Therefore, the situations in their schools should be known in detail.

2. Organization of Research

Purposes:

-Characterization of school culture;

-Facilitating direct contact, relationships and communication beyond prejudices and stereotypes;

Research hypothesis

Provided that there are background elements (Communist or Western) incorporated into the school culture, some of them can be consciously assumed and explicitly formulated in the form of assertions about behavior and school events. School employees can easily identify the traits specific to their field of activity. They not only describe a state of fact, but they can also ***build*** up further events and school situations as well as explanations that serve as a base for actions and behaviors. [1.3]

3. Research Methodology

3.1 Methods used

In view of both the aspects studied in the theoretical part of the work and the desire to capture the objectives pursued, we decided on the following investigative methods:

1. **A questionnaire for teachers;**
2. **A case study;**

3.2 Specific objectives pursued:

a) Identifying the problems faced by teachers from the perspective of the people involved in the professional development process;
b) Establishing proper instructions for achieving effective activities carried out in the educational field;

c) Adapting trends from the globalizing school culture (Western models) **and/or** maintain elements of traditional school culture;

Target groups: teaching staff, management staff, guidance and control positions, non-didactic staff.

Time Period: January – May 2018

Elaboration of working instruments: When drafting the questionnaire, it was granted that the questions were clearly formulated to avoid confusion. We mention that the questions and requests in the questionnaire mainly pursued the identification of the cultural dimensions specific to pre-university education. The **questionnaire** is a document containing a set consisting of 30 questions and is anonymous, confidential, and requires about 10-15 minutes to complete. The respondents could only check one box out of the five options given. The technique used is the self-administration of the questionnaire. This choice took into account the benefits of:

• Low costs;• Removing disruptive influences of the operator;• Correct recording of replies;• The condition of anonymity;• Providing sufficient time for thinking;• Ensuring a large number of respondents

The answers were collected and transmitted after teachers had been informed about the purpose of the study and how the conclusions would be used. The transmission and the collection of the completed questionnaires were carried out primarily by electronic means. The respondents completed and sent the questionnaires to the e-mail address: and were inputted into the database. The questionnaire was formulated to support the achievement of some of the major research objectives:

• Identifying the cultural dimensions specific to the Romanian pre-university educational system.
• Collection of the teachers' valuable suggestions from the educational system.

4. Relevance and representativity

One of the main problems of investigation in the area of socio-human sciences is ensuring the representativity of respondents for the phenomena category. In the case of this study, it has been noted that the results and conclusions correctly outline the needs of most teachers who teach technical disciplines in pre-university education.

The following considerations are expected to be solid arguments in support of the relevance of the study conclusions. According to the current data collection methodology, a strict breakdown of the teaching staff in high-school, vocational and post-secondary education is difficult. This situation generates a number of obstacles in calculating indicators relating to human resources. However, the number of completed and transmitted questionnaires is large enough to be considered sufficient in the description of the investigated situations. The arguments are presented below.

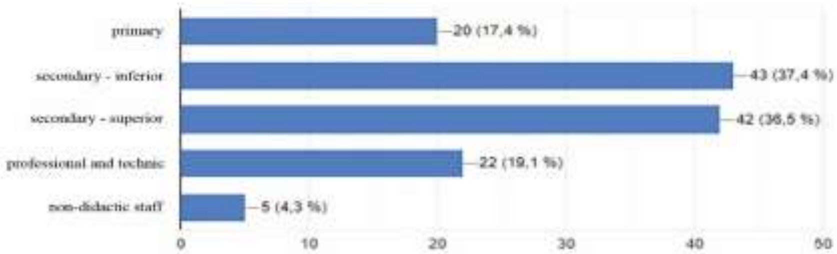
1. Respondents form a representative sample at a national level in relation to the distribution of development regions. Teachers from all development regions answered the questions in the questionnaire.

2. Numerically, the sample is representative. The indefinite area of statistical records on teachers is the numerical non-differentiation of teachers who teach in high school education in the technological field, as well as teachers who work in vocational and post-secondary education. Furthermore, based on the number of didactic frames contained in the official statistics of the INS, those who teach specialized disciplines cannot be numerically highlighted, and there is no way of knowing how many of them have their specialization acquired through Bachelor studies in the fields within the project. To estimate representativity, it was opted for the Taro Jamane expression. The 115 administered and processed questionnaires enclose the error limit to 3% in terms of an estimation based on the data set out above.We believe that the above arguments are sufficient to support the relevance of the study results and can ensure the representativity of the target group.

5. Results of the study

5.1. Description of the respondents' group

The study was conducted by collecting responses from the target group consisting of teachers working in pre-university education. The fields of specialization acquired through the Bachelor's degree are further displayed, but one should keep in mind that non-didactic staff also responded to the questionnaire. The questionnaire was a survey for identifying cultural dimensions in pre-university education (annex 2). It was applied to a sample of 115 respondents coming from pre-university education in Romania. As shown in the figure below, the distribution based on the level of studies was the following:



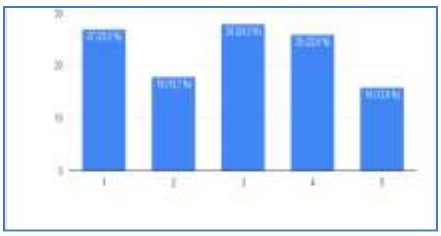
Graph 1 the distribution based on the level of studies

Then, they were detailed on the four cultural dimensions and their interpretation was performed. The results are presented in the form of graphs in which on the vertical axis we find the number of respondents, and on the horizontal axis **1** represents total disagreement, **2** partial disagreements, **3** do not know for sure, **4** partial agreement, **5** strong agreement.

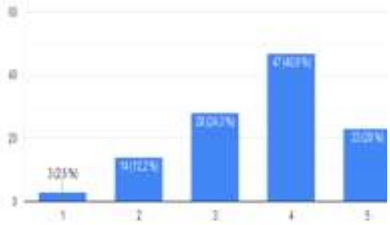
Figures that express the maximum number of answers to questions are relevant for research.

5.1.1 "Distance from power"

It measures the degree of inequality in society and exemplifies the differences in power. A large "distance from power" indicates the preponderence and preference for authoritarian styles. The opinions of the bosses should be listened to in a non-critical manner, only by virtue of the formal authority with which they are invested. It indicates the extent of which the staff with lower influence accepts that the power is unevenly distributed.



aph No. 2. The answers to question: felt uncomfortable or shy when ad to come in conflict with my boss."



Graph No. 3. The answers to question: "Generally, bosses take decisions based on the overall info they have and then communicate it to their employees. The way my bosses take their decisions seems to be adequate for the general educational system."

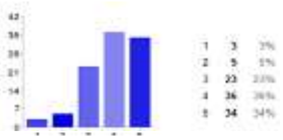
Graph No. 4 The answers to question: "For me, financial gains are more important than a good relationship with my boss."

Graph No. 5. The answers to question: "For me, it is more important to advance in my career than to have a quiet, peaceful life."

Graph No. 6. The answers to question: "For me, having a stimulating job is more important than having a stable one."

Graph No. 7. The answers to question: "The competence of a teacher must be appreciated more than their friendly attitude towards students."

Graph No. 8. The answers to question: "Performance and equity are more important than solidarity and equality."



Graph No. 9. The answers to question: "Scholar failure represents a negative for students."

This proven uncertainty about the distribution of power can also happen because of the various changes through which the Romanian education has gone in recent years. Teachers try to avoid conflicts with their bosses or are reluctant in this regard; the increased financial gains or position advancements are not a goal and are uncharacteristic for this profession, and most teachers prefer to keep their secure job. The competence of a teacher is the main focus, while the friendly attitude towards the pupils is not regarded as essential, and the achievements and performances are worth more than solidarity and equality. School failure is obviously seen as a disastrous result for pupils.

5.1.2 Communitarianism-Individualism

Regarding the second defining dimension, it refers to the consideration of the group's interests as opposed to the individual's. "People are educated to take care of themselves, or to be integrated with the group." [4] The size poles do not have a political cargo and do not necessarily characterize state regimes. The parameters for Communitarianism are those referring to: perfectionism, physical working conditions, use of qualifications for employment.The parameters for individualism are those that refer to: personal time, freedom, expression of options.

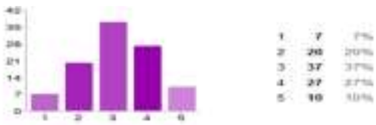
Graph No. 10. The answers to question: "For me, peace is more important than conflicts."

Graph No. 11. The answers to question: "Teachers are similar to philosophers who transmit their knowledge to pupils."

Graph No. 12. The answers to question: "Students must always be respectful towards the teachers and any informal language should be forbidden."

Graph No. 13. The answers to question : "Employees are used to do as they are told."

Graph No. 14. The answers to question: "My job allows me to have enough free time for my family and myself."



Graph No. 15. The answers to question: "During class, the majority of the educational initiatives must come from the teacher."

The maximum score is obtained for maintaining harmony and avoiding conflicts in school. The answers from graph no. 13 confirm the general consensus, that teachers are seen as "philosophers" who transmit their own knowledge to students, but students must also show their respect to them.These results from graph no. 15 underline a commonly known issue – because of the constant changes made in the recent years, the teachers from the Romanian educational system no longer have as much free time.Regarding how well the students can execute what they are told to do, and how much of the teachers' authority is present, uncertainty is observed. It can be concluded that, when talking about these two cultural dimensions, there is no clear inclination towards Communitarianism or Individualism. Communitarianism is perceived as a social harmony, a source of personal fulfillment, with Individualism being praised for its freedom of choice and promotion of expressivity.

5.1.3 Masculinity - Femininity

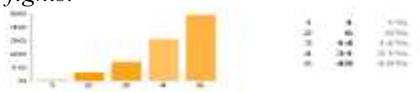
"Femininity" and "Masculinity" are two opposites maintained in balance, where masculinity represents "pragmatism and efficiency" and doesn't cultivate individualism. Therefore, we can conclude that this dimension relates to the social value given to arrogance, the valorization of the

[4] Hosfede, 1996,p.69

individual and the freedom of expression, which are considered to be specific to the male culture, or, otherwise, to the sensitivity, modesty, rooting of good relations, acceptance and obedience to the interests and values of the group, which are considered specific to female culture.Masculine culture means greater gains, personal recognition, advancement and competitiveness, while feminine culture means good relations with the bosses, cooperation, a personal sphere of work and workplace safety.

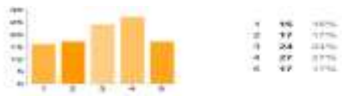
Graph No. 16. The answers to question: "Boys are not allowed to cry but are expected to fight, while girls are allowed to cry but can't ever have fights."

Graph No. 17. The answers to question: "If you ant a qualified person to perform at their best, provide them with clear and concise instructions."



Graph No. 18. The answers to question: "Many schools would function better if conflicts were reduced."

Graph No. 19. The answers to question: "My students prefer exact study methods and are interested in the accuracy of the results."



Graph No. 20 The answers to question: "The teacher is expected to be able to answer to any question."

Graph No. 21. The answers to question: "For me, having people recognize my worth and my competence is more important than working in a team that is based on cooperation."

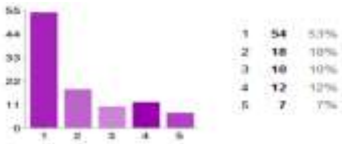
Graph No. 22. The answers to question 26: "I prefer not to change the school in which I teach very often."

Graph No. 23. The answers to question: "As a teacher or a principal, you must always be prepared to answer to both students and employees."

As seen in Graph No. 17, the most common answer is "strong agreement" when asked if the instructions should be clearly given when somebody wants to achieve something of quality. The data from Graph No. 18 suggests that people strongly agreed on the elimination of conflicts in school, as they recognize the existence of this phenomenon and its negative implications.The answers from graph no. 22 show that, for most respondents, stability is very important.They prefer steadiness and staying in the same school. They would also like the school programs not to change unless it is really necessary.

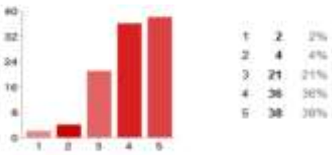
5.1.4 Avoidance of uncertainty

The fourth dimension indicates how alterity and differences are culturally accepted, and the extent to which the members of a culture feel threatened by uncertain situations. In the cultures with a high degree of uncertainty avoidance, the dominant idea is that "what is different is dangerous", while in the cultures with a small degree of uncertainty avoidance, then slogan becomes “what is different, is curious”, representing how these two polarizing cultures conceive truth and accept risk. Avoidance of uncertainty refers to the extent of which the members of a culture feel threatened by uncertain or unsecure situations. Among other symptoms, this feeling is expressed through high stress, anxiety and the need to know a set of predictable rules-written or unwritten. People that come from communities with a high degree of uncertainty avoidance are agitated, nervous and even aggressive. In cultures with lower degrees of uncertainty avoidance, people are looking for a solid structure in the organizations where they work in order to help them determine foreseeable events.

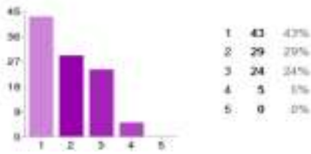


Graph No. 26. The answers to question: “I feel harassed at my workplace.”

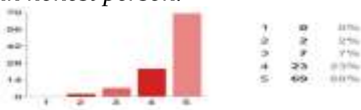
Graph No. 27. The answers to question: “The main purpose of education is to teach people how to behave.”



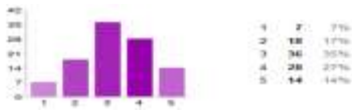
Graph No. 28. The answers to question: “Telling the truth directly is a trait of an honest person.”



Graph No. 29. The answers to question: “What is different is dangerous.”



Graph No. 30. The answers to question: “The main purpose of education is to teach people how to learn.”



Graph No. 31. The answers to question: “Generally, during class, I take most of the decisons and share them with my students.”

After these results, we can conclude that, in the opinions of teachers from pre-university education, the main purpose of education is not to teach you how to behave (this should be done by family and society), but to teach you how to learn. Truth is associated with honest people, and a high degree of avoidance of uncertainty leads to a need for governance and leadership with pre-established rules. Most people do not feel harassed at their workplace and the non-recognition of stress (which can be a negative result of over-working) expresses an attitude that assumes this state as being normal and natural.

6. Conclusions and proposals:

Teachers do not want to interfere with their bosses or are reluctant, they agree with the decisions their superiors take and show their care for the superiors. Teachers are seen as "wise mentors", students must respect them, and the competence of a teacher is valued more than their friendly attitude towards pupils. They tend to value performance and equity over solidarity and equality, and school failure is seen as a catastrophe for pupils. These opinions are, in my view, the result of the changes that have been made in the school system in the last few years. On the other hand, in terms of study practices about analytical programs or educational initiatives, there is a need for a fixed analytical program with accurate answers that can help the teachers in the process of training. The financial gains or advancements are not a real goal and are uncharacteristic for this profession, with people opting for a secure job instead.The parameters for individualism refer to personal time, freedom of choice and expression of options, and those for Communitarianism are referring to perfectionism, physical conditions of work and use of qualifications for employment. A teacher's inclination towards Communitarianism is expected.Essentially, it can be said that teachers have a tendency for stability and security.A specific preservationism is observed, with the freedom of expression being limited by what the bosses and the higher institutions consider to be the norm. There is also the sight of free-time getting lesser, which has been reported more and more by teachers in the recent years. Knowing the cultural dimensions of teachers from pre-university education, a more thorough analysis of teaching needs to be done, and training programs can be proposed, as they will have a positive impact on the educational system.

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S e c t i o n

SOFTWARE SOLUTIONS

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E-Work Platform for Automatic Creation and Intelligent Task Management in Collaborative Applications

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Abstract

This paper proposes a web application that provides adaptive pen management for the activities within a university or an IT company, in order to facilitate the work of employees and to improve the learning and internal development process. The proposed system is focused on planning, organization and, last but not least, on improving performance. Teamwork is an important factor for the success of any project, both in education and in industry. As a result, developing an efficient team is one of the essential responsibilities of an educational or administrative manager. Teamwork amplifies the results of each member so that the overall result is superior to the individual contributions made by each individual member.

Keywords: E-activities, E-work, Task Management, Business Intelligence, Educational Web Application, Automatic Platform, Collaborative Work Systems, Software Tools, Advanced Technologies, Online Management, Virtual Learning

1 Introduction

In order to promote high performance and effective teamwork it is necessary to clearly define the project objectives for all team members, to ensure that all members understand the assigned tasks and, last but not least, to encourage collaboration, which in the proposed application is represented by feedback. In order to be more efficient in terms of the activities required for a university or an IT company, it is necessary to automate these processes, so there is a need for a software system that includes all these activities, to help minimize the time required to carry out activities, as well as providing users with a friendly and easy-to-use interface.

Many existing platforms are mostly project management and not task management or employee performance improvement apps. The main objective of this paper is to provide a software solution in this regard for a university or an IT company. This solution aims to facilitate the work of employees through the functionalities it provides. Taking into account the observed, it is deduced the need to create a compact application that has functionalities for task management and performance improvement.

2 Task Management Tools

2.1 Electronic Task Management Tools

Using computing power, electronic task management tools offer increased flexibility and functionality. Digital or electronic task management tools are not limited to physical space, but allow users to add as much or as little information as they want. These usually include a wider range of features, such as tracking and analysis. Unlike manual ones, electronic task management tools can be accessed from a portable device (laptop/phone) (Riss et al, 2005).

Electronic systems typically come in a variety of forms, from basic spreadsheets to intensive load management applications. These tools can also be integrated with other work and organizational applications to build a complete task management solution.

2.2 Online Task Management Tools

They combine the depth of an e-task management tool with the unlimited expansion of the internet, resulting in online task management. These systems can be packaged as software or online applications, allowing individuals or teams to organize and monitor tasks from any location.

Online task management tools are especially useful for multi-tasking teams with different descriptions and priorities, in addition to helping collaborate with remote team members. They allow information, measurements, reports, analyzes or any other files to be easily accessed through an internet connection. Most online task management tools work in the Cloud, so users can allocate storage and store critical information without overloading their internal networks. Online task management tools also provide teams with better ways to communicate and collaborate. Using an internet connection, team members can receive status updates via email or discuss task details.

2.3 Benefits of Using Task Management Tools

Task management tools are an effective communication resource for teams, but can also be used by individuals. Task management tools help end users work smarter and be more successful.

When applied correctly, task management tools can:

- Manage and organize the workload – It is known what needs to be done and what elements have priority.
- Increase efficiency and productivity – Applying an optimal amount of resources and time for a task means reducing the time allocated in the business cycle.
- Improves the quality of work – Quality is never sacrificed for work speed when tasks are well organized and information is used correctly.
- Lead to good collaboration – Teams work best when there is a common understanding of what needs to be done and ideas can be easily communicated through a visual task management system.
- Reduce unnecessary information – It eliminates time spent analyzing what needs to be done next or redone after because tasks were not completed correctly on the first attempt.

2.4 Choosing Appropriate Task Management Tools

Selecting the task management tool that best suits your needs takes time and thought, not something that should be guessed or assumed. There are top tools to choose from: (Trello, 2020), (Tomuş, 2018), (Microsoft Project, 2020), (Basecamp, 2020), (Asana, 2020), (Hibernate, 2020), (H2 Database, 2020). Some of them are extremely basic, while others offer a wide range of functionalities, offering enough values to satisfy even the most numerous teams. It is essential to remember that the simplicity or complexity of an instrument is not the most important criterion. It is essential to balance the needs to help teams work better together, become more efficiently organized and stimulate production. Software dimensions that cross almost all task management product lines include task creation, task viewing, notifications, resource allocation, compatibility, configurability, scalability, and reporting.

3 Software Tools

A few years ago, Web technologies were used only by large companies, mainly due to the high costs of developing software licenses. Today, thanks to the growing development of Open Source solutions, anyone can afford to build web applications at no cost. The IT tools used in the development of the e-work platform are: Maven (Microsoft Project, 2020), Spring Boot, Thymeleaf (Spring Boot & Thymeleaf, 2020), Hibernate (Hibernate, 2020), Bootstrap (Bootstrap, 2020), Angular (Web Technologies, 2020), IntelliJ IDEA (IntelliJ JetBrains, 2010), MySQL workbench (Docker, 2020), and Visual Studio Code (Visual Studio Code, 2019).

4 System Functionalities

This section presents the features that underlie the implementation of the web application. The system is analyzed from several perspectives: a general analysis and an analysis that follows the functionality of each component were performed then a research on the technologies used for the development of the web application was performed. A task planning and management system was developed for work needs using Agile methods (Agile, 2020). The system is modeled on the basic functions of existing solutions (jira / trello / tfs / redmine).

4.1 Features

The objectives proposed for this project can be achieved by building a web application, which offers the possibility to manage projects, tasks, project and task assignment processes as well as the feedback process between employees, and for analysis on complex projects, reports can be viewed which help to draw conclusions and make appropriate decisions. The application main functionalities are: creating user accounts, project/sprint/task management, and sending feedback messages.

4.2 Description of the Main Application Components

The management of user accounts is done by filling in a form for creating the account. Relevant user data is completed by existing project administrators in the application. Users will be managed later by the application administrator.

The main objective of the application is the management of IT development projects of a university or company. This is done through a project creation and management interface. Each project is created by a project administrator, which will be the one who will later have the possibility to edit, delete and manage the details of that project. The project creation form contains some essential details: project name, description, and project administrator (project manager). After creating the project, it is displayed in a list of projects, where one can see all these details.

Another feature of the application is the sprint management part. Sprints are related to existing projects. A list of sprints where one can view the details is displayed. One can create new sprints or edit/delete existing ones. The implementation takes into account the fact that sprints must be validated so that no two sprints with overlapping data can be created. The task management functionalities can be viewed in a list, and their illustration is modeled on the Trello platform (Tasks Modeling, 2019), i.e., a graph can be seen in which they are arranged, depending on the progress, where the person to whom each task is assigned can be viewed. All tasks appear by default in a table, filtered by the desired sprint.

5 E-work Platform Implementation

5.1 The Database

The application must have a simple structure. After analyzing the needs and important functionalities of other applications, we designed the basic structure of the desired application, the implementation starting with the database structure. To implement the model, we need a relational database, in which to define the tables in which the necessary data are stored and the relationships between them. The database diagram is as follows:

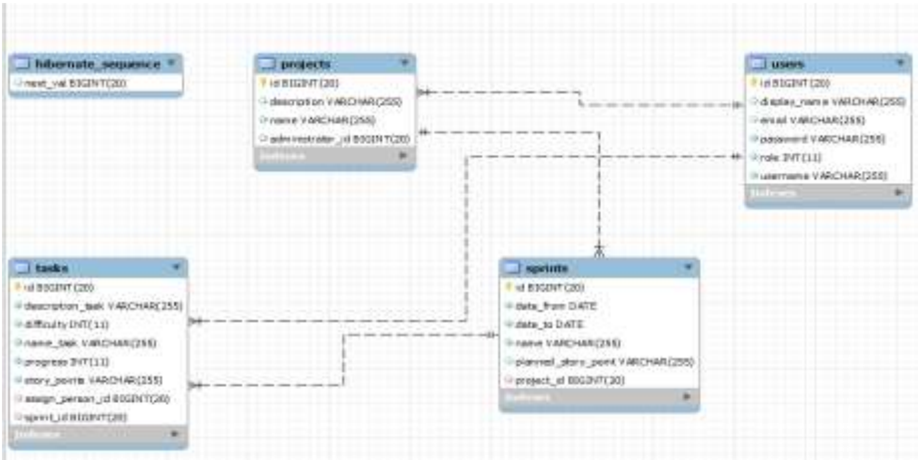

Figure 1. The database diagram

The implemented application allows accessing (creating, editing, listing, deleting) data from a simple database, but which contains most of the basic elements in object-relational correspondence (tables, associations). The database is implemented in MySQL, and the back-end part is implemented using the IntelliJ tool.

5.2 The Structure

The platform contains several components arranged in the 8 packages from Figure 2.

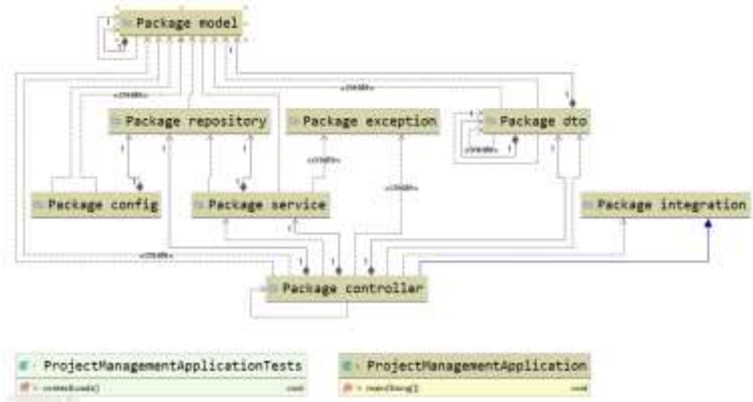

Figure 2. The structure of the designed e-work platform

6 Platform User Manual

The steps described below are consistent with planned use cases following the analysis of existing task management systems. The use cases are extended by exposing the appearance of each component of the system interface and explaining how to use them.

1.

2. *6.1 Registration and Login in the System*

The registration of users in the system is done by the administrator. Registered users will receive an email with account data, and using their username and password will be able to connect to the system. The tests showed that validations are needed for the user to observe which data must be filled in and which are needed to save in the database. These validations do not allow the user to enter incomplete information.

Figure 3. Fields validation to create an account

Figure 4. Fields validation to create a task

Figure 3 shows the validations performed on the fields required to create a new account, all data being required, and Figure 4 shows the validations performed on the fields intended for creating a task.

Figure 4 shows the web interface for registering a user, created as a form to enter data. After pressing the "Create" button, the data is saved in the database.

The "Roles" field displays the list of roles that the administrator can select. The Admin role refers to the project manager and is allowed to use several implemented functionalities. A user without the Admin role cannot delete or edit anything, he can only view or create new tasks or sprints. Users with the role of project admin have the responsibility to manage all data and to modify or delete where something is wrong.

Figure 5 shows the Login page, in which the user enters the username and password in the specific fields, and if they are valid then the user has access to the system. If the user does not fill in one of the two fields he will receive a warning message, as in Figure 6, that field is mandatory, and if he does not enter the authentication data correctly he will receive another error message warning that the data entered is wrong.

Figure 5. Login page

Figure 6. Validation of authentication data

6.2 Detailing the Functionalities

The key functionalities of the application are the visualization, modification and deletion of projects, sprints and tasks. Below are detailed some of the main features provided by the platform. After authentication, users with the role of Project Admin have the opportunity to create users and projects, being able to view the status of all projects, sprints and tasks. The platform has a menu on the left where each user can see his name and email address with which he is registered in the application.

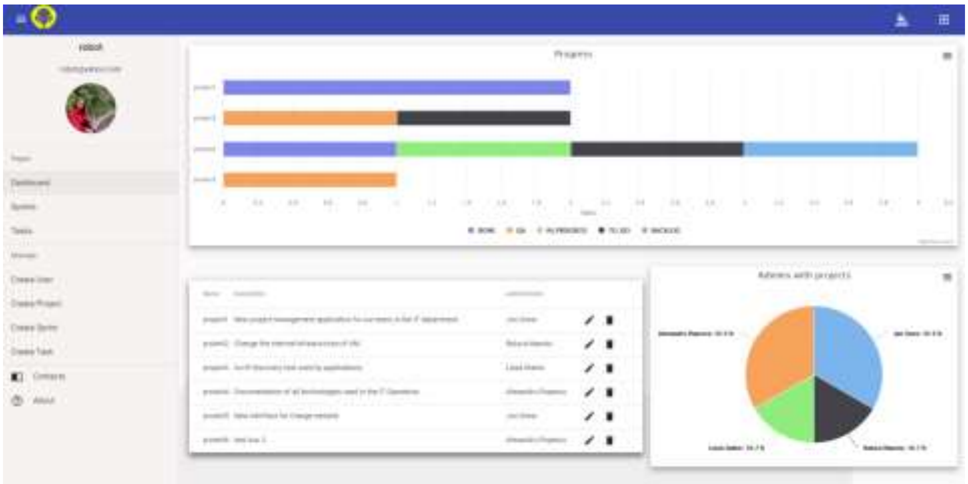

Figure 7. Main page - Dashboard

Figure 7 shows the main page, which shows the list of projects and graphs of interest. Next to each project there are two buttons, edit and delete. In order to have an overview of the statuses of each project, several graphs have been created in which you can see the evolution of the projects, what projects each of the admins has and the status of each one.

Add project and assign manager to project. This operation is performed by the user with the role of Admin. To add a new project the user fills in the required fields, which can be seen in Figure 8. To add a project admin, a manager for that project is selected from the list. After creating a project, it is saved in the database and displayed in the interface, where it can be edited later. The edit form looks the same as the creation form, but the existing data is already pre-filled in the fields and can be modified. When the update button is pressed, the new records are saved in the database under the same name and project ID, meaning the database is updated with new information.

Creating an individual to-do list. It is possible for each user to individually set a "to do list" for that day, as in the example in Figure 9.

Figure 8. Manager assignment

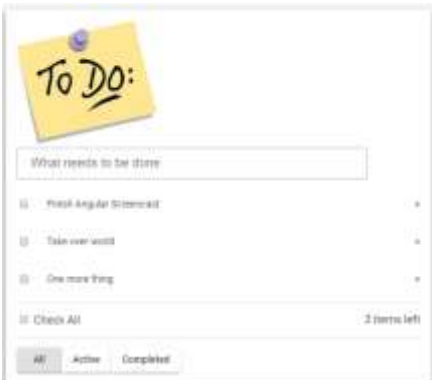

Figure 9. Individual to-do list

Feedback. So that users can easily communicate and send feedback on tasks assigned to other users, everyone has the option to send a message by selecting a task and then filling out the form in the interface. As can be seen in Figure 10, they fill in the address and a text message that will later be emailed to the user assigned that task.

Figure 10. Requests and feedback message changes

Contact Us. This is the page where the application admin can be contacted and where each user can send feedback to the application administrator in case of a malfunction or a problem of any kind. The form to be completed can be seen in Figure 11.

Project manager reports. These allow viewing of all project managers and their involvement in the assigned projects. As can be seen in Figure 12, everything can be easily viewed in the form of a PieChart diagram.

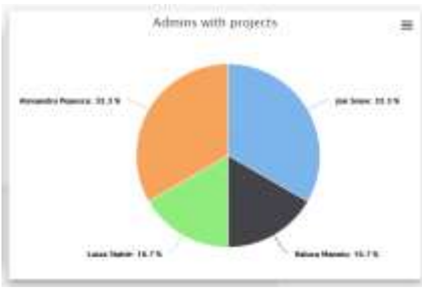

Figure 11. Reporting a problem Figure 12. Reporting administrator involvement

Request status report. It allows you to view the status of the requests and the number of requests with the users assigned to them. The report is in the form of a histogram, as shown in Figure 13. All graphs, tables and diagrams are types of histograms, being used to provide a visual way to analyze the information as suggestive as possible.

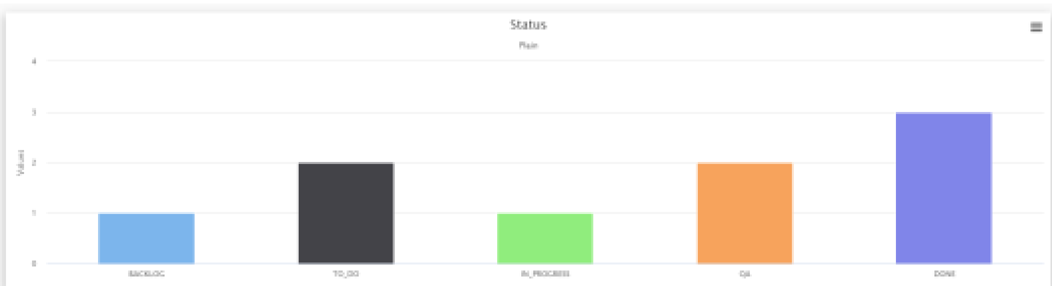

Figure 13. Request status report

Project progress reports. These allow viewing the progress of each project and the status of the assigned requests, also in the form of a histogram, as in Figure 14.

Figure 14. Project status report

7 Testing and Feedback

The testing on the Business Intelligence component was done on a group of 10 people who applied the principles of Agile and BI, and who previously used various platforms for software project management. Following the survey conducted by giving grades from 1 (bad) to 10 (very good), we obtained the results from Table 1. BI and Agile principles and concepts have been implemented and overall expectations were generally favorable.

Table 1. Users' feedback on the proposed e-work learning platform

No.	Aspect and visual impact	Easy to use	BI integration	Expectations
1	7	5	7	10
2	8	7	6	8
3	9	9	8	9
4	9	8	7	8
5	8	6	5	10
6	8	7	9	7
7	8	8	8	9
8	9	6	7	8
9	9	8	8	9
10	9	9	7	9
Av.	8.4	7.4	7.2	8.7

8 Conclusions

The proposed e-work platform achieved its proposed objective, successfully managing the activities within an educational or economic organization. Regarding the analysis of the projects, the platform allows to view reports that help to draw conclusions and make appropriate decisions. The purpose of feedback is to improve employee performance and optimize the operation of relationships between them.

The architecture of the proposed platform is designed to provide users with an intuitive, friendly and easy-to-learn graphical interface, by building it with the help of advanced IT technologies and tools that can meet the desired development requirements. The tools are simple to use, open source, and with well-designed documentation. Task management has a huge impact on the way projects are carried out within a university or company and knowing that IT systems of this type are frequently subject to extensions, the proposed platform is designed to allow for further developments. The platform is designed to give users the opportunity to learn to do their job easier and to obtain better performance in team work. The platform is easy to expand, thanks to the organization on layers, the addition of new components being facilitated by the implemented design, and users who tested the application were very pleased with this platform.

Today any change, regardless of whether it comes from the educational, economic, social or political environment, is acutely felt by most people. This has led to situations where decisions can no longer be made empirically. Therefore, this paper includes how to implement the concepts of a Business Intelligence system to meet these important conditions. Thus, the implemented system contributes significantly to avoiding decision-making blockages that may occur within an educational or business organization.

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Learning Tool for Applying Static Vulnerability Analysis of Office Documents Based On Automatically Extracted Information from the Associated Macro Code

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Abstract

The idea from which this paper started is the interest for the learning part of the security elements of Office documents, but also the one related to the main vectors of infection of ordinary users. This field is constantly evolving and therefore learning to use any automated tool can be useful for both users and those who work actively with malware components to make their work easier. The notion of machine learning implies the need for minimal human interaction in order to achieve certain objectives presented from the beginning. The paper aims to present the steps taken in implementing and learning the application of an automatic tool for analyzing Office documents based on information automatically extracted from the macro code associated with them. To complete the implementation of this tool, notions of Machine Learning were used, but the learning process involves the accumulation of experience in malware analysis, notions of programming in the Python language and much other IT knowledge.

Keywords: Static Vulnerabilities, Cyber-attack, Educational Application, Automatic Platform, Security Systems, Advanced Technologies, Machine Learning, Decision

1 Introduction

Compound File Binary Format (CFBF) files are those that are based on storing multiple file structures (streams) inside a single parent file, as is the case with Office files. Normally, a regular user recognizes the type of files by their extension, but a common way of infecting it is to change the file extension in order to fool the user and influence him to open a malicious file faster. Many documents come in the form of images, although they are not basically images, but executable files or malicious documents.

This is possible due to the fact that the operating system runs the files in different programs, depending on the file signature or its "magic number", after which any type of file is recognized by the computer. This field is usually represented by the first bits of the file that are used by the operating system to know with which program to open a file.

This paper focuses primarily on specific Microsoft Office formats for Word and Excel. Macro code is essentially a piece of code written in the Visual Basic for Application (VBA) programming language. Its original purpose was to help automate certain tasks in a document, such as opening a new sheet in Excel, while recalculating a formula.

2 Malware and Solutions

2.1 The Concept of Malware

The term *malware* comes from the combination of the words malicious and software. These two words mean malicious software, and by definition malware is a type of software program designed to damage or infiltrate a computer, and/or damage or infiltrate an entire computer network without the owner's consent. Malware files are classified according to their purpose and how they are used to achieve this purpose (Malware1, 2020). There are many types of malware, but some of them are considered *grayware*, i.e., applications or files that are not considered exactly malware, but which can have quite pronounced malicious influences (Malware1, 2020).

2.2 Ways of Malware Spreading and Methods of Prevention

When it comes to prevention, a common idea, regardless of the type of malware targeted, is very important that any device has an antivirus installed. This action must be done right from the first use, to run on the device a software program specialized in anti-malware protection because it can be infected from the first browsing on the internet or when running a program. This software should always be used to scan any email, disk, or new file before saving and running it on the device.

Another way to protect the computer from malware attacks is to prevent the user from using an account with administrator privileges for daily use because the malware files work with the account privileges from which they are installed. There are malware that can gain this privilege regardless of the account it was run with, but most fail to do so.

One thing that facilitates the spread of malware is that most users prefer to use pirated versions of applications and even operating systems. Unfortunately, they do not come with various types of security exploits and they do not have all the prevention methods that the original software has, thus making both infection and spread much more likely.

Depending on how certain types of malware files spread and act, prevention can be done in a more specific way for each (Malware1, 2020).

Any device infected with malware will give various signs that may vary depending on different aspects such as the type of virus, the specifications of the device and how to use it. Some types of malware, such as *ransomware*, for example, are highly visible and even aim to make the infection obvious. These usually come with a prompt notifying the user that they have been infected and the steps they need to follow to receive the decryption key needed to recover the files.

Other types of malware, on the other hand, aim to spread as quickly and widely as possible, so those who design them want them to run in the most invisible way possible. At the base of this desire is both the idea of spreading, because practically every device is like a node of the network responsible for spreading the file, but also for reasons to combat it.

Once they find out about the existence of a new type of malware, it doesn't take long for specialized institutions and companies to find ways to remove and publicly expose the file. Regardless of the structure of the malware file and the purpose of the attacker, signs of the fact that a device has been infected will always exist. Some are obvious, and others will be noticed only by those who have in-depth knowledge of the systems (Malware1, 2020). The impact that viruses and implicitly cyber-attacks have on both ordinary people and companies is much greater than anyone can imagine (Malware2, 2020).

3 The Structure of Office Documents and the Magic Number

Compound File Binary Format (CFBF) files are those that rely on storing multiple file structures / streams within a single parent file, as is the case with Office files. There are mainly two major types of file structures. Office: with binary file structure and archive structure containing XML documents (OOXML, 2020).

Normally, a regular user recognizes the type of files by their extension, but a common way of infecting it is to change the file extension in order to fool the user and influence him to open a malicious file faster. Many documents come in the form of images, although they are not exactly images, but executable files or malicious documents. This is possible due to the fact that the operating system runs the files in different programs, depending on the signature of the file or its "magic number" (Magic Number, 2020).

Any type of file is recognized by the computer by the signature of the file or the magic number. This field is usually represented by the first bits of the file and is used by the operating system to know with which program to open a file. In this paper we will focus mainly on specific Office formats for Word and Excel.

4 The Macro Code and Its Malware Component

Malware found multiple vulnerabilities, which they exploited. The malicious behavior comes from the fact that the existing activity in the mail servers has increased exponentially. Another very serious problem was that before the macros in a document were run automatically, so that users were infected by simply opening the document. This changed with the introduction of the enable/disable property. This means that macros (Macro, 2020) are disabled by default, and to activate them the user must follow an optional step to request this. Through VBA code, a document can interact with the entire system, having access to the console, PowerShell, internet connection, DLL upload, etc., so accessing system functions, all through a few lines of code. Because such code is very easy to understand and therefore detectable by AV companies, malware developers have resorted to other methods in order to make the code more complex and difficult to understand. One of these methods is obfuscation. Obfuscation is the deliberate act of making it difficult to understand a code, by replacing it with confusing and ambiguous language, without changing its functionality.

There are several types of obfuscation:

- By changing the names of functions and variables with random strings. This type of obfuscation is mainly aimed at fooling AV programs that have some generic rules for searching for word combinations such as: PowerShell, HTTP and download, for example, blocking the running of that file.
- By separating commands/words and linking them by variable names and join operators.
- By using coding algorithms or operations such as replace or shift.

5 The Classification Algorithms

The term *machine learning* is very well known and common, especially in recent years. Machine learning is a branch of artificial intelligence that aims to learn computers, based on various mathematical calculations, to draw certain conclusions automatically, without human influence.

In this paper, the results of four different algorithms were compared:

- NB (Naive Bayes) is a family of probabilistic classifiers based on the well-known Bayes theorem, which determines the probability of belonging of events and objects to a particular class.
- SVM (Support Vector Machine) builds a spatial representation of the examples from the training phase and tries to delimit them on classes from a spatial point of view with a demarcation area, as large as possible, in order to make the classification as obvious and easy as possible.
- MLP (Multilayer Perceptron) is part of artificial neural networks and uses the backpropagation algorithm. It consists of three layers of neurons – the input, the output and the hidden layer, placed between the input and output.
- RF (Random Forest) is an algorithm based on decision trees formed by several branches of type (if ... then ...), whose representation suggests the tree branches.

6 The Implementation Based On Automatic Macro Code Extracted Information

The final result of this paper is a learning tool implemented in the Python programming language, based on Spyder, an open source cross-platform IDE, implemented specifically for the

Python programming language, which has at the entry an Office document and at the exit a malware/clean verdict obtained following the various automatic classifications made by it.

6.1 Choice of the Document Subject to Classification

The document for which the classification is to be made must meet several important criteria for the final result to be correct:

- It must contain undamaged VBA macro code;
- It must not contain characters other than UNICODE (Unicode, 2020) because various functions are used inside the code that cannot interpret characters.

6.2 Extracting the Macro Code

A lot of tools have been implemented to extract the macro code. Among the best known are Office Mal Scanner (Reconstructer, 2020) and OleDump (OleDump, 2020) . Both are written in Python, which is the main reason why this programming language was chosen for the development of this static analysis tool. OleDump is a tool that analyzes CFBF files, and from the result of running this tool on an XLS file, depending on the parameters used, the VBA code can be extracted for analysis.

This tool is most used for automatic analysis of Office files. For this reason, a special Python package with its functionalities, called *oletools* (OleTools, 2020), has been implemented. The function used to extract the macro code calls two functions from the *oletools* package:

- VBA_Parser – it is used to parse the document from the disc. Before that, it can be seen that it was read with the *open()* function using the 'rb' – read bytes parameter.
- Extract_macros – it returns the VBA macro code as text, then written inside a text file to be further processed.

The exact reason why all macro codes extracted from the document are transformed into text files is mainly about security. Because it works with malicious code, it is very possible that if the .vba extension is kept, at the simple click of a button it will be executed and the computer will be infected.

6.3 Preprocessing the Macro Code

There are several steps in which the macro code is processed, including the classification algorithms in the following steps. At this stage, however, preprocessing refers to the fact that if several different files with VBA code are extracted from a document, they will be concatenated into one and it will be further introduced in the classification algorithms, depending on its characteristics. Another preprocessing step is the immediate change of the file extension extracted from .vba to .txt, both for security criteria (see above), but also to be easily read by the tool using the *read()* function.

6.4 The Algorithm for Obfuscated/Non-obfuscated Classification

The dataset was retrieved from (Virustotal, 2020), using the following search criteria:

- For the obfuscated documents, the documents received from 2018 until now were chosen, which contain the tags "macros" and "obfuscated". To ensure the selection of really obfuscated files, the criterion "detection no." > 20 has been added.
- For non-obfuscated documents, documents received in the same period were chosen, which contain the tag "macros" and do not contain the tag "obfuscated". To ensure the selection of truly non-obfuscated files, "detection no." was added.

Following these queries, files from Table 1 were selected.

Table 1. The data set for the obfuscated/non-obfuscated classification algorithm

	Nr. of files	Nr. of macros	Nr. of unique macros	Dimension
Obfuscated	500	865	341	13 KB – 1.52 MB
Non-obfuscated	300	685	349	50 KB – 3.5 MB

The VBA macro code is based on a code in a programming language so, in general, it is represented by text. Mainly, classification algorithms work with numerical values. For this reason, a way must be found to convert the text into numbers. To do this, some distinctive features were extracted between the obfuscated and the non-obscured code (Sangwoo et al, 2020):

- Text entropy, a very useful criterion for detecting random obfuscation. In the case of VBA macro code analysis, the analyzed events are actually the appearance of each character in the code text. The entropy values are in the range [0.8]. The higher the entropy, the more likely the file is to be obfuscated (non-obfuscated files generally have entropy values between 4.5 and 5). (Entropy, 2020)
- Average number of words per line – a code with more than 100 characters per single line is often obfuscated (Obfuscation, 2020).
- The average number of characters in each word – when there are very long words in the code, they are either coded portions of code or the code is obfuscated by the technique of renaming variables or functions.
- Total code length – when the code hides many features or other malicious portions of code it may be larger than others.
- Number of special characters – punctuation marks, numbers or symbols.
- Number of functions used in obfuscation techniques for text manipulation.
- Number of arithmetic functions – widely used in various types of obfuscation.
- Number of character or string-level conversion functions – used for different types of encoding, encryption or obfuscation.

The basic idea behind the implementation of the classification algorithm (Sangwoo et al, 2020) is to choose two sets of features extracted from the VBA macro code of an Office document database divided into two classes: obfuscated/non-obfuscated in order to implement automatic algorithms of machine learning.

Based on this data set, the four algorithms mentioned above were tested to make a comparison in terms of classification accuracy on the selected database. The results obtained are presented in Table 2.

Table 2. Accuracy values obtained by classification algorithms

Algorithm	Accuracy
Naive Bayes	73.39%
SVM	43.84%
MLP	73.89%
RF	98.52%

It is easy to see that the RF algorithm had the best results. For this reason, this will be the algorithm used in the classification, the accuracy of over 98% being a very satisfactory one. The implementation of the obfuscated/non-obfuscated classification algorithm contains two distinct parts, represented by the two main parts, the training part and the prediction part. These are very similar, but there are some minor differences. The criteria for extracting the feature vector are obviously identical. The only difference is that there is no second associated label vector, because the purpose of the classification step is to classify the file in one of the two categories obfuscated/non-obfuscated.

6.5 The Algorithm for Malware/Clean Classification

In this case, unlike the case of obfuscated files, in which we concluded quite directly that they are malicious, now we can no longer do so. There are malware files that are not obfuscated and use various other techniques to trick the user or antivirus software. These are as dangerous as the obfuscated ones, so they must receive the same attention as the others. In the same category are the clean files, which are written clearly for the obvious purpose of automating tasks or completing certain activities (extracts, reports, etc.).

The dataset was retrieved from (Virustotal, 2020), using the following search criteria:

- In order to find the clean documents, the time interval from 2018 until now and the “macro” tag were chosen. To make sure the files are really clean the criterion "detection no." > 2 was added.
- To find the malicious documents the same period and the same “macro” tag were chosen. To make sure that the files are really malware, "detection no." > 25 was added.

The Bag of Words technique (Bag of Words1, 2020), (Bag of Words2, 2020) fits very well the classification of non-obfuscated documents because they, being written clearly, the words in the macro have exactly the meaning they have in terms of functionality. This may not be the case with obfuscated files, where function names are hidden under different names just to camouflage their functionality and therefore their malicious intentions.

The Bag of Words technique can be used in a lot of other circumstances, which is why there are a multitude of libraries that have implemented this functionality in a single line of code – such as the *sklearn* library – CountVectorizer. This technique aims to turn words into numbers, so that they can then be used by different classification algorithms.

The steps of the Bag of Words algorithm are:

Step 1 – Divide each sentence into words;

Step 2 – Create a dictionary with the frequency of occurrence of each word.

Step 3 – Create the model: it represents the implementation of a matrix that has as columns the words chosen in the previous step, after filtering the words used for analysis (using the *regular expression* function, keeping only letters in the code and turning them all into lowercase letters), and as lines each sentence.

Since we obtained very good results with the classification algorithms in the previous section, we decided to try for the first time the same ones, and if the results are not satisfactory, to try others. From our point of view, an accuracy of 90% or more is desirable.

Table 3. The values of the accuracy obtained by each classification algorithm

Algorithm	**Accuracy**
Naïve Bayes	83.14 %
SVM	85.39 %
Linear SVM	85.39 %
MLP	91.01 %

RF	87.64 %

As can be seen, in this situation there are not such big differences when comparing the values of the obtained accuracy, but the best value was obtained using MLP, which fulfills the criterion initially proposed. In conclusion, MLP will be used for the final malware/clean decision algorithm. The feature analysis part is, in short, a comparison between the features extracted in the training phase and those existing in the given file as input.

To make this comparison, the aforementioned CountVectorizer function was also used, but for the vocabulary parameter the already extracted vocabulary was given as a reference. Based on this step, the algorithm classifies the input file into one of the two clean/malware classes.

If, after classification, the document is considered obfuscated, it is automatically concluded that it is also malware. Obfuscation is also used in clean applications because those who implement applications want to hide the source code to avoid copying it or even using it for malicious purposes. This is mainly the case with PE applications, but in the case of documents, applications that can be implemented using VBA code cannot issue copyright claims because their functionalities cannot be compared to those of an executable. In the case of Office documents, the desire to obfuscate hides malicious intentions in 99% of cases.

8 Conclusions

The paper presents the steps taken to implement a tool for learning to apply static analysis of the vulnerability of Office documents based on information automatically extracted from the associated macro code. In most cases, the obfuscated code is also malicious, and the experimental results of the paper prove the detection efficiency by applying the detection and protection methods proposed in this paper.

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Serious games for modelling sustainability skills and competencies

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Abstract

In the last decade, sustainability skills have become critical for preparing the future workforce and efforts have been made to implement sustainability principles across various disciples. In this context, serious games have been promoted as a viable approach that can be used to reshape the learning environments and facilitate the development of sustainability skills and competencies. Serious games are known to make learning interesting and fun, and they have been employed to create engaging spaces for learning, spaces where students have more freedom and take more responsibility. This paper seeks to explore how serious games can foster the acquisition of key sustainability skills and competencies, frequently needed on the labour market. Three games have been analysed starting from their specificity such as the narrative and educational context, the target group, the game mechanics used, up to the identification of sustainability skills and competencies that can be acquired during the game play and the pedagogical methodologies used to acquire certain skills and competencies.

Keywords: Serious games, Skills, Competencies, Sustainability education;

1 Introduction

The concept of sustainability in education implies developing a series of skills which will allow students to face the future challenges that the current globalized labour market, will demand (Picatoste, Pérez-Ortiz & Ruesga-Benito, 2018). Education for sustainability seeks to empower people of all ages to assume responsibility for creating a sustainable future (UNESCO). The current learning environments need a new approach on what constitutes effectiveness and efficiency in learning and serious games support players to get a more motivating and efficient learning experience, delivering multimodal information and disseminating knowledge in a socially complex environment (Gee, 2009). Serious games might be included in every educational environment, as a way to engage students in the learning process and fostering transferable skills and competencies (Gee, 2008; Squire, 2011). Beside the motivational and entertaining aspects, serious games involve factors, such as rules, interaction, and instructional planning, while making learning fun and facilitating the acquisition of sustainability skills and competences that are harder to acquire in a traditional learning environment. Facilitating the creation of rich environments for learning and the acquisition of in-demand sustainability skills, serious games should be incorporated into one of the key learning areas, as either a teaching or learning tool, for assessment or as a learning motivator, to encourage:

- ***Discipline-specific knowledge*** (Koehler 2015) – serious games are designed to teach relevant concepts within a discipline and through the narratives, game mechanics and challenges, the player can extract discipline-specific content;
- ***Creation of sustainable solutions for real problems*** – serious games allow players to experience unfamiliar environments, where they have to think strategically and to make

sustainable decisions. Serious games are developed based on a trial and error approach, allowing players to try different paths to solve a problem;

- ***Active participation*** – serious games facilitate the active participation of the player, through the challenges provided, offering opportunity for practice and repetition;
- ***Behavioural change*** - serious games motivate student to play using challenges, actions or rewards, facilitating behavioural change through experience and engagement;

Starting from the definition of sustainability skills defined in (DT4S Project, 2020), three serious games have been analysed in Chapter 2 to evaluate their capacity to support the development of sustainability skills.

2 Skills and competencies by means of educational games

Games are environments designed for players to experience interactively through play (Stapleton, 2004) and specifically, educational games combine the educational message with the entertaining element, to facilitate behaviour changing or the adoption of new skills or competencies. To create successful learning activities the learning goals must be carefully defined and connected with well-known taxonomies (Gunter, Kenny & Vic, 2006). A frequently used model to define user-centred learning outcomes is the Bloom's Taxonomy of Cognitive Skills, revised (Krathwohl, 2002). The revised model is based on six levels of learning, named as Goals. We linked these goals to different games and game mechanics, to identify the sustainable skills needed (Table 1).

Table 2. Bloom's Goals related to sustainability skills and serious games

Goals	Sustainability skills	Games & Games Mechanics
Remember	Recognize; Recall of information; Observe; Define; Memorize;	**Games:** Quiz; Puzzle; Logic **Mechanics:** Identify; Check; Collect; Match; Drag and drop
Understand	Understand; Interpret; Classify; Summarize; Compare; Explain;	**Games:** Quiz; Puzzle; Logic Adventure; Storytelling; Simulation **Mechanics:** Identify; Check; Collect; Match; Trigger; Moving actions; Listen; Path follow;
Apply	Transferring knowledge to the real world; Problem solving; Demonstrate; Research; Implement an effective solution	**Games:** Logic; Strategy; Simulation; **Mechanics:** Identify; Check; Collect; Match; Trigger; Moving actions; Path follow; Capture/Eliminate; Resource management;
Analyze	Critical thinking; Describe; Categorize, Organize; Prioritize;	**Games:** Quiz; Puzzle; Logic; Strategy; Simulation **Mechanics:** Identify; Check; Collect; Match; Path follow
Evaluate	Evaluate potential solutions; Validate solutions;	**Games:** Quiz; Puzzle; Logic; Adventure/ Exploration; Storytelling; Strategy; Simulation; RPG; **Mechanics:** Identify; Check; Collect; Match; Trigger; Moving actions; Listen; Path follow; Capture/Eliminate; Resource management;
Create	Integrate and synthesize of information;	**Games:** Strategy; Simulation **Mechanics:** Identify; Check; Collect; Match;

	Generate new ideas;	Path follow; Capture/Eliminate; Resource management;

Starting from the structure offered by this model, three educational games have been analysed: *Lure of the Labyrinth*, *Eye of the Donkey* and *Generic Quiz* (customizable). We divided the analysis in two parts, one for the structure of the game and the other one for identifying the skills and competencies that can be obtained during the play and the pedagogical methodologies that can be used to develop the listed skills and competencies.

2.1 Game Structure

Lure of the Labyrinth

Lure of the Labyrinth, a game developed within the Learning Games to Go (LG2G) project, funded by a Star Schools grant from the U.S. Department of Education, is a math-based game, where students are asked to solve math problems to complete the tasks in the game. The game is a story-driven approach and can be used as a full game, where the students must solve the challenges, following the storytelling, or as standalone activities, accessing only the puzzles and not following the story on the game.

Table 3. Lure of the Labyrinth game structure

Target Group	6^{th} – 8^{th} grade
Type of Game	Logic
Purpose	The game is structured in three sections, named "wings", related to different mathematics subjects which are part of a typical curriculum  **Figure 13. Lure of the Labyrinth quests**
Narrative flow	Your beloved pet is missing and your mission is to find it. Before you know it, you are teleported to a world where your only friend is a mysterious girl with wings. She says there are others ... others, what? Other pets? Well, there sure are plenty of monsters. They are all over the place, stinking up the joint and forcing you to do crazy jobs.  **Figure 14. Lure of the Labyrinth storytelling**
Game mechanics	Avatar creation; Click; Select; Drag and drop; Type; Path follow

Rewards	Coins; Pets
Technical details	Web browser; Flash Player plugin; Internet connection
Assessment	Teacher can track the progress of each player in many aspects of their work and performance
Customizable	No

Eye of the Donkey

Eye of the Donkey, created by Nobel Media AB based on the 1993 Nobel Prize in Chemistry, awarded for the invention of PCR, is a knowledge testing quiz game in the field of the forensic science, where the player must use the basic principles of the PCR methods to copy a DNA, in order to collect enough material to use as evidence in a crime. Same as the previous game, the Eye of the Donkey game is also based on a story-driven approach, but the player is not allowed to play the challenges independently and must follow the narrative part, to advance in the game.

Table 4. Eye of the Donkey structure

Target Group	$11^{th} – 12^{th}$ grade; University
Type of Game	Quiz; Hidden object; Simulation
Purpose	The game is a short one and is structured in two parts: the first part presents information about PCR, DNA and forensic science in a quiz type game and the second part, based on hidden object quests and a simulation, regarding the PCR method.  Figure 15. Eye of the Donkey quests
Narrative flow	A crime took place in a Museum. Unware of it, you attend the last lecture at a Forensic Lab course. After the lecture, you leave the auditorium and a car stops next to you. You are asked to help the Forensic Lab to collect evidences to solve the crime.  Figure 16. Eye of the Donkey storytelling
Game mechanics	Click; Select; Drag and drop; Type;
Rewards	-
Technical details	Web browser; Flash Player plugin; Internet connection;

Assessment	No
Customizable	No

Generic Quiz

Generic quiz, developed within the BEACONING project, funded by the European Union, through the Horizon 2020, is a knowledge testing quiz game. In the game, the answers can be formed by choosing the correct answer or by drag and drop actions of the correct answers in the blank spaces, where the educational content must be defined by the teacher. The game it is not based on a story-driven approach but the BEACONING platform offers the possibility to create a story-driven lesson plan, by using one of the game plots available. For the purpose of this analysis, we created a gamified lesson plan using a game plot and the mini game subjects are geography and natural hazards.

Table 5. Generic Quiz structure

Target Group	$5^{th} – 8^{th}$ grade
Type of Game	Quiz
Purpose	The game flow takes place during 6 narrative scenes, each scene having attached a quiz-type mini game. Notions regarding natural hazards are tested.  **Figure 17. Generic Quiz quests**
Narrative flow	The game plot presents the story of Professor Tibia who was once a human named Tobias. He started an expedition on a different planet, where he meet a strange squid creature. This creature was chased by an unidentified object which wanted his translator device. Instead of attacking the creature, the unidentified object attacked Tobias and as a result, he woke only with his bones.  **Figure 18. Generic Quiz storytelling**
Game mechanics	Click; Drag and drop; Type
Rewards	-
Technical details	Web browser; Flash Player plugin; Internet connection;
Assessment	The game provides at the end of each session a summary of the

	results for each question. The teacher can track the progress of the students.
Customizable	Yes

2.2 Skills and competencies

Lure of the Labyrinth

The game is based on fun challenges divided in puzzles, which become increasingly complex and difficult to solve, as the player progresses in the game. The challenges are not really well explained and the player must experiment different moves to understand what is going on. This can be useful to encourage learning by trial and error and to obtain skills such analytical thinking skills, judgment, problem solving. According the Bloom's taxonomy, the following skills and competencies can be acquired during the game play.

Table 6. Sustainability cognitive skills from Lure of the Labyrinth game

<table>
<tr><th>Sustainability cognitive skills</th><th>Methodologies</th></tr>
<tr><td>Remember: Recall of information; Observe; Define; Memorize;</td><td rowspan="7">Project/Problem -Based Learning; Cooperative Learning; Gamification; Design Thinking; Competency-Based Learning</td></tr>
<tr><td>Understand: Compare; Explain;</td></tr>
<tr><td>Apply: Problem solving; Implement an effective solution</td></tr>
<tr><td>Analyze: Critical thinking; Organize; Prioritize;</td></tr>
<tr><td>Evaluate: Evaluate potential solutions;</td></tr>
<tr><td>Create: Innovative thinking; Integrate and synthesize of information;</td></tr>
<tr><td>Other skills: Digital literacy; Information and media literacy; Independent and autonomous learning; Creativity; Storytelling skills;</td></tr>
</table>

Eye of the Donkey

The game is divided in two parts, one presenting information about PCR and providing two-question quizzes and the second part is represented by a virtual lab simulation of PCR. The game provides clear instruction of a three step PCR method, but it does not give clues about the order of the steps to be followed, thus requiring the player having to use the information obtained during the classroom, in this situation. This interpretation of the game is useful for developing skills and competencies, which can be subsequently applied in a specific setting.

Table 7. Sustainability cognitive skills from Eye of the Donkey game

<table>
<tr><th>Sustainability cognitive skills</th><th>Methodologies</th></tr>
<tr><td>Remember: Recall of information; Observe; Define; Memorize;</td><td rowspan="7">Project/Problem -Based Learning; Design Thinking; Competency-Based Learning</td></tr>
<tr><td>Understand: Understand; Interpret; Compare; Explain;</td></tr>
<tr><td>Apply: Problem solving; Implement an effective solution</td></tr>
<tr><td>Analyze: Critical and analytical thinking</td></tr>
<tr><td>Evaluate: Evaluate potential solutions; Validate solutions;</td></tr>
<tr><td>Create: Innovative thinking; Integrate and synthesize of information;</td></tr>
<tr><td>Other skills: Digital literacy; Information and media literacy; Independent and autonomous learning; Creativity; Storytelling skills; Transferring knowledge to the real world; Following systemic design processes</td></tr>
</table>

Generic Quiz

Being a customizable game, the teacher can create as many games as it is needed and can adapt them according to the lesson plan. The Generic Quiz used in this analysis, includes six questions, divided for the 6 interactive areas of game plot. Generic quiz provides a useful template to create a knowledge-testing quiz, focused more on communication skills such as speaking, writing and listening.

Table 8. Sustainability cognitive skills from Generic Quiz game

Sustainability cognitive skills	**Methodologies**
Remember: Recall of information; Memorize;	Competency-Based Learning
Understand: Understand; Interpret; Explain;	
Apply: Demonstrate; Research	
Analyze: Describe; Prioritize	
Evaluate: Evaluate potential solutions; Validate solutions;	
Create: Integrate and synthesize of information;	
Other skills: Digital literacy; Information and media literacy; Independent and autonomous learning; Storytelling skills;	

3 Conclusions

Serious games are considered effective tools for teaching and learning. They can be used as bridge between theory and the real-life situations and for better understanding of concepts learned through traditional teaching methods. By analyzing different educational games, which addresses different topics, we wanted to show how educational games could foster the acquisition of sustainability skills and competencies through the game mechanics, the narrative structure and the pedagogical approach used by each game.

For example, analyzing the *Lure of the Labyrinth* game, we identified that through its levels that increase in difficulty, problem solving and critical thinking is promoted and the students must connect the knowledge learned previously with new knowledge as they move through the game. In addition, the game through its different scenarios based on user input, encourage the trial and error learning for finding the best solution. Students can acquire intrapersonal skills and competencies, such as initiative, openness to criticism/ feedback, flexibility and adaptability. The *Eye of the Donkey* provides students with a virtual lab, where they can apply the knowledge acquired in a safe and protected environment, while training technical skills. The game promotes the acquisition of problem-solving skills and competencies, such as the ability to transfer knowledge to the real world, the ability to follow systemic design processes, the ability to evaluate potential solutions. The *Generic Quiz* game, through it customizable structure, can be used for a wide range of study topics, pursuing the acquisition of technical skills and competencies and meta- cognitive skills and competencies such as willingness to learn and independent and autonomous learning. Therefore, the games analyzed and educational games in general, are not just for learning different subjects, but they are also used to familiarize the students with a certain level of thinking, to make sense of information, experiences and ideas.

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Enhanced Distributed Data Mining Application using the PostgreSQL Database Management System

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Abstract

Due to the current COVID pandemic, virtual laboratories are becoming increasingly important in the educational process. To support the online learning we developed the third version of a distributed machine learning application that allows the participating students to extract useful information from the PostgreSQL servers alongside other major database management systems that were used in the previous versions(Microsoft SQL Server, MySql and MongoDB). The data sets are distributed among multiple distributed PostgreSQL servers arranged in a master-slave topology. In this version, the data was imported from the MySql database management system. In our experiments from the class we use three data sets: iris1, wine1, conc1. The entire system will function like a Distributed Committee Machine that mines simultaneously through distributed data stored on servers in order to achieve better classifying results compared with the centralized case in which we have only one neural network and one data set. The application provides three neural networks: the classical multilayer perceptron, the pulsating multilayer perceptron and the autoresetting multilayer perceptron. Besides manipulating neural networks, in this virtual lab, the students will deal with some preprocessing operations on data (importing and data arrangement) from the KDD process and they will also learn how to configure the replication of the data sets into the chosen distributed topology.

Keywords: Elearning, Distributed Data Mining, Distributed Relational Database Management Systems, Machine Learning, Replication

1 Introduction

As a consequence of the COVID-19 pandemic, most countries around the world temporarily closed the educational institutions with the hope of stopping the new virus.

An unprecedented number of schools, universities and students were affected worldwide by the current situation. This research was done in order to be applied in the databases for scientific applications laboratory in our university. It can be used in classes of about twenty students. If it is needed, the entire experiment can be simulated individualy by students with virtual machines.

This paper presents the further improvments that were brought to the previous eLearning application presented in our research(Pupezescu, V., Dragomir, M., 2019). In this new version we added the support for the PostgreSQL database management system. The functionality of the Distributed Committee Machine (DCM) was kept and the entire system is functioning using the replication capabilities offered by PostgreSQL. The neural structures that were used in experiments were the autoresetting multilayer perceptrons (Pupezescu, V., 2017).

2 Application Architecture

The Figure 1 represents the architecture of the DCM application while in Figure 2 we represented the theoretical model of DCMs. On the PostgreSQL master server we have the combiner module that is functioning based on the “winner takes all” policy. On every distributed node we have Java TCP or UDP servers (in our experiments we used TCP servers) that will wait for the initial parameters of neural networks. After setting up the configuration of the neural structures, the server will send the data to the distributed machines. Every system will compute and write the missclasification rate in the PostgreSQL master node. Through the replication process the PostgreSQL master server will replicate the written data to the slave nodes. By doing this, the system makes sure that everyone from the class will have access to the final classification results. Furthermore, each server will also write the results locally in Excel files for further processing. An important observation is that the entire databases from the slave nodes are read-only replicas. At this moment we did not implemented multimaster replication.

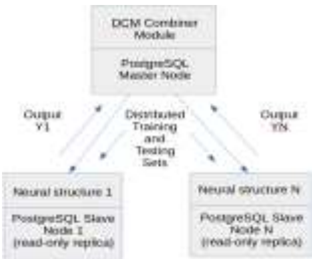

Figure 1. The implementation of DCM architecture with the PostgreSQL DBMS

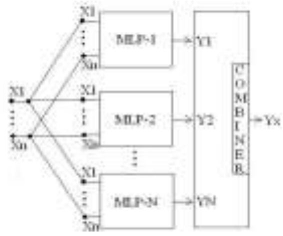

Figure 2. Distributed Committee Machine (Pupezescu, V., Rădescu, R., 2016)

The entire application was developed in the Ubuntu Linux 20.04 Operating System in the Java programming language. The implementation was done in Eclipse IDE 2020-06 (4.16.0). All the distributed experiment for this paper was realized using two Linux machines (Ubuntu 20.04) that have PostgreSQL DBMS installed. The host machine will act as the DCM Combiner module.

3 Data Preprocessing for the PostgreSQL DBMS

The students that will attend to this virtual lab will have the possibility to choose from a variety of data sets. The most important sets that can be mined will be Iris1, Wine1 and Conc1 data sets (https://archive.ics.uci.edu/ml/datasets/iris, https://archive.ics.uci.edu/ml/datasets/wine). The Conc1 set is a self generated data set – in this set all the data is arranged in a concentric manner.

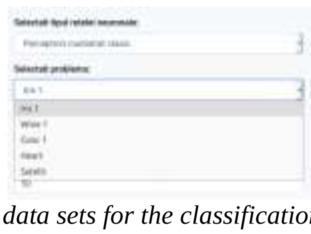

Figure 3. Available data sets for the classification task in the application

The preparation of the data sets involved their import from the MySQL database management system(DBMS) to the PostgreSQL DBMS.

The importing process is quite time consuming because it involves the creation of dedicated tables for each data set. All the data is exported from MySQL in CSV format at the first step.

Afterwards, all the data is imported from individual CSV files to the new created PostgreSQL tables with the import tool available in PostgreSQL 12.

When importing, the students must select the option "Header" because the initial CSV file contains the columns of the table on the first row(this row will be ignored at the importing process).

Below(in Table 1), we present the metadata for the main data sets that were used in the application:

Table 1. iris1, wine1 and conc1 data sets (Pupezescu, V., 2016)

iris1	trr	tsr	trs	tss
Lines	100	50	100	50
Columns	3	3	4	4
wine1	trr	tsr	trs	tss
Lines	90	88	90	88
Columns	3	3	13	13
conc1	trr	tsr	trs	tss
Lines	200	100	200	100
Columns	1	1	2	2

Because PostgreSQL is a relational DBMS, all the data will be stored in classic table format. Besides the tables that contain the actual data we have also two more tables that store the classification results ("rezultate")and the metadata for each classification problem("configuratie").

Once the students finished to import the data sets they can continue by implementing the replication process on all the PostgreSQL servers. In this example we will show how this operation is achieved (Schönig, H. 2015; Shaun, T. 2020) using three PostgreSQL servers: one is installed on the host and the other two(named Ubuntu1 and Ubuntu2) will run inside Oracle VM VirtualBox. Before starting to configure the PostgreSQL servers the students first must verify that all the operating systems are able to communicate with each other. The IPs are assigned as follows:

Table 2. IP allocation among the distributed systems

Sy tem	The master system	The first slave system (Ubuntu1)	The second slave system (Ubuntu2)
IP	192.168.1.7	192.168.1.4	192.168.1.5

The configuration for the replication process is made in teams by the students in two major steps: in the first one team will configure the master system; in the second step, every other student will configure its allocated system(in our case we used just two PostgreSQL slave servers in Oracle VirtualBox for experimental purposes):

Master configuration steps:

1. On the PostgreSQL master we must create a dedicated user for the replication process(note that the password should be a strong passphrase):

sudo su postgres – this command will allow the user to acces the postgres user.

psql – with this command we enter in terminal on their postgresql servers.

CREATE USER replication REPLICATION LOGIN CONNECTION LIMIT 1 ENCRYPTED PASSWORD 'REPLICATION_PASSWORD';

2. In order to increase the number of accepted connection we will use the following command:

ALTER ROLE replication CONNECTION LIMIT -1;

At this moment, if we check(with \du command in a psql connection – see Figure 4) the user list in PostgreSQL we should see that we do not have a connection limit:

Figure 4. Output for the "\du" command

3. In this step, the students must edit the main configuration file from the PostgreSQL server – "postgresql.conf"; they will open a new terminal and type the following command:

sudo gedit /etc/postgresql/12/main/postgresql.conf

In this file they must find, uncomment and modify four lines as follows:

listen_addresses = 'localhost,192.168.1.7'
wal_level = replica
max_wal_senders = 10
wal_keep_segments = 64

3. Another configuration file that must be modified is "pg_hba.conf":

sudo gedit /etc/postgresql/12/main/pg_hba.conf

At the end of the file, the students must add the ip addresses of the slave servers:

host replication replication 192.168.1.5/0 md5
host replication replication 192.168.1.4/0 md5

Above those lines, the students must also add these lines(# IPv4 local connections:):

host all all 192.168.1.7/0 md5
host all all 192.168.1.5/0 md5
host all all 192.168.1.4/0 md5

After this step, the PostgreSQL master server must be restarted with the following command:

sudo service postgresql restart

The command for checking the status of the server is the next one(the status should be active) :

sudo service postgresql status

Note that is this commands are given in a rapid succesion in the same terminal window it will not be necessary to write the key word "sudo" at each command.

Slaves configuration steps:

1. Before starting the configuration of slaves the PostgreSQL servers must be stopped. On each slave server the students must run this command:

sudo service postgresql stop

With the following command they will also check the status of the server:

sudo service postgresql status

2. Now the student teams can start modifying the main postgresql configuration files. Every student that operates on PostgreSQL slave servers will run this command:

sudo gedit /etc/postgresql/12/main/postgresql.conf

The following lines must be uncommented and modified with the slave IP address(in our case we changed the IP address for the other slave postgresql server – 192.168.1.4):

listen_addresses = 'localhost,192.168.1.5'
wal_level = replica
max_wal_senders = 10
wal_keep_segments = 64
hot_standby = on

3. For every slave server we also must edit the "pg_hba" configuration file:

sudo gedit /etc/postgresql/12/main/pg_hba.conf

With the following line, the students will grant access to the replication user from the master postgresql server:

host replication replication 192.168.1.7/0 md5

Above these lines there is also a section(# IPv4 local connections:) where we must add these lines (for the other server we put 192.168.1.4/0 at first line) and save the file:

host all all 192.168.1.5/0 md5

host all all 192.168.1.7/32 md5

4. In the next step we will enter with the root privileges in the /var/lib/postgresql/12/main/ directory:

sudo su

cd /var/lib/postgresql/12/main/

5. The students that configure the slave systems must delete all content from that directory: sudo rm -rfv *

6. All the content from the master postgresql server will be copied on each slave server (in a new terminal they will enter with root privileges on the postgres user):

sudo su postgres

pg_basebackup -h 192.168.1.7 -U replication -p 5432 -D /var/lib/postgresql/12/main/ -Fp -Xs -P -R

7. In another terminal window the students will start and check the status of their postgresql servers:

sudo service postgresql start

sudo service postgresql status

In order to be able to start the eLearning application all the students must edit the host file for every distributed system. Every machine from the distributed system(in our case the servers are named ubuntu 1 and ubuntu 2) must be present in this file:

sudo gedit /etc/hosts

On the master system we will add the following lines:

192.168.1.4 ubuntu2

192.168.1.5 ubuntu1

On the slave systems we add the master server(named P775): 192.168.1.7 P775

After all the configuration process all the students must check that the PostgreSQL servers are synchronized. In Figure 5 we checked the result table on all servers and verified that the replication process is functioning (these results are for the experiments that were done in the next

	epoca [PK] bigint	pcicg double precision	durata bigint	ip [PK] character varying	durataantrenare bigint
1	0	46	990	192.168.1.4	31
2	0	60	82	192.168.1.5	0
3	1	43.99999999999999	1002	192.168.1.4	43
4	1	38	86	192.168.1.5	4
5	2	14.000000000000002	1008	192.168.1.4	49

section – we displayed only five rows from a total of 2000 rows):

Figure 5. The query results on all servers are the same for the "result" table

4 Experimental Distributed Committee Machine v1.2

Like in our previous work (Pupezescu, V., Dragomir, M., 2019), we added a new section in the application dedicated to the PostgreSQL execution(in the index.jsp page). In this new section we are able to set and modify the same parameters like in our previous version (see Figure 6). In the "start_postgres.jsp" page we also added for the students the architecture image of the entire distributed application.

In Figure 6 and Figure 7 we show the interface that allow students to set the initial neural network parameters, the IP addresses and ports of the slave PostgreSQL servers that will receive the replicated data.

As we can see in Figure 8, students will be notified if the distributed experiment starts. After all the participating student teams in the experiment will finish the experiment, the team from the master server will press the "Continue" button in order to display the best classification results obtained inside the DCM(see Figure 9).

Furthermore, the application will query for the final results for each system in the database after the IP address and automatically generate a chart with the missclassification rates obtained on all systems(see Figure 10 – distributed run for 1000 training and testing epochs for the iris data set, 4 neurons on hidden layer, pulse=100).

Figure 6. The start_postgresql.jsp page

Figure 7. Setting the IP addresses and ports for the slave PostgreSQL servers

As we mentioned the implemented DCM application has a special module that automatically writes locally in excel files (on every slave node) all the classification results. This is very useful because they can take and independently analyze the obtained results. They can even import those data in other frameworks if they wish.

Figure 8. Acknowledgment for sending the startup configuration parameters

Figure 9. Distributed results for the classification task

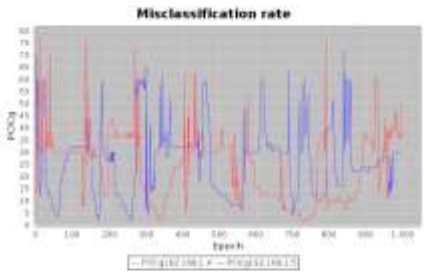

Figure 10. The final classification results obtained on all distributed systems

5 Conclusions

This paper presents an improved Data Mining eLearning application with the new added support for the PostgreSQL database management system. This version makes use of the fast replication process offered by PostgreSQL. All the data sets that were analyzed were replicated among all the distributed PostgreSQL slave nodes. Every node worked to achieve the classification task and wrote the classification results at each testing epoch onto the PostgreSQL master node. Through the replication process all distributed systems had access to the same data thus ensuring the redundancy and high availability for analyzed data sets.

Also, the application offered a dedicated module that exported in excel format on each system the local classification results as well as the automatic display on the master system of the classification results obtained on all distributed systems from the DCM architecture.

In the next version we will implement the multimaster replication offered by PostgreSQL for further optimizations of the DCM architecture. The purpose of this paper is to help students and teachers to cope with the current situation and to continue the educational process and research in areas such as Elearning, Distributed Data Mining, Knowledge Discovery in Distributed Databases and Machine Learning.

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Interactive Elearning Application for Cycle-Consistent Adversarial Networks

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Abstract

The COVID-19 pandemic has disrupted the education systems worldwide and in this context the virtual learning software solutions have been of critical importance in supporting the continuous learning process when the social distancing makes very difficult the physical attendance for classes. In order to support the learning process for the students in the domain of generative modelling we have developed an interactive web application that streamlines the process of understanding Generative Adversarial Networks (GANs) and Cycle-Consistent Adversarial Networks (CycleGANs), a class of unsupervised machine learning models that enables the generation of synthetic images that follow the statistical distribution of the images in the training data set. Our work consists in training from scratch a CycleGAN model and in designing and building a responsive web interface that allows the students to experiment with an application of the CycleGANs, the style transfer. We strive to inspire the students and to motivate them to deepen their knowledge in this area by implementing an interactive web application and by structuring it into two major sections: the first section is oriented towards a practical approach and we encourage the students to upload a photo at their choice and analyse the result of applying the style transfer from the images in the training data set to their uploaded image. The second part emphasizes the theoretical part and introduces the students to the concepts behind GANs and CycleGANs.

Keywords: Generative Adversarial Networks, Cycle-Consistent Adversarial Networks, Virtual learning, Responsive web interface

1 Introduction

In order to support the online learning in the context of the Covid-19 pandemic we have implemented an interactive application that helps the students interested in learning more about the GANs and CycleGANs models by providing them a tool that allows them to experiment with an application of the CycleGANs, the style transfer.

1.1 Generative Adversarial Networks

Generative Adversarial Networks (GANs) (Goodfellow et. al., 2014) are an important class of generative models and they belong to the unsupervised learning field. They were introduced by Ian J. Goodfellow et. al. in the paper “Generative Adversarial Nets” in 2014 (Goodfellow et. al., 2014) and they represent a turning point in the evolution of the generative models.

The GANs framework consists of 2 intrinsic parts that are modelled as fully differentiable deep neural networks: Generator (G) and Discriminator (D) (Fig. 1).

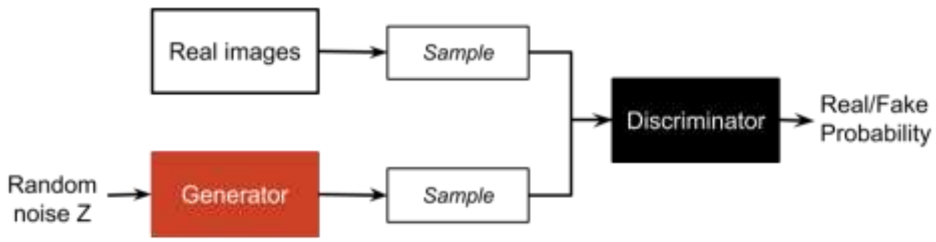

Fig. 1. GAN architecture

The core idea that lies at the heart of the great success of the GANs is the adversarial training between the two networks. They play a two player minimax game with the value function V(D, G) illustrated in Fig. 2.

D and G are trained simultaneously using the backpropagation algorithm and they compete with each other: D is trained to maximize the probability of correctly classifying the samples applied to its input, it maximizes the term log(D(x)) from V(D, G). G is trained to minimize the only term where it contributs in the mathematical expression ofV(D, G): log(1 – D(G(x))).

$$\min_G \max_D V(D, G) = \mathbb{E}_{\boldsymbol{x} \sim p_{\text{data}}(\boldsymbol{x})}[\log D(\boldsymbol{x})] + \mathbb{E}_{\boldsymbol{z} \sim p_{\boldsymbol{z}}(\boldsymbol{z})}[\log(1 - D(G(\boldsymbol{z})))].$$

Fig. 2. GANs value function [1]

The Generator network produces synthetic samples from noise (Z) and its mission is to continously improve the generated data until it becomes indistinguishable from the training data. The Discriminator network is a classifier that has the goal to correctly classify the synthetic data from the real data. It outputs the probability that the input data is real of fake.

The training ends when none of the two competing networks can improve anymore, they reach the Nash equilibrium (Goodfellow et. al., 2014)when the distribution of the synthetically generated samples converges to the distribution of the real data set. At this point, the Generator producessamples that follow the distribution of the original data set, whilst the discriminator can no longer distinguish between the original or synthetically generated data, it outputs the probability 0.5.

1.2 Cycle-Consistent Adversarial Networks

Cycle-Consistent Adversarial Networks (CycleGANs) were proposed in the paper “Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks” (Jan-Yan Zhu et. al., 2017).

CycleGANs models belong to the GAN family, but they have architectural particularities that enable image-to-image translation between two domains, X and Y, in the absence of paired images for training.

A CycleGAN model is composed of two generators (G and F) and two discriminators (D_X and D_Y) as illustrated in Fig. 3.

D_x tries to distinguish between the images in the X domain and the translated images from the Y domain, F(y). D_y attempts to distinguish between the images in the Y domain and the translated images from the X domain, G(x).

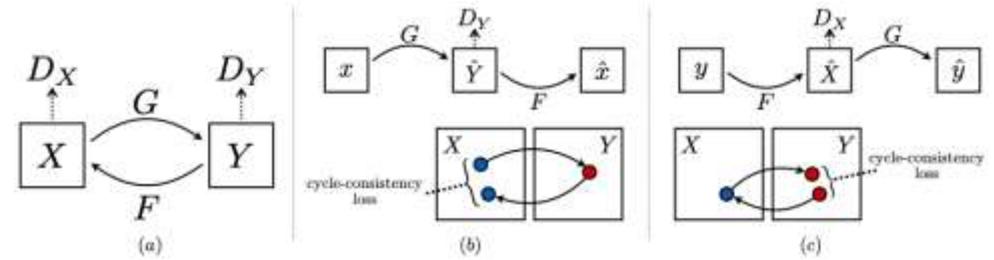

Fig. 3 CycleGAN (Jan-Yan Zhu et. al., 2017)

As it can be observed in Fig. 3, G will translate an image from domain X to domain Y, whilst F will perform the opposite translation between the domains, it will translate an image from domain Y to domain X. With this setup, the following assumptions apply: for an image x that belongs to domain X, the function F(G(y)) = y. The same reasoning applies to the images in the domain Y: G(F(x)) = x.

In order to achieve the mapping from the X to Y domain, the objective function of the CycleGAN model [1] has additional constraints comparing to the traditional GAN models, applied in the form of the Cycle consistency loss [3].

[1]

$$G^*, F^* = \arg\min_{G,F}\max_{D_x,D_Y} \mathcal{L}(G, F, D_X, D_Y)$$

$$\mathcal{L}(G, F, D_X, D_Y) = \mathcal{L}_{\text{GAN}}(G, D_Y, X, Y) + \mathcal{L}_{\text{GAN}}(F, D_X, Y, X) + \lambda\mathcal{L}_{\text{cyc}}(G, F),$$

[2]

$$\mathcal{L}_{\text{GAN}}(G, D_Y, X, Y) = \mathbb{E}_{y\sim p_{\text{data}}(y)}[\log D_Y(y)] + \mathbb{E}_{x\sim p_{\text{data}}(x)}[\log(1 - D_Y(G(x))]$$

[3]

$$\mathcal{L}_{\text{cyc}}(G, F) = \mathbb{E}_{x\sim p_{\text{data}}(x)}[\|F(G(x)) - x\|_1] + \mathbb{E}_{y\sim p_{\text{data}}(y)}[\|G(F(y)) - y\|_1].$$

Fig. 4. CycleGAN loss functions (Jan-Yan Zhu et. al., 2017)

The loss functions that are involved in the training process of the CycleGAN model are highlighted in Fig. 4: [1] reflects the full CycleGAN objective function, [2] reflects the adversarial loss for the mapping functions, F and G. [3] Defines the CycleConsistency loss, it has a very important contribution to the total loss function because it enforces that the cycle consistency property is maintained, so that a translated image can be mapped back to the original image.

2 Our work

In this paper we present a multifunctional tool that helps the students interact with the GANs: on the one hand they can experiment with the style transfer from pictures painted by Claude Monet toimages at their choice and see the generated results in real time. On the other hand they can expand their knowledge on the subject with the help of the documentation section.

2.1 CycleGAN model

The network architecture that we used for the CycleGAN follows the implementation described in the "Transforming the World Into Paintings with CycleGAN"web article (Sebastian Theiler, web article), where the generator network is slightly different from the original architecture from (Zhu et. al., 2017). The generator was modelled using a pix2pix architecture (Isola et. Al, 2017), a modified version of the U-Net architecture. (Ronneberger, 2015)(Sebastian Theiler , web article) We trained from scratch the CycleGAN model for 50 epochs. The data set used for training the generative model was the monet2photo data set (291.09 MiB), available in TensorFlow Datasets collection. Fig. 5 highlights the architectural details that define the discriminator and generator networks. After training was complete we saved the model in Keras H5 format and we used the trained model to power the interactive application to generate new images translated to Monet style.

2.2 Interactive application

We designed and implemented a responsive web application using the HTML5 markup language for structuring the content as well as Bootstrap 4, a popular frontend framework that allowed customizing the layout through the use JavaScript plugins and extensive components which are essential for building responsive websites. The backend that powers the functionality was built using the Flask micro web framework, it is written in Python and allowed us to define the routes for the application (index, results and documentation)and the associated content to be served (views).

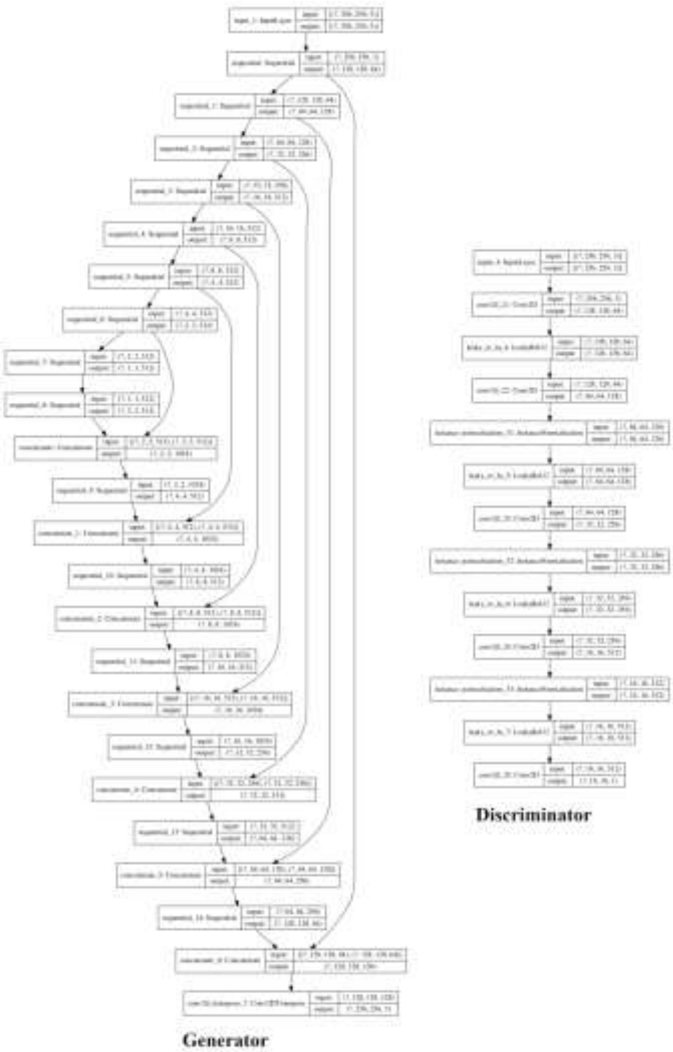

Fig. 5 Architectures for Generator and Discriminator networks

The web application is composed of two major sections. The first section is dedicated to the practical approch for learning an application of a CycleGAN model, the style transfer from the images in the data set to a new image. In this section, the students can upload an image of their choice and see, the original image as well as the generated image "painted" in the Claude Monet style, as illustrated in Fig. 6.

When an image is uploaded, a POST request is sent to the /results route. The request is processed, the image uploaded is temporary stored using the BytesIO buffer module from Python. Before being fed to the neural network the image is preprocessed: it is resized to 256x256 px and normalised. After the generative model predicts the image, it is converted to base64 encoding and set as image source in the HTML template.

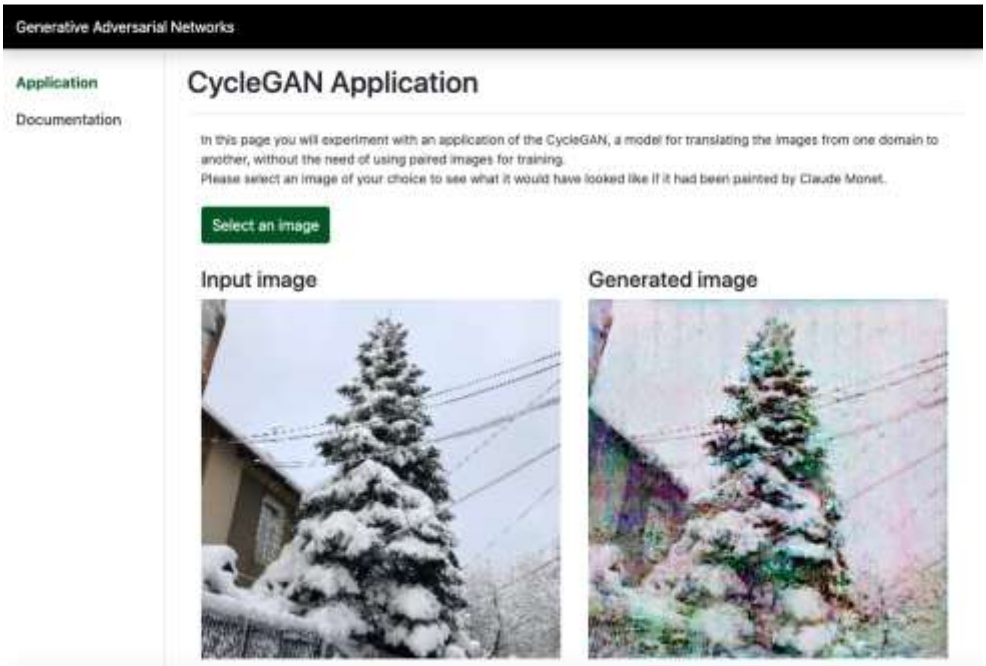

Fig 6. Application section

The second section, illustrated in Fig. 7, is oriented towards the theoretical concepts behind GAN and CycleGAN frameworks and encourages the students to delve into the theory that powers the generative models that make possible, but not limited to, the image translation from one domain to another, as they experimented in the Application page.

The students can easily navigate through through the fundamental topics related to GANs and CycleGANs models using the left side menu to learn more about: GANs basic notions, GANs training process, GANs objective function as well as the theory behind the CycleGANs, CycleGANs training process and the particularities of the CycleGAN objective function.

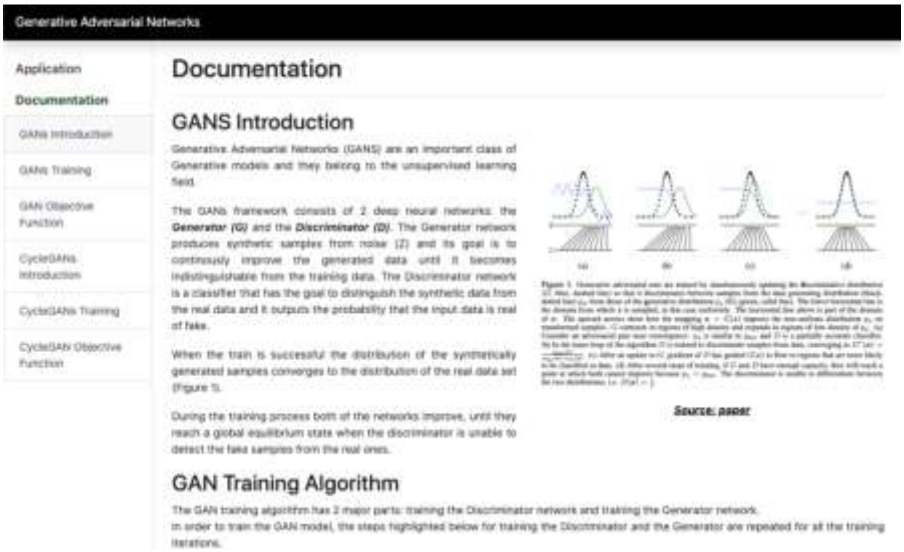

Fig. 7 Documentation section

Conclusions

In this paper we described an interactive web application that we designed and implemented from scratch whichemphasizes an application of a CycleGAN model: the style transfer between two domains. This application is dedicated to the students that want to expand their knowledge about the generative adversarial networks and their impressive applications. We described the theoretical notions behind the GANs and CycleGANs, we presented the architecture of the CycleGAN model that was trained from scratch using the monet2photo data set and was used to generate the new images in the Monet style in the app. We also highlighted the frontend and the backend technologies used to build the web application.

In the next version of the interactive tool we will enhance it to include more applications of the generative adversarial networks.

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Approaches on Slack Workspace Design

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Abstract

Successful teaching requires constantly adapting and improving the content, methods, and activities of the taught courses. This includes the adoption and tailoring for teaching purposes of those tools that ease communication and collaboration. The paper discusses Slack workspace design approaches used by educators to develop a virtual learning space. The analysis on the identified workspace designs following several criteria is presented. Practical experience on designing Slack workspaces together with relevant lessons learned are reported.

Keywords: learning management systems, communication and collaboration tools

1 Introduction

Modern teaching makes use of learning management systems (LMSs) that create a learning environment mainly focused on content delivery and less on communication and collaboration. Integrated features that allow notification on posts or comments create often a great amount of e-mail to clean-up by teachers and students. Collaboration on different team-based projects is not highly promoted by LMSs. Therefore, other tools that enforce communication and collaboration are required, especially for computer science (CS) courses focused on various software development activities. Collaboration with industry representatives is important in CS-based course teaching, helping students to acquire competencies for their career by getting feedback from industry experts. This cannot be achieved using LMSs that are accesable to teachers and students only.

This paper addresses approaches on Slack workspace design used in CS-based courses for higher education. Slack platform is mainly used for communication purposes and project management and was smoothly integrated in teaching. Present work reports the findings on *how* Slack can be integrated in teaching from a technical perspective.

The main contributions of this paper are:

- an empirical research on the Slack workspace design and the identification of four types of raw workspace types that are combined by educators in order to achieve learning goals;
- the analysis of the Slack workspace design approaches following relevant criteria as organization, communication and collaboration.

The paper is organized as follows: *Section 2* briefly introduces the Slack platform, while the CS-based courses and the workspaces studied are discussed in *Section 3*. Section 4 describes in great detail Slack workspace design specifics and the analysis on different criteria. Practical experience on designing workspaces and lessons learned are included in Section 5. The paper ends with conclusions in future work..

2 Slack Platform

Slack (Slack, 2020) is a channel-based communications platform released in 2014. By the first quarter of year 2020, Slack platform reported over 12,000,000 of daily active users (Smith, 2014).

Slack is the acronym for *searchable log for all communications and knowledge*. The tool is mainly employed for business projects, where teams make use of a virtual space to communicate using text/video, file sharing and feedback submission. Over 3,000 higher education institutions use Slack platform to keep their classes and administrative activities online.

Basically, Slack allows to build an environment centered on communication and collaboration, by relying on the *workspace* concept that represents the team (group) that works together. Workspace members can send messages on *channels* or as *direct messages* to designated collaborators. Further discussion on a specific topic can be achieved by creating *threads* for already sent messages.

Slack platform is used in the software industry for communication purposes and project management goals as well. Simple integration with already employed software project management tools creates a space that promotes team connection and productivity.

3 Computer Science-based Courses

This section presents the CS-based courses that adopted Slack platform for several teaching and learning sessions, together with their participant profiles.

3.1 Courses

Slack is a communication platform that is used by a wide range of teams that collaborate in various types of projects. Slack platform was extensively used starting with year 2017 in four different CS-based courses at the Faculty of Mathematics and Computer Science from Babeş-Bolyai University of Cluj-Napoca (Romania).

Slack platform was firstly used in a post-graduated intensive course of 7 weeks on verification, validation and automated testing (VVTA) (Chisalita-Cretu, 2018). The course is part of a CS-based Professional Conversion Programme (PCP) designed for professionals that aim to make a career change.

Subsequently, the platform was used for other three CS-based courses at undergraduate level. Verification and Validation of Software Systems (VVSS) (Chisalita-Cretu, 2020c) [19] course is a mandatory (M) course for the 3rd year undergraduate level students. Test Design Techniques (TDT) (Chisalita-Cretu, 2020b) and Robotic Process Automation (RPA) (Chisalita-Cretu, 2020a) are both elective (E) courses for the 3rd year undergraduate level students. The last three courses are 12 or 14 weeks long courses.

3.2 Participant Profile

Table 1 shows the details of the nine workspaces that were created for the CS-based courses, held from 2017 to 2020, included in our research. Data on the average age indicates for the VVTA course that adult participants were over 35 years old, all of them already having a higher education degree. Students enrolled in VVSS, TDT and RPA courses were young adults studying for their first university diploma.

Professionals from the software industry are an important resource for CS-based courses. They were greatly involved in elective courses, mentoring student teams and providing valuable feedback in designed activities. Professionals together with other audit participants are the externals enrolled in a course session.

Table 1. CS-based courses that adopted Slack platform

Course/ Workspace	Course Type	Course Duration (in weeks)	Users	Students	Teachers	Profes-sionals	Student Average Age

VVTA2017	M	7	33	31	2	0	40
VVSS2018	M	12	198	195	2	1	21
VVTA2018	M	7	40	38	2	0	37
VVSS2019	M	12	200	195	2	3	21
TDT2019	E	12	91	82	1	8	21
VVTA2019	M	7	33	31	2	0	36
RPA2019	E	14	134	113	1	20	21
VVSS2020	M	12	199	196	3	0	21
TDT2020	E	12	86	78	1	7	21

4 Slack Workspace Design

This section addresses the ways Slack workspaces can be designed in order to achieve learning goals. There are several approaches that can be adopted when designing a Slack workspace used for classrooms. These perspectives are analyzed in the following, using relevant criteria by educators.

4.1 Workspace Design Approaches

Slack is a versatile platform that allows to design the workspace in order to achieve the intended learning objectives. There several ways to accomplish them, considering a few factors as:

- *course duration*, e.g., from 7 weeks in intensive courses to 12 or 14 weeks in whole term courses;
- *participant profile*, e.g., students enrolled may have or not extensive knowledge in using LMSs or other communication tools;
- *activity type and frequency*, e.g., students can acquire expected competencies by attending different types of activities designed by the educators, as individuals or working in teams;
- *teaching and learning resources*, e.g., materials' genre presented to the students that may include: lecture slides, activity-based requirement files, source code projects, audio/video files, etc.

Communication and collaboration on Slack is organized around the *workspace* and the *channel* concepts. Usually, teachers create a Slack workspace for a course, allowing students enrolled in the course to join a virtual space that facilitates communication and collaboration during classes. The teacher is the owner of the workspace and he organizes it according to the considered learning objectives by creating various channels (or groups) having different purposes. Based on the course outline and/or designed activities, the teacher may use the following raw approaches, each of them having certain particularities:

1. **timeline-based** – channels are created for each week and for each activity type;
   - participants are frequently asked to join specific channels to attend scheduled activities during the course deployment;

   Benefits:

- participants access the information related to the discussed topic considering their order in the initial teaching plan;
- useful for small groups that attend short courses;

Downsides:
- for large groups of students that collaborate in a specific activity at a specific time, the channel can get easily flooded with messages;
- information on topics covered in several channels is scattered over the workspace;
- participants easily lose the course overview due to the large number of channels;

2. **content-based** – channels are created considering the topics addressed over the entire course;
   - participants are frequently asked to join specific channels in order to access details on the new topics while the course advances;

   Benefits:
   - participants have all the details on specific topics in a single place in the workspace;
   - useful for courses consisting of topics that are scarcely related;
   - useful for small groups that attend short courses;

   Downsides:
   - for large groups of students that collaborate in a specific activity, the channel gets easily flooded with messages and relevant information is scattered over the channel;
   - participants may not see the exiting relationships between various topics extensively discussed on different channels;
3. **activity-based** – channels are created for each type of activity designed to take place;
   - channels are created in advance or when the first activity is scheduled to be held;

   Benefits:
   - participants access the details on a specific activity type in a single channel;
   - useful for courses consisting of a wide range of activities, e.g., seminars, labs, etc;
   - useful for large groups of participants attending short or long courses;
   - recommended when industry experts are involved in some activities (mentorship);
   - a better overview due to a reduced number of channels;

   Downsides:
   - some participants may not find related tasks and topics placed in different channels;
   - teacher needs to be very organized and refer correctly to each resource added to the channels;
4. **group-based** – channels are created for each group that attends the course on a particular activity;
   - it can be shared by various groups having different participant profiles;

   Benefits:
   - participants access the information in a single place;
   - useful for short courses having a few activities or groups with different background;

   Downsides:
   - not recommended for long courses, where the channel content is constantly increasing, reducing the clarity on the discussed topics;
   - teacher work gets redundant when making available for students needed resources.

4.2 Analysis

The raw approaches previously presented are rarely used separately by teachers. Most of the times a Slack workspace design for a course follows the activity and group-based organization and least the *timeline* or *content*-based approach. Modern teaching places the student in the center of the educational process (Alario-Hoyos et al, 2016; Infanti 2018; Ross, 2019). Teaching platforms adapted to this aim, considering the competencies the acquired by attending various activities, as individual or as part of a group. Table 2 shows the summary of our analysis on the four default Slack workspace design approaches used in teaching. Three category criteria were investigated, focusing on:

a. **Organization** – the course degree of clarity reflected by the workspace structure;
b. **Communication** – the ease to communicate and interact over the workspace, considering its structure;
c. **Collaboration** – the ease to collaborate to achieve some tasks over the workspace, considering its structure;

The impact of some approach on a specific criterion can be *positive* (+) or *negative* (-) in cases the workspace structure favours or disfavours the named criterion. Still, there are cases where *the teacher may influence* the impact of the approach in one of the two ways (+/-). Therefore, it depends on the teacher's skills to lean the balance towards the positive (or negative) effect of the addressed criterion.

Table 2. Analysis summary on Slack workspace design approaches

Criterion	Timeline	Content	Activity	Group
Organization				
optimal number of channels	–	+/–	+	–
disciplined topic organization	+/–	+	+/–	–
single place for information	+/–	+/–	+/–	–
Communication				
teacher to student(s)	–	+/–	+	–
student to teacher	–	+/–	+	+
Collaboration				
promotes team engagement	+/–	+/–	+	–
facilitates feedback offering	+	+	+	+

Considering the **organization criterion**, a course should have an optimal number of channels. A large number of channels available for *timeline* and *group*-based approaches disfavours the participant on having an overview of the activities he is involved in and how the discussed topics relate one to another.

A disciplined topic organization is required for any course. *Timeline* and *activity*-based approaches seems to require an additional effort from the instructor's part to remind the participants when and where were detailed the topics discussed in different activity types. For the *activity*-based approach this aspect is reduced as the existing channels are mapped to the carried out activities, e.g., lectures, seminars, labs, etc.

For *group*-based designed Slack workspaces, the information redundancy is increased, along with an consistent effort from the teacher to keep all the groups updated with the needed details. This aspect does not occur in *timeline* and *content*-based approaches if a topic is addressed during a single learning session. In case the course follows the *activity*-based design approach, the teacher can manage the redundancy in a reasonable manner.

Efficient **communication** from instructor to student(s) is essential in teaching. Communication may have various forms, e.g., announcements, polls, individual or team assistance. Slack workspaces designed based on the *timeline* and *group* approaches provide a low rate efficiency in terms of communication while the same information needs to be reminded several times on different learning sessions or to several groups of participants. Other approaches are less prone to redundancy by relying on channels created to provide a specific type of information.

Communication from student to teacher is enhanced in Slack workspaces regardless its design. For participants that share similar difficulties, it gets easier to benefit from tutoring or other support type. Workspaces designed based on the *timeline* approach have the advantage of considering previous learning session as content archives that needs to be handled by the student. Still, many participants that do not keep the pace or miss classes may find difficult to manage these channels and to grasp knowledge.

Tasks assigned for different activities elaborated by the teacher are mostly heterogeneous, allowing the participant to gain specific competencies. Engagement in diverse teams and taking responsibilities represents an opportunity to develop hard and soft skills required in future employment. Compared to other approaches, the *activity*-based approach firmly favours **collaboration** with people from the industry, i.e., software companies, that have a mentoring role in the classroom. This setup of the workspace creates a welcoming environment to collaborate, not burdening mentors with unsolicited requirements. Each approach on workspace design allows prompt feedback. The answers may have various forms, from a simple reaction or emoticon to elaborated feedback placed within a discussion thread. Thus, the flow of the discussion can be organized around a topic and not the comment entry throughout the channel.

5 Results

This section presents practical experience on designing Slack workspaces together with some lessons learned from adopting Slack platform in teaching.

5.1. Practical Experience on Designing Slack Workspaces

Different types of Slack workspace designs were used during the investigated period of time. Figure 1 shows the workspace designs employed for two teaching and learning sessions of different courses. On the left hand side, there is a snapshot of several channels created within VVTA2017 workspace, that consisted of 30 channels, built following the *timeline*-based design. On the right hand side, the *activity*-based design is shown for the VVSS2020 workspace, that consisted of 9 channels.

Figure 1. VVTA2017 and VVSS2020 workspaces design.

The first Slack workspace was employed for a short duration course, while the second workspace was used for a whole term course period. The amount of information processed for both courses was similar. Students enrolled in VVTA2017 Slack workspace did not complain about the large amount of channels. Still, the general feedback indicates that students incline for the *activity*-based design for Slack workspaces. This aspect is influenced by the activity range that students are involved in. *Timeline*-based design is hard to manage by the teachers, as channel naming guidelines apply.

5.2. Lessons Learned

Similar to most teaching and learning tools, Slack platform exposes along with benefits several downsides and limitations. Teacher should consider the fact that some student may not have used Slack platform before and there may be a learning curve in the target group. Tool presentations, demos and tutorials on how to use it are welcomed when educators use the same communication platform for several years for different groups.

Students should be coached in the beginning of the course on the main intent of each channel. This helps the students having an overview on the Slack workspace, the activity types and the way the communication will occur using public/private channels and direct messages. When the teacher clarifies from the beginning, students are confident to use it. Teachers should offer technical support on Slack platform for students, when needed.

This cannot be achieved by other administrative staff, especially in cases where many teaching and learning tools are used by different educators. The Slack workspace owners have administrative responsibilities as well. Our experience in using Slack platform for content, communication and collaboration in CS-based courses indicates that each course session should have a dedicated workspace. The use of one a single communication tool instead of several tools that may overlap in some features is reported by Robert Talbert (Talbert, 2019) as well. Public communication using Slack channels and private communication through direct messages is recommended.

Conclusions

This paper addresses the Slack workspace design used for teaching purposes. We have presented *timeline*, *content*, *activity* and *group*-based approaches on the Slack workspace design, that can be combined in order to achieve the learning goals. We have identified several factors that have an impact on deciding the workspace design as: the course duration, participant profile, activity type and frequency, and the teaching and learning resources. We have analyzed the identified Slack workspace design approaches considering the organization, communication and collaboration criteria.

Future research in Slack adoption in the classroom include application integration especially in CS-based courses. More, we intend to pursue our investigation toward the bots development and integration in Slack platform from the teaching perspective, addressing the advantages and possible issues.

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Crystal hetero-structure design with Intel®Parallel Studio XE Fortran

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Abstract
The positions of atoms for un-relaxed structure in a face-centered cubic hetero-structure of conical and hemi-toroidal shapes are obtained by a numerical code written in *Fortran from Intel®Parallel Studio XE. The GaSb/GaAs quantum dot is considered in simulations. The code may be used to introduce university students to the problem of crystal symmetry in the solid state physics and Intel®Parallel Studio XE Fortran programming platform. The code is available at*: https://github.com/tocheche/ICVL_Fortran

1. Introduction

Worldwide efforts to implement technology in support of learning are more intense than ever due to the COVID-19 pandemic. Learning and teaching and in universities involves adapting technology to allows students and teachers access education from anywhere and at any time. In this context, physics is both the manufacturer and the user of technology constantly at the forefront of society's progress. Use of the scientific software programs became the most important tool in the scientific research today. As a result of this trend, the study of scientific software programs and use in teaching plays an important role in physics and programming in universities.

Fortran, C++, Python, Julia, Java are programming languages used in science, engineering, and economics in, for example, machine learning, data processing, statistics, image processing, robotics. Such languages are used to create programs more specific to different research domains. In physic, from a large list, for example, Comsol[1] (a program developed to solve differential equations modeling physical processes) uses Java language, while WIEN2k[2] (a software which solves problems in solid state physics) is written in Fortran.

Since this paper is not intended to be a review, the use of programming in physics is introduced by presenting of several works by the author related to programming, research in physics and educational physics. Other several related works are also mentioned.

Thus, the elastic properties (strain field) of semiconductor quantum dots (QDs), ‘nano’ size semiconductor structures, are investigated. QDs of conical shape are studied within both continuum elastic[3] and atomistic model based on the valence force field method.[4] The atomistic model is developed within a numerical code written in the Visual Fortran[5] from Compaq, while the analytical results are checked with Mathematica.[6] For the study of the core-shell QDs numerical codes written in Fortran provided by both Compaq or Intel and also in Mathematica[7,8,9] are used. The absorption and photoluminescence spectra of GaAs/AlAs and InAs/AlAs in semiconductor QDs[10,11,12], the intrinsic spin Hall conductivity in a two-dimensional electronic gas[13,14,15], the electron transfer reactions and relaxation of dissipative systems[16,17,18,19] are research topics where the author obtained results by writing numerical codes in Fortran and using analytical and graphical functions of Mathematica. Regarding the educational physics, in the study of dynamics of a pulsejet engine in vertical motion in a uniform gravitational field without[20] and with drag[21,22], the probabilistic coin toss modeling[23,24], the complex motion of a gravitational pendulum[25] and the heat transfer in a Puluj type experiment[26], the author used Mathematica, Python, and C++ . From the large list of educational software programs we mention VPython[27] which is often used for animation and 3D representations.[28]

Under the C++, Fortran, Python programming languages, Intel created powerful computing platforms.[29] The main purpose of the paper is to introduce a program, written in Fortran from Intel[30], that is capable of designing semiconductor heterostructures QDs, a nano-structure intensively studied in physics today. In the next section the algorithm and program are introduced, in the third one some results are presented, and the last one encloses conclusions.

2. Algorithm and program

Zinc-blende structure is the generic name given to crystals in which the unit cell has two different atoms; each type of atom is placed in a face-centered cubic (FCC) lattice and any atom is located in the center of a regular tetrahedron which has in the four vertexes the other type of atom. The program locates atoms in FCC symmetry for a QD embedded in a matrix. The QD is a hemi-torus (HT) or cone which stands on a wetting layer (WL) and is embedded in a matrix (rectangular box).

2.1 Algorithm

The QD heterostructure we study has two component materials, GaSb for QD and GaAs for the matrix. Next, to describe the GaSb/GaAs QD heterostructure we name Ga as atom of type 1, Sb as atom of type 2, and As as atom of type 3. The space position of the atoms in bulk zinc-blende structure is such as one of the two species of atoms (Ga or Sb, for example, in GaSb) is translated relative to the other one by a quarter of the lattice constant, *a*, in each of the three orthogonal directions of the *xyz* Cartesian system of coordinates. First, we observe that there are 4 *representative* families of planes parallel to the plane $z = 0$ in the *xyz* system. We start with a one face-centered square with side length equal to *a* and Ga atom placed in the origin of *xyz* Cartesian system of coordinates. Then, in this family of planes the Ga atoms are located at

$$x = ma\,,\ y = na\,,\ x = a/2 + ma\,,\ y = -a/2 + na\,,\ \text{and}\ z = pa \tag{1a}$$

with m, n, p integers. The second representative family of *z* planes for Ga atoms is translated by $x \to x$, $y \to y + a/2$, and $z \to z + a/2$; the position of the Ga atoms in this family of *z* planes is given by

$$x = ma\,,\ y = a/2 + na\,,\ x = a/2 + ma\,,\ y = na\,,\ \text{and}\ z = a/2 + pa\,. \tag{1b}$$

By the translations $x \to x - a/4$, $y \to y + a/4$, $z \to z + 3a/4$, from eq. (1a), we obtain the positions of As atoms in the third representative family of *z* planes as

$$x = a/4(4m-1)\,,\ y = a/4(4n+1)\,,\ x = a/4(4m+1)\,,\ y = a/4(4n-1)\,,\ \text{and}\ z = a/4(4p+3)\,. \tag{1c}$$

By the translations $x \to x + a/4$, $y \to y + a/4$, $z \to z + a/4$, from eq. (1a), we obtain the positions of As atoms in the fourth representative family of *z* planes as

$$x = a/4(4m+1)\,,\ y = a/4(4n+1)\,,\ x = a/4(4m+3)\,,\ y = a/4(4n-1)\,,\ \text{and}\ z = a/4(4p+1)\,. \tag{1d}$$

2.2 Fortran numerical code

In the code, the subroutine FCCbox gives the FCC atom coordinates of the two types of atoms in a box of lattice constant equal to unity. Then, by multiplication of the coordinates of the atoms in the box by the lattice constants of the two materials, a_1 and a_2, two FCC rectangular boxes for the component materials, GaAs and GaSb, are generated. The subroutine ConeQD (or QDHTF) generates the geometrical function for the Cone+WL (or HT+WL) shape and interrogates if the atoms of box 1 are outside Cone+WL (or HT+WL) and the atoms of box 2 are inside Cone+WL (or HT+WL). For example, the function shape in the subroutine ConeQD is written as

```
rho=dsqrt(x**2+y**2)
log1=(rho.le.(h-z)*Rc/h) .and.(z.le.h).and.(z.ge.0d0)     !log1=true for (x,y,z) inside Cone
log2=((z.le.0d0).and.(z.ge.-WL))                          !log2=true for (x,y,z) inside WL
log=log1.or.log2                                          !log=true for (x,y,z) inside Cone+WL
```

where Rc is the base radius of the regular cone and h is the cone height. The function shape in the subroutine QDHTF is written as

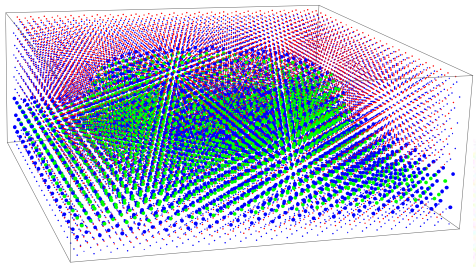
```
Rt1=Rt-Rq
Rt2=Rt+Rq
rho=dsqrt(x**2+y**2)
log1=((rho.ge.Rt1).and.(rho.le.Rt2).and.((rho- Rt)**2+z**2.le.Rq**2) &
     .and.(z.ge.0d0))              ! log1=true for (x,y,z) inside HT
log2=((z.le.0d0).and.(z.ge.-WL))   ! log2=true for (x,y,z) inside WL
log=log1.or.log2                   ! log=true for (x,y,z) inside HT+WL
```

where Rt is the distance from the center of the tube to the center of the torus and Rq is the radius of the tube. The subroutine HTWLB collects the coordinates of atoms located in the QD+WL embedded in the matrix. The subroutine Cross_section collects the atoms located in a layer parallel to the *yz* plane; the layer is centered on the origin of the *xyz* system and has an input thickness. The Fortran code is available at: https://github.com/tocheche/ICVL_Fortran

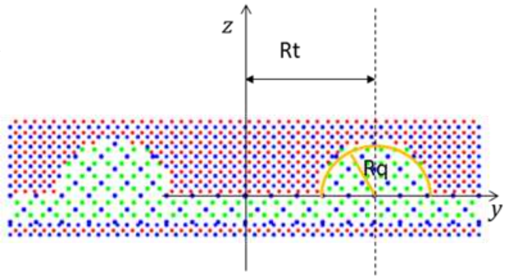
3. Results

To visually feature the difference between the materials composing the heterostructure, imaginary values are chosen for the lattice constants, a_1=4.5Å and a_2=6Å, instead of the realistic ones a_1=5.653Å for GaAs and a_2=6.058Å for GaSb. Figures 1a, b shows the results obtained from the code for GaSb HT QD and wetting layer in a GaAs matrix for an un-relaxed atomic structure with Rt=30Å, Rq=13Å and the cross-section layer width equal to 12Å. Figures 1c, d shows the results obtained with the same semiconductor materials for Cone+WL QD with Rc=30Å, h=30Å, and the cross-section layer width equal to 12Å.

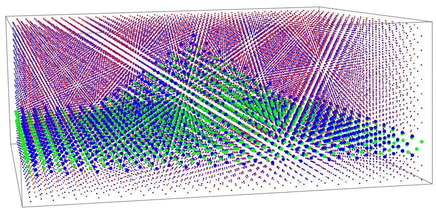
Fig. 1. Un-relaxed atomic structure of GaSb QD and wetting layer in a GaAs matrix: (a) 3D simulation for hemi-torus QD; (b) 2D cross-section for hemi-torus QD; (c) 3D simulation for cone QD; (d) 2D cross-section for cone QD. The width of cross-section parallel to the *yz* plane centered on the origin of *xyz* Cartesian system of coordinates is 12Å.



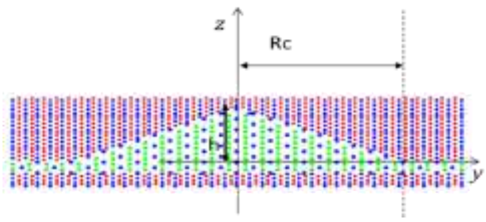
(a)



(b)



(c)



(d)

Conclusions

The Fortran code we presented designs the un-relaxed position of atoms in an QD+WL embedded in a matrix for two QD shapes, cone and hemi-torus and. The code may be used in teaching the symmetry in crystal heterostructures and introducing Fortran. By writing appropriate subroutines it may be used to design practically any regular QD shape embedded in a matrix. The results may be compared with the code written by the author in Mathematica for the same problem.[31] The code might be used in research as the beginning part in the study of elastic properties of heterostructures QD by allowing the atoms to relax toward their equilibrium positions.

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Interdisciplinary study of fluid dynamics using interactive conceptual maps

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Abstract

Nowaday students don't want to study in the way their parents did. The problem could be solved by changing the teaching methods, by creating a constructivist learning environment. This paper proposes an interdisciplinary study of the fluids in our lives through conceptual maps, by combining the fields of instruction and technology. The concept map, made on three levels, introduces a presentation in Microsoft Office Power Point 365 with some hyperlinks to 3D educational animations on the Mozabook digital interactive lesson creation platform through which the teacher can show his creativity in teaching. Level 2 concept map is an exposition of fluids in science. The level 3 concept map presents some applications of fluid dynamics in biophysics, more specifically in blood circulation, namely: the first application involved calculating the speed of blood flow through the aorta, the second application estimated the value of Reynolds number for blood flow through the aorta, through the third application the value of the blood speed in the capillaries was obtained and the last one refers to the pressure exerted by the blood on the walls of the blood vessels, being able to explain the phenomenon of regulating blood flow through fluid dynamics laws.

Keywords: fluid's dynamics, conceptual maps, interdisciplinarity.

1.Introduction

Most published articles describing the use of the concept map concept refer to Novak and Gowin. The "Novakian standard concept map format" is used on the IHMC CmapTools website (Cañas and al, 2004) as well as on the website of the First International Conference on Mapping Concepts (Åhlberg, 2004). The development of efficient pedagogical strategies has led to an understanding of how students learn, so that they can easily deepen and retain new concepts. When concept maps are integrated in a way significant and systematic in teaching, the effectiveness is better compared to the usual modes of teaching (Osman and al, 2013).

2.Concept mapping: a short theoretical background

From the perspective of the cognitive theory of learning on the behavioural approach of the 1960s, the teaching had to be carried out so that the learning material was conceptually clear and adapted to the previous knowledge of the students (Ausubel, 1968). As educational research tools, concept maps were used as data analysis tools in 1972 (Novak and Cañas, 2006). The importance of students' prior knowledge inspired Novak and Gowin to introduce teaching alternatives, including concept maps. They also observed that making concept maps is a creative activity, in which the student makes sustained efforts to clarify the meanings of concepts in a particular field (Novak and Gowin, 1984). Since 2000, Edmondson says concept maps have been widely used for effective teaching. The map was useful not only in presenting the qualitative aspects of learning, but could also be used as an assessment tool (Edmondson, 2000). In the teaching and learning processes, the conceptual map is used to introduce new information based on the knowledge that students already possess (Gurlitt, and Renkl, 2010). It was later shown that the concept map is useful for knowledge transfer in several stages of learning, namely: acquisition, communication, application, acceptance and assimilation (Tseng and al, 2012).

3.Interdisciplinarity in fluid dynamic's

Liquids dominate physical phenomena from the microscopic scale of biological activities to the macroscopic scale of galactic structures. Fluids more or less ensure our comfort, indoors or outdoors, influence our recreational and entertainment activities (McDonough, 2009). As it is quite difficult to maintain the concentration of high school students during one class, it is important to use the computer during teaching activities. Technology causes major changes if used in the classroom (Bransford et al, 1999). Solving students' concentration problems involves a different way of interdisciplinary teaching of physics, using graphic organizers.

4.The constructivist approach of the fluid's dynamics

A constructivist environment is inclusive, interactive and receptive that generates cooperative learning and reflects a democratic management and organization that allows teachers and students to share responsibility in decision making (Aitken and Deaker, 2008).

In the conceptual map presented in figure 1, the main concept is "fluid dynamics", fluids that at pre-university level can be studied both within the "ideal fluid" model as well as "real fluids", a situation encountered in reality. Starting from the "ideal fluid model", the properties of the ideal fluids were described, namely the fact that they are incompressible and free of viscosity. The level 1 concept map shows the quantities that characterize the ideal fluid flow: mass flow, volume flow and the relationship between them. These are given by relations [1], [2] and [3].

[1] $$Q_m = \frac{dm}{dt}$$

[2] $$Q_v = \frac{dV}{dt} = \frac{Svdt}{dt} = Sv = S\pi r^2$$

[3] $$\frac{dm}{dt} = \frac{d}{dt}\int_{R(t)} \rho dV = 0$$

The incompressibility of fluids and the fact that they are continuous structures implies a finding that boils down to the continuity equation presented and its differential form, a form that could be taught in the eleventh grade, because students had the necessary mathematical analysis understanding. Bernoulli's equation [4] shows students that along a current tube the total pressure in the fluid is constant.

[4] $$p_1 + \frac{\rho U_1^2}{2} + \rho g h_1 = p_2 + \frac{\rho U_2^2}{2} + \rho g h_2$$

[5] $$\nabla \times U = 0$$

Equation (5) tells us that velocities are an irrational field. The two equations [3] and [4] are valid for the ideal fluid model, as shown in Figure 1.

The continuity equation [3], which appears in the first level of conceptual map, is also valid in the case of blood circulation through blood vessels, circulation shown in figure 3.

The flow of a fluid through a hole gives rise to reaction forces on the rest of the system. The force, determined by the impulse variation, is friction, independent of the fluid density. This reaction force, given by relation [6] is an application of fluid dynamics and is also presented in the level 1 concept map. This effect is used for rocket propulsion studied as the movement of a solid in a fluid, in connection with the aerodynamic lift.

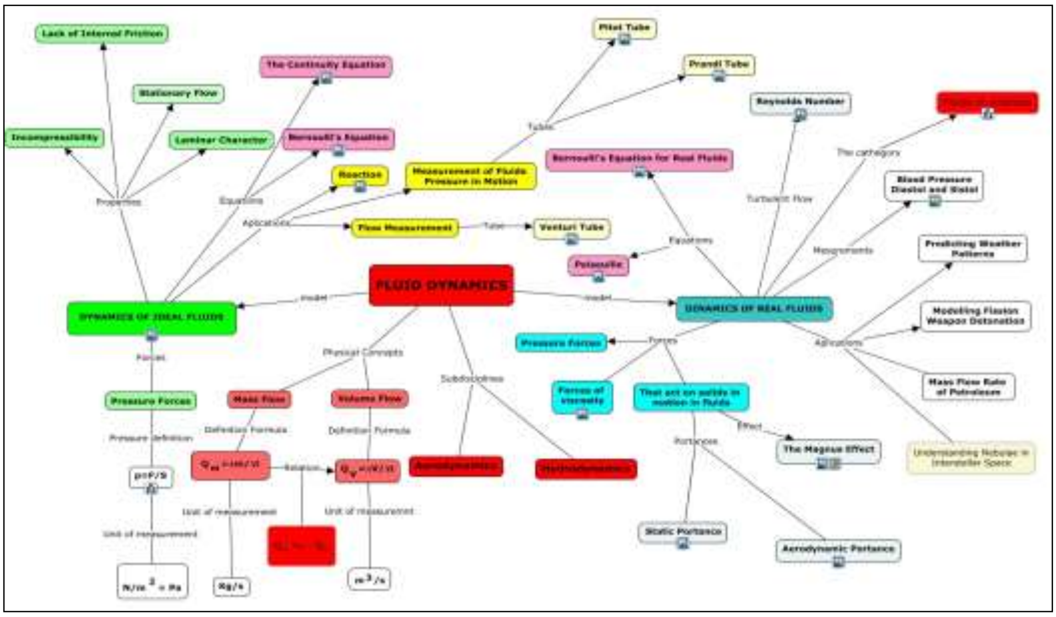


Figure 1. The first level of conceptual map; ideal and real fluids

[6] $f_{reaction} = \dfrac{v\Delta m}{\Delta t} = \rho S v^2 = 2S\left(p - p_a\right)$

Starting from Bernoulli's equation [4] we were able to explain to students its practical applications in aeronautics: Pitot Tube and Prandtl Tube. Also in the first level of conceptual map appear the Pitot type probe, which allows the measurement of the total pressure and the Prandtl type probe needed to measure the dynamic pressure, which uses the manometer in a differential assembly. In the processes where permanent pressure loss is not tolerable are used Venturi Tubes. Also Venturi Tubes are used where maximum accuracy is needed in case of highly viscous liquids.

Referring to the dynamics of real fluids, the classification of the type of laminar, turbulent or transition flow between the two types is made according to the Reynolds number given by equation [7]:

[7] $R_e = \dfrac{\rho D \bar{v}}{\eta}$

The resistance force in the case of a body moving in a fluid depends on the square of the speed of movement of the body but also on its surface, as observed in relation (8).

[8] $F_r = C \cdot S \cdot \dfrac{1}{2}\rho v^2$

Relation (9) is obtained from the elementary volume flow of liquid flowing through a portion between r and și $r + dr.$

[9] $dQ_V = v(r)dS = \dfrac{\left(R^2 - r^2\right)}{4l\eta} 2\pi r dr$ z, where $dS = 2\pi r dr$ it represents the area of the circular crown.

$$[10]\quad Q_V = \frac{\pi R^4}{8\eta} \cdot \frac{p}{L}$$

According to Poiseuille's formula, given by relation [10], a doubling of the pipe diameter caused a 16-fold increase in flow, while keeping the diameter constant, the same effect could be obtained by a 16-fold increase in pressure. The effect is used in medical practice, when it is necessary to introduce fluids into the body under conditions of physiologically limited pressure and the flow is important for the success of the maneuver.

As fluids are found everywhere, from the microscopic to the macroscopic level, students were asked to find applications of fluid dynamics, applications found in the level 2 concept map in Figure 2, which shows the dynamics of fluids found in science: atmospheric physics, oceanography, geophysics. The volcanic eruptions that cause earthquakes and the movement of tectonic plates are part of the category of convection phenomena in the Earth's mantle. In the Earth's core, the convection phenomenon determines the appearance of its own magnetic field. Following the concepts in the macroscopic domain of the second level of conceptual map, we arrive at astrophysics, the movement of galactic structures and stellar evolutions from gravitational collapse to death as supernovae.

Fluid dynamics is found in cellular processes and in the respiratory and circulatory systems of organisms. Because the heart is the central organ of the blood circulation system, the study of the heart has been very suitable for an interdisciplinary study. Having the role of pumping blood in the network of vessels made up of the arterial and

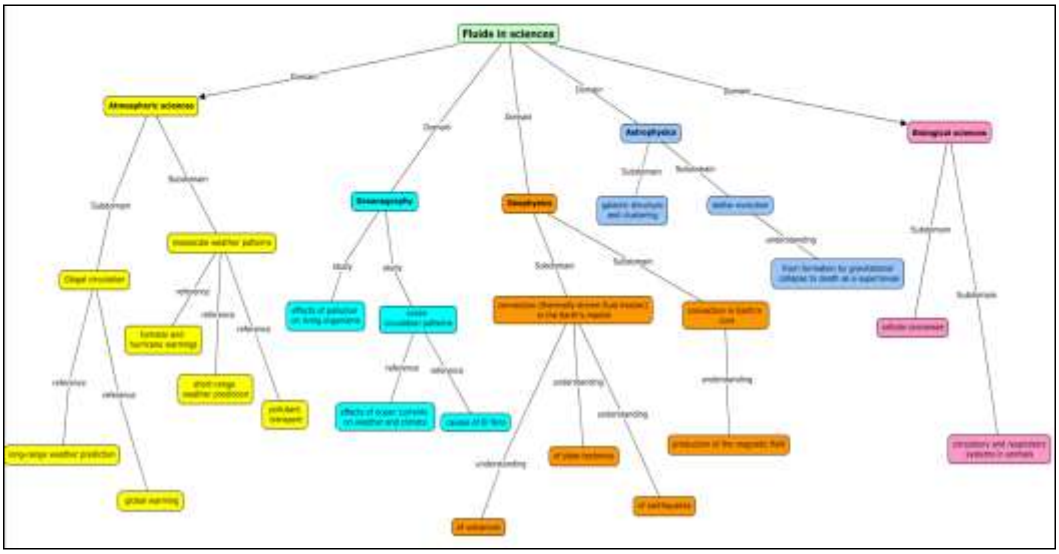


Figure 2. The second level of conceptual map; fluids in science

venous shaft, the heart could be likened to a double suction-repellent pump, with ”coupled” circuits: one circuit is of the lungs, the other of the rest of the body.

In Microsoft Office Power Point 365 you can insert a hyperlink to a 3D model of the heart, which can be rotated and viewed from all angles. The 3D models were taken from the Mozabook interactive digital lesson creation platform. The insertion of the 3D model is shown in Figure 3. To view the 3D animation on the computer you must install the m3dviewer program that can be used on both Windows 10 and Android.

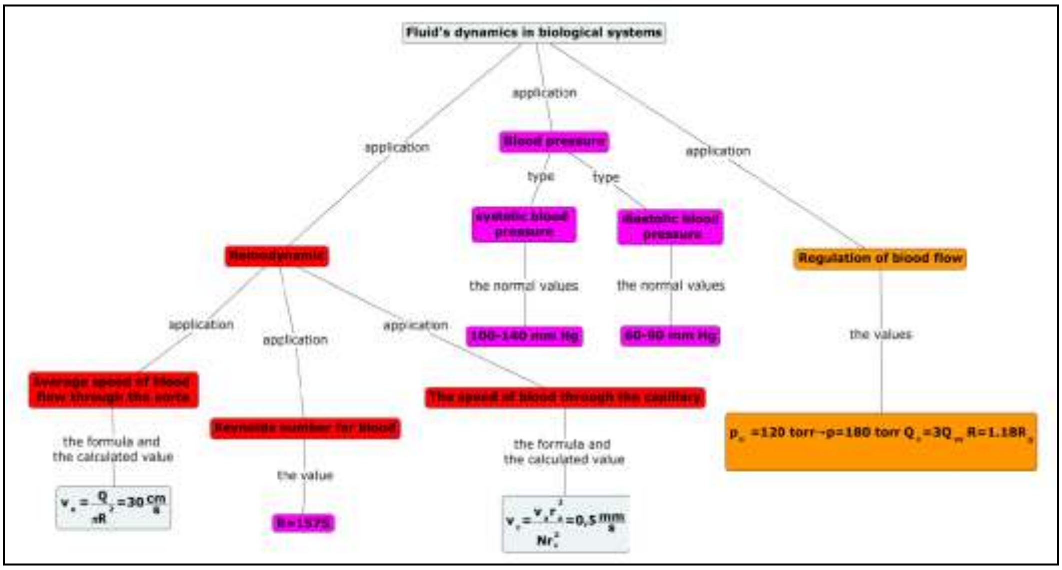
Figure 3. The insert of 3D animation in Microsoft Office Power Point 365 from Mozabook

The third level of conceptual map in Figure 4 shows three applications of fluid dynamics in biophysics and, more specifically, in blood circulation.

The first application involved calculating the speed of blood flow. Knowing that the volume of blood flows through the aorta $Q_v = 5{,}65\frac{l}{\min}$ and the value of the radius of the aorta $r = 1\text{cm}$, we were able to calculate the average speed of blood flow through the aorta. Starting from the relation [2] that connects the volume flow to the flow rate, it results:

Figure 4. The third level of conceptual map; fluid's dynamic in biological systems

[11] $v = \frac{Q}{\pi r^2} = 30\frac{cm}{s}$



By a second application it was possible to estimate the value of the Reynolds number for the flow of blood through the aorta, considering the density of the blood $\rho = 1050 \frac{Kg}{m^3}$, $r = 1$ cm, blood velocity $v = 30 \frac{cm}{s}$ and the viscosity coefficient $\eta = 4.10^{-3} daP$. Using formula [7] we obtain R=1575, so the students came to the following conclusion: the blood flow through the aorta is laminar and is quite close to a turbulent one.

The third application referred to the calculation of blood velocity in capillaries. The blood in the aorta finally reaches the capillary network. The radius of the aorta is given above, the number of capillaries in the human body is approximately $N = 4 \cdot 10^9$ and their average radius is $r_c = 4 \cdot 10^{-4} cm$. Starting from these values it was possible to determine the speed of the blood through capillaries. We considered blood as an incompressible fluid, we applied the continuity equation [3] in the form:

[12] $v_a S_a = N v_c S_c$

where v_a is the speed of the blood through the aorta, S_a the area of the aortic section, v_c is the speed of the blood through the capillaries and S_c the area of the capillary section. Then:

[13] $v_a \pi r_a^2 = N v_c \pi r_c^2$ and it results:

[14] $v_c = \frac{v_a r_a^2}{N r_c^2} = 0{,}5 \cdot 10^{-3} \frac{m}{s}$

Another application in the level 3 concept map is the pressure exerted by the blood on the walls of the blood vessels. Because the contraction and relaxation of the heart causes an oscillating flow of blood through the human body, blood pressure must be measured both at the time of heart contraction-systole and at the time of relaxation-diastole.

And the regulation of blood flow could be explained using fluid dynamics. Blood pressure when the body is at rest is p_0=120 torr and the blood flow is $Q_{v0}=5\frac{l}{\min}$. In the case of physical effort it increases to $Q_v=15\frac{l}{\min}$ and the pressure at p=180 torr. Then from the relation of Poiseuille (9) it was obtained:

[15] $Q_0 = \frac{\pi R_o^4}{8\eta L} p_0$

[16] $Q = 3Q_0 = \frac{\pi R^4}{8\eta L} p$

It follows from relations [15] and [16] that $R = 1.18 R_0$. This means that the radius of the artery increases. So, by changing the radius of the blood vessels in the arterial system, the blood flow is controlled and the increase in blood flow is done without the pressure in the blood vessels increasing much. It follows that the arteriole system largely controls blood flow.

Conclusions:

Interactive tools can be used in the teaching, learning and assessment processes. The concepts and connecting words were chosen carefully, so that the concept maps have become particularly useful tools for observing the nuances, helping the students in organizing the thinking, summarizing the studied subject. From an educational perspective, a growing number of researchers in the field indicate that the use of concept maps can significantly facilitate learning (Coffey and al, 2003). The result was a spatial organization of knowledge about fluids and their dynamics. The students built their own maps using a version of CmapTools, and the goal was for the students to succeed in their study efforts. Concept maps have contributed to improving the quality of teaching and evaluation of fluid dynamics in pre-university education, being designed as computer tools in a constructivist environment.

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Mathcad interactive didactic tool for studying the trajectory of a satellite around the Earth

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Abstract

The manuscript describes an interactive teaching tool made with worksheets in Mathcad for studying the trajectory of a satellite around the Earth. The satellite is modeled as a mass point, while the rotational motion of the Earth around its own axis is neglected. Depending on the initial conditions specified by the launch altitude, the initial velocity and the angle between the initial velocity vector and the initial vector radius, the trajectory of the satellite is plotted. It is shown how the facilities of Mathcad worksheets for numerical calculation and for graphical representation in polar coordinates can be explored. The modification of the initial conditions allows for the observation of the feedback on the elliptical trajectory. Thus, there can also be obtained the particular situations corresponding to the ballistic trajectory or the escape from the terrestrial gravitational field when the trajectory becomes a parabola or a hyperbola. The use of this tool in the classroom helps students to develop their graphic representation skills in Mathcad for the study of the motion in a central force field. Students can clarify how the initial conditions determine the trajectory of a mass point in a central force field with gravitational potential.

Keywords: Mathcad, didactic tool, artificial satellite, central force field, gravitational potential, physics education.

1 Introduction

The problem of motion in a central force field is one of the most studied problems of classical mechanics given its importance for astronomy and astrophysics, as well as atomic physics. For the teaching and learning of this topic, a series of didactic tools have been elaborated, thoroughly described in the specialized literature.

The "safety domain" of the elliptical orbits of the satellites, respectively the ballistic trajectories of missiles in the central gravitational field was studied, compared to the parabolic trajectories of the projectiles in the uniform gravitational field. Examples of practical uses of the envelope of the family of orbits were discussed (Butikov, 2015). The n-dimensional problem of Kepler-Coulomb orbits was investigated by generalizing the angular momentum and the Laplace-Runge-Lenz vector in several dimensions. It has been shown that Kepler's three laws remain valid even in higher dimensions by establishing analogies between the physical quantities characteristic of an orbital motion both from a conventional and an n-dimensional approach (Önder and Verçin, 2006). An attempt was made to generalize Bertrand's theorem for the motion in a central force field for relativistic systems. Thus, a stability criterion was deduced for the central potential that produces stable orbits in the relativistic motion. It has been shown that the Coulomb potential passes the stability test for circular orbits at relativistic velocities while the harmonic potential determines the instability of the orbits (Kumar and Bhattacharya, 2011).

The radial motion of an object in the gravitational field generated by a single isotropic mass distribution at the origin was studied. Using the Mathcad program, various star trajectories were analyzed for a given distribution of the galaxy mass (Zürcher and Kaufman, 2011). The PROPAT

Matlab function package to simulate the orbit of a satellite was described and several simulations performed with this package were presented, for example for the 1U CubeSat satellite (Carrara, 2015). In the C^{++} programming environment, using the Qt Framework, the GUI software package was created to simulate the dynamics of satellites near the Earth (Ivanov et al, 2019).

The motion in the central gravitational force field was also approached with Excel spreadsheets. It has been shown that the spreadsheet can provide concrete models for the motion of the satellite. Thus, using the iterative method of solving the equations of motion in the gravitational field, the trajectory of the satellite can be graphically represented in the spreadsheet (Quale, 2012). In the approximation of the constant gravitational field and in the presence of a resistive medium, tools were described both for the study of vertical motion (Grigore and Barna, 2015; Grigore et al, 2017 b) and for the study of projectile motion (Grigore et al, 2017 a).

This paper describes an interactive teaching tool made with worksheets in Mathcad to study the trajectory of a satellite around the Earth. The satellite is considered a point mass while neglecting the rotational motion of the Earth around its own axis. Depending on the input data, the trajectory of the satellite launched into orbit around the Earth can be reproduced. The modification of the initial conditions allows the observation of the feedback on the elliptical trajectory. Also, particular cases can be obtained corresponding to the ballistic trajectory or the escape from the terrestrial gravitational field when the trajectory becomes a parabola or a hyperbola.

2 Theoretical background

We consider a body of mass m, modeled as a point mass, which moves in the gravitational field of a massive body of mass M, where M>>m. In relation to an inertial reference system related to the mass body M, the trajectory of the point mass is a conic whose equation, in polar coordinates (r, θ), is transcribed (Aaron, 2002):

$$[1]\quad r_{(\theta)} = \frac{p}{1+\varepsilon\cos(\theta-\gamma)}$$

In equation (1) p is the semi-latus rectum of the conic, ε is the eccentricity and γ the anomaly angle.

The measures p, ε and γ are determined by the initial conditions of the motion.

We set the initial conditions by the distance from the center of force, r_0, the magnitude of the velocity vector, v_0, and the angle α_0 between the position vector $\vec{r}_0$ and the velocity vector $\vec{v}_0$ as shown in figure 1.a.

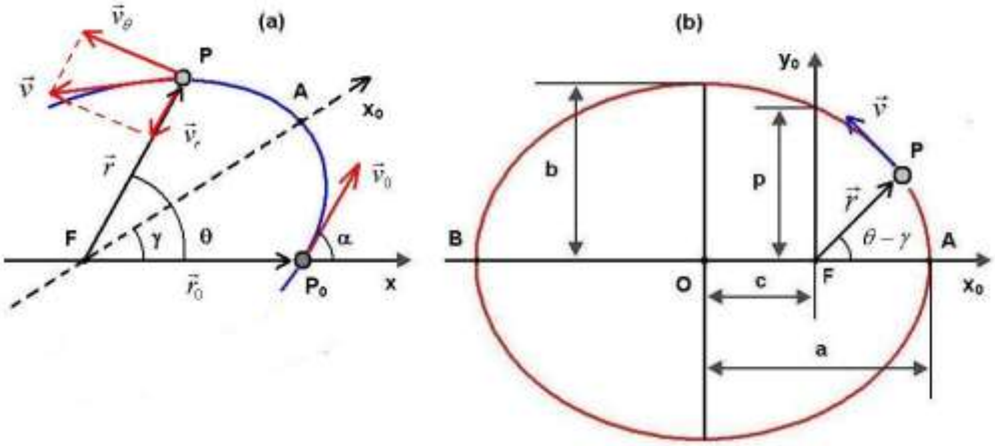

Figure 1. Motion in a central force field: a) Specifying the initial conditions; b) Elliptical trajectory relative to the symmetry axes

The angular momentum of the point mass, L, and the total energy of the system formed by the two bodies, E, are conserved. We have:

[2] $L = mr^2\dot{\theta} \qquad E = \frac{1}{2}mv^2 - k\frac{mM}{r}$

where k represents the gravitational constant and v is speed of point mass.

The two constants of motion, L and E, can be transcribed according to the initial conditions:

[3] $L = mr_0 v_0 \sin\alpha_0 \qquad E = \frac{1}{2}mv_0^2 - k\frac{mM}{r_0}$

The semi-latus rectum p, the eccentricity ε and the angle γ between the axis Ox and the symmetry axis Ox_0 of the conic is calculated as follows:

[4] $p = \frac{L^2}{km^2M} \qquad \varepsilon = \sqrt{1 + \frac{2EL^2}{k^2m^3M^2}} \qquad \gamma = arctg\,\frac{p}{(r_0 - p)tg\alpha_0}$

If E<0 then the trajectory is an ellipse having one of the foci in the force center. The semi-axes of the ellipse, a and b, the focal distance c and the orbital period T are given by the relations:

[5] $a = \frac{kmM}{2|E|} \qquad b = \frac{L}{\sqrt{2m|E|}} \qquad c = \varepsilon a \qquad T = 2\pi\sqrt{\frac{a^3}{kM}}$

During the motion on the elliptical trajectory, the minimum and maximum distance of the point mass from the center of force (distance to the perigee, respectively to the apogee), are given by the equations:

[6] $r_{\min} = a(1-\varepsilon) \qquad r_{\max} = a(1+\varepsilon)$

The velocity of the point mass according to the vector radius is calculated taking into account the conservation of the total energy given by equation (2). We obtain:

[7] $v_{(r)} = \sqrt{\frac{2E}{m} + \frac{2kM}{r}}$

To calculate the maximum velocity – velocity at perigee, respectively the minimum velocity – velocity at apogee, we replace r_{min}, respectively r_{max}, from relations [6] in equation [7].

3 Organization of Mathcad worksheets

The Mathcad document for studying the motion of a satellite around the Earth is divided into three sections: Input Data, Solution, and Results, each section having its own subsections. Figure 2 shows the Mathcad sheet with the Input and Solution Data sections.

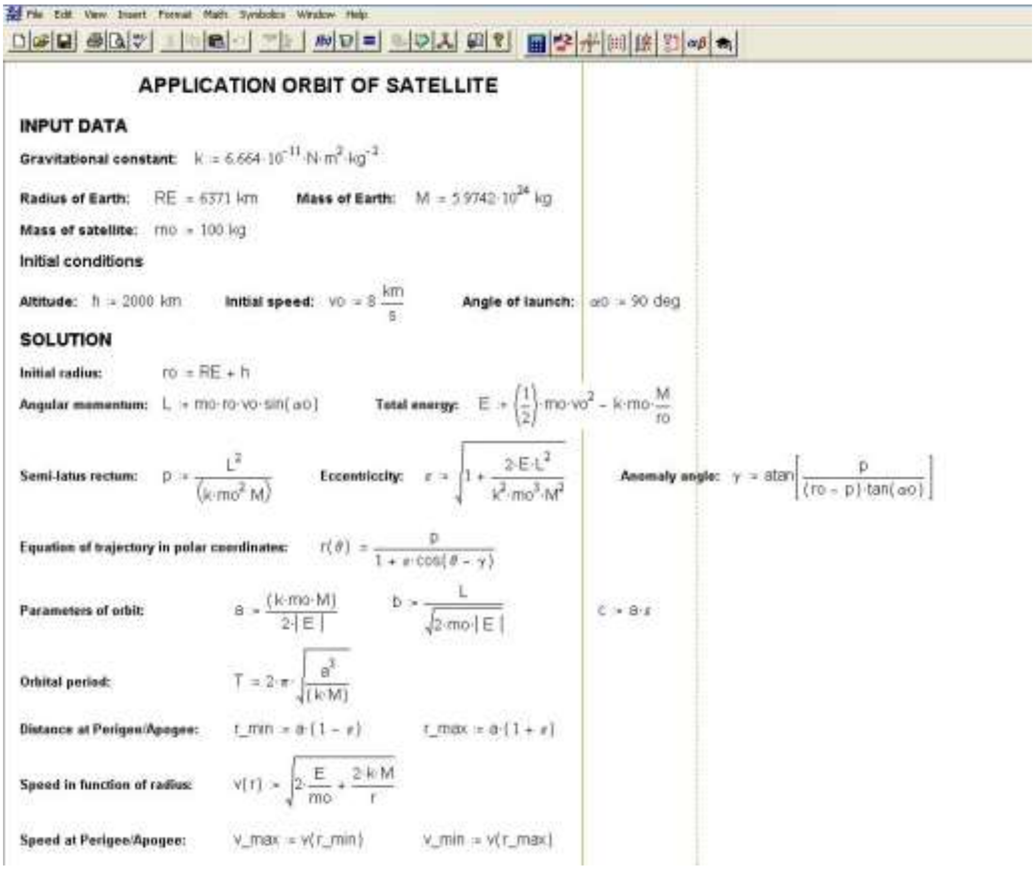

Figure 2. Mathcad worksheet with the sections Input Data and Solution

The input data are grouped into two subsections, General data and Initial conditions. In the General data subsection the following parameters are introduced: gravitational constant, k; radius of the Earth, RE; mass of the Earth, M; satellite mass, mo. In the Initial conditions subsection the following parameters are introduced: altitude, h; initial velocity, vo; launch angle αo which represents the angle between the vectors $\vec{v}_0$ and $\vec{r}_0$. The numerical value of each parameter from the input data has been multiplied by the corresponding unit of measure considering that the Mathcad program also includes the units of measurement in the calculations.

In the Solution section we have written the calculation formulas taking into account the order in which the Mathcad program reads them, namely, from top to bottom and from left to right. This feature of the program allows a compact dimensioning of the solution of the approached problem.

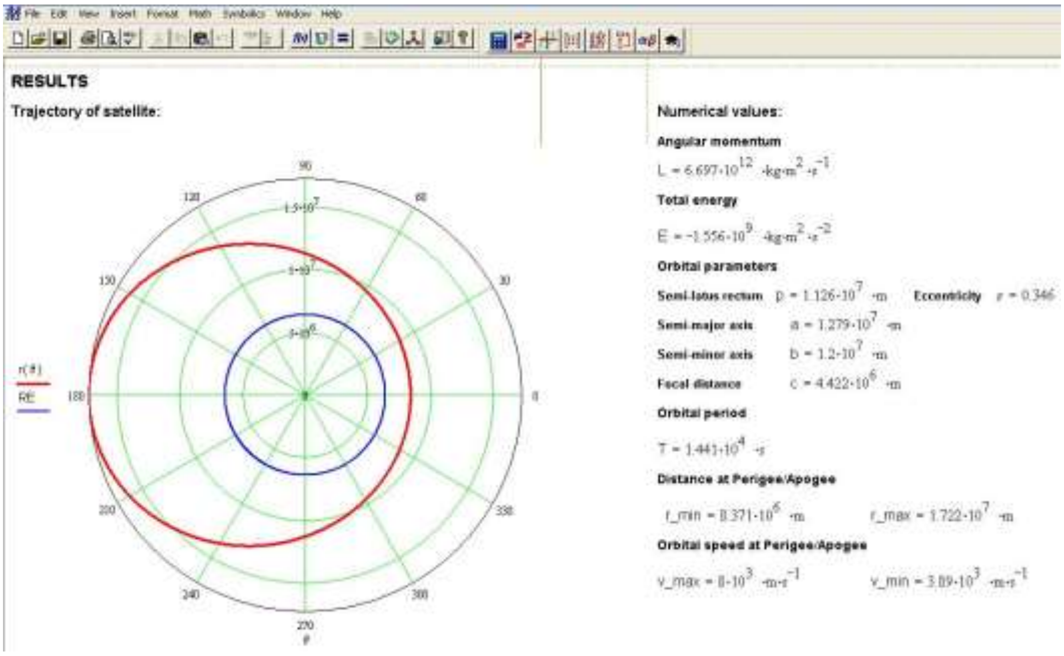

Figure 3. Mathcad worksheet with the Results section. The trajectory of the satellite around the Earth for m_0=100 Kg, h=2000 Km, v_0=8 Km/s, α_0=90°

On the first line of the Solution section we have written the Mathcad formula for the magnitude of the initial vector radius, r_0, as the sum between the Earth radius and the launch altitude:

[8] $ro := RE + h$

On the second line we have written the Mathcad formulas to calculate the angular momentum, L, and the total energy, E. To do so, we have transposed in the Mathcad worksheet equations (3) taking into consideration the initial conditions set in the input data:

[9] $L := mo \cdot ro \cdot vo \cdot \sin(\alpha o)$ $\qquad E := \left(\frac{1}{2}\right) \cdot mo \cdot vo^2 - k \cdot mo \cdot \frac{M}{ro}$

Next, on the third line, we have written the Mathcad formulas to calculate the semi-latus rectum p, eccentricity ε and the anomaly angle γ according to equations (4).

On the fourth line of the Solution section we have written the Mathcad formula to calculate the equation of the trajectory in polar coordinates in conformity with relation (1). On the following lines we wrote the Mathcad formulas for the calculation of the trajectory parameters, of the orbital period and of the distances and velocities at perigee and apogee according to equations (5)-(7).

The Results section comprises two subsections:

- In the first subsection, as seen on the left side of figure 3, the trajectory of the satellite in a reference system associated with the polar coordinates is shown. The trajectory curve is colored red and the circle associated with the surface of the Earth is colored blue. It is observed that the center of the Earth is one of the foci of the ellipse.
- In the second subsection, shown on the right side of figure 3, the numerical values for the following parameters were calculated: the angular momentum L, the total energy E, the semi-latus rectum p; the eccentricity ε, the semi-axes of the ellipse a, b and the focal

distance c; the orbital period T; the minimum distance r_{min} and the maximum distance r_{max} from satellite to center of force; the maximum velocity v_{max} and the minimum velocity v_{min} of the satellite in orbit (the velocity at perigee and the velocity at apogee). The units of measurement of the calculated quantities are rendered in the International System.

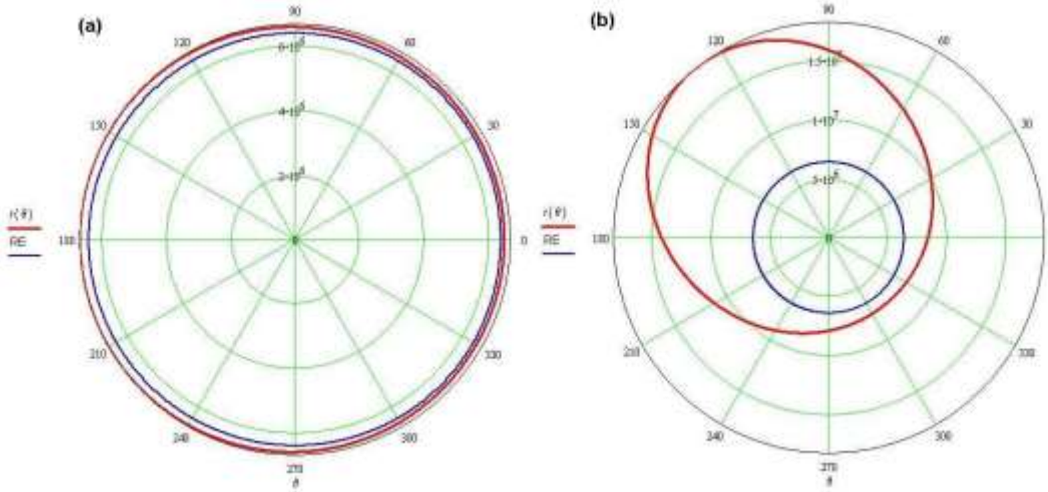

Figure 4. a) Trajectory of the satellite for h=100 Km, v_0=7.9 Km/s, α_0=90°; b) Trajectory of the satellite for h=2000 Km, v_0=8 Km/s, α_0=75°

For the construction of the satellite trajectory we have used the Insert menu, chosen the Graph option, and from the drop-down menu we have opted for the Polar Plot. Following the Polar Plot command, in the current position of the cursor on the surface of the Mathcad window, the construction area of the graph in polar coordinates was inserted.

In the place-holder associated with the horizontal axis we entered the angular coordinate θ and in the place-holder associated with the vertical axis we entered the parameters RE, the radius of the Earth, and r(θ) - the function associated with the equation of trajectory in polar coordinates given by equation 1.

With the help of the Mathcad tool we further describe various situations for launching a satellite with a mass m_0=100 Kg:

A. Launch from the height h=2000 Km with velocity v_0=8 Km/s below the launch angle α_0=90°. This is the situation shown in figure 3. In the subsection on the left of the figure is shown the trajectory of the satellite and in the subsection on the right the numerical values for the measures characteristic of the orbital motion.
B. Launch from the height h=100 Km with the velocity v_0=7.9 Km/s below the launch angle α_0=90°. Basically, we can consider that the satellite is launched close to the surface of the Earth. In this case we obtain the trajectory from figure 4.a. It is observed that the ellipse closely follows the surface of the Earth, i.e. it can be approximated with a circular trajectory. We are close to the limit state of the first cosmic speed.
C. Launch from the height h=2000 Km with the velocity v_0=8 Km/s below the launch angle α_0=75°. In this case the elliptical trajectory is inclined to the axis from which the angular coordinate θ is measured, as seen in figure 4.b.
D. Launch from h=100 Km with the velocity v_0=8 Km/s below the launch angle α_0=60°.

This is the case of the ballistic trajectory. The motion of the body is delimited by the launch point and the point where the ellipse intersects the surface of the Earth as seen in figure 5.a.

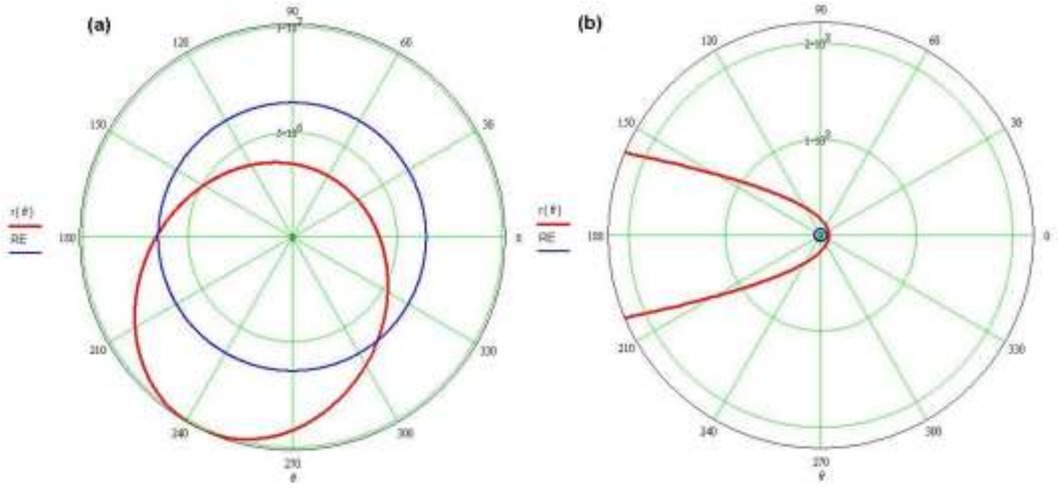

Figure 5. a) Ballistic trajectory for h=100 Km, v_0=8 Km/s, α_0=60°; b) Satellite parabolic trajectory for h=2000 Km, v_0=9.76 Km/s, α_0=90°

E. Launch at height h=2000 Km with the velocity v_0=9.76 Km/s under the launch angle α_0=90°. In this case, the trajectory of the satellite is parabolic as shown in figure 5.b.

Conclusions

The use of this tool in the classroom helps students to develop their graphic representation skills in Mathcad for the study of the motion in the central force field. Students thus explore the polar coordinate system and the modalities of graphical representation in this coordinate system. Students can clarify how the initial conditions determine the trajectory of a point mass in a central force field with gravitational potential.

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Computer programs: Mathcad 7.0

Arduino Setup Used as Didactic Tool for the Dynamic Study of Torsion

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Abstract

The paper presents investigations of the dynamic study for the torsion of a wire by means of an experimental setup based on an Arduino micro-controller device. This method turns out to be very efficient, while the experimental results are in very good agreement with the theoretical calculations and with other investigation methods. Moreover, the Arduino based data acquisition setup is cost effective, easy to install and operate and the software is free (also open source). This approach represents an integration of new technologies in physics education, offering users applicable modern alternatives in didactic physics laboratory.

Keywords: Arduino, Dynamic study of the torsion, Physics education

1 Introduction

Theoretical approach [Cheche and Barna, 2006; Cheche and Chang, 2005], modelling-based learning activities [Marciuc et al, 2016; Grigore et al, 2013; Marciuc and Miron, 2018; Grigore et al, 2015; Lazar 2019] and experimental data [Pantazi et al, 2019; Dinu et al, 2019; Barna et al, 2004; Gatin et al, 2000a; Gatin et al, 2000b] play a crucial role in understanding and learning the concepts of physics. There is large diversity of results through scientific studies in traditional face-to-face or in blended educational frameworks [Lazar et al, 2020]. Investigation Based Learning (IBL) approaches lead to a better understanding of the physics phenomena and of the used concepts [Galan et al, 2017] that can be used in all teaching and learning contexts.

In this respect, experimental devices adequate to the needs of the proposed investigation, that provide a high level of precision, while being explicit and modern, are very useful. Projecting an experimental setup, including the means of measuring and data analysis can develop students' competences in a high degree and help them to better understand the theoretical abstract notions and how they fit in the daily life, to make connexions between concepts, between theoretical models and real phenomena [Wong et al, 2015; Dauphin and Bouquet, 2018; Liang et al, 2017].

Using new technologies in physics laboratories is highly necessary from many points of view. Firstly, it helps to increase the precision of the measurements and ease the calculus part, graphic construction, while leading to more accurate results with lower error level. In many situations, use of new technologies is a cheaper procedure to update the physics laboratories using electronic devices instead of the old ones.

The authors already tackled the dynamic study of torsion by means of video analysis procedure with tracker software [Chiriacescu et al, 2020a] and the present paper represents another experimental approach while using an Arduino device.

2 Experimental setup and methodology

For the dynamic study of torsion, we used an experimental device (Fig. 1) made up by two main parts: the mechanical part (a torsion pendulum) identical with that one used in [Chiriacescu et al, 2020a] and the electronic part for measurements (Arduino device and required auxiliaries).

The main mechanical part of the setup consists of a steel-string vertically suspended on a fixed stand. On the wire, a rod is attached horizontally and symmetrical with respect to the vertical axis. Two identical cylinders are attached to the rod. The cylinders can slide along the rod (the small grooves allow positioning the cylinders symmetrical on both sides of the rod). The device has also a circular protractor that allows the measurement of the deviation angles from the equilibrium position.

The main goal of the experimental setup is to determine the torsion constant C of the wire following the relation [Chiriacescu et al, 2020a; Ciucu et al, 2009; French, 1971; Hristev, 1984]:

$$T_0 = 2\pi\sqrt{\frac{I_0}{C}} \tag{1}$$

where T_0 is the period of oscillation of the rod and I_0 is its moment of inertia about the axis passing through the center.

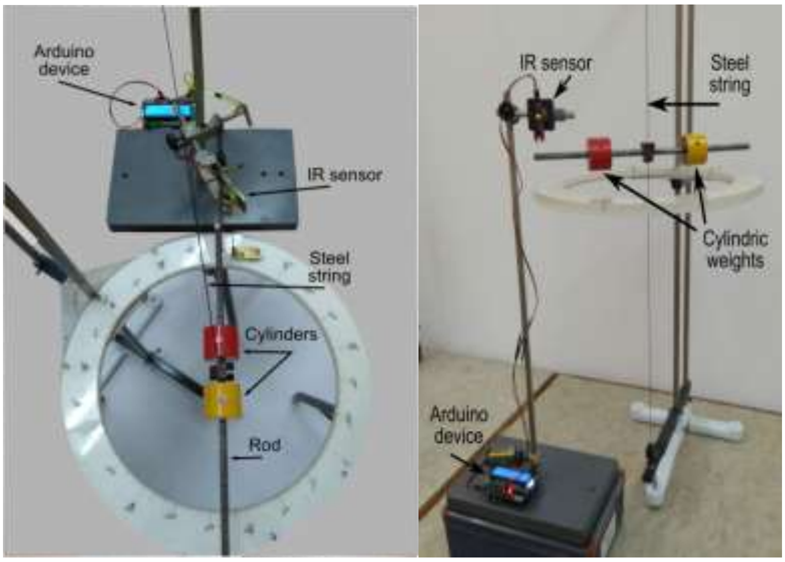


Fig. 1. Details of the Experimental Device.

The values for the parameters of the experimental setup are summarized below [Chiriacescu et al, 2020a; Ciucu et al, 2009]:

- length of the rod: $l = 358 \pm 1\ mm$;
- mass of the rod: $m_0 = 150 \pm 0.5\ g$;
- mass of a cylinder: $m_c = 350 \pm 1\ g$;
- length of the cylinder: $l_c = 35 \pm 1\ mm$;
- outer radius of the cylinder: $R = 20 \pm 0.05\ mm$;

- inner radius of the cylinder: $r = 3.95 \pm 0.05\ mm$;

The above values are used to estimate the following main physical quantities that are later employed in the data processing [Chiriacescu et al, 2020a; Ciucu et al, 2009]:

- moment of inertia of the rod about the axis passing through its center:

$$I_0 = \frac{1}{2} m_0 l^2 = 1.602 \cdot 10^{-3}\ kg \cdot m^2 \quad [2]$$

- moment of inertia of a cylinder relative to its center

$$I_c = \frac{1}{4} m_c \left(r^2 + R^2 + \frac{1}{3} l_c^2 \right) = 0.072 \cdot 10^{-3}\ kg \cdot m^2 \quad [3]$$

- moment of inertia of the ensemble of the rod and the cylinders situated with their centers situated at distance d from the wire (which coincides with the center of the rod):

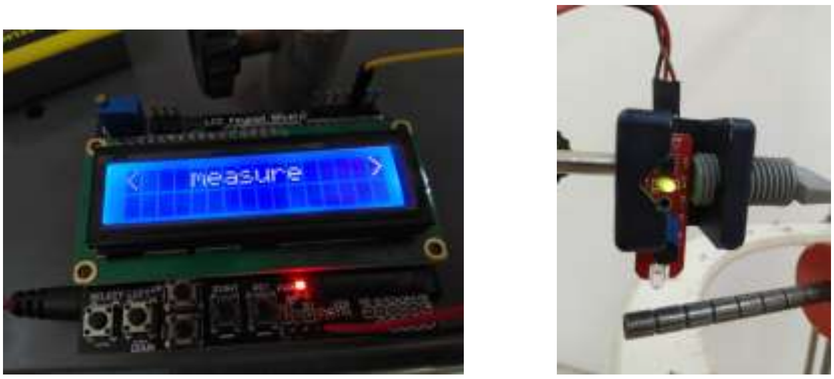
$$I = I_0 + 2I_c + 2m_c d^2 \quad [4]$$

The moment of inertia of the ensemble has a constant part (Z) which is calculated elsewhere [Chiriacescu et al, 2020a]:

$$Z = I_0 + 2I_c = 1.746 \cdot 10^{-3}\ kg \cdot m^2 \quad [5]$$

From the above considerations, one can notice that the most important part is to measure the periods of oscillation, that is achieved by means of the Arduino component and it is the main objective of the present paper.

The electronic device used to measure the pendulum oscillation periods is made of an infrared sensor and an Arduino micro-controller [https://www.arduino.cc/en/Guide/HomePage]. It is an open-source platform consisting of a motherboard connected with several peripheral devices, sensors and output devices. In this case, the device has an LCD screen attached and also a control panel (Fig. 2a). The employed sensor is based on a TSOP (Thin Small Outline Package) detector (Fig. 2b).



a) b)

Fig.2. Electronic device – details: a) Arduino device with attached LCD screen and control panel; b) IR sensor based on a TSOP detector.

The operating principle is shown in Fig. 3. A LED (Light Emitting Diode) emits an infrared (IR) beam towards the end of the rod that reflects the ray. The reflected fascicle is received by the optical sensor, the TSOP device that firstly transforms it to an electrical signal, which it is amplified and sent to the Arduino device. The sensor detects only a certain IR radiation; in this way, the measurements are not influenced by visible light from the Sun or other environmental lights [Chiriacescu et al, 2020b].

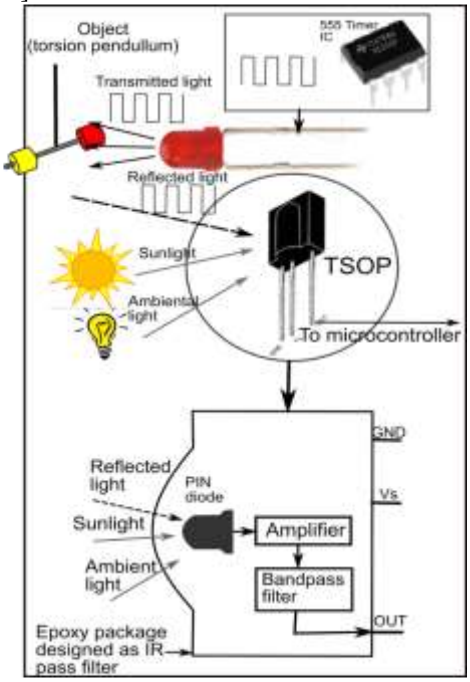


Fig. 3. The experimental sensor setup and the Arduino device for measuring the oscillation period.

The sensor points towards the end of the rod and it's activated by the passing of the metallic rod in its vicinity. In this way, two periods of time can be determined: the time that the rod is in the range of the sensor and the time that the rod is outside the range of the sensor when the detector doesn't read anything. The sum of the two periods of time represents the pendulum's oscillation period. The collected data is then sent to a computer where it is registered, processed and interpreted. In order to start the experiment, the two cylinders are symmetrically fixed by the oscillation center in different positions along the metallic rod [Chiriacescu et al, 2020a]. The cylinders are moved successively with steps of 1cm, starting from the extremity of the rod towards the center. The rod is then taken out of the equilibrium position. In the wire is therefore induced a torsion momentum that will try to bring back the rod in the equilibrium position. In this way, we manage to obtain small oscillations of the rod (the oscillation angle should not be greater than 5 degrees, in order to maintain the conditions of small oscillations). Moreover, the oscillations should be just in the horizontal plane. By employing the control panel, one can start registering the oscillation period. The measurement should be made for a large number of oscillations, in order to ensure an increased precision of the acquired data. A reference measurement of the oscillation period is made in absence of the cylinders, considering only the metallic rod.

3 Results and discussions

We used the experimental setup to determine the oscillation period of the rod with cylinders symmetrically situated at different distances from the wire. The dependence of the oscillation period on the parameters of the experimental setup is given by [Chiriacescu et al, 2020a]:

$$T^2 = \frac{4\pi^2}{C}\left(Z + 2m_c d^2\right) \quad [6]$$

It follows that the dependence of T^2 on d^2 is linear and, from the parameters of the graph, we can determine the torsion constant C of the wire. The experimental data are in very good agreement with the theoretical calculations and the linear dependence is depicted in Figure 4.

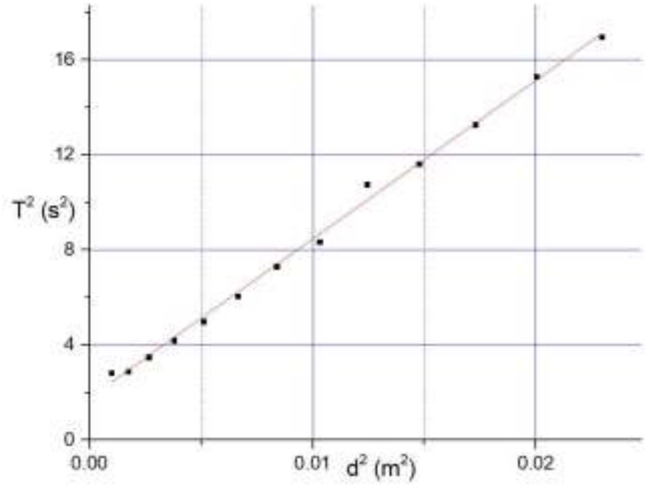


Fig. 4. The plot of T^2 versus d^2 obtained from the processed experimental data

The linear fit of the curve in Fig. 4 has the slope $a = 667.685 \pm 11.006\ \frac{s^2}{m^2}$ and the intercept $b = 1.788 \pm 0.132\ s^2$.

From equation [6], by using the slope and the mass of the cylinder, we get the torsion constant of the wire $C_{graph} = 4.13 \cdot 10^{-2}\ N \cdot m / rad$.

After the constant G_{graph} is determined from the slope, one can use the intercept in equation [6] and also calculate $Z_{graph} = I_0 + 2I_c = 1.872 \cdot 10^{-3}\ kg \cdot m^2$, (the obtained value is quite similar to the theoretical value).

In order to further check the validity of our measurement method, we also calculated the value of $Z_{\exp}$ by using the method described in [Chiriacescu et al, 2020a]: if T_1 is the oscillation period for cylinders situated at distance d_1 from the center of the rod and T_2 is the oscillation period for cylinders situated at distance d_2, then the value of $Z_{\exp}$ is given by:

$$Z_{\exp} = 2m_c \frac{T_1^2 d_2^2 - T_2^2 d_1^2}{T_2^2 - T_1^2} \quad [7]$$

From the data set, we selected $d_1 = 5.15\ cm$ with $T_1 = 1.871\ s$ and $d_2 = 13.15\ cm$ with $T_2 = 13.271\ s$ and we then calculated $Z_{\exp} = 1.815 \cdot 10^{-3}\ kg \cdot m^2$.

Using $Z_{\exp}$, we determined the moment of inertia of the rod, obtaining $I_{0\,\exp} = 1.634 \cdot 10^{-3}\ kg \cdot m^2$, value very close to the calculated one. With $I_{0\,\exp}$ and with the oscillation period of the rod without cylinders in equation [1], we obtained again the torsion constant of the wire, $C_{\exp} = 4.14 \cdot 10^{-2}\ N \cdot m / rad$.

The resulting values obtained in this paper are in very good agreement with those in [Chiriacescu et al, 2020a], validating both of the experimental methods that we used to determine the torsion constant of the wire.

4 Conclusions

The presented physical method has multiple advantages. The most important one is related to an increase in the precision of the measurements (we pointed out the accuracy of the obtained experimental data in the paper). Implementing the new technologies in the physics laboratories can open new perspectives of the experimental techniques. The Arduino device and its auxiliaries prove to be an excellent opportunity for updating the lab technology while maintaining a low budget. The software used is free of charge and open-source with a great number of users and programmers that leads to frequent updates and helpful tutorials. There is also a big pool of free documentation on the Internet, which eases the implementation of these experimental methods, even for less experimented students. From the students' point of view, the present approach clearly increases the experimental aptitudes in projecting an experimental setup, boosting the IT and technological competences, while additionally rising critical thinking ability.

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Virtual and experimental aerodynamic study for student's lab

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Abstract

This paper presents an aerodynamics study of different flat shapes using a virtual wind tunnel. The results of the simulation using Comsol Multiphysics software consist of a field of air velocity distribution and one of the distributions of dynamic pressure values. Flat surfaces as triangle, rectangle and circle are compared. Drag coefficients are calculated for rectangle and circle. An experimental study is also done in the same conditions, in order to compute the drag coefficients. The values are about the same in the both cases-virtual and experimental. This is an important result concerning the e-learning teaching, in condition of Coronavirus restrictions. This virtual lab is an opportunity for students to understand the aerodynamics principles concerning the effect of wind on turbine blades. Also, it is an economical way to choose the optimal shape for blades to build an efficient turbine.

Keywords: aerodynamic study, virtual lab, e-learning teaching, drag coefficient

1. Introduction

Nowadays education requires quick changes and adaptations due to many reasons. First of all, the advances of technology and its inclusion in the daily activities that contributes to the overall awareness of learners' intention to use new educational resources in mixed educational contexts (Lazar et al., 2020) makes the need of specialists in the Sciences' field more acute. Research is a key determinant for education (Lazar, 2019) due to its contribution to understanding the predictors of students' academic performances. According to The Organisation for Economic Co-operation and Development (OECD), we can expect that an average of 35% of the youth from the member countries will graduate a form of higher education until reaching the age of 30 years old (OECD, 2006). The problem stressed by the report is that only a quarter of them would choose a scientific or technological career. It is obvious that this percentage is far from insuring the request of the labour market. On the other hand, the context brought by the COVID 19 crisis has shown that the importance of the e-learning will increase for reasons of health security. An UNESCO study shows that most of European countries choses to close the schools and to provide online classes for the students (https://unesdoc.unesco.org). These facts lead to the conclusion that educational tools for a better e-learning of the Science, Technology, Engineering and Mathematics (STEM) topics are needed (Lazar et al., 2020). A lot of studies provide different methods and tools for these purposes (Berlic and Constantinescu, 2004, Marciuc et al., 2016, Ion and Voinea 2018, Marciuc and Miron 2018, Mihalache and Berlic 2018, Danesc and Voinea, 2019, Dinu et al., 2019, Voinea et al. 2019, Chiriacescu et al., 2020).

The aim of this paper is to compare the results of an experimental laboratory and a virtual one, in the study of some physical phenomena, to switch between them, if the educational conditions require it. Thus, we analyzed the behaviour of different geometrical flat shapes (rectangle, triangle, circle), placed in a stream of air both in virtual and experimental labs. We have also calculated and compared the drag coefficient, obtained from the experimental values and with those obtained from computer simulations. The results can be further used to investigate the possibility to build real models of aerodynamics shapes used as turbine blades (Oukassoua et al., 2019, Chiriacescu et al, 2021).

Moreover, this approach may be developed to create a supply of virtual laboratories that can be complementary used with the actually ones.

2 Methods

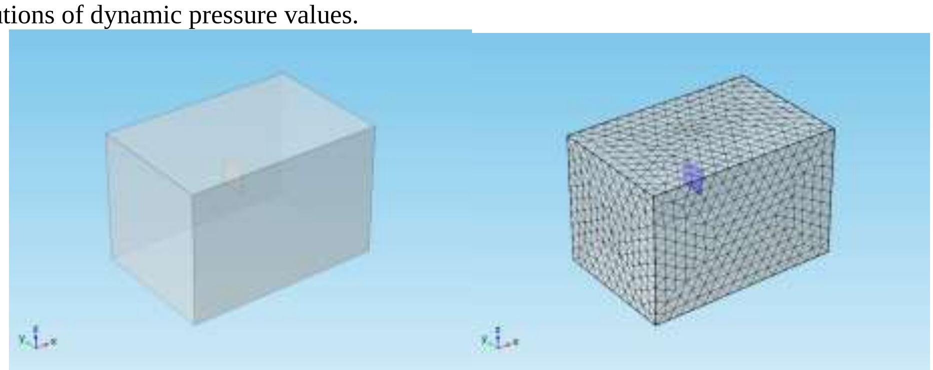
2.1 Virtual study

From the fluid dynamics theory, the motion of the airflow in tunnels can be described by standard k-ε turbulence model, utilized in COMSOL Multiphysics. We used a complex model for simulation the turbulent flow model of an incompressible fluid SST (Monter's Shear Stress Transport). This model describes both the condition at a distance from an obstacle (k-ε model) and near the studied shapes (k-ω model) in the CFDModule (https://doc.comsol.com/5.4/doc/com.comsol.help.cfd/CFDModuleUsersGuide.pdf).

Based on this model, one may study the behaviour of surfaces of different shapes when they are placed in an air stream, being able to make a comparison between their behaviour as function of shape, under the same conditions.

The surfaces were built in FreeCAD (https://www.freecadweb.org) and imported into COMSOL. To create the simulation, the aerodynamic tunnel is built (Fig. 1a) in the shape of a parallelepiped (300 mm on Ox, 200 mm on Oy and Oz). The parallelepiped is centrally aligned, the center of the coordinate system being the geometric center of the parallelepiped.

We defined the surface through which air enters and the initial wind speed along the Ox axis with the value of 10m/s ("Inlet" command), the surface through which the air exits ("Outlet") and the tunnel walls, the four remaining faces, as well as opaque surfaces ("Symmetry"). To the shape of study, it is assigned the role of obstacle with the command "Wall". It is considered a thin solid body, with a thickness of 1.5mm, with an area of about 1600 mm^2. The meshes are further defined (Fig. 1b) and there are small tetrahedral figures that establish a network inside and on the surface of the material. In the nodes of the network we calculated the physical quantities of interest. For air, we choose a lower density of knots ("Coarser"), and for the surface of the body a higher density ("Normal" or "Fine"). In addition to the dimensions, we also used other physical quantities, such as wind speed, materials used (air for fluid, iron for body), boundary conditions and the physical model. Figure 2 illustrates the different settings that are made after importing the model to be studied. Once the settings are set, the program is run with the "Compute" command. The results of the calculations consist of a field of air velocity distribution (Fig. 2) and one of the distributions of dynamic pressure values.



a) b)

Figure 1.a) The virtual aerodynamic tunnel with the studied shape inside b) Meshes

The Comsol program allows the calculation of the normal pressure force on the contact surface by integrating the forces acting on its infinitesimal areas.

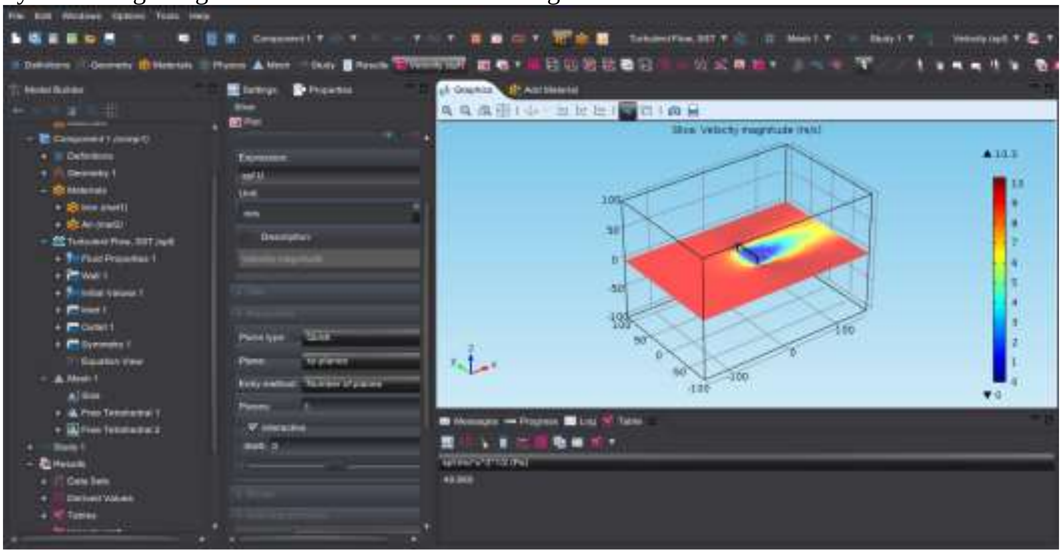
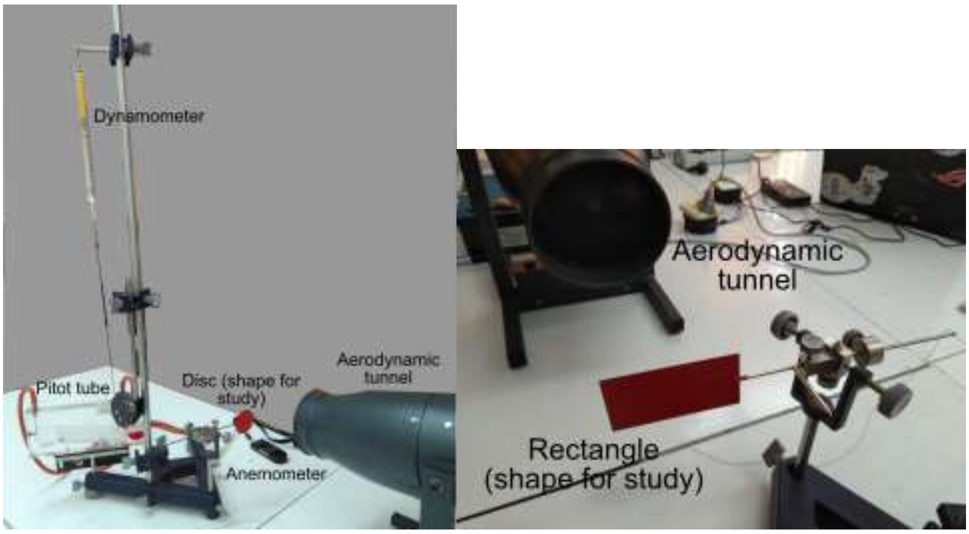


Figure 2. Working panel of COMSOL Multiphysics. In the right window the velocities field for a square plate is shown.

2.2 Experimental study

The design of the experimental device is presented in Figure 3 and consists in a dynamometer to measure the normal pressing force on the shape for study (disc or rectangle with the same sizes as in the virtual experiment) and mounted on the stand, the Pitot tube to measure the dynamic pressure and an aerodynamic tunnel. The surfaces of different shapes are placed in front on the aerodynamic tunnel, which can be set to different values of speed. The wind speed is measure with the anemometer.



a) *b)*

Figure 3. a) Experimental setup – overall view; b) Experimental setup - detail

2.3 Drag coefficient

The drag coefficient C_d is a proportionality constant and describes the „aero-dynamic quality “of the body: the higher the aerodynamic quality of a body, the lower C_d and thus the corresponding drag force (Gasch and Twele, 2012).

The dependence of the resistance force on the dynamic pressure from the relationship [1] has been studied.

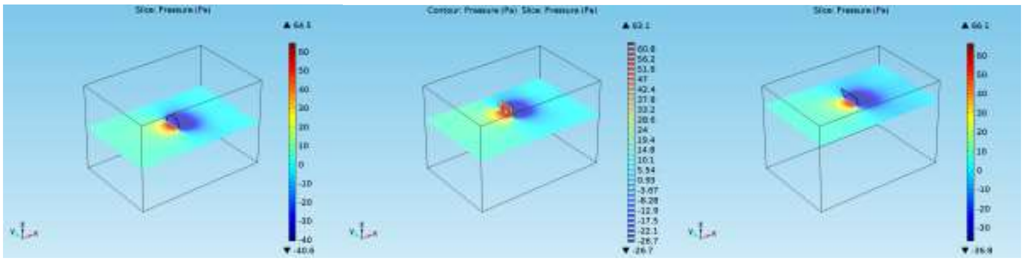
[1] $$F = C_d \cdot p_d \cdot S$$

For a certain surface S, the resistance force has a linear dependence on the dynamic pressure. From the slope of the graph, we calculated the coefficient C_d. The dynamic pressure varied by the values of the wind speed from aerodynamic tunnel.

3. Results

a) Simulation of aerodynamic of flat shapes placed in virtual wind turbine

The geometric shapes are placed in a virtual wind tunnel built in Comsol, perpendicular to the wind direction. The wind speed is considered to be 10 m/s. The program shows the pressure field and the trajectories of the air particles. As seen in Fig. 4, the dynamic pressure field is visualized by color code, the corresponding values being related to the normal atmospheric pressure - 1atm. The red areas represent higher pressures and the blue ones pressures lower than atmospheric pressure.

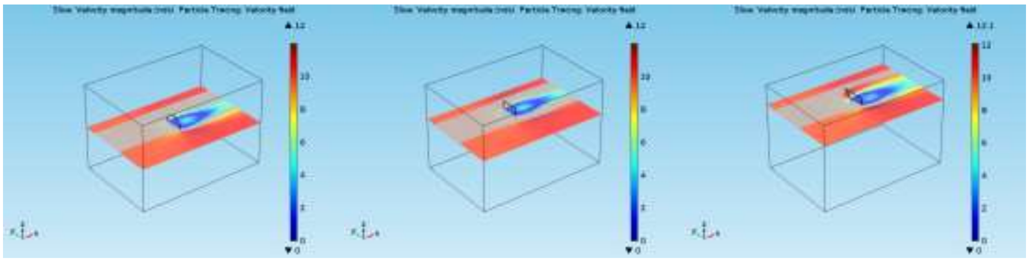


a) *b)* *c)*

Figure 4. Pressure field for: a) disk shape; b) square; c) triangle; the colors legend shows the pressure difference with respect to the atmospheric pressure in Pa.

A qualitative analysis of the shape influence on the air flow may be performed by the students observing the color according with the dynamic pressure values in the vicinity of the body. The program allows to change the plane of the field, so a more detailed image can be obtained, as in the tomographic imaging. Even though in the central positions the pressure field is almost the same, when we get closer to the border of the shape, certain differences can be observed. A quantitative study may be made, following the values of the dynamic pressure that can be obtained in any space point of the space inside the “tunnel”. It is also possible to analyze how the wind speed changes in different regions in the vicinity of the obstacle (Fig. 5). On the right side of the image the color legend is displayed - each color being assigned to a velocity value. The air particles trajectories are shown in pink color. It can be seen that behind the surfaces, the wind speed significantly decreases, to less than half of the initial value, regardless of the studied shape.

The velocity field distributions behind the obstacle show a significant deviation of the air particle trajectories in the vicinity of the shapes’ outline and higher values of speed than in the middle part, corresponding to the pressure variations.

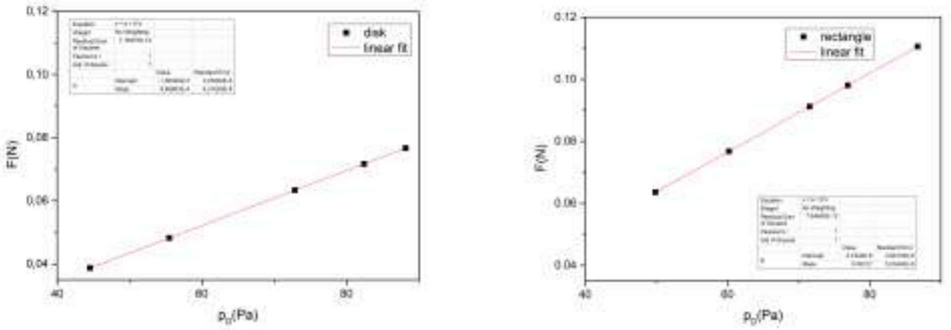


a) *b)* *c)*

Figure 5. Velocities field for a) disk b) square; c) triangle; the colors legend indicates speed in m/s and pink color is used to show the airflow trajectories.

From the analysis of the velocity field and the trajectories of the air particles, the students can understand how the effect of rotation of a compact surface placed in a stream of air occurs. The analyze of the particles trajectories represents a useful method to understand the aerodynamics of different shapes. For example, we can see in Fig. 5c) that the air trajectories are different close to the sides of the triangle, as this shape has a different behaviour in wind than rectangle and disk.

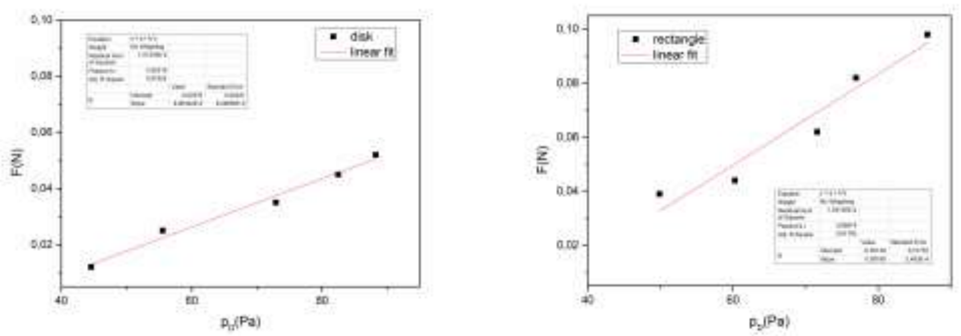
We calculated the normal drag force on the contact surface for rectangle and disk from the simulated values of the pressure, in order to compare with the experimental ones. The variation of this force on dynamic pressure is shown in Fig. 6. The dependence is linear as in equation [1]. From the statistical analyses, we evaluated the slope of the graph and from equation [1] we computed the drag coefficient. We obtained a value of 0.92 for C_d in case of the disk shape and 1.09 for the rectangle.



a) *b)*

Figure 6. Drag coefficients-simulating values a) Disk (C_d=0.92); b) Rectangle (C_d=1.09)

From experimental results, the linear fit of the data give the values for the drag coefficient: 0.91 for the disk and 1.34 for the rectangle. The experimental values have some errors, as we expected, but the statistical analyses indicated a good linear fit (Fig. 7).



a) *b)*

Figure 7. Drag coefficients- experimental values: a) Disc (C_d=0.91); b) Rectangle (C_d=1.34)

The values obtained in literature for the drag coefficients are 1.11 for the circular plate (disk) and 1.10 for the rectangular one (Gasch and Twele, 2012), so the results obtained from both virtual and real experiment are quite close to these values.

4. Conclusions

The analysis of the behaviour of bodies with different geometric shapes in the virtual wind tunnel is a simple method that does not require special resources leading to a better understanding of the physical principles used in fluid mechanics, in our case showing how the turbine blades are working.

We demonstrated that the virtual experiment can be a good complement for the real ones, held in laboratories. Moreover, some more features, as pressure and velocity fields and the trajectories of air particles (like the smoke used in real aerodynamic studies) are very visible in computer simulation. As long as it approximates very well the reality, those images can be used for aerodynamic studies. In this way, depending on the simulation results, different shapes and sizes can be chosen to build real models for blades that can be physically studied in laboratory conditions. On the other hand, it can be a good starting point for further studies and can offer a better image of what can expect to obtain from real experiments. Moreover, due to the widely use of e-learning due to isolation conditions, the virtual laboratory can partially replace the experiment held in lab. As the nowadays youth are very attracted by the new technologies and computer applications, this kind of virtual experiments can be very challenging, attracting them towards STEM studies.

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Methods of introducing Physics concepts, exemplified by two projects, “The Science of Music” and “Landing on Mars “

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Abstract

The purpose of this paper is to point out an interactive method to introduce basic physics concepts to younger students. We make our point by appealing to a number of specific software and school projects. This kind of projects can develop links between Physics and Mathematics, Physics and Astronomy, Physics and Economy, or even between Physics and Music, providing outstanding results in the teaching process. The interdisciplinary, transdisciplinary and multidisciplinary perspectives on the methods of approach and exploration and on dropping anchors in the previous knowledge could lead the students to achieve various 21st century skills. We will study the impact made by these school projects upon the progress achieved by the students.

Keywords: Interdisciplinary, Multidisciplinary, Transdisciplinary, School projects, Educational software

1 The interdisciplinary, multidisciplinary and transdisciplinary approach, a necessity of the modern teaching - learning – assessing process

On the one hand, in order to lead the students to achieve 21st century skills, an intradisciplinary approach, within the scope of a single academic subject, just isn’t enough. Dropping anchors only in the previous knowledge don’t allow students to investigate the complex problems of reality. In order to develop in the frame of a given subject the kind of knowledge able to engender in students the capacity to analyze information and apply it to real life cases, and in order to improve students’ understanding and make the learning process more productive, an approach in both an interdisciplinary and multidisciplinary way becomes a must have of the educational process. Interdisciplinary involves the combining of two or more academic disciplines into one activity and allows the students to learn by making connections between ideas and concepts across different disciplinary boundaries. Students learning this way are able to apply the knowledge gained in one subject to another different subject as a way to deepen the learning experience. Interdisciplinary study addresses students' individual differences and helps to develop important**,** transferable skills [Jones, C. 2010].

On the other hand, the new 21st century students’ skills require an approach focusing primarily on a multidisciplinary perspective, with the declared purpose of studying a topic from the viewpoint of more than one discipline. A multidisciplinary team approach involving several professionals with their own expertise is important in attaining an optimal effect. The multidisciplinary approach benefit is that people from different disciplines, working together and bringing their own discipline’s perspective, will explore the subject in the light of what other fields may have to offer.

A multidisciplinary approach involves drawing appropriately from multiple disciplines to redefine problems outside of normal boundaries and reach solutions based on a new understanding of complex situations. The use of the term 'multidisciplinary' has in recent years been overtaken by the term ‘interdisciplinary’, for what is essentially ‘holistic working’ by another name [Jones, C. 2010].

If the interdisciplinary and multidisciplinary approach is related more or less to the content/curriculum, the transdisciplinary approach refers to how science actions merge to create a unity intellectual framework, beyond the disciplinary perspective [http://www.open.edu/openlearn/education/what-are-the-benefits-interdisciplinary-study].

2 Introducing basic physics concepts to younger students from an interdisciplinary and multidisciplinary perspective

2.1 Science of Music project

A lot of students are keen about Physics and Music but they don't make connections between these fields. With that in mind, the authors, together with former students from "Tudor Vianu National High School of Computer Science", created an educational software, *Science of Music*, which offers a journey in the world of music guided by the laws of physics, thus managing to observe the regularities that appear [Moraru et al., 2007].

The software is a useful tool which can be used as an auxiliary material during Physics classes, especially because of its rigorously mathematical explanations, as well as during Music classes, where the teacher can show the students the science behind sounds, and in general by practically anyone who is interested in any of the two subjects [Stoica et al., 2010]. Normally, during a classical lesson the students can achieve notions about waves in an **intradisciplinary perspective, dropping anchors in Physics notions** such as mechanical oscillations, elastic body, motion etc. Using this educational software, the Mechanical Waves topic can be approach in an **interdisciplinary perspective**: one can bring up notion from both Physics and Music in a rigorous, mathematical way.

Moreover, this educational software, containing an interactive virtual piano and a virtual guitar, can lead a student to perform a real investigation, allowing him or her to study this subject using **the Inquire - based learning** method. The student can see, at his or her own pace, how the musical notes are distributed on the piano, hear them while playing the piano, and understand the science behind both the physics and the music.

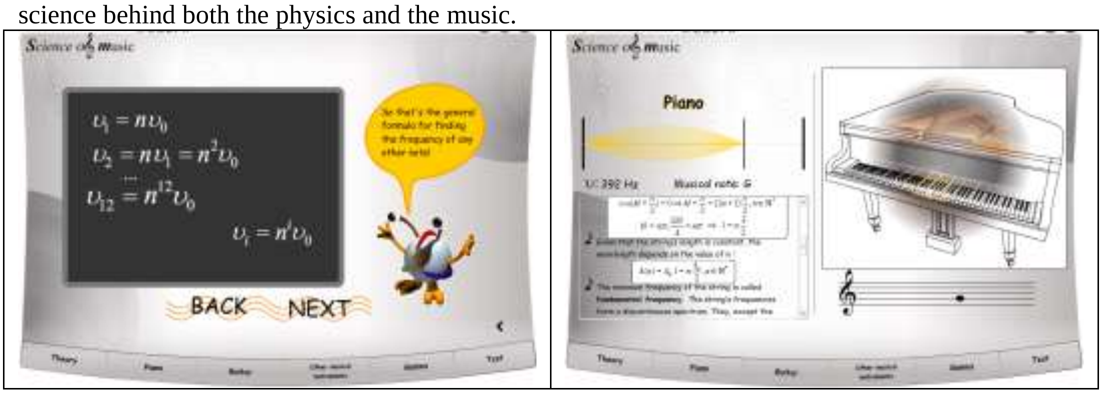

Figure 1. Two Screenshots from the Science of Music *Educational Software*

2.2 "Landing on Mars" project

The purpose of this project is to **design and build a "lander"** that will protect one "astronaut egg" through flying and touching down.

This project **is designed** for schools which adopt curricula focused on Mathematics, Physics, Sciences and Computer Science and for classes that allocate a greater number of lessons weekly for subjects like Physics, Mathematics, Natural Sciences, and Computer Science.

Curriculum areas/ domains involved are Physics, Mathematics, Computer Science, Economy, and Art.

Using different materials, as eggs, paper, rubber bands, plastic cups, straws, balloons, tape, aluminum foil, and scissors, the **students should** be able to:

- design and build a Lander that will protect one "astronauts egg" through flying and touching down;
- follow the engineering design process to design and build a shock-absorbing system out of simple materials;
- improve their design based on the results of test landings [https://www.jpl.nasa.gov/edu/learn/project/make-an-astronaut-lander/].

During the first stage the students will design and build the Mars Lander in an **intradisciplinary perspective, dropping anchors in Physics notions:**

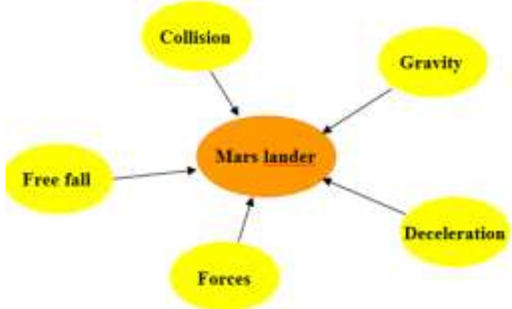

Figure 2. An intradisciplinary perspective

During the second stage, the **students should** be able to **improve the design and** build the Mars Lander considering the science as a whole: after assigning internal roles in the team, a scientist, a designer, an engineer, a communicator, and an economist, the students should set up a research investigation:

- Choose a certain target to reach (the Moon, Mars, Venus or beyond)
- Research the specific conditions out there as compared to the ones on Earth (atmosphere, gravity etc).
- Consider Archimedes's buoyant force should atmosphere exist.
- Consider using a parachute, should atmosphere exists.
- Choose the suited materials from the heat phenomena perspective.

During this stage the students are supposed to design and build the Mars Lander in an **interdisciplinary perspective, considering** the price of materials and the maximum budget available, the same for each team, as well as the manner in which they decide to share their conclusions and results such as a Power Point presentations and the like. Mathematics shall play a major role here too, alongside the fact that the prototypes will be developed using computer aided design.

This project can be put in place during the so-called "Informal Week". The students, working together with their Physics Economy Math Chemistry Astronomy and Informatics teachers each with their own discipline's perspective, will explore the problem in the light of what other fields may have to offer. Thus they could design and build the Lander in a **multidisciplinary perspective**.

All these teachers together with their students will create frames which brought together will form the final project.

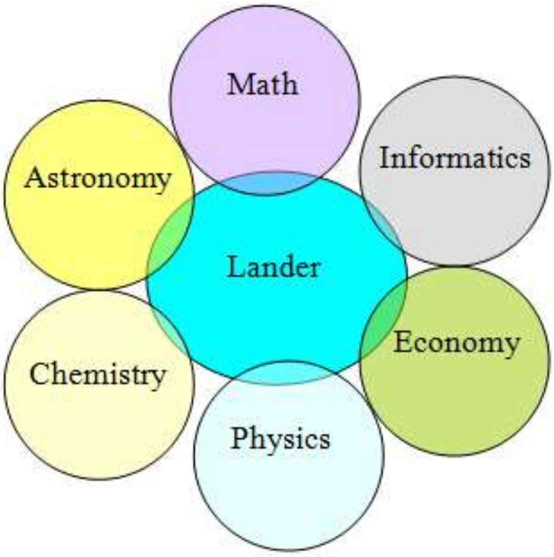

Figure 3. Science as a whole approach

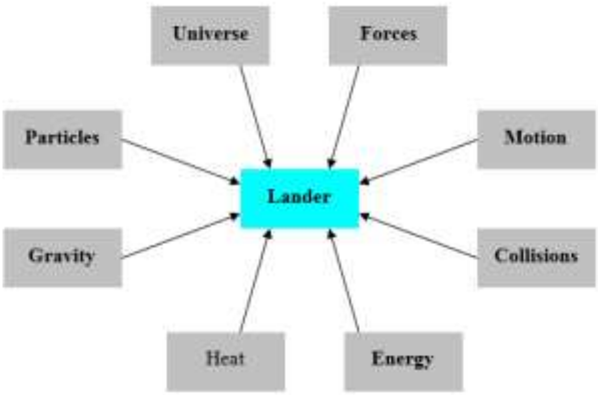

Figure 4. An interdisciplinary perspective.

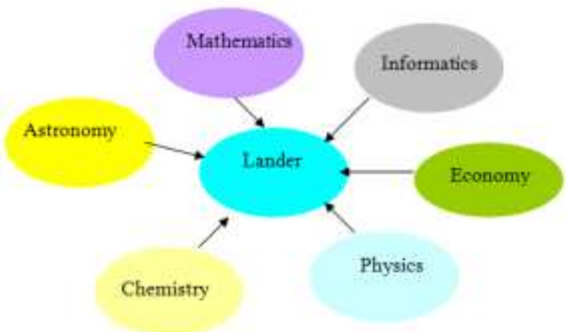

Figure 5. A multidisciplinary perspectives

3 Conclusions

Compared to the intradisciplinary teaching method, an interdisciplinary and multidisciplinary approach allows for a wider range of tools and enhances the students' motivation and, most importantly, opens up opportunities for them to be creative and more independent. As we mentioned before, the interdisciplinary and multidisciplinary study leads to synthesis of ideas and the synthesis of characteristics from many disciplines [Jones, C. 2010]. At the same time it addresses students' individual differences and helps to develop important, transferable skills, and, very important, students studying in this manner begin to consolidate learning by synthesizing ideas from many perspectives and consider an alternative way of acquiring knowledge. As a conclusion, we suggest this type of lessons based on an interdisciplinary, multidisciplinary and even an transdisciplinary approach by broadening of the area of interest, lead to a better students' motivation and to an improvement of the learning skills. This way, the student becomes more self confident and more prepared for a new step in his life, and he can extend his knowledge beyond the school.

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Evaluation of the Maritime Higher Education didactic support during the coronavirus pandemic. Case Study

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Abstract

The unforeseen appearance of the pandemic situation imposed the interruption of face-to-face courses in all educational institutions in Romania, and maintaining the educational quality standards in these conditions was a real challenge. Thus, the ensuring of education support is a determining factor in carrying out online teaching activities. The teaching support in e-learning involves the cumulative implementation of several factors, as follows: stable and high-speed internet connection, high-performance hardware and communication software tools, digital teaching and learning resources for each discipline in the curriculum, technical and pedagogical support. The case study presented aims to identify the impact produced on the maritime higher education by the sudden transition from the classical teaching and assessment system to the online and distance hybrid one. The analysis is done from the perspective of ensuring teaching support, considering the fact that, compared with the conventional methods of teaching and evaluation, online education requires a more elaborate didactic and diversified technology. The evaluative and transversal research was carried out on a sample of 300 students and 27 professors from the "Mircea cel Bătrân" Naval Academy by applying online questionnaires. For the analysis of the obtained data, statistical analysis techniques and tools were used. The difficulties encountered in carrying out the teaching activities are analysed and the identified and applied improvement solutions are presented.

Keywords: E-learning, Didactic support, Statistical analysis, Teaching, Assessment

1. Introduction

Starting with March 11, 2020, following the appearance of the coronavirus pandemic, the face-to-face courses in all Romanian educational institutions were suspended. In order to ensure the continuity of education, it was imperative that the education system to quickly shift to online and distance education.

The transition from the classical education system to the online one was unpredictable, the education system was faced with a challenge of a magnitude that has never been seen before being forced to continue the teaching activities online. Therefore, it was necessary to quickly find solutions to adapt the education system to the real situation, both in terms of the reorganization of curricula and of the didactic support assured in terms of resources, tools and of e-learning communication platforms necessary for an education that takes place in virtual space. The didactic support is an essential factor in online education fulfilment.

The article presents the research carried out in order to identify the impact on maritime higher education, by moving from the classical teaching system to the online and distance teaching and assessment system. The difficulties encountered in carrying out teaching activities from the perspective of providing didactic support were analysed and solutions to improve it were identified, in order to be implemented within the “Mircea cel Bătrân” Naval Academy (MBNA), as well as at the maritime higher education level.

MBNA is a Romanian maritime higher education institution internationally recognized. The educational offer includes both academic programs (undergraduate and postgraduate) and training programs in the field of navigation, naval electro-mechanics, electrical engineering, port management and operations, naval equipment and automation, sustainable development and the marine environment. The educational and training programs are fully accredited by the national and international authorities and are organized in compliance with the international rules in the framework of ISO 9001/2015 standards (www.anmb.ro).

2. Research methodology

The didactic support evaluation of the maritime higher education within MBNA, during the development of online and distance education, it was done by choosing a method of evaluative and transversal research.

The target group of the research is represented by the 1793 students and 58 professors from the MBNA.

The research was conducted based on the answers of 300 students from all undergraduate and master's degree programs and 27 professors, from the two faculties belonging to MBNA. The questionnaires were anonymous, and the survey was realized online, between 25.05-16.06.2020.

The sample from the study is representative of the target group population, with a permissible error of +/- 5%, for a confidence level of 95%; data validation was performed by identifying the minimum sample calculation based on the population under research (Pomohaci and Pârlea, 2008).

For the data analysis, the following statistical techniques were used:

- Reporting the percentages where it has followed the presentation data sample and/or the frequency of use applications.
- The average and the standard deviation (variability of the data within the sample of the respondents) and the minimum and maximum scales Likert considered where it was intended to report the intensity with which respondents perceive the effects of the current situation of the difficulties in teaching, from the point of view of ensuring the didactic support (Cardinal and Aitken, 2006).
- Simple ANOVA analysis of variance, F test, and Bonferroni t-test to compare the data of the two categories of respondents in the study. In this case, the following data were reported: the number of respondents, the average, significance threshold, the value of the F test, and the meaning of the differences between the averages of the two compared categories (students and professors) (Cardinal and Aitken, 2006).

3. Results of the study

Compared to the classical teaching and assessment methods, the online education form requires a much more elaborate and diversified technology based didactic support.

Therefore, for the realization of the online education, from the point of view of ensuring the didactic support, the cumulative fulfilment of the following factors is necessary:

- Stable and high-speed internet connection;
- Existence of high-performance hardware tools;
- Existence of stable communication software tools;
- Providing digital teaching resources for each discipline in the curriculum;
- Providing technical and didactic support at the institutional level.

3.1 Internet connection

The internet connection is essential for online and distance education (Stan, 2014). The study analysed the existing internet connection at the institutional level used by professors, as well as the one at home, used by both categories of respondents, as both locations were used for online education. The analysis of data presented below has been found mostly the existence of a permanent connection, uninterrupted and high speed for both respondents (74.07% - professors, 59.8% - students).

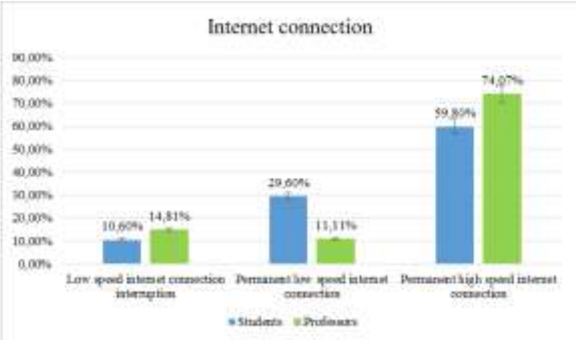

Figure 19. Percentage distribution of respondents according to the internet connection

3.2 Hardware tools used in online education

The hardware tools used for video communication that are available by professors and students are computer, tablet, and phone. Among them, due to hardware performance and ease of use of software tools, the computer is the most used. During the study, the degree of use of these tools was analysed, the data obtained are presented as a percentage in Figure 20.

The study reveals that all professors use the computer in the online education process and, in parallel, the telephone, which is used to a lesser extent (14.8%). At the same time, the student respondents use both the computer, in a percentage of 87.7%, and, less (58.8%), the telephone. Also, it can be observed the reduced use of the tablet by the respondents (3.7% of professors and 6% of students).

Although the institution provided fixed computing units in specially designed spaces, they could not be used for online courses (videoconferencing) due to inadequate places for simultaneous teaching of online courses, the constraints of mobility, and the social distancing of professors, imposed by the pandemic situation. Consequently, professors used personal portable devices (laptop, telephone) and high-speed internet connections (personal modems belonging to mobile telephony services, mobile phone hotspot, etc.).

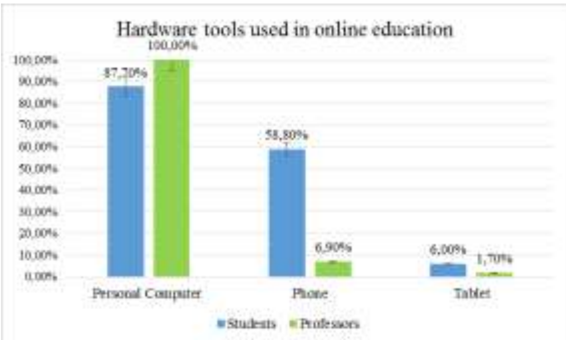

Figure 20. Hardware tools used in online education

3.3 Communication software tools used for online education

Digital technology has greatly facilitated the continuation of the online and distance learning activities during the interruption of face-to-face courses. To support these activities, professors and students used various software tools specific to synchronous and asynchronous online communication, such as Zoom, Google Meets, Cisco Meets, Whatsapp, Facebook messenger, email, telephony, etc. Furthermore, in the MBNA there are developed e-learning and e-mailing platforms for achieving institutional communication between professors and students.

The study analysed the degree of use of these digital tools, as well as the difficulties encountered in how to use them during online and distance learning, in relation to the years of study. The analysed data are presented in Table 9; the averages on a Likert scale from 1 to 4 were used (1-never, 2- once a week or less, 3- once every few days, 4 - daily).

The comparative analysis performed using the Bonferroni t-test, concluding:

- the institutional e-learning platform was almost daily used by all respondents (79.9% of students and 66.7% of professors) - Likert scale average – 3.736;
- the email was used for communication between professors and students, almost daily (Likert scale average of 3.506),. The percentage analysis shows a higher use by professors, given that 77.8% of them used this communication system daily, compared to students who used this mode of communication in 58.5%.
- the institutional e-learning platform was supplemented by the free of charge audio-video communication platforms (Zoom, Google Meets, Cisco Meets) with a Likert scale average of 3.067, namely almost once every few days of use, as follows: 42.1% of students daily and 36.5% once every few days, while professors used it in a proportion of 25.9% daily and 25.9% every few days).
- the communication platforms (Facebook - messenger, Whatsapp, etc.) for audio and chat communication were used (average of 2.991, once every few).

Significant comparisons (differences in averages greater than 0.5) in the use of other videoconferencing platforms relative to other respondents, were identified to students of third-year. This fact can be explained due to the large share of specialized disciplines studied by this category of students, which determines the e-learning platform to support very high data traffic due to the use of digital content and open educational resources. Correspondingly, the professors used the least other e-learning platforms (an average of 2.519), the explanation being that they were familiar with the use of the institutional platform and also not all professors used digital data high data traffic required as educational resources in the teaching process. (average of 2.556).

Software tools	Average	Standard deviation	Students N = 300				Professors	F	Significant differences *
			Year I N=86	Year II N=61	Year III N=40	Year IV N=112	P N=27		
Institutional e-learning platform	3.736	0.564	3.820	3.767	3.732	3.630	3.625	1.032	No
E-mail	3.506	0.674	3.477	3.508	3.575	3.438	3.778	1.544	No
Other e-learning platforms	3.067	0.977	3.151	2.885	3.450	3.098	2.519	4.568	III>II; III > P I < CD
Audio and chat communication	2.991	1.094	3.023	2.984	2.975	2.920	3.222	0.439	No
Open educational resources and digital content	3.0	0.983	2.	3.	3.	3.1	2.556	5.0	III > P; I > P II > I; IV > P

	52		814	295	325	25		83	
* Significant differences identified using the Bonferroni t test.									

Table 9. Software tools used for online and distance learning

3.4 Digital teaching resources used in online education

Due to the fact that the form of online and distance learning previously existed at MBNA for certain study programs, which required the creation of digital resources by professors, these resources were later developed for all classical study programs. Therefore, the impact of the pandemic situation on the existence of digital resources necessary for online education was not a major one, which emerges from the answers given by both categories of respondents confirming that the courses in electronic format existed on the e-learning platform of the institution at starting online and distance learning. Moreover, for the individual study, the students used the online library in a percentage of 62.2%, virtual laboratories in a percentage of 51.8%, simulations on professional platforms in the field of specialization in a percentage of 51.2%, as well as educational software in a percentage of 54.5%. Professors used, in addition to courses in digital format, virtual laboratories (37%), simulations on professional platforms in a percentage (30%), educational software (41%), and video educational materials (56%).

3.5 Support and guidance during online education

At the level of each faculty, a support group consisting of professors and IT specialists was set up. The support objectives focused on the technical and didactic aspects and, in particular, on the organization and development of teaching activities in the online education environment. The respondents emphasise that most benefited from the edification received from this support group (84.5% of students and 81.5% of professors), but also from their colleagues (26.1 % of students and 37% of professors).

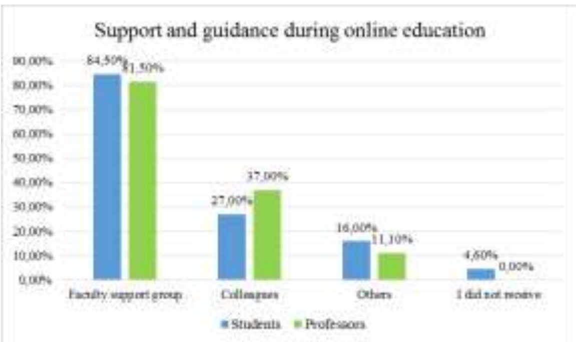

Figure 21. The relevance of support and guidance in online teaching activities

3.6 Difficulties in ensuring the support of teaching activities

During the online and distance teaching activities, both categories of respondents faced different challenges due to the lack of information on the time allocated perspective and to the very special regime of further online educational activities. The analysis is performed both according to the answers of the student respondents considered by years of study and to the internet connection, they benefited from. These difficulties were not analysed from the perspective of the use of technical devices by the respondents, as most of them used the computer as a hardware device during the teaching activities. The data analysis results obtained are presented in

Table 10. In the statistical analysis of the data, the following averages on a Likert scale from 1 to 4 were used: 1 - never; 2 - rarely; 3 - partially; 4 - frequently.

The study reveals that, during the period in which online and distance learning and teaching took place, both categories of respondents encountered minor difficulties on the following issues: the of educational content in digital format, the lack of time for understanding and proper use of digital tools and resources, the planning of the online teaching activities, lack of habit of carrying out teaching activities using new technologies. Significant differences highlighted by the Bonferroni comparison test (Table 10) are between the third-year student respondents and other respondents on the digital skills of using new technologies, how to use them for the management of teaching activities in the online education environment and how to plan online teaching activities.

Regarding the time required for the understanding and proper use of digital tools and resources, it is noted that the fourth year students adapted the most to them, as a result of the experience gained during university studies.

Software tools	Average	Standard deviation	Students N = 300				Professors	F	Significant differences *
			Year I N=86	Year II N=61	Year III N=40	Year IV N=112	P N=27		
Technical difficulties	2.037	0.970	2.186	2.049	2.575	1.741	1.963	6.672	III >IV III > CD III > II
Lack of educational content in digital format	1.607	0.841	1.605	1.623	1.850	1.446	1.889	2.675	No
Lack of time for understanding and proper use of digital tools and resources	1.804	0.947	1.988	1.869	2.075	1.563	1.667	3.795	III > IV I > IV
Planning of the online teaching activities	1.727	0.916	1.674	1.623	2.175	1.661	1.741	2.872	III > II III > IV III > I
Lack of habit of carrying out teaching activities using new technologies	1.721	0.937	1.826	1.557	1.950	1.580	2.000	2.608	Nou

* Significant differences identified using the Bonferroni t test.

Table 10. Support difficulties in carrying out teaching activities related to the respondents

3. Conclusions

The study was conducted at an interval of two months from starting the transition from classical to online education, including both teaching and evaluation activities, which allowed, with specific limits, to obtain results based on practice. Normally, such an evaluative research would have required a certain chronological detachment, for the respondents' opinions to be outlined on the basis of long experience. The analysis on the didactic activities support consisted in the evaluation of the logistic infrastructure (internet connection, hardware tools, software tools, didactic resources), of the technical and didactic support provided to the respondents, as well as of the difficulties encountered by both categories of respondents.

The research highlight that the maritime higher education system has some key points in terms of providing teaching support during online education activities, as follows:

- The specificity of maritime higher education imposes the existence of its own e-learning platform able to fully cover the specific requirements for the optimal development of online and distance teaching activities, both in terms of videoconferencing and the increasing of the digital database necessary for the didactic activities progress.
- The existence of an institutional high-speed wireless internet connection would allow the fulfilment of the constraints imposed by the pandemic, the increase of professors' mobility, and different appropriate spaces for online courses.
- Limits on student access to digital teaching resources (10%) because they don't a proper internet connection that allows high data traffic and their participation in video conferencing courses.
- Need for online and distance access to simulators specific to maritime higher education that means the acquisition and implementation of the new software (Stan, 2014).
- Although the study shows that both students and teachers have the desired digital skills to use hardware tools to carry out the activities in the virtual education environment, there is essential to develop specific skills for online and distance education, especially for teachers to accomplish necessary digital resources for the management and use of software for the development of interactive digital didactic materials for teaching, learning, and evaluation.
- It is important to develop digital teaching resources for each discipline (virtual laboratories, simulations, etc.) and to make available high-performance mobile hardware devices (laptop, tablet) for professors in order to increase their mobility.

Furthermore, during the online and distance activities, the study highlighted the following positive aspects specific to maritime higher education:

- Quality technical and didactic institutional support offered to both students and professors throughout the period of online and distance teaching activities.
- Efficient collaboration between the students and professors in order to solve the teaching tasks received online.
- Online teaching activities have been properly planned.

Therefore, in the conditions of the limitations imposed by the pandemic situation, for the good conditions new academic year progress, it is imperative maritime higher education matching to the existing situation and flattening the provided teaching support deficiencies so as not to affect the quality of education.

Consequently, the didactic support represents a determining factor in online and distance education activities to quality standards imposed by national and international law, on initial and continuing training of naval officers.

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Challenges in the Maritime Higher Education from the perspective of implementing the online teaching and evaluation activities

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Abstract

The unpredictable emergence of the pandemic coronavirus situation has forced the maritime higher education to change the approach to teaching by implementing the online learning and teaching environment. The main actors of education, teachers and students, as well as the decision makers in the education system were faced with a challenge of unprecedented scale. Even if this transition from the classical education system to the online one took place suddenly "overnight", maritime higher education already used certain specific education methods of the virtual environment, due to the particularity of the naval industry on internationalization, standardization, and continuous specialization. In order to evaluate the adaptation of the maritime higher education to the specificity of online education, between May and June 2020, within the Naval Academy a cross-sectional evaluation study was conducted. This period was overlapped with activities of teaching / evaluation online. The study presents the analyses the teaching activities carried out online, by assessing the students and teachers degree of perception on how to conduct them, in terms of advantages, limitations and difficulties and by considering feedback of student - teacher two-way relationship. The identified conclusions by the statistical processing of the collected data through anonymous online questionnaires, could be generalized and applied to improve the e-learning process within maritime higher education institutions.

Keywords: Online education, teaching activities, cross-sectional evaluation, the maritime higher education

1. Introduction

The unpredictable occurrence of the coronavirus pandemic situation has forced maritime higher education institutions to change their approach to teaching through the implementation of online and distance learning. Thus, all the actors of higher education: teachers, students, as well as the decision-makers, were faced with a challenge of a magnitude that has never been met before.

Although this transition from the classical education system online was suddenly realized, however, at that moment, maritime higher education was no stranger to online and distance education, due to the specific requirements of the maritime industry for lifelong learning and continuous training imposed by the internationalization, specialization, and standardization. (Stanciu, 2014)

Consequently, during the conference of the parties to the STCW Convention, held in Manila in 2010, the maritime industry has accepted the implementation of online education for the continuous training of workers, in order to be able to provide accessible training to all without time and location restrictions (www.imo.org).

Following the online education trend imposed by the STCW Convention, the maritime universities have offered to the students the online education and distance e-learning, in parallel with classical education. One such university is the ”Mircea cel Bătrân” Naval Academy (MBNA) in Constanța, which is a higher education institution in Romania, aims to provide education at the academic level, for the personal development of the students, with an emphasis both on the professional insertion of students and to meet the need for the competence of beneficiaries and the economic environment in the maritime and naval area (www.anmb.ro).

In this context, the article presents the case study developed in MBNA, between May and June 2020, having the aim to evaluate the adaptation of maritime higher education to the specificity of online education. The specific objectives consist of the analyses of the teaching and evaluation activities carried out online, by assessing the students and teachers degree of perception on how to conduct them, in terms of advantages, limitations, and difficulties and by considering the feedback of student-teacher two-way relationship.

The specific objectives consist of the analysis of the teaching and the evaluation activities carried out online. The teaching activities were analysed from the point of view of the respondents' degree of perception on how to conduct them, in terms of advantages, limitations, and difficulties and by considering the feedback of student-teacher two-way relationship. The analysis of the evaluation activities consisted of the identification of the most appropriate online assessment methods from the two groups of respondents' perspectives.

2. Characteristics of the statistical processing of collected data

The study was conducted on a sample of 327 respondents, students and teachers, as follows: 300 students, out of a total of 1793 and 27 teachers, out of a total of 58.

For data collection was used the technique of electronic opinion survey sounding through anonymous online questionnaires. The sample of the study population was representative for the target group, with an error margin of +/- 5%, for a confidence level of 95% (Pomohaci, 2008).

For data analysis it was received theoretical advantages of the ANOVA variance statistical analysis, as well as, the t-test.

The simple ANOVA technique was used because it allows the evaluation of the null hypothesis between the averages of two or more data series, with the restriction that they be components of the same independent variable, such as, for example, the evaluation of the teaching activities in the virtual education environment (Cardinal, 2006)..

In general, the studied aspects contain an independent variable with several components, as faster fulfilment of teaching tasks, facilitation of learning, acquisition of new digital skills and, implicitly, those groups of subjects: students and teachers, and a single dependent variable, for example, the quality of teaching.

Using the simple ANOVA, the dispersion of the two components of the dependent variable is analysed, as follows: the dispersion inside each formed group that reflects the deviations due to the different components of the independent variable and the dispersion between the averages of the groups and the main average. Both components reflect the dispersion due to random selection of the sample (Cardinal, 2006).

The Bonferroni multiple comparison method was used, which involves a sequence of t-tests in which the significance threshold is divided by the number of comparisons. The F- test was used to determine whether the dispersions of the two groups could be considered equal, taking into account the dispersing of data in the two groups. To collect data that provides a perspective on the nuances and opinions of the participants, Likert scale was used. For the statistical analysis, averages on a Likert scale from 1 to 4 were used (1 - don't know; 2 - don't agree; 3 - neutral; 4 - agree).

3. Perception of teaching and assessment online activities

It is well known that any form of education has its advantages and disadvantages, as well as the fact that each actor actively involved (professors and students) generates different opinions on these education forms. Accordingly, the study aims to evaluate the teaching and assessment activities in the virtual education space using questionnaires focused on issues aimed to identify the advantages, opportunities, limitations and difficulties that online teaching offers.

The statistical analysis of some positive aspects of respondents' perception of online education (Table 11) was performed on the two groups of respondents.

Respondents' answers reveals, according to the average values, that both categories of respondents have a neutral position in relation to the positive aspects considered advantages in the online questionnaire. It is also noted that teacher respondents have an attitude of rejecting the supposed benefits mentioned in the questionnaire. Regarding the fact that online education helps to accomplish teaching tasks faster, teachers disagree with this statement (average of 2.593), compared to the opinion of the students from the second and fourth year of study who have a neutral position with tendencies towards agreement (average of 3.241 – 4th year of study, respectively average of 3.262 – 2nd year of study). Similarly, the situation regarding the usefulness of digital skills acquired in the analysed period for subsequent activities is presented: teachers disagree on the trend towards neutral on this statement (average of 2,556), while most students have a neutral position (averages around of 3).

The answers of both categories of respondents regarding the fact that the period of interruption of classical courses and transition to the online and distance education allows teachers and students to focus on the essential, qualitative, skills and competencies, reveals that the opinions of respondents are neutral to this statement (overall average of 3.064). However, the detailed analysis by categories of respondents shows that teachers' perception is around an average of 3.630, which means that most of them agree with, which is in discrepancy with the perception of students, who have a neutral position towards this statement.

Regarding the impact on the teaching activities by the online education sudden transition, both categories of respondents consider that the teaching activities have been greatly affected (average of 2.770).

Online education advantages	Average	Standard deviation	Students N = 300				Professors	F	Significant differences*
			Year I N=86	Year II N=61	Year III N=40	Year IV N=112	P N=27		
Quick achievement of teaching tasks	3.083	0.861	2.930	3.262	3.025	3.241	2.593	4.728	II > P IV > P
Facilitates student learning	3.172	0.816	3.058	3.082	3.200	3.304	3.148	1.356	No
Acquiring Digital Skills	3.178	0.862	3.360	3.213	3.050	3.214	2.556	5.010	I > P IV > P II > P
Focusing on essential, qualitative, capacities, and competences	3.064	0.911	2.930	3.180	2.975	3.000	3.630	3.665	P > I P > III P > IV
Moving teaching activities online has not affected their quality in any way	2.770	0.904	2.651	2.725	2.836	2.893	2.556	1.380	No

* Significant differences identified using the Bonferroni t test.

Table 11. Online education benefits respondents' perception

Given the unforeseen transition from classical to online education, the study also aimed at an analysis of the degree of perception among students about how to carry out activities in the virtual education environment. After statistical data processing, according to the data presented in *Table 10* it can be ascertained that teaching activity was properly managed during the transition to online education (average statistical responses obtained is around 3 - neutral), meaning the students have not encountered major difficulties.

Beyond advantages, the online activity has limits and difficulties, both in the teacher-student relationship, and in the development of teaching activities, due to an important side of the classical teaching activity cannot be done virtually.

Regarding the identification of possible limitations arising from changing the way teaching activities are carried out, both type respondents were interviewed about relevant issues for this purpose.

From the statistical data presented in Table 13, as a result of the suspension of teaching activities, the following conclusions on these activities are found:

- course activities: professors consider that these activities have been affected, while students have a neutral position on this statement;
- seminars and laboratories: both categories of respondents agree that these activities have been affected;
- the necessary support provided by teachers: both categories of respondents agree that in the online education environment this activity took place like in the classical one;
- the lack of human contact can be compensated by well-designed remote activities: both categories of respondents have a neutral position towards this statement, which can be explained by the fact that the short period of online activities did not allow the design of these kinds of activities;
- limiting the interaction between teachers and students, as well as the feedback between these categories were not negatively influenced by the transition to online education;
- limiting the efficient structuring of the discipline content taught online: both categories of respondents consider that do not exist differences in the structure and content of the disciplines taught in the educational online environment versus the classical education system.

Students' perception	Average	Standard deviation	Students N = 300				F	Significant differences *
			Year I N=86	Year II N=61	Year III N=40	Year IV N=112		
I am content with the online teaching-learning process related to the study program	3.224	0.855	3.217	3.311	3.125	3.125	0.592	No
I hope to be used in the classical teaching some of the digital tools and resources from online	3.274	0.908	3.227	3.361	3.375	3.227	0.787	No
I can learn the same in both education systems	2.987	0.952	2.970	3.000	3.050	2.970	0.125	No
All tasks are very clear to for entirely followed online disciplines	3.097	0.931	3.111	3.148	2.950	3.111	0.610	No
I know how I will be evaluated to all online disciplines	3.304	0.918	3.273	3.361	3.375	3.273	0.349	No
For me, is easy to implement online education	3.294	0.837	3.116	3.262	3.150	3.438	2.831	No

* Significant differences identified using the Bonferroni t test.

Table 12. Online education students' perception

The identification of possible difficulties in carrying out online teaching activities was made in the study by using questionnaires common to both respondents, as well as specific to each group of respondents. The answers to the specific questions of the professors are presented in Table 14.

Following the statistical analysis of the results obtained, it can be observed the increasing the professors workload compared to classical education, especially due to the preparation of educational materials specific to teaching activities in the virtual environment and time spent for student assessment. This is due to the need for teachers to transpose the content and questionnaires they had from classic format into digital format.

However, even if there was a sustained volume of work from teachers, the digital resources made can be reused in the future education activities with minimal effort on their part. It remains to be seen whether this perception of teachers will change in the future.

In the study, special attention was paid to the analysis of types of assessment in online education in order to identify the appropriate forms of evaluation that reflect the correct the knowledge assimilated by the students during online education. The evaluation types analysed in the study were the following: online multiple choice test form, online multiple choice test automatically generated, oral examination, written examination and submitted by e-mail, written essay, and essay oral tested.

Limits of online teaching activities	Average	Standard deviation	Students N = 300				Professors	F	Significant differences *
			Year I N=86	Year II N=61	Year III N=40	Year IV N=112	P N=27		
Interruption of classical teaching activities negatively influences lectures and course activities	2.945	0.972	3.140	2.803	2.825	2.741	3.667	6.736	P > IV P > II P > III I > IV
Interruption of classical teaching activities negatively affects the seminar/laboratory activities	3.248	0.906	3.337	3.230	3.250	3.152	3.407	0.737	No
Professors can no longer provide the necessary support for an efficient online course	2.926	0.919	3.302	2.803	3.125	2.679	2.741	7.161	I > IV I > P I > II
Human contact can be compensated by online well-designed activities	2.951	0.910	3.047	2.885	2.975	2.982	2.630	1.201	No
Limiting interactions between teachers and students	2.727	0.993	2.953	2.525	3.075	2.438	3.148	7.059	P > IV III > IV I > IV
Limiting the efficient content structure of the discipline taught online	2.767	0.964	2.942	2.770	3.150	2.545	2.556	4.261	III > IV I >IV
Limiting feedback received from students	2.617	0.913	2.605	2.557	2.850	2.545	2.741	1.020	No

Limiting feedback received from professors	2.663	0.920	2.628	2.492	3.025	2.527	3.185	5.150	P >II; P > IV III > II, III > IV
Limiting carrying out teaching tasks in online education	2.828	0.892	2.965	2.689	3.050	2.741	2.741	1.851	No

* Significant differences identified using the Bonferroni t test.

Table 13. Limits of online teaching activities respondents' perception

Difficulties encountered by professors during the online teaching process	Average	Standard deviation
Felling to work with very tight deadlines	2,593	1,010
The workload is higher than in classical education	3,444	0,892
Online education does not help in teaching tasks	2,889	0,698
The time allocated to preparation for student assessment is longer than in	3,444	0,847
Online teaching / assessment tools are familiar	3,407	0,888
Free time is reduced due to the preparation of teaching materials in online	3,444	0,847
Online evaluation of students	3,000	1,144
Adaptation to new teaching / evaluation methods	1,852	0,864

Table 14. Difficulties encountered by professors during the online teaching process

From the answers given by both groups of respondents, illustrated in Figure 22, they appreciate the evaluation types that can be used in the system of online education as follows:

- online multiple choice test automatically generated – are agreed to be used to assess the knowledge assimilated as a result of the followings activities: course (67.66% students and 51.8% teachers), seminar (62.35% students and 59.25% teachers), and laboratory (54.33% of students and 22.22% of professors).
- written essay – both categories of respondents agree with this type of evaluation only for the seminar activities;

oral examination, written examination and submitted by e-mail, online multiple choice test form ,and essay oral tested - were not appreciated by the respondents as assessment methods usable in online education.

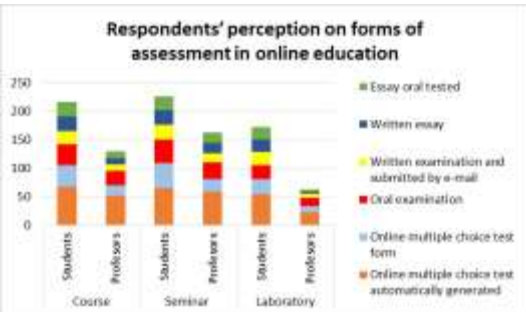

Figure 22 Respondents' perception on forms of assessment in online education

It is noted that online multiple choice test automatically generated and the written essay are the forms of assessment agreed by both groups of respondents to be used in online education. Also, 59.73% of student respondents appreciate the essay report as a very appropriate form of course activities evaluation. They have a similar approach for the evaluation of seminar activities: 43.89% of students consider suitable to use online multiple choice test form and 41.91% of students, the method of written examination.

3. Conclusions

As a result of the analysis of the didactic activities carried out in the virtual education environment, the following conclusions were drawn:

- the course and seminar activities are partially suitable for online education, while the laboratory activities for the specialized disciplines cannot be carried out in the virtual education environment;
- most students have adapted quickly to the new requirements imposed by online education;
- the time allocated and the volume of teaching/learning tasks have increased compared to a classical education for both students and teachers, without being found an increasing the quality of teaching;
- • students and teachers consider that the unforeseen transition from classical to online education has affected the way in which teaching activities are carried out, as well as, to a small extent, their quality;
- the students considered that the online teaching activity was properly managed on the occasion of the transition to online education so that no major difficulties were encountered in its implementation;
- human contact absence and mutual feedbacks were offset temporarily by well-designed activities;
- both groups of respondents prefer the online multiple choice test automatically generated and the written essay for the online assessment. There is a subjective approach of the students regarding the evaluation of the course and seminar activities through the written report, which contradicts the majority opinions of teachers.

Although marine higher education was somewhat familiar with online education methods, the results of the study highlighted a few key points. These sensitive aspects are not only specific to maritime higher education, but have a general character applied to the Romanian education system can be remedied by additional teacher training (Botnariuc et al, 2020), both in terms of using specific teaching methods in the online environment and in curriculum development and of teaching materials using state-of-the-art ICT (virtual learning, 3D and augmented reality, etc.) (Vlada et al, 2009; Vlada et al, 2011)

Even if the system will return to face-to-face education, support and educational acquisitions accumulated during this period will contribute to improving the maritime higher education. Also, the experience gained during this period can be capitalized by continuing distance learning for students doing internships on ships.

Even if the system returns to face-to-face education, maritime higher education will not be the same as before the pandemic, and the experience gained during this period will contribute to increasing the quality of education and developing opportunities to train students and train staff who works in the maritime field. One proposal in this sense could be the implementation of distance learning for students doing internships on ships during the academic year. This can be achieved by collaborating between academia and the maritime industry in ensuring optimal conditions for online learning on board ships.

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Pressure measurements by means of digital technology for educational purposes

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Abstract

Many scientific hot topics that are closely related can be taught by means of an interdisciplinary approach. An example of such a subject is pressure. Pressure measurements can be performed by classical instruments (manometers, barometers etc), but also by modern means, respectively by using digital technology. By employing during the physics hours of educational experiments based on data loggers (that have built-in sensors or attached external sensors), or scientific tablets (such as the Einstein Tablet), can definitely lead to a better understanding of the physical concept of pressure. These types of trials can determine as well whether the students are aware of the connections between physics and biology in this area and if this can effectively help them describe appropriate physical phenomena in the human body in connection for example with the blood pressure measurements. In this manuscript, we employed the Einstein Tablet, having attached the blood pressure, heart rate sensors and the LabMate data logger (that can also be connected to a computer) therefore transforming the entire system into a truly portable/wireless science lab. By also adding a pressure sensor to our system, one can perform experiments for highlighting how the external pressure variations can have an impact and change the total volume of certain bodies.

Keywords: sensor, blood pressure, interdisciplinarity

1. Introduction

Nowadays Physics and Chemistry are less affordable disciplines. There is a tendency to look for interesting topics that combine concepts and skills from different topics of natural sciences. It is extremely useful to associate the theory that should be assimilated in the context of everyday life so that physics is exemplified by processes encountered around us. Students are attracted to interdisciplinary connections, especially those related to medicine and the human body. Teachers should establish a direct connection between theory and practice, then their work will be easier and students could better understand the respective targeted subject (Volná and al, 2014). Students should be able to link information and knowledge from various disciplines in the field of science and create interdisciplinary relationships (Stal, 2011).

Lately, the experiment was not considered only as a supplement to the learning process. The experiment has even moved to the center of school learning in active learning strategies (Millenbah, 2003). By accomplishing this task, we managed to find an interesting subject in biology, but with a rich physical content, that could train more high school students which are not directly interested in physics. The laboratory in which computer information technology are implemented can clearly facilitate students’ motivation, can stimulate both their interest and increase the attraction to the discussed topic and boost the amount of knowledge acquired. Research shows that the use of technology contributes to and encourages the development of constructivist environments and supports the learning atmosphere in the classroom (Millar, 2005). Students explore new information about themselves and the processes that take place in the body, therefore making connections between physics and biology.

In the biophysics of complex systems we can observe physical aspects such as fluid dynamics in the circulatory system that can be compared to a tube system. The heart can be considered a pump and the center of the circulatory system. The heart uses pressure to push blood through our circulatory system of arteries, veins and capillaries, a system that makes up a coordinated functional unit and is perfectly adapted to the body's needs. The flow of blood through the arteries is normally laminar and sometimes turbulent. Blood circulation is subject to the continuity equation. In measuring blood pressure in the circulatory system we distinguish diastolic and systolic pressures, caused by mechanical contractions of the heart. These contractions occur as a result of electrical waves circulating along the heart muscle (Volná et al, 2014). For a doctor, the first indicator of a human body problem is the value of blood pressure. Peripheral pulse analysis to assess blood pressure was first described in the 19th century (Sandrine et al, 2006). The pulse wave provides important information about the cardiovascular system. Noninvasive health check leads to the idea of real-time pulse wave monitoring, which has a crucial effect for early prevention of high blood pressure and improving treatment efficiency (Meng et al, 2019). Measuring blood pressure under different conditions is an example of applying fluid dynamics to our lives.

2. Materials and Method

The Einstein tablet operates on the Android system and, through the Google Play Store, includes access to thousands of different applications. Unlike a common tablet, apart from a microphone, headphone jack, USB port, an HDMI port, power outlet, SD card slot and reset button, the Einstein tablet has eight integrated sensors (from the factory) that can be used in the experimental study of scientific disciplines. The tablet already has Einstein World and MiLAB^{TM} installed. The tablet includes the humidity sensors, ultraviolet, light, the jack for the heart rate sensor and four ports for external sensors. Under the "Applications" icon on the screen one can access applications installed on the tablet, among which - MiLAB, the application employed in this paper. After launching the MiLAB application one can see the list of all available sensors. We can press the circle next to the sensor name (in our case ”Blood pressure”); via the sensor setting button we added additional properties to the measurement such as the time interval or the recording speed of the sensor. After clicking the ”playback” button, the MiLAB software began recording the active sensor data either for an already set time or the experiment could be interrupted at any time, by pressing the ”finish” button. At the end of the data collection process,

the results are saved and later found in the ”archive” section. Data can be exported or shared with others via Google, email, Bluetooth, or a learning management system. The materials used in the experiment can be viewed separately in Figure 1 (a) and during the experiment in Figure 1 (b).

Figure 1 (a- left figure) Component parts of the experimental device: heart rate monitor (top left) heart rate sensor (top right) and sphygmomanometer (bottom)
(b-right figure) Experimental set-up for the determination of blood pressure

Accurate measurements can be made using the Einstein^{TM} heart rate sensor in Figures 1(a) and 1(b). This was connected simultaneously to the finger of the person whose pulse was also recorded on the Eistein Tablet, through the port of the heart rate sensor that the tablet possesses (through an external sensor). The heart rate sensor was selected and the blood pressure sensor measures the amount of pressure exerted by the blood on our arteries. Blood pressure reading involves two parts, namely: systolic reading which measures the pressure when the heart contracts and pushes blood through the circulatory system and diastolic reading, taken when the heart is at rest. Systolic pressure is always the higher of the two readings. Because people's bodies are different, blood pressure varies from person to person and can be affected by factors such as height, age, sex and is even influenced by diets. The blood pressure sensor (figure (1 a) below and figure 1(b)) contains several parts: an inflatable cuff, two hoses, an inflating pump, a pressure control button and the sensor itself (figure 5(a) top right). The sensor is compatible with MultiLAB for computers or MiLAB for tablets.

2.1 Blood pressure measurement

To start the experiment, we connected the two hoses to the sensor and the measurement interface, namely the Einstein tablet. We launched MiLAB and it automatically detected the sensor it displayed in the "View Launcher". We chose a three-minute data collection time and a sampling rate of 25 measurements per second. We wrapped the inflatable cuff around the arm of the test person. The winding should be located 2 cm above the bend of the elbow with the tubes along the elbow facing downwards, as shown in Figure 1 (b). We start the experiment by pressing the "Run" button. Using the inflation pump of the inflatable cuff, the latter was inflated slightly above the value of 180 mm col. Hg. We stopped pumping and made sure that the test person remained calm and did not move, in order to get accurate reading values. The measurement stops automatically after the set time expires and a result window appears on the tablet screen showing the systolic, diastolic pressure values and the pulse value, as observed in figure 3. With the above mentioned settings we obtained a total of 4500 values per measurement (the data was the stored in ".csv" format).

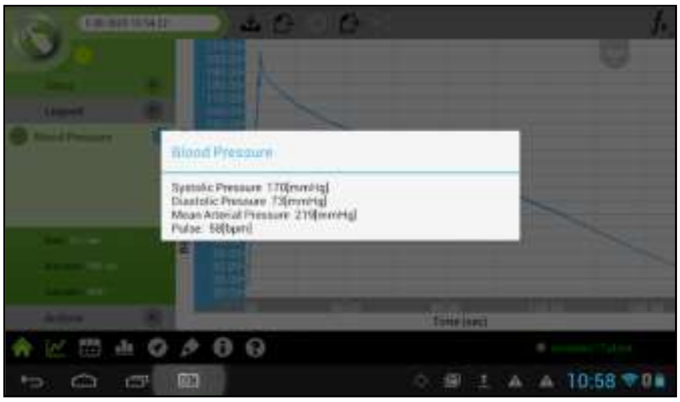


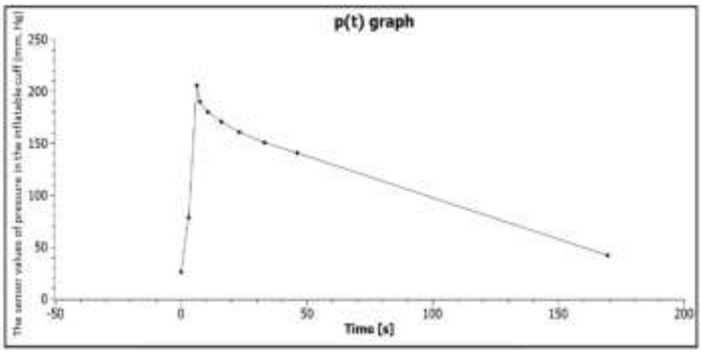
Figure 2 Graph of Presure in the cuff (mm. Hg) vs Time (s). One can also see the set measurement parameters on the left side

The pressure graph as a function of the time obtained is observed in figure 2; the pressure in the cuff being expressed in mm. col. Hg, and time in seconds. In our experiment, the obtained values were: 170 mm. col. Hg, 73 mm. col. Hg and 58 bpm, respectively.The values are shown in Figure 3 and can be written as 170/73 mm Hg.

Figure 3 The values obtained of Systolic Pressure, Diastolic Pressure and pulse at the end of the measurement

Time (s)	The sensor values of pressure in the cuff (mm. Hg)
0.04	25.883
3.04	78.329
6.32	205.699
7.64	190.16
10.76	180.262
16.08	170.735
23.32	160.74
33.24	150.848
46.28	140.303
169.6	41.608

Table 1



Experimental data from the pressure values sensor in the cuff
Figure 4 Time - Pressure in the cuff dependence via SciDAVis

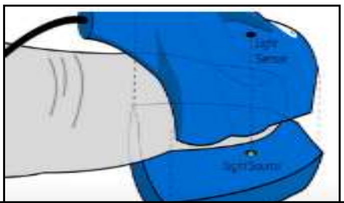
In table 1 are presented some experimental data and in figure 8 the graph made by the students based on these data. The latter is very similar to the one on the tablet display.

2.2 Pulse measurement

In biophysics or medicine, the pulse means the effect of the heartbeat, manifested by the regular swelling or deflation of an artery, so it can be included in the category of periodic phenomena. This rhythmic beat is synchronous with the ventricular systole. It is obtained from the ”conflict” between the blood that already exists in the arterial system and the blood pushed during systole. There is a rhythmic relaxation of the artery that determines the ”pulse wave”. By accurately measuring the number of beats per minute by pulse wave we have a noninvasive diagnosis of a disease associated or not with high blood pressure. The pulse is correlated with various physiological diseases. We studied how the sensor works when the heart pumps blood into the capillaries in our fingers. Inside the clip there is a light source and a light sensor, as shown in Figure 5. The sensor was placed correctly on the finger, under the middle of the nail, so we made sure that nothing could block the light transmission from the light source to the sensor. The finger should be held still for five to ten seconds to read a correct first value. Any movement could interfere with the way light is transmitted. When the heart beats, the capillaries fill with blood. When the capillaries fill with blood, the light is blocked, the sensor capturing a heartbeat.

Figure 5 Location of the light source and the light sensor inside a finger heart rate monitor (adapted from https://www.youtube.com/watch?v=uOFbIHm3cCg*)*

Because the operation of the sensor is based on blocking a luminous flux, it is



recommended that the experiment be performed away from a strong direct light source. The frequency/pulse obtained for our experiment was 58 bpm, as shown in Figure 6. The normal pulse rate is 60–80 beats per minute [book a)]. In the second measurement, in which we also used the heart rate monitor simultaneously, the red line in figure 6 indicates the pulse of the test person (a value of around 60 bmp, that is within normal limits).

Figure 6 Graph for the Heart Rate (bpm) and Pressure in the cuff versus Time

At the end of the experiment, press the sphygmomanometer control valve to release all the air from the inflatable cuff.

2.3 The influence of the external pressure on the shape of some balloons

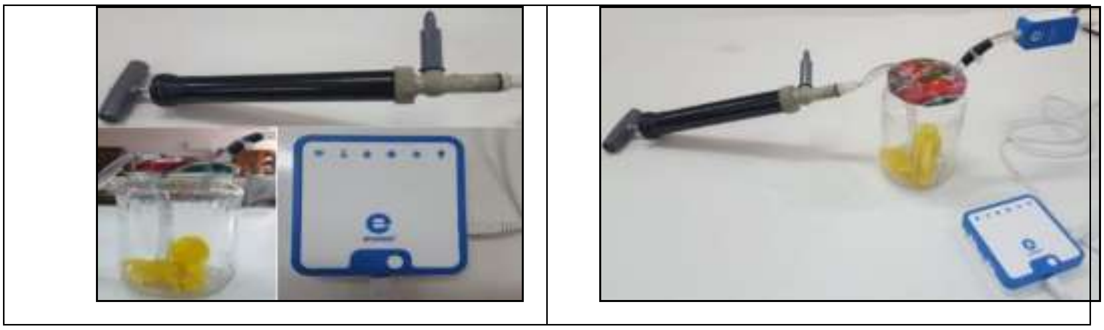


Figure 7 Experimental set up used for the pressure variation experiment

One slowly reduces the air pressure in the vacuum chamber by using the manual vacuum pump. As the air pressure in the jar decreases, the students noticed that the two balloons inflate, from which they concluded that the air pressure outside the balloons is lower than the air pressure inside the balloons p_0. The minimum pressure we can get in the vacuum chamber is 210^4Pa. Once the air valve is opened the balloons deflated again because the external pressure of the balloons returned to the initial value p_0 of 10^5Pa. The collected experimental data determined the shape of the graph in Figure 8, made with SciDAVis.

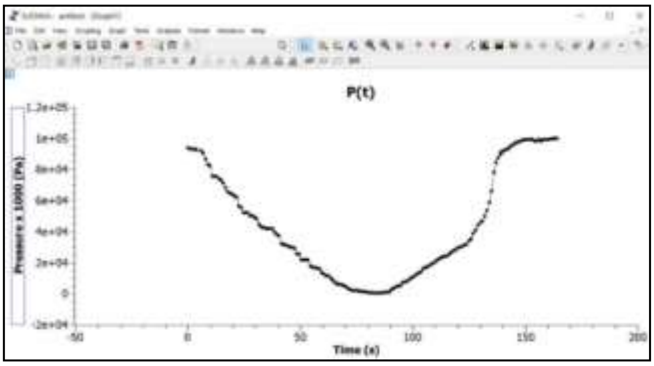


Figure 8 Time - Pressure dependence plot for the balloon experiment.

From the graph, the students noticed that the pressure did not decrease constantly as in the case of using an electric vacuum pump.

Conclusions:

Through the first experiment we were able to investigate how the concept of pressure in physics could be applied in biology, more specifically in human physiology. Specific sensors can be used both in physics experiments and in various biology experiments. We employed modern technology in education to obtain, process, store, convert and transmit data, namely the Einstein Tablet. We can study the variation of blood pressure during physical activities for example, by measuring blood pressure both before and after exercise. The accuracy of the heart rate sensor is ± 3 mm Hg, and of the heart rate monitor of one (one) bpm. It results that the method is ideal for school level, but also for coaches etc. The employed blood pressure sensor is designed for educational purposes only and should not be used for medical applications. The second experiment that we performed showed the inverse proportionality between pressure and volume when the laboratory air temperature remained constant.

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Alternatives in Assessment: Student-generated Videos and Online Written Case presentations in Medical English

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Abstract

Creation is the top level of intellectual skills in Bloom's taxonomy. It requires learners to move from gaining knowledge, through analysing and eventually synthesizing, to making judgments. Although rarely do we attain the formation of this top skill in formal English learning environments, it is attainable with advanced medical students and especially desirable as they have to demonstrate perspicacity in the medical practice as early as their first clinical year, representing a key life-time competence for the future physicians. This presentation will document and analyse two assessment alternatives targeting precisely professionally relevant oral and written Medical English (ME) creative language use within an asynchronously-connected Facebook group as part of the ME blended learning format with students of UMFST GE Palade of Targu Mures during the academic year 1917-1918. The research employed a descriptive method. I explore the use of student-generated videos (individual presentations recorded on mobile devices) and written case presentations (Padlet.com) as alternatives in formative assessment, underlining their specific added values for Medical English: deep learning as well as professionally-relevant, more authentic, autonomous, skill-integrative productions that capitalise on the students' ability to use and produce the language rather than demonstrate knowledge of the language (inherent in exercise solving and tests). Student satisfaction questionnaires demonstrate that student-generated videos and online written case presentations are relevant, complex, and memorable means of assessment of Medical English progress that can complement online tests/quizzes, especially for the current context of full online learning and assessment.

Keywords: student-generated videos, case presentations, Medical English

1 Creating a student-centred Blended and Facebook-integrated learning (BL-FB) in Medical English

The topic of student-generated videos (S-gV) as alternative assessment in English for Specific Purposes (ESP) is under-represented in research (Ozguc, 2016) and even more severely so are clinical case presentations (CC) for online Medical English learning and assessment (Guest, 2018). One study mentions that students of Spanish enjoyed creating videos which helped them learn Spanish better (Kannan & Munday, 2014) while another study proposes student created videos in economics as a tool for enhancing learning experience (Greene, 2012). A recent study (Hawley, 2018) considers that academic staff may be reluctant to transform their assessment practices without evidence of strong benefits for doing so and brings relevant best practices of student-generated videos that increased the students' competencies, communication skills, and collaboration. However, all these reviewed cases referred to collaborative video creation and consequently the collaborative group assessment posed further group-dynamic complications (Lavy, 2017).

The subjects of the current study were second-year students (N=116) engaged in Medical English blended learning that combined face-to-face classroom practices with Facebook-group asynchronous content delivery and activities (BL-FB) during two academic semesters (2017-2018). The BL-FB model was adopted for reasons of social media pervasiveness, ease of use for students (Pop, 2018), but also for context-specific considerations pertaining to working with large groups of students, the need for a more democratic approach that would actively engage all the students, and a more faithful, field-relevant evaluation. The BL-FB target was optimal integration of online content and collaboration to promote active learning extension beyond the two hours/week of class practical activities, as well as inclusion of alternative evaluation (30%) as stipulated in the syllabus. Four FB assignments per semester (one per month) integrated the communicative ME skills contributing towards the formative alternative assessment, two of which (S-gV and CC presentations) form the object of the current research.

2 Alternative Assessment

In its traditional form, assessment as gathering of information about the learners' knowledge is performed through tests/quizzes, generally accepted as valid and reliable measurements of what students know. Testing is the traditional component that may, however, fail to assess deeper forms of learning (Kulieke et al., 1990). A test is a timed, single-occasion exercise, usually a mid-term or/and final/exam that measures student learning. While tests may be successful and reliable instruments that offer scoring on the task performance, other alternatives to evaluation of deeper learning exist that capture the students' ability to apply and work on their knowledge.

The term *alternative assessment* (Huerta Macias, 1995; Nasab, 2015) including the use of journals, logs, self-evaluation, and teacher observations as „an alternative to standardised testing" appears in the literature alongside *alternative in assessment* (Brown &Hudson, 1998), the latter with reference to personal-response assessments (portfolios, conference, self- or peer-assessments) versus two traditional assessment types: a) selected response assessments (matching, True/False, multiple choice), and b) constructed response assessment (short answer, fill in, performance assessment). To these, the term *alternative approach to assessment* was proposed by McNamara (2006, cited by Derakhshan, 2011). *Alternatives in assessment* (AA) has been adopted in this paper to include student-generated videos and online clinical case presentations (CC) as alternatives to ME tests and exams. I **hypothesize** that by complementing tests/quizzes with AA, I provide a more authentic evaluation of what the students have actually learned by looking at their application of the acquired knowledge, allowing for reflection and problem solving i.e. applied proficiency, rather than assessing knowledge by providing answers to specific questions, inherent in tests/exams (Rousseau, 2018). While there is expressed concern about the validity and reliability of alternative assessment (Bachman, 2002), I entertain that an approach that blends tests with performance-based applications in a continuum is likely to cover more assessment principles of practicality, complexity (S-gV), interaction, and authenticity (CC presentations), engaging a broader range of language abilities, which is of utmost significance for the future medical practitioners.

2.1 Elements of FB assignments for alternatives in assessment (AA)

The assessment criteria in our ME context consisted of 70% (mid-term written test and final oral exam) and 30% - the alternative assessment and included formative data on:

1) *Overall ME goal*: mastering oral interactions in professional settings with physicians and patients. The primary goal was to improve Medical English in two contexts: reporting information to specialists (employing the so-called Med-speak) versus giving explanations and instructions to patients (using simple, jargon-free language);
2) *Specific objectives* (criteria): a) to be able to report information and make effective and concise oral and written clinical case presentations; b) to consolidate medical terminology on system-related diseases and give clear explanations and instructions to patients about their conditions; c) to use medical jargon and abbreviations/acronyms adequately;
3) *Key elements of AA pedagogy*: natural/spontaneous presentations, active, autonomous learning as a process with peer/teacher feedback, making judgments, and reflecting;
4) *Reliable evaluation and systematic peer feedback*: a 5-point Rating sheet for S-gV and CC presentations that considered: a) task completion, pronunciation, and delivery, ranging from 5

(excellent) to 1 (poor); b) peer feedback in terms of: content, presentation skills, and takeaway message.

2.2 Performance-based AA 1 – Student-generated videos (S-gV)

Videos have a larger prominence in current language learning than ever before especially due to the proliferation of sophisticated smartphones that allow easy and fast recording and distribution of content. If video productions are uploaded on an asynchronous-communication platform such as FB, they allow remediation and asynchronous communication including reflection and teacher- and peer-feedback. Exploration of voice and video recordings shifts the student's role from consumer to creator of content in a student-centred autonomous learning medium – a pedagogy that leads to the consolidation of speaking in authentic situations and which further attracts student engagement, higher motivation, creativity in content delivery, but also collaboration and peer-assessment. Despite all these, video creation for assessment remains an innovative emerging form of AA (Hawley, 2018). In this paper, **videos** are defined as short recordings (1-2min) of individual student presentations via a mobile phone (with both audio and video).

2.3 Engaging students through video creation - Results

Students created four two-minute video monologues in order to document their knowledge and ability to apply: reporting conditions to peers, explaining and advising patients (a), reflecting on medical practice (b), employing jargon-free language and maintaining rapport (c), and reflecting on their own first medical experiences (d). In each of the four video types below, students gathered materials, synthesized so as not to exceed the time limit and recorded several times until they achieved a natural speaking flow, adequate tone, modulation and rhythm to conform to the assignment requirements:

a) **Tutorial videos** - *A neurological disease: Reporting to physicians versus talking to patients*. Students chose a neurological condition and the target listener (physician versus patient) and employed either the medical jargon or the simple, jargon-free, language to patients, respectively, demonstrating deep understanding of the disease (etiology, investigations, therapy). Results_a: 85 videoclips
b) **Opinion videos** - *Reflections on disease and pain in a child*. Students had to talk to a child and his/her parents (in hospital or area) to find out about their ordeal of disease and pain, and then report their findings: history of the disease, child's attitude to pain and condition, parents' attitude to their child's disease, their own personal reflections. Written peer feedback on content and presentation together with takeaway message was also required. Results_b: 108 videos

Peer feedback e.g.:

From my colleague's presentation I've learned two main things: First of all, hospitals are not a priority for our government to be supported with medication for patients and they do not create a friendly environment for kids. Secondly, I've learned that asthma can be a severe illness if the patient is not careful with his medication; the patient needs special intervention and body positions for breathing in cases of emergency. The presentation was captivating, with clear explanations, adequate vocabulary, correct pronunciation (PCM).

c) **Narrative video**s – *Reflections on doctor-patient communication*: *How vocabulary affects patient outcomes*. The assignment integrated watching several videoclips with reading articles on the role of vocabulary, rapport, and interruptions in clinical interactions. Results_c: 67 videos.
d) **Reflection video**s – *Reflections on my learning*. Students offered details on what they had learnt, stressing the importance and impact of their learning rather than just giving factual information, including challenges. Results_d: 106 reflection videos, explaining the process

of deep learning. Apart from developing the language of metacognition, reflection videos offered insights into aspects that did not surface in formative assessment i.e.: what worked and what failed.

2.3.1. Discussion: Degree of engagement with video

Quantitatively, the 366 videoclips (a, b, c, d above) with an average of 2.12 min length/video meant an extension of the ME practice with about 776.75 min/year (i.e. 13 hours), without taking into consideration the preparation, re-recordings, and listening to peers. More than half of the students created all of the videos while 95.10% of them created two: one tutorial/opinion and one reflection video.

Asynchronous speaking allowed students to work on pronunciation and fluency, especially lexis, demonstrating greater self-regulation. Along with managing content, many students edited their videos while others resorted to design creativity such as introductory effects and advertising.

Other *strengths* of S-gV in AA: a) students could make choices of topic and created content that was listened to by their colleagues; b) students were connected and offered constructive feedback, thus promoting a culture of positivity and support, essential in their future careers; c) video recordings were more emotionally resonant than a test and their presentations had high quality; d) there was breadth of content, added variety and attractiveness (high number of visualisations); e) students could reflect on their own speaking (especially pronunciation of medical terms), thus applying critical thinking. However, besides challenges associated with video recording/voice quality, time investment, and task difficulty on the one hand, the S-gV posed an emotional obstacle for some students who felt uncomfortable about video recording.

2.4 Performance-based AA 2 – *Padlet* Online Case presentations

Making presentations is a key skill for the medical profession (Pascan, 2018). Giving oral, rapidly moving clinical case presentations during ward rounds is similarly basic for hospital environments, a type of reporting which is then documented in writing and transmitted to other physicians. Clinical case presentations represent one written genre of the medical discourse that follows a ritualised format. It is a highly condensed medical record that follows the so-called SOAP framework: the patient's complaints (Subjective), the doctor's observation of the patient's condition (Objective), assessment (A), and plan (P). In its written variant, CC presentations are terse, usually one-slide elliptical forms of expression which exploit depersonalisation, omission of terms, and a plethora of medical abbreviations that students need to understand and use. This canonical structure is part of every clinician's repertoire, which benefits the physicians' understanding of complex cases. However, when asked to SOAP a patient, medical students often struggle with what is expected of them. That is why it is highly recommended that students should be taught the accepted CC presentation style early in their clinical experience and Guest (2018) pleads for including CCs in the Medical English curriculum teaching and practice.

The FB-BL clinical case presentation assignment required students to take notes on a patient they would meet during their internship/practice and then SOAP him/her in the form of a *Padlet (padlet.com)* online slide, employing adequate language and resorting to relevant media, wherever the case (see Fig. 1 and 2 below).

Padlet is an extremely valuable tool at the teacher's hand allowing notifications, sharing and embedding, filtering, and, what is mostly relevant for the presenter, insertion of test results as different media (e.g. image – X-ray, EKG). Having all the 116 case presentations in one place and the students' possibility of re-editing contributions are further values for the process of formative assessment but also for the students' ME learning of tricky vocabulary spelling and abbreviations.

Apart from the online written CC presentation the AA included the face-to-face BL-FB component: the oral presentation of the case in class as part of the final oral exam (delivery, use of abbreviations), which remains outside the scope of this paper.

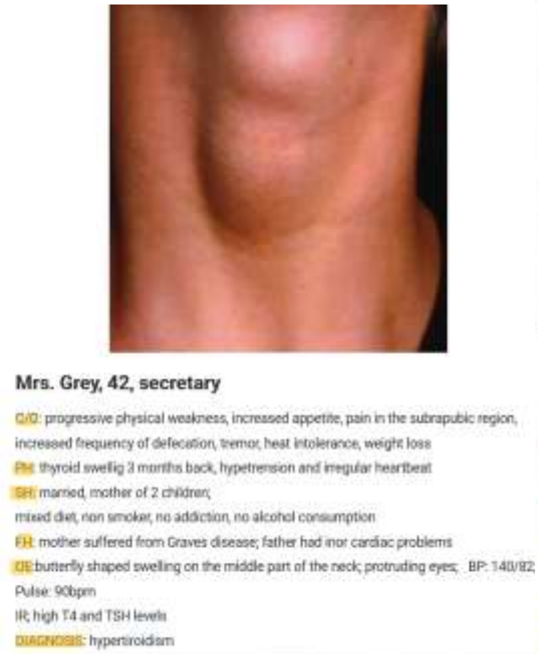

Fig. 1. CC1: Hyperthyroidism

Fig. 2. CC2. Toxic megacolon

3 Students' perception of FB-BL alternative assessment

A 10-item Google Form questionnaire designed for evaluating students' satisfaction with FB-learning administered at the end of the academic year, included questions that also targeted evaluation of students' satisfaction with the assessment alternatives, i.e. creation of videos and written case presentations.

Of the 89 respondents, 95.5% were satisfied (38.2%) and extremely satisfied (57.3%) with their FB-BL English learning and 86.4% found the activities relevant and helpful for their Medical English progress. The most relevant AA assignment was the clinical case presentation (32.6%) followed by giving bad news (31.5%) and defective doctor-patient communication (25.8%), whereas the most interesting were in order: case presentations (43.2%), giving bad news (28.4%), and reflection on learning (18.2%).

Content analysis of the questionnaire responses enabled isolation of several themes:

1) Increased motivation and engagement as students learnt from peers' models, e.g.:

Those assignments were very nice to do especially the reflection and case presentations because ***you can also read what other students wrote****. I didn't fancy that much the speaking one because you had to record yourself with video, even though I must admit it was a very important, relevant topic (CN).*

2) Relevace for the medical career, e.g.:

Because there were so different topics and so ***practical*** *that they* ***will*** *really* ***help us in the future.*** *Honestly, since we started university, and by this, I mean the first year, nobody ever told us precisely* ***how we should behave when communicating with a patient****. By watching models and thinking about cases we met in our practice I realised that I can make progress to improve my communication in order to have a "healthy" relationship with the patient (E.K).*

3) With adequate support, video creation was an enjoyable activity, e.g.:

Recording my speaking with videos gave me the possibility of thinking more, before talking in front of the camera. This work is not spontaneous but I enjoyed it a lot, and even if at the beginning I was a little reticent, I would be very enthusiastic if we could continue working like this. In my opinion, FB activities helped us to develop and maintain a certain ***level of interest*** *regarding the class activities. Combining these two types of activities is, probably, one of the best ways of transforming the course into a real and productive process of learning this (PL).*

4) Asynchronous work allowed drafting and successive revision stages, which facilitated deeper learning, e.g.:

I like doing the writing tasks on the FB group, because this way I can form and re-write my answer, making it more understandable, paying a little bit more attention to my grammar as well (RN).

5) A negative qualitative feedback: higher-anxiety and lower comfort level in video recording as alternative in assessment. Nevertheless, if some students felt nervous recording their first video, later, they became more confident and proud of their results.

Conclusion

If tests and exams are valid and relevant measurements of student progress - the scientific component in assessment - performance-based alternative assessments offer the bigger, more complex picture of what students can or cannot do with the language in more authentic, complex, and professionally-relevant contexts (i.e. the creative part in assessment). As demonstrated herein, alternatives in assessment captured what students learnt, applied, observed, and commented, which are important elements of progress and actual professional English. Through videos and case presentations, students were creators rather than mere consumers, made judgements and choices, they actually lived the language rather than applied it.

Video (S-gV) as AA was a highly engaging, time and effort consuming strategy that also contributed to the formation of medical competences: making judgments, peer-adapted oral presentations, reporting to patients, and reflecting.

On the other hand, **clinical case presentations** (**CC)** helped students to enhance their diagnostic reasoning and reporting skills and thus contributed to the formation of another key competence required for lifelong medical practice (Dell, 2012).

To conclude, this continuum blend of traditional testing and performance-based applications besides covering more assessment principles (practicality, complexity, interaction, relevance) renders a more faithful image of the students' real abilities that matter most for their future careers. Likewise, alternatives in assessment are feasible for the current context of online learning.

Finally, as the distribution of students' feedback illustrates, if assessment is to take into consideration the students' satisfaction with their learning in terms of perceived relevance, authenticity, autonomy, student choice, and interestingness of tasks, alternatives in assessment should be considered.

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Relationship between smartphone use and stress, approach from the PubMed publications perspective

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Abstract

Today, more and more people use smartphones, daily, in various moments, locations, and contexts. There are platforms for health education that provide information about depression, anxiety and stress. Smartphone and stress studies have been conducted with populations of several continents: North America, Europe, Middle East and Far East. Smartphones play an essential role in everyday life, being useful in simplifying communication, entertainment, education and many daily activities. There is an association between depression, anxiety, stress and smartphone addiction. But the use of smartphones can not be limited to the category of young adults or students, rather it can be applicable to general adult.

Keywords: smartphone, stress, PubMed publications

1 Introduction

It was found in 2012 that 91% of the population owned a mobile phone (Pearson et al., 2017). 3.2 billion people can easily access the Internet (1), and over 8 billion devices are connected simultaneously, via mobile phones, to the WWW, (2).

The present material is a continuation of the authors' interest in the field of stress, especially regarding the evaluation (Jurcău et al., 2018b) and stress moderation (Jurcău et al., 2016; Jurcău et al., 2017; Jurcău et al., 2018a).

2 Stress

Stress occurs when there is an imbalance between the stresses to which a subject is subjected and the possibilities of its rectification (3). Two types of stress are described: acute stress, which occurs in short-term situations and may be accompanied by physical and psychological reactions; chronic stress in long-term stressful situations, traumatic experiences (4), leading to overexposure of the body stress hormones and the appearance of various disorders eg. cardiovascular (Chockalingam et al., 2003), gastrointestinal (Mönnikes et al., 2001), depression (Plieger et al., 2015).

3 Smartphone - Definition, Monitoring

A smartphone is a mobile phone equipped with functions found on a computer (5). Today, more and more people use smartphones, daily, in various moments, locations, and contexts (Raento et al., 2009). 3.4 billion smartphone subscriptions were in 2015 (6) and a third of the world's population used a smartphone by 2017 (7). There are multiple smartphone applications, some of which are designed to monitor calorie intake, physical activity, sleep, menstruation, health and well-being (8). Smartphone monitoring can be performed by recording data or automatically, through built-in sensors (Kailas et al., 2010).

4 Smartphon - Healthy Use

Public health interests are also strengthened and supported by mobile devices (Rehalia, Prasad, 2016). There are platforms for health education (Nelson, Staggers, 2017), for improving patient-centered care (CCP) (Tang et al., 2016) and for the promotion and continuity of self-care of patients (Finkelstein et al., 2012). It was found that over 56% of health care settings include using mHealth to help with clinical practice (Franko, Tirrell, 2012), 31% of mobile phone owners use these health apps, and 19% have installed a mobile app. to manage their health and well-being (9). There are also services that provide information about depression, anxiety and stress (Kelders et al., 2013).

5 Interventions Through Mobile Applications - Examples

5.1 Weight management applications

It increases participants self-monitoring of calorie intake (Hertzberg et al., 2013). The use of SMS messages, led to small to moderate, weight and body mass index (Partridge et al., 2015).

5.2 Applications for physical activity management

Physical activity management in pregnant women had a reduced effect on increasing the number of steps performed per day, while reducing the prevalence of depressive symptoms (Choi et al., 2016). The use of the SMART MOVE application for 2 months provided a significant effect to moderate to high, in increasing the number of steps (Glynn et al., 2014).

5.3 Applications for depression

The Moodful Moods application was an effective tool for assessing the symptoms of depression, with the Patient Health Questionnaire-9 (Torous et al., 2015). The use of the application called my Compass led to the reduction of depression to moderate, after a follow-up period of one month, as evidenced by the Depression Anxiety Stress Scale (Proudfoot et al., 2013).

5.4 Applications for anxiety and stress

The use of the my Compass application had a significant small effect, on anxiety and a significant moderate effect on stress and after one month of extensive use of the application, the effects became greater (Proudfoot et al., 2013). Following the use of an anonymous application, moderate effects on stress were obtained (Ly et al., 2014).

6 Smartphon - Stress Self-Assessment

Smartphone is used in programs for depression (Richards and Richardson, 2012), bipolar disorder (Faurholt-Jepsen et al., 2016), and anxiety (Mayo-Wilson and Montgomery, 2013). Some studies used a yes or no question to measure self-assessed stress (Ottaviani et al., 2015), and other studies used questionnaires (Adams et al., 2014). In most studies, participants were asked to report stress levels several times: weekly (Pipingas et al., 2013), once daily (Pärkkä et al., 2009), every half hour (Adams et al., 2014).

7 Smartphone - Stress and Addiction

Excessive use of mobile phone dialing and texting features is linked to depression, anxiety and stress (Strassberg et al., 2013). One of the psychological tests used to assess smartphone addiction, is the Smartphone Addiction Inventory (SPAI) contains 26 items and four subscales, for: compulsive behavior (CB; 9 items), functional impairment FI, 8 items), withdrawal (W; 6 items) and tolerance (T, 3 items) (Lin et al., 2014).

8 Smartphone and Stress - Continental Studies

8.1 Studies in North America

Out of 82 managers enrolled in the MBA at a Midwestern university, it was found that nocturnal use of a smartphone for professional purposes led to sleep disruption, exhaustion of self-control and negative consequences on daytime activity (Lanaj et al., 2014). In another study, conducted with 276 African-American students, it was found that 11.2% had anxiety and social phobia, the consequence of smartphone addiction (Bun Lee, 2015).

8.2 Studies in Europe

A study of 362 Swiss high school students found that teens with smartphones delayed sleep hours and reported significant sleep difficulties and decreased sleep duration during the week compared to those with conventional cell phones (Lemola et al., 2015).

8.3 Studies in the Middle East

Lebanon. In a single study conducted at a private university in Lebanon, 44.6% of 249 students (average age = 20.96 years) were found to be at high risk of dependence on smartphones (Hawi and Samaha , 2016).

Turkey. Another study, conducted on 367 Turkish university students, social interaction anxiety and social phobia emerged as positive independent predictors of smartphone addiction, there was a significant positive correlation with smartphone addiction score (Darcin et al., 2016).

8.4 Studies in the Far East

China. A study of 414 Chinese students (aged 19 to 26), using a composite smartphone addiction index, identified five symptoms of smartphone addiction: ignoring the harmful consequences, concern, inability to to control appetite, loss of productivity; loneliness, which is extremely positively associated with depression, has emerged as the strongest independent predictor of smartphone addiction score (Bian et al., 2015).

Taiwan. The findings of a study of 325 Taiwanese adults (age range = 17-97 years), comparable in terms of age and sex, with a nationally representative sample, showed a statistically positive effect - social interaction anxiety on use compulsive use of smartphones (Lee et al., 2014).

Japan. In a study of 126 Japanese medical students, depression emerged as an independent predictor of immersion score in Internet communication (Toda et al., 2015).

South Korea. Similar findings were reported in another nationally representative study of 795 high school elementary school students using a Smartphone Addiction Proneness Scale (SAPS) for youth. Symptoms of smartphone addiction: disruption of adaptive functions, orientation to virtual life, withdrawal and tolerance (Kim et al., 2014). Another study conducted in 2013 by the Korean Ministry of Gender and Family Equality on 448 students reported that 17.9% of Korean teenagers showed addiction to smartphones; a significant positive association between neurotic personality character and the severity level of smartphone dependence has been demonstrated (Mok et al., 2014). In a study of 353 Korean students, both aggression and impulsivity scores emerged as significant independent predictors of smartphone addiction, with impulsivity being stronger; depression was a significant independent predictor independent of smartphone dependence (Kim et al., 2015). One study, which involved 210 Korean female students (mean age = 22 years), found that 30.5% had a high risk for smartphone addiction (Lee et al., 2015).

Instead of Conclusions

Smartphones play an essential role in everyday life, being useful in simplifying communication, entertainment, education and many daily activities. However, the interaction with smartphones can lead, in some cases, to dangerous addiction patterns and stress, with its various forms of manifestation, among the most notable in studies being those of depression and anxiety. So far, it has been found that there is an association between depression, anxiety, stress and smartphone addiction. It seems that smartphone addiction is influenced by the high level of perceived stress. The link between depression, anxiety, stress and smartphone addiction cannot be limited to the category of young adults or students, rather it can be applicable to the general adult population.

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The dynamics between adolescent's perceptions and learning motivation

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Abstract

There is no human action that is not determined by motivation or an entire motivational structure, which generate, lead and support that process initiated by man. In this sense, in the field of education a large number of psychological and pedagogical research conducted in the field of learning mechanism have proven that motivation is at the basisof educational success. Also, the way a young person perceives school, learning, teacher's activity and social success can influence the orientation and support of his actions. Any teacher should get to know the students he works with as well as possible, what determines them to make certain decisions, how the relationship between educational and social success is perceived, and the way young peopleperceive the role of learning in their personality development.This study aims to capture some of the dynamicsthat exist between learning motivation and these perceptions of high school students. The research considers a sample of 154 young people, aged between 14 and 19. The aim of the research, is to capture the perceptions of high school students that influence the motivation of learning. The objectives of the research were the following:a) to identify the students' perception regarding the role of school in social success; b) establishing the adolescents' perception on the impact that school learning has, in the development of their personality; c) capturing the factors that determine, from the students' perspective, social success; d) identification of the factors that determine the student not to learn and of the factors that determine him to learn. The tool used in the research was the questionnaire. The results obtained can be the source of further debates and research so as to identify other nuances of interactions between motivation and student's perceptions on various activities and social phenomena.

Keywords: learning motivation, perception of learning, teachers' perception, perception of social success

1 Introduction

Motivation is the engine of personality, any choice we make in life and any decision we make in crucial moments or in a simple human context, all are determined by motivational structures or other psychic mechanisms that can become motivation. Any state of the body is actually a motivational state (Maslow, 2007). One of the ways in which we can understand human behavior is undoubtedly to decipher the mystery of human motivation. Starting from these general ideas, but also from many researches of pedagogy and psychology, in the field of education, we can say that the motivation of learning is the key to understanding social and educational success. There are many theoretical constructs, which try to explain the motivation in the context of school learning and to identify ways to optimize the classroom activity.

This study aims to observe the interactions between learning motivation and students' perceptions. In the school context, motivation is the mechanism that initiates, stimulates, orients and supports the student's learning activities (Popenici, Fartusnic 2009). This simple and concise definition clearly indicates the functions of motivation in the particular case of learning: it determines an action, guides it and supports it in order to achieve the proposed goal. Many factors that influence the motivation to learn can appear in the educational field. One of these factors is the student's perception of school and social reality. Social perception is the ability to make interpretations and inferences about other people based on their physical appearance and verbal and nonverbal communication patterns (Aronson et al., 2010). Perceptions allow people to understand others and the social groups of the world leading to social knowledge (Smith, Mackie

2000). In conclusion, we can say that social perception is a process of understanding, evaluating and interpreting ourselves and others.

Adolescents work in a social context and interact with adults in a social institution called a school. Without having a comprehensive approach to the dynamics between perception and motivation, I will try to highlight various studies and research that show the interaction between motivation and perception.

Young people's perceptions about teachers (Wehlage et al. 1989; JF, J., Swabey, K., Pullen, D., Getenet, S. and Dowden, T. 2018), about school (Kagan, 1990; Kramer - Schlosser 1992), about the society in which they live, about the social success (Popenici et al. 2004), all prove the existence of some changes in the plan of learning motivation either in a positive or in a negative sense. The perceptions that students have about teachers, of different activities and social phenomena determine a certain way of thinking, of relating, of having a certain behavior. The way you relate to certain people, to certain activities, to certain events in the school space or outside it also determines a certain level of learning motivation. For example, students' perceptions of the school environment influence their academic achievement, school participation, school identification and use of self-regulation strategies (Wang, Holcombe, 2010). The social reality and social phenomena of postmodern society, to which students are exposed, have direct effects on learning, motivation and school results (Cuciureanu et al., 2014).

The adolescent is not detached from the values and norms promoted by the social environment in which he lives, and these can cause changes in the level of learning motivation. The socio-cognitive perspective highlights that motivation depends on a well-defined social context in which the student's perceptions interact with his environment (Zimmerman, 1990). The motivation of learning is influenced by the object of learning, but also by the conditions in which the learning takes place and by the student's perceptions on the didactic activities (Viau, 2004). Taking into account these researches, but also others, in the field of the relationship between motivation and perception in students, we tried through this study to identify the perception of high school students in relation to certain components of school reality.

2 Research design

Objectives

The aim of the research is to capture the perceptions of high school students, which influence the motivation of school learning. The following objectives are subordinated to this purpose: a) to identify the students' perception regarding the role of school in social success; b) establishing the adolescents' perception on the impact that school learning has, in the development of their personality; c) capturing the factors that determine, from the students' perspective, social success; d) identification of the factors that determine the student not to learn and of the factors that determine him to learn.

Participants

The sample has 154 students from two high schools (vocational and technological) in the city of Focșani aged between 14 and 19.

Research instrument

I used a questionnaire that investigates students' perceptions of various components of school reality: perceptions of social success, perceptions of school and learning, factors that decrease learning motivation, factors that increase learning motivation

3 Results and discussions

Regarding the perception of high school students on social success, the following results were reached. It is clear that a huge proportion (99.4%) of students have as their main goal social success, this is the main reason why young people go to school (Popenici et al. 2004). Very interesting is what students understand by the concept of social success. Social success is seen by 86.4% of students as equivalent to a successful career and the opportunities offered by such a career.

The second place in the perceptions of young people in terms of social success is the founding of a family 72.1%. Social success is associated with the money of 64.9% of respondents. School and learning are perceived by respondents as means by which they can achieve their ultimate goal - success in life. The main reason why the students investigated in this research learn is to succeed in life (87.7%). Also, school success is seen by 89.6% of students as being closely related to social success. 80% of young people consider that if you have more studies, the possibility of having a better job is higher. These results show us that the perception of the school is still a positive one, the school is valued by a significant percentage of students.

Learning activity is perceived by students as important, due to the impact it has on the development of their personality: increased self-confidence (73.4%), increased imagination, divergent thinking, and inventiveness (78.6%), increasing the ability to reason and make judgments (85%). All these elements show us that a large proportion of the investigated students consider the learning activity as beneficial for them and as helpful in achieving the main goal, "social success". This perception of learning determines supportive behaviors and stimulates motivation for learning.

The main factor, which is an obstacle in the learning activity, is the teaching style of teachers, which is one based more on information, on the lack of a real dialogue with the class. About 60% of respondents have this perception.

Another factor perceived as an obstacle is the overcrowded curriculum is considered by 68.8% of respondents. From the category of factors perceived as beneficial for learning motivation are: interactive teaching methods, for 42.9% of respondents this factor is considered very important. The socio-emotional climate during the classes is perceived by 46.1% of students as important in increasing the motivational level for learning. This indicates the need for students to be valued, accepted by both school and teachers. Emotional tension, teachers' rigidity are aspects that induce anxiety, stress and affect the level of learning motivation. A school environment that facilitates a sense of community, a sense of belonging among students is very important (Allen et al. 2018; Battistich et al. 1997; Osterman 2000).

Conclusions

Analyzing the research results, we can make some comments. First of all, all the other perceptions are built around the perception of social success. The purpose of adolescents is to promote and integrate into society and gain a higher social status through a professional career. This seems to be the main mechanism that influences learning motivation.

The perception of the learning activity shows a valorization of the school and the learning activity which is seen as having a positive impact on the intellectual and social development. This perception also has beneficial effects on learning motivation. The factors perceived as an obstacle to motivation are not a surprise, as they continue to show some shortcomings of the education system.

Any teacher should know as well as possible the students he works with, what determines them to make certain decisions and to have certain behaviors. In order to understand them, we need to know their expectations, perceptions and their own life goals.

The limitations of this research, which is on a small sample of two high schools in the province, must also be taken into account. The research results can only be extended strictly to the investigated population. The objective of the research was not to establish statistical correlations between various items, but an accumulation of information in order to deepen this phenomenon through further research.

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Possibilities of choosing innovative E-learning technologies

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Abstract
The purpose of this approach is to present and validate some possibilities of choosing innovative e-learning technologies that the teachers in higher education in the field of military sciences can use in the teaching-learning process. The author considers that in the conditions of a modern university education that is adapted by the most demanding requirements regarding the quality and performance of the teaching act, technology is an important factor during the educational activity in the higher military education. The peculiarity of the military sciences field is that the teaching-learning process, even if it uses specific innovative e-learning technologies, is also based on practical activities, which cannot be entirely carried out using only these technologies. Therefore, the novelty of this approach is represented by the proposal of the accomplishment of the two objectives of the research, carrying out two case studies using two models of analysis (ACTION and SECTIONS methods) through which to offer two options for choosing a technology necessary for the educational process.

Keywords: E-learning technologies; innovative technologies; ACTION model; SECTION method.

1. Introduction

As teachers in military higher education, the field of military sciences, we often have the opportunity to identify and put in the position to choose the most appropriate teaching-learning method. Under the conditions of a university education adapted to the most demanding requirements regarding the quality and performance of the teaching act, technology is an important factor during the educational activity. The purpose of this article is to identify ways of analyzing the teaching-learning methods that use innovative *E-learning* technologies that will produce positive effects on the educational system in the military sciences.

The hypothesis of this approach assumes that if technologies occupy an important place in the military sciences, then there is the possibility of adapting the teaching-learning methods and to the innovative E-learning technologies. For this purpose, two case studies using two similar analysis models, identified in the international educational environment, which represent the inspiration for this approach, are set as objectives of the research. In this sense, the ACTION (A. W. Bates, Tony Bates, 2005) and the SECTIONS (A. W. Bates, Gary Poole, 2003) methods are used and are the main tools to validate the working hypothesis and to achieve the proposed purpose. Technologies occupy an increasingly important place in education so that the field of *E-learning* is one of the most technologically advanced because of the most innovative technologies aim to cover the need in the field. This aspect is shared by specialists from other areas as well: "*E-learning*, especially when offered online, can greatly increase the opportunities to access information and other resources. This can be particularly important when relevant information and expertise are not available locally and therefore cannot be used for classroom instruction."(ICAO Council, 2016)

2. E-learning in the Military Sciences

The term *E-learning* has an Anglo-Saxon origin, being adopted in the current international language and extended from its primary meaning. Today the term refers to teaching-learning activities and educational activities through increasingly modern electronic means. In a general framework, *E-learning* means all the specific activities carried out in the educational field in which communication means and information technologies are predominantly used. ”In essence, e-learning is a computer based educational tool or system that enables you to learn anywhere and at any time. Today e-learning is mostly delivered though the internet…”(Epignosis LLC, USA, 2014). The most used and handy technologies are the computer and multimedia electronic devices, which are used as a means of teaching-learning-evaluation through communication in the virtual environment.In a particular framework, *E-learning* is understood as a form of distance education, organized by specialized educational institutions, which realizes the educational process through a particular method of teaching-learning, adapted to certain educational objectives.The presentation of the topics is done sequentially with the help of computer technologies that use innovative hardware and software and the communication is done through the Internet. The aspect is approached and detailed in specialized works, most authors emphasizing the essence of the term: “*E-learning* represents the interaction between the teaching/learning process and the information technologies [... ..] covering a wide spectrum of activities, from computer-assisted education to fully-developed online education.”(Iuliana Dobre, 2010 *apud* Brut, M., 2006)Having presented some aspects that underline certain general characteristics of the *E-learning* domain, it is further utilized in this approach, a hypothesis demonstrated in paper *E-learning technologies, necessary but not sufficient in military sciences* (authors Scipanov Lucian Valeriu, Scipanov Dănuța Mădălina), which states that the e-learning technologies used in the teaching-learning process in the field of military sciences are necessary but not sufficient.

The peculiarity of the military sciences field is that the teaching-learning process, even if it uses specific innovative technologies E-learning, is also based on practical activities, which cannot be entirely carried out using these technologies.

The factors that characterize the teaching-learning activity in the field of military sciences are institutional and professional in nature, or action, temporary and spatial in type:

- institutional;
- professional;
- actional;
- temporal;
- spatial.

The factors of institutional nature refer to the structure of the military organization, the specific regulations, and procedures, the resilience of the military organization. The professional factors refer to the access to information, the classification level, the field specializations. The action-type factors refer to the possibility of carrying out activities by observing military regulations, rules of conduct, etc. Temporary factors refer to the time periods when the teaching-learning activities can be carried out, depending on the planned training cycle (instruction-operationalization-maintenance).The factors of spatial type, refer to the working environment, place of activity, specialty (land, air, naval) and domain (surface, air or sea).For all factors mentioned above, we must be paid great attention to the resilience of the military education system, which, due to tradition and conservatism, may slow down the implementation of technology. ”Some organizations and their employees may reject e-learning (or other learning activities) because of the norms and values of the society to which they belong. Some cultures that value learning in the presence of a qualified teacher, for example, may reject e-learning or accept it with more difficulty. The opposite may occur in places where using technology is culturally accepted or valued.” (ICAO Council, 2016)

It is honorable that the current leaders of the military higher education institutions are open to innovation and promote the principles of modern education, in which *E-learning* technologies occupy a quite important place.

In the particular case of military art, a component of the field Military Sciences, taking into account all the factors that can influence the educational process in this particular field, the participation in tactical-applicative exercises, is carried out by combined methods, which even if they need technical and communications means, as a rule, are also carried out with the help of classic means and materials such as maps, plans, typefaces, procedures, etc.

Practically, in this case, the educational process is carried out adaptively to the existing technologies, but these are more quickly working tools than educational methods.

To see which are the most suitable innovative e-learning technologies in the teaching-learning process in the military field, two case studies will be performed by using appropriate methods, which provide a different answer on how to adapt decision-makers on the choice of teaching-learning methods that use these technologies.

3. ACTION Model Learning

This method (ACTION model learning) is useful in the e-learning field because it includes a logical scheme that can be used as inputs for analysis software specific to innovative technologies. The peculiarity of the method is that during the teaching-learning process, the participants can adapt their teaching-learning methods during the process, by permanently evaluating the effects that occur, i.e. the results.

Thus, if the objectives change, the knowledge accumulated up to then can contribute to the best decisions, depending on the experience of the participants, and the interaction with external factors. This method is based on inductive reasoning, with a slight intuitive characteristic.

The teaching-learning process cannot be carried out using a single technology, therefore, there is a need for a selection procedure of the best technology from a wide range, through which the teaching objectives can be achieved. Thus, the manner of selection will have a considerable impact on the educational process through the effect it produces, which is why it is important to make it known.

ACTION model for technology selection includes the next component for analyzing: Access; Costs; Teaching & learning; Interactivity & User-friendliness; Organizational issues; Novelty; Speed. (see Fig. 1)

Adapting this analysis model to the selection of an optimal technology required for the teaching-learning process in the military sciences, the paper will try to identify those answers according to the proposed model that will give us an orientation towards an optimal solution.

For this, the types of questions identified in the ACTION method have been adapted, so that for analysis, the following questions and answers can be used for each criterion.

Next, it is performing an analysis based on the ACTION model, through which it validates the usefulness of the method in identifying the best technology in the field of military science.

-ACCESS - With this criterion, it is possible to analyze the accessibility and flexibility of potential users to innovative technologies

Question: How accessible is this technology for master and doctoral officer students?

Answer: Technology is accessible to all master and doctoral officer students or for a percentage of them. In this case, the percentage is identified and we evaluate how this impediment can be overcome.

Question: How flexible is it for officer students, master, and doctoral student's degree?

Answer: The technology is very flexible, flexible or less flexible. This answer can identify the fact that there is a risk that can be quantified.

COSTS - This criterion aims to identify the costs of technology implementation, the benefit/cost ratio, and similar variants.

Questions: What are the cost structures of technology? What is the unit cost for a master and doctoral officer student? What are the opportunity costs vs other technology choices?

Answer: It is being evaluated the costs for procurement, implementation, maintenance for the entire technology but also other related costs (personnel, operating, licenses, etc.). The amount identified can be evaluated and reported as needed, the benefits, the efficiency, the cost per participant, etc. Under these conditions, there is enough information to provide an image of the extent of the investment and whether it is worth buying, compared to other technologies identified on the market.

ACTION MODEL

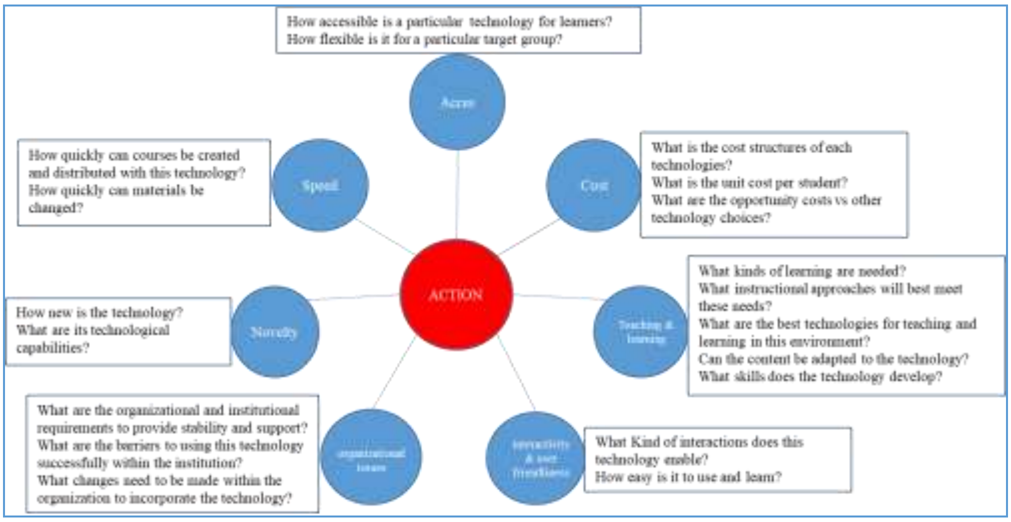

Fig.1. ACTION MODEL for *E-learning* technology selection (adapted from T. Bates)

TEACHING & LEARNING - This criterion provides an indication of the efficiency of the educational process.

Questions: What kinds of learning are needed? What instructional approaches will best meet these needs? What are the best technologies for teaching and learning in this environment? Can the content be adapted to technology? What skills does the technology develop?

Answer: It is identified the learning methods that are appropriate to the technology or which teaching-learning methods are recommended. It is identified which methods are appropriate and useful to the field of military science, which is an area close to the branch of social science, with interference in engineering, mathematics, history, geography, etc.

Also, the possibility of adapting the educational content to this technology is evaluated, or conversely, it is evaluated whether the technology supports these contents. It is evaluated which objectives and competencies are developed with this technology. In this case, it can be considered that a percentage of over 50% of favorable answers, allow the educational process to be carried out under optimal conditions.

INTERACTIVITY & USER FRIENDLINESS - This criterion considers the degree of interaction between participants and between participants and technology, the attractiveness of the technology, the ability to work with it.

Questions: What kind of interactions does this technology enable? How easy is it to use and learn?

Answer: To be followed if the technology allows the interaction between users if it is friendly, easy to understand, permissive in use. These issues, even if they tend to be subjective, can be easily identified.

ORGANIZATIONAL ISSUES - this criterion aims to identify the problems of the organization of the military educational institution, what obstacles or syncope of use might appear during the use of technology, eventually we can identify remedial solutions and development proposals.

Questions: What are the organizational and institutional requirements to provide stability and support? What are the barriers to using this technology successfully within the institution? What changes need to be made within the organization to incorporate the technology?

Answer: Military institutions usually have high degrees of trust, so this suggests stability and real support for the implementation of new technologies. This criterion needs a faster analysis at the institutional level, at the command team level, at the leadership level. Therefore, it is not sure that solutions would be found favorable to the implementation of innovative technology.

NOVELTY - this criterion allows an analysis of the opportunity of the technology from the point of view of its novelty on the one hand but also from the point of view of the novelty that it generates.

Questions: How new is the technology? What are its technological capabilities?

Answer: The novelty of the technology would have a great impact only if it adds value to other systems, but the major advantage is the potential it offers, an aspect that can be easily identified by the evaluator.

SPEED - this criterion allows an evaluation of the speed of implementation, adaptation, and acceptance of the technology on the one hand, but also of the contents of the themes to this technology, on the other hand.

Questions: How quickly can courses be created and distributed with this technology? How quickly can materials be changed?

Answer: The answer is not difficult to identify, as each teacher has already quantified the effort they need to make to create a course that fits the technology. Sometimes the exchange of technology is easier, sometimes harder, but I'm sure the effort of the teacher will not be in vain. From the point of view of the speed of implementation of the technology, this is not a too important criterion, because of the opportunity is finally identified to be implemented in an honorable time. In my opinion, the most important factors that underlie the efficiency of innovative technologies in the field of military sciences are those that are defined by the ACCESS and COST criteria. From the point of view of the costs of implementing new technology, these are not as high as the valuable technology, the actual costs being variable depending on the complexity of the systems used, which will be compensated anyway. Over time, the costs of designing, implementing, and operating an innovative technology will be adjusted to a level of bearable access to a respected institution." As a general rule, e-learning is costless to design and develop than classroom instruction, but much less costly to deliver and repeat over time. True cost assessment must, therefore, consider initial design and development, and delivery over time." Regardless the costs, any new technology implementation in the educational system has an effect on the organization. Depending on their complexity and destination, one can also identify the place and role that technology has in the educational process, so that each technology is particular to a particular field and it is assigned a teaching method, which does not always reach all educational objectives. In this situation, it is highlight in the field of military sciences, the discriminatory character of technology.

4. SECTIONS method

Another identified method, which determines the choice of the best technology for carrying out the teaching-learning process in the military sciences is the SECTIONS method (A. W. Bates, Gary Poole, 2003). Therefore, at this stage of the case study, an analysis based on the SECTION model will be performed, whereby will validate the usefulness of this method as another variant of identifying the best technology in the field of military science.

Each letter of the acronym for the SECTIONS method represents a component to analyze, by generating a set of questions whose answers can provide an argument. The method offers the possibility to meet the following analysis criteria with the related questions for: S = students; E = ease of use and reliability; C = cost; T = teaching and learning; I = interactivity; O = organizational issues; N = novelty and S = speed.

The essence of the method is that it is possible to identify those sets of questions by which the optimum technology can be selected through which the teaching-learning process can take place. Compared to the identified method, in order to carry out a customized analysis in the field of military sciences, we adapted the set of questions so that the answer would guide the teacher to choose an optimal method.

S = STUDENTS

Questions: What data do we have about the participants in the educational process? From what environment and military specialty do they come? In the environment from which they came, did they have access to E-learning technologies? Will they be able to access this technology again? What is the level of adaptation of the participants to this technology?

Answer: The teacher evaluates the answers to these questions, and if they are favorable, a decision will not be difficult for you to make. As a rule, the military environment offers the possibility of using similar technologies, so that the participants will adapt easily, especially if there is a training period.

E = EASE OF USE AND RELIABILITY

Questions: How accessible is it? How easy is it for participants to use this technology? Can the system's reliability be demonstrated? How friendly is the technology? How easy is it to learn and apply?

Answer: Accessibility and ease of use of technology are easily subjective criteria, they are largely dependent on each participant. The participants will go beyond the minimum accessibility threshold and will quickly acquire information on how to use them. The criterion becomes important when accessibility to technology cannot be ensured for all participants.

C = COST

Questions: What is the unit cost assigned to each participant? What is the cost of implementing the technology; What are the maintenance costs? What is the cost/benefit ratio?

Answer: The answer to this question is similar to the ACTION method.

T = TEACHING AND LEARNING

Questions: What methods are appropriate for the technology? Which technologies fit the educational requirements and objectives?

Answer: This is a criterion for which the teacher can best decide the answer, after analyzing the compatibility of the possible methods with the technology.

I = INTERACTIVITY

Questions: What is the quality of the relationship? Do the participants interact?

Answer: The degree of interactivity is evaluated by the teacher. It will not be difficult to identify the level of interactivity, in my opinion, a teacher can even contribute to this. However, in the military sciences, the interactivity of the participants is imperative.

O = ORGANIZATIONAL ISSUES

Questions: What are the institutional objectives and how does the technology influence the product? What are the limitations of technology? What does it mean to adapt to the military educational institution to technology?

Answer: This criterion can be evaluated by the teacher, but it is more of an attribute of the driving factors. It is more than certain that at the level of the management of military educational institutions the risks and solutions will be identified to overcome the limits of technology.

N = NOVELTY and S = SPEED

Questions: How new and innovative is the technology? Are the participants familiar with the technology? How soon will the new technology be accessible to participants? How fast can the courses adapt to this technology be?

Answer: Novelty is an objective criterion, but the evaluation can be subjective. A teacher can identify an objective answer. The speed of access can be easily identified. Due to the experience, the teachers will easily adapt the educational content to the new technology, consequently, the novelty and speed will be easy criteria to evaluate.

5. Conclusions

These two methods of analysis, regarding the efficient way of choosing a teaching-learning method, represent a model at the disposal of any teacher who wants to validate on well-founded criteria, a technology that will support the educational process. These variants of choosing the innovative technology will produce positive effects because it allows the realization of an analysis based on criteria established at the institutional level but also on a series of questions presented in the two previously used methods, whose answers provide a reference line regarding the choice made. Today's generations have a great advantage because they have grown with technology and accepted technological advances much easier. In this case, the use of technology represents an efficient way of experimenting, implementing and using new teaching-learning methods. Therefore, the educational process is best to take place in a classroom organized environment, otherwise, the technology can solve only part of the problem, with its advantages, and disadvantages. In the classroom, interactivity is much better utilized as opposed to its manifestation through technology in the virtual environment.

In conclusion, using innovative technology in the right context can be an excellent way to improve the student’s learning experience in the military sciences, often with an advanced level of experience. Andragogy is the main approach for these specialist students. When a teacher gets to make the decision on the use of a particular technology, there is only one risk to be overwhelmed by the multitude of possibilities and the volume of available devices and software.

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E-learning technologies, necessary but not sufficient in military sciences

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Abstract

This study aims to identify the relationship between necessity and sufficiency of innovative technologies used in the educational process of the military sciences field. The core subject of this study is that “technologies are necessary but not sufficient”. As specialists in the military art, we often wonder what is the role of E-learning technology and how it influences the teaching-learning process in such a particular field. It can be considered that the emergence of new disrupted technology in e-learning may be the subject of a paradigm. Thus, using innovation in the teaching-learning process is a brave practice, but this is a double edge sword. On the one hand, there is the resilience of the system and on the other hand the opportunity of a new teaching-learning method. It can be admitted that most of the time the technologies in the e-learning field are innovative. Therefore, starting from the hypothesis that using e-learning technologies is necessary, even recommended, it is true that the e-learning technologies are not enough? To accomplish the purpose of the paper, in this approach will be used the following main research methods: the SWOT analysis and the 5 R theory by which is intended to validate the proposed thesis. The novelty of this approach consists of the fact that it uses two tools devoted to the analysis in identifying the relation between necessity and sufficiency in the case of innovative technologies used in education.

Keywords: E-Learning technologies; E-Learning methods; Military Sciences

1. Introduction

In this approach, it is proposed to identify the influence that innovative technologies have on the teaching-learning process carried out in the field of military sciences. As practitioners, but especially as theoreticians in this field, we have found the need to use consecrated or new methods, processes, techniques, and tools, adapted to the teaching-learning process. It is noticed that innovative technology, as a teaching-learning method, is the most often used in the E-learning field. Thus, the purpose of this approach is to identify the necessity and sufficiency of these innovative technologies used in the educational process, by particularizing the analysis in the field of military sciences. To accomplish the goal, it will be using the following research methods: field observation; comparative analysis; the SWOT analysis; the 5 R theory; the demonstration, and method of induction.

By and large, it can be assumed that the use of E-learning technologies, which encompasses all forms of educational technology in the teaching-learning process, is necessary, but not sufficient. “An E-learning system consists of a planned teaching-learning experience, organized by an institution that provides educational resources stored on electronic media in a sequential and logical order to be assimilated by subjects in their own way, without constraining them to group synchronous activities. The task of education and training based on new information and communication technologies is not to replace the traditional types of training, but to complete them in order to increase their efficiency.” (Dobre, Iuliana, 2010)

We often wonder what the role of an E-learning technology is, what these technologies are, how it influences the teaching-learning process, how they can be used, and what are the methods of identifying the best teaching methods using these technologies. For example, E-learning technologies include hardware (desktop, PC, tablets, electronic devices, etc.), software, media devices (mobile phones, smartphones, tablets, etc.), which can contribute to the learning process in a fun and interesting way.

To demonstrate the thesis of this study, that technologies are necessary but not sufficient, it has been set out three research objectives. Thus, the first objective of the paper is to identify the way in which the educational system accepts these technologies. The second objective is to identify the opportunity to use a new teaching-learning method. The third objective is to carry out a comparative analysis of the advantages and disadvantages of using E-learning technologies in the field of military sciences.

Let's see what are the implications of using innovative E-learning technologies in the teaching-learning process in the specific field of military sciences. Most of the time, the technologies in the E-learning field are innovative. Therefore, the analysis starts with the hypothesis that the use of E-learning technologies is necessary, even mandatory.

Moreover, this aspect represents a criterion for evaluating the teachers' performance. In the conditions in which this hypothesis is validated, the next hypothesis, it is proposed to check if the use of E-learning technologies is not sufficient. If both hypotheses are validated, it set out to identify what their correspondence is in the thesis, so that it will identify what is the relationship between the intrinsic value attributed to technology as necessary and sufficient and to technology as necessary but not sufficient. So, if it is identified a minimal difference, then the thesis is validated, thus, it can be stated that the use of innovative E-learning technologies in the military sciences is necessary, but not sufficient.

It has been noticed that at the international level there is a great concern regarding the development and use of innovative teaching-learning methods, the E-learning technologies occupy a special place in the concerns of the teaching staff of most universities. This is also a remaining concern, for which has been set the declarative purpose of this study approach: to identify the relationship and the ratio of between the necessity of E-learning technologies and the degree of sufficiency in the field of military sciences.

It is noticed that at the international level there is a great concern regarding the development and use of innovative teaching-learning methods, the E-learning technologies occupy a special place in the concerns of the teaching staff of most universities. This is also a general concern, for which was set out the declarative purpose of this approach: to identify the relationship and the ratio of between the necessity of E-learning technologies and the degree of sufficiency in the field of military sciences.

2. Innovative technology in the military sciences

As specialists in the field, many of us often faced this challenge, for which we adapted the solution to reach the didactic objectives of the discipline, by the analytical program and the discipline curricula.

Throughout our teaching career in the military art specialization, we had the opportunity to benefit from the existence of E-learning technologies and we were able to choose an innovative teaching method to respond to desired outputs.

Adaptation to these technologies was also because, alongside the classic formats of educational content, we often used presentations in certain electronic formats, which could be designed or uploaded in the virtual environment.

Uploading these presentations from the physical domain to the virtual domain, on the ADL platforms, offered by the university, where teaching-learning activities can take place, was a simple formality. In these conditions, we can adapt very easily to the advantageous conditions offered by E-learning technologies.

However, in all these cases they did not have advantages, so in this approach, the concrete advantages and disadvantages of using such innovative technologies will be identified, performing comparative analysis, from which will be underlined some relevant conclusions.

In most cases, in the discipline curricula, it can be identified lectures, seminars, laboratory work, guidance, tutoring, etc. In the particular case of the military sciences, the mandatory disciplines are military art disciplines, foreign languages, other specialized disciplines in the field and the optional disciplines are mainly specialized or related.

In the case of the military art disciplines, which occupy the largest share of the analytical program, there is a share of lectures, seminars, and laboratories, which confer on students, master, and doctoral students, specific skills in the field studied.

From a summary analysis of the possibilities of carrying out the teaching-learning process, it can be admitted that the lectures can be carried out in the online environment, using a specific ADL platform, in which the E-learning means can be used. Also, some seminars could be held in the online environment. However, if lectures, seminars, and tutoring, can be taught online, we cannot admit the same thing about the laboratory hours. The activities carried out within the laboratories are too far away from practice to identify some possibilities for their development outside the framework organized under specific conditions.

In the case of military art within the field of military sciences, the laboratory hours have a certain peculiarity, being carried out in the form of tactical applicative exercises, usually on the map, in combination with the use of simulation programs, other methods (war game, analysis, testing of courses of action, options, making decisions, evaluations, etc.) which require the presence of the whole team of students involved in the process of planning, elaboration, and evaluation of the developed products.

As we can encounter in certain situations, technology is even the teaching method, a process, or even a working tool in the didactic activity. In other words, the use of a certain technology can determine the definition of a certain teaching-learning method.

The emergence of new disrupted technology in E-learning may be the subject of a paradigm. In this situation, it can be considered that the use of innovation in the teaching-learning process is a brave practice, but it is a double edge sword. On the one hand, there is resilience (Risk intelligence: A Centre for Risk Research discussion document) of the system and on the other hand the opportunity of a new teaching-learning method. Therefore, the risk of implementing new technology with applicability in E-learning must be carefully identified and addressed.

Resilience is a term that relates to the success of an organization. Organizational resilience is the ability to quickly adapt and reorganize to unfavorable situations or changes that have occurred in the life of the organization. That is resistance to the influence of a paradigm that determines the updating and adaptation of some principles of the organization.

Is it possible for an organization, a higher education institution, a university teacher in the military sciences to admit the resilience of the organizational system under the conditions of this paradigm?

To get an answer, the research will lean on an analysis based on a theoretical model launched by the international organization AIRMIC (Association of Risk Managers and Insurance in Industry and Trade) (https://www.airmic.com/), the 5 R theory (https://www.airmic.com/technical/library/roads-revolution-executive-summary), which even though it was launched in 1999 (Cannon, T., 1999), is still topical.

The 5 R theory uses the following analysis criteria: *Risk Radar; Resources and Assets; Relationships and Networks; Rapid Response; Review and Adapt*.

3. The 5 R theory; Aligning Resilience with Digital Transformation

By this theory, it can be identified the particular approach of the digital domain, which presents 8 principles (Roads to Revolution - executive summary, 2018) regarding the achievement of resilience under the conditions of digital transformation, that is to say, the emergence of those innovative technologies.

Given these 8 principles (risk radar; resources, relationships, rapid response, review and adapt, redesign, retain stakeholders, and reinvent purpose), it can be seen that the first five principles underpin the 5R Theory model.

Essentially, this theory allows to identify the risk, the resources, the relationships, the response, the way of adaptation, identify those solutions of resilience and transformation into 5 points:

a. *Risk rada*r identifies the trends and the evolution of the technology that offers the organization opportunities to improve the teaching-learning activity - Emerging Risks. Thus, from the point of view of radar risk, the emergence of a new E-learning technology improves the teaching-learning activity. The teacher has an important role, in this case being a promotional vector.

b. *Resources and assets* provide the opportunity to fully benefit from the evolution of technology- Strengthen Resources. From the point of view of Resources and assets, the adoption of a new E-learning technology enriches the educational resource. Any acquisition that brings benefits must be encouraged.

c. *Relationships and networks* refer to that partnerships are a way of realizing the transformative capabilities of the educational organization - Extend Networks. Within the educational organization, relationships and networks can be applied through partnerships, consortia, and joint projects. This attribute belongs to the management factors and must be one of the institutional objectives.

d. *Rapid Response* - allows the educational organization to accept the transformations and to adapt. For example, inter-institutional cooperation and adaptation allow clear identification of roles and responsibilities within the educational organization or a consortium -Remove Barriers. The adaptability of the educational organization, by applying the Rapid Response principle, requires the acceptance of the new, the adaptation to it, its application, but without affecting the image of the institution. Also, this principle must be an instrument of the driving factors and must be one of the institutional objectives.

e. *Review and Adapt* represents the ability of educational organizations to protect, review, and adapt the organization's reputation through leadership -Enhance Reputation. In the case of increasing the reputation of the organization, the principle of Review and adapt applies only in the sense of contributing to the growth of confidence. In this regard, the leadership of the organization plays an important role.

As a result of this analysis, the organizational resilience in the educational field can be overcome by the attitude of the teacher, the collective attitude, the acceptance of the new, and the adaptation of the new technologies to the needs of the organization.

Given these findings following the analysis of how to adapt the educational organization, by accepting resilience, it can be considered that attitude is the key. Thus, no principle could be forced to be applied and the educational organization is able to easily accept the adoption of new E-learning technologies.

It has been basically identified the solutions for each criterion of 5R theory so that the organization can overcome its resilience to the emergence of those innovative technologies.

Because it has been demonstrated the need for technology, it has been validated as the first hypothesis. Next, it will be demonstrated that the technology is not enough to validate the second hypothesis of this approach.

It has been identified the solutions for each criterion of 5R theory so that the organization can overcome its resilience to the emergence of those innovative technologies.

So far, it has been demonstrated that the need for technology validates the first hypothesis. Next, the scope of this pilot study is to demonstrate that the technology is not good enough, which conduct to the validation of the second hypothesis.

4. Is the innovative e-learning technology necessary and sufficient?

In order to find out the answer, it will be identified the relationship between the intrinsic value attributed to the technology as necessary and sufficient and to the technology as necessary, but not sufficient.

R = technology required but not sufficient / technology required and sufficient

In order to find out the value of this report, it will be assigned an intrinsic value to the two components (the necessary and sufficient technology and the necessary but not sufficient technology).

so,

- technology required and sufficient = a; - technology required but not sufficient = b

If this ratio is balanced (see formula 1):

[1] $R = b / a = 1$,

then, the hypothesis that the use of *E-learning* technologies is not sufficient is not validated.

Because if $a = b$, ($x = 0$), $R = 1$, the technology is necessary and sufficient.

In order to validate the hypothesis, it can be considered that if a technology is not sufficient, it needs certain factors that complement the need to be sufficient.

so,

[2] $a = b + x$,

where,

- x represents that variable that is assigned a minimum threshold for which technology is sufficient. That is, x represents the sum of factors that have a certain weight in this equation.

In this case, it is obvious that $a > b$, so,

[3] $F(x) = b / a \neq 1$,

Thus, the hypothesis is validated, one technology is not enough, it still needs certain factors to complete it to become sufficient.

5. SWOT analysys

Next, let's see what are the factors which determine the necessary but insufficient character of technology. It is obvious that some factors are beneficial (positive) and some are unbeneficial (negative). For this, it will be analyzed these factors, which can be identified among the advantages and disadvantages of using these innovative technologies. In this regard, it will be performed a SWOT analysis.

At first glance, SWOT analysis comes up with a series of advantages, disadvantages, opportunities, and threats to the implementation of innovative technologies. Therefore, it can easily be identified what are those particular advantages and disadvantages in the field of military sciences.

The result of the analysis confirms that the use of innovative technologies presents a number of advantages and disadvantages, which are factors that argue the necessity of using certain technologies, but diminishes their sufficient character.

The SWOT analysis shows that technology is necessary but not sufficient, and it draws to this conclusion that innovative technologies should not have disadvantages and, if present, they must be minimal and not negatively influence the educational process.

SWOT analysis

	Beneficial to use innovative technology	**Endanger the use of innovative technology**
Internal source	Strengths of using innovative technologies	Weaknesses of using innovative technologies
	-the teaching-learning process is attractive and interesting; -it increases the motivation of the participants; -it increases the interest of the participants; -increase the availability of participants; -allows participants to practice the skills learned in a virtual environment; -contributes to strengthening the interactions between the participants; -gives participants more options for expression; -allows the objective evaluation of the participant; -immediate feedback; -permanent evaluation and adaptation to needs; -it identifies new skills; -flexibility; dynamism; -quantifiable activity; -certain teaching-learning methods can be easily selected; -identification of individual skills; -development of individual skills.	- it can be incorrectly implemented; - the degree of attention of the participants cannot be controlled; - not all the teaching objectives can be achieved; - accessibility may be limited; - the participants' experience of using new technologies is different; - the degree of satisfaction differs from one participant to another; - the costs of technology can be high; - could occur technical errors; - human errors may occur; - the prejudices of the participants are manifested; - the interaction is sometimes affected by social distance; - decreased empathy; - the degree of physical and social isolation increases; - some teaching-learning methods cannot be used; - prioritize the tradition of classical education; - variations in individual availability; - the level of classification of information; - does not stimulate critical thinking; - automation of actions; - lowering the perception of reality; - group skills cannot be used; - affected teamwork.
External source	OPPORTUNITIES	THREATS
	-the possibility of developing educational programs; -the possibility of accessing the structural funds; -openness in inter institutional relations; -attracting new beneficiaries and target groups; -increasing institutional confidence; -development of group availability; -developing receptivity; -increase the efficiency of the educational process; -the effectiveness of the educational	- deterioration of social relations; - low level of social empathy; - lack of physical interactions; - insufficient financial resources; - maintaining the mentality; - risk of falling institutional interest - the intensity of learning decreases over time; - tasks become a constant pressure; - social prejudices; - becomes discriminatory for certain areas; - lack of cooperation; - the appearance of biases; - the decrease in participation;

	process is easily identified; -it contributes to the increase of educational performance; -increasing the quality of teacher performance; -development of the ADL platform; -partnerships with other educational institutions; -capitalization of heuristics; -development of innovation; -identification of working skills in projects.	- increases confidence in technology and decreases confidence in the teacher; - decrease the availability of beneficiaries; - depreciation of the real reality; - the impossibility of developing group skills.

Table 1. SWOT ANALYSIS

6. Conclusions

Due to the advantages/disadvantages ratio, resulted from the SWOT analysis, innovative technologies offer opportunities but also limitations. More than that, technology offers both, advantages and disadvantages to the education system.

It has been previously emphasized that in the case of using innovative technologies in education, the attitude of the participants is the key to success. How can we cope with this paradigm in the field of military science?

The tradition and educational culture of an organization is difficult to influence. In military art, only the most revolutionary decisions have changed the course of history. In the 21st century, there is an optimum degree of acceptance of innovative technologies within the military organizations, which represent the main beneficiaries of the products in the field of military sciences.

Therefore, the acceptance of technological innovations in education is prudent. Over time, working tools were accepted in the educational field, but these were based on the need for education in accordance with the working conditions existing to the beneficiaries. (simulators, polygons, etc.)

The result of the analysis confirms that the teaching-learning process is more than innovative technology. As specialists in the military art, the authors would like to mention that technology is necessary, but not sufficient for the teaching-learning process.

It is generally known that the specialists in the field agree that in the teaching-learning process the technology is not sufficient, but only complementary, emphasizing the role of the teacher and the school, a conclusion being presented as before.

When we talk about innovative E-learning technology in the field of military science, we approach the most developed, the newest technology, which will allow me to reach the most objectives and acquire sufficient capabilities to meet the student officer’s expectancy, with a degree high efficiency. In these conditions, for teachers, the effort to complete the difference between using or not using innovative E-learning technology is minimal, so that the achievement of the proposed performances can be achieved by the classical methods known.

In order to have a performant educational system, the use of E-learning technologies in education in general, and in the military sciences in particular, is imperative and needs a strategy. Neither an innovative technology cannot compensate for a weak teaching act, nor a modern teaching method can ignore an innovative technology.

Even repeating what is obvious, the teaching-learning process needs more than innovative technology. Performance education cannot be done without followings aspects:

- the active participation of students;

- the existence of conforming educational contents;
- the application of appropriate methods;
- the use of appropriate tools;
- the existence of an educational organizational framework conducive to a combined education, factors that are essential for modern education.

The optimization of the percentage of these factors leads to the consolidation of the b/a ratio which can tend to the value 1 so that the intervention of the teacher is minimal but not minimized.

Due to the fact that it has been validated the hypotheses proposed with the help of the specific research methods and by fulfilling the proposed objectives, the purpose of this approach has been met, so the thesis proposed in this study is confirmed, in military sciences, *E-learning* technologies are necessary but not sufficient!

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The Influence of Digital Technologies on Modern Youth's Physical and Mental Health

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Abstract

The article explores the relationship between screen time and physical and mental health of young people, such as visual impairment, sleeplessness, eating disorders, as well as Internet addiction, loneliness, and depression.The article contains the results of the survey, conducted in November-December 2019 in Russia (Saratov region) among university students aged 18-22 (n=386) to identify the connection between virtual communication in social networks and the youth's mental health. The main research method was a survey. The questionnaire consisted of 25 questions, which were divided into four blocks: 1) the amount of screen time daily; 2) subjective attitude towards virtual friendship and communication; 3) characteristics of individuals, communicating with online; 4) the attitude to online communication as a way to overcome loneliness. As a result, on-line activity of young people does not lead to the development of sociability, building real friendships or romantic relationships, it takes a lot of time, enhancing the feeling of loneliness and provoking the emergence of depression. The author highlights the problem areas that impede the effective solution of these problems: the ambiguity of the experts' opinions regarding the impact of digital technology on the development of modern teenagers and youth; the conflict of interests between providers, business structures, advertisers and minor users; poor Internet literacy of parents and educators compared with modern teenagers and youth that hinders the development of adequate technologies for early detection, prevention and providing assistance to minors who could become real or potential victims of cybercrime.

Keywords: Youth, Social Network, Physical Health, Mental Health, Digital Media.

1. Introduction

The modern generation of children and youth perceives information technology as an integral part of their lives, which allows communicating not only in real but also in virtual space, regardless of the time and location of the communicators, their age, gender, social status, using mobile devices with the Internet connection.

Today, digital devices are used for business, information, education, entertainment, interpersonal communication in social networks (Vkontakte, Odnoklassniki, Instagram, Facebook, Twitter, etc.). For example, when Facebook was started in 2004, 4/5 of 13–16-year-olds in the UK became its users (Livingstone et al., 2011). Nowadays, Facebook has about 1.6 billion active users all over the world, where 34.5 % (or 552 million) of them are young people aged 18-29. In 2018 Instagram platform accounted for 55 % of youth at the age of 18-24 (Instagram, 2019). The most popular platforms in Russia are YouTube, Vkontakte (19 million subscribers, a quarter of them are minors), and such messengers, as WhatsApp and Viber (All popular statistics, 2019).

According to the survey "EU Kids Online", 93.4 % of children and adolescents in Bulgaria used the Internet daily, 4.3 % – 1 or 2 times a week, 0.7 % – 1 or 2 times a month, 1.2 % – even rarer (Online experience of children, 2016). The main purposes of using online resources were: preparing homework, study – 85 %; leisure (playing video games, watching video clips, etc.) – 83%; communication (sending messages, posts, images) – 62%; using file-sharing sites – 16% or blogging – 11%. About a third of young people were interested in downloading movies, music, visiting online stores, reading news or communicating with family members and friends in a case of separate location. In Russia, almost a half of adolescents aged 14-16 (44 %) spent from 1 to 3 hours per day chatting in a social network, while others less than an hour (16 %), 3-5 hours (21 %), 5-8 hours (11 %), 8-12 hours (5%) and more than 12 hours (3%) (The role of social networks, 2014).

2. Main Part

2.1 Factors, Influencing the Youth's Physical Health

Today, the impact of digital devices on the sensory, musculoskeletal, cardiovascular systems, as well as on the mental health of children and adolescents is not well understood. At the same time, recent studies of Russian (Khukhlaeva, 2003; Arzhanykh et al., 2014; Bulycheva and Setko. 2019) and foreign scientists (Oshima, 2012; French et al., 2013; Parent et al., 2016; Cheung et al., 2017; Hou et al., 2017) allow us to establish a relationship between screen time and youth' physical and mental health functioning.

Sleep is one of the most important vital needs that have a direct impact on human development. During sleep, the hormone melatonin is produced, which is involved in the regulation of immunity, which is able to prevent cancer. According to B.A. Parent, M.A. Weasley-Sanders, R. Forehand, sleep disorders associated with excessive screen time have a strong positive correlation with the social, psychological and communication problems of an individual, both in the present and in the future (Parent et al., 2014).

Saying on-line for hours is considered to affect physical activity, the quality of sleep, which leads to obesity, increasing passive leisure. Children and youth from higher socioeconomic status had a number of expensive, powerful devices with unlimited Internet access, while teens from low-income families more often reported watching TV programs at night (Cheung et al., 2017). Sleep disturbance leads to drowsiness, apathy, distracted attention, fatigue, decreased of mental activity and poor school performance (Parent et al., 2014; Cheung et al., 2017).

It is proved that some actions or events online just before bedtime (for example, playing video games, writing messages or watching horror movies) can enhance psycho-physiological arousal and lead to sleeplessness. In addition, the sending of advertisements, notifications, SMS-messages in chats and groups at night, accompanied by sound signals, cause unplanned awakenings, nightmares, and insomnia (Oshima et al., 2012).

Vision is one of the main senses when we use Internet resources, so it can be significantly damaged. If in 1999 the average screen time spent on-line by children and youth aged 8-18 was 6.21 hours per day, in 2009 it was 7.38 hours per day (Magee et al., 2014). Recent studies, conducted by French scientists (French et.al., 2014) have shown an inverse correlation between staying outdoors and having myopia. As a result, children who spent less time outdoors were more often diagnosed with myopia, because the release of dopamine from the retina under the influence of daylight reduces the risk of developing the disease.

In addition, researchers have noted the harmful effects of electromagnetic radiation on the reproduction, leading to infertility (Adams et al., 2014); the occurrence of structural changes in the frontal lobe of the brain, which is responsible for the ability to critical thinking, solving complex problems, empathy, and social adaptation (Hou et al., 2017).

A sedentary lifestyle, long breaks between meals, unhealthy diets as well as overeating associated with immersion in virtual reality are often causes of obesity. According to the International Association for the Study of Obesity and the International Task Force on Obesity (IASO) and the International Obesity Task Force (IOTF), there are 40-50 million of obese children and adolescents in the world, who more often than others suffer from somatic and psychosomatic diseases, have a lower self-esteem, higher level of anxiety, depression compared with peers with normal weight (Atlantis and Ball, 2008).

A comparative study of two groups of Belgian teenagers of 5-12 grades showed the following results: first group included teens with high body mass index (n = 102) and a control group with normal weight, similar in age and gender parameters (n = 102), showed that the former were harassed twice as often compared to the latter in cyberspace (17.2 % and 7.8 %, respectively). In this case, obese youth were 2.5 times more likely to be the victim of cyber-bullying than nonobese youth and can be attributed to the risk group for socio-psychological well-being (DeSmet et al., 2014). This fact is also confirmed by Russian scientists: obese youth had higher level of anxiety as well as negative emotional feelings and stress, leading to eating disorder and an excessive increase in the sympathetic tone of the autonomic nervous system (Bulicheva and Setko, 2019).

2.2 Factors, Influencing Youth's Mental Health

Mental health is defined as the harmony of a person with himself/herself and with the environment - other people, nature, space (Khuhlaeva, 2003). Modern researchers from different fields of knowledge express concerns about the impact of digital technologies on the children and youth's mental health, leading to violation of behavioral, cognitive, emotional and volitional development, causing hyperactivity and attention deficit disorder.

According to British researchers, for the past decade the level of anxiety and depression among teenagers has increased by 10 %, which is partly caused by aggressive media propaganda. The annual study, made by the UK Department of Health, showed that 14-15 years old girls twice as likely as boys of the same age suffered from different kinds of psychopathology (37 % and 15 % respectively) (Department of Health, 2015).

Excessive consumption of virtual reality influences the personal identity. During the adolescent and youth periods, an individual has to go through some external and internal changes, get self-knowledge, an experience of interpersonal relationships with peers, including romantic or sexual. This process requires confidentiality, the internal individual work, while social networks, on the contrary, make a teenager be open and spread personal information through posts, comments, photos, which directly contradicts the process of forming personal identity at this stage.

The gender is most differentiated in the digital space: girls often use the Internet for communication, while boys for instrumental purposes, mainly for network or video games. In the study, conducted by Canadian scientists, 71 % of girls used social media for more than two hours daily, compared with 29 % of boys. This fact partly explains the gender imbalance in digital media (Sampasa-Kanyinga and Lewis, 2015).

In addition, visual self-presentation of one's own body on-line is more typical for girls. One of the reasons is the existence of social stereotypes about a woman as an object of sexual attraction, created and supported by fashion, advertising, media, which form and transmit certain standards of appearance, faces, figures, leading to early sexualization of adolescents, fears and complexes regarding physicality, eating disorders (anorexia or bulimia) and mental health.

3. Data and Methodology

3.1 Methods and Materials

The main purpose of the research was exploring the connection between virtual communication in social networks and the youth's mental health. The empirical study was conducted in November-December 2019 on the basis of Balashov Institute of Saratov State University (Russia) on the principles of confidentiality and voluntary participation. The sample consisted of 386 students aged 18-22 (girls – 250, boys – 136). The researcher gave a five-minute introduction before the survey, after that participants filled out a questionnaire independently, which took on average fifteen or twenty minutes.

The main research method was a survey. Firstly, the whole sample included 450 respondents, but during the operational stage 64 questionnaires were excluded because they did not match the criteria of the research. There were four blocks of questions: 1) the amount of screen time daily; 2) subjective attitude towards virtual friendship and communication; 3) characteristics of individuals, communicating with online; 4) the attitude to online communication as a way to overcome loneliness. Processing the results of the study was carried out by using SPSS Statistics v. 22.0.

3.2 Results and Discussion

The survey involved students from the 1st to 4th year of study in all areas of training. At the time of the survey, 59.6 % of respondents had from 100 to 300 or more friends online, with 35-65 of them they were personally acquainted, but the rest were unfamiliar people in real life.

The participants used virtual communication for the following purposes: “take time” – 51.0 %, “express my opinion” – 7.1 %, “show the best aspects of my life” – 10.6 %, “find a job/fulfill oneself” – 7.8 %, “to cope with loneliness” – 23.6 %.

A quarter of students noted that anonymity made it possible to play roles that were not available in real life, while 73.1 % agreed that virtual friends should not always be trusted. According to the survey, it was not necessary to get acquainted with a virtual friend in person, such communication served for social and psychological support, help, advice, leisure or opportunity to speak out. In a case of different interests or undesirability of continuing communication, the partner could safely delete or block it.

Regarding the screen time, 84.0 % of respondents chose the answer “more than two hours per day” and “during the day always”. An inverse correlation had been established between having friends of both sexes in real life and the beginning of online communication: young people who had real friends and romantic relationships later created an account on social networks, compared to those who started communicating on the network before adolescence.

Young men showed higher level of loneliness than girls (74.4 % and 65.3 %, respectively); 84.5 % of respondents believed that on-line communication helped temporarily cope with loneliness. The behavior of young people in social networks predominantly repeated the same patterns in real life. The virtual communication did not fulfill the expected compensatory function and intensified loneliness. Trying to overcome the feeling of loneliness, expand their social circle, compensated loneliness, and strengthen the status, young people intensified their communication in social networks: they made posts and photos, changed status, put likes, wrote messages, sent cards and gave gifts.

According to the respondents, this took a lot of time and tires (82.1 % of boys and 67.0 % of girls respectively). In this regard, to overcome the feeling of loneliness, psychological support for youths during the formation of personality is necessary, aimed at creating harmonious interpersonal relationships, a positive attitude towards oneself, adults and peers.

Thus, the on-line activity of young people did not lead to the development of sociability, building real friendships or romantic relationships, it took a lot of time, increasing the feeling of loneliness and provoking the emergence of depression (70.7 % are girls, 48.2 % are boys). Among other things, 74.4 % of respondents said that in the Internet communication there were a lot of falsehood, exaggeration, and fake information.

4. Conclusion

In the modern world, the visual channel of consumption and transmission of information predominates. It is facilitated by the rapid development of digital media as well as the annual increase in the number of messengers and social networks’ users, a significant proportion of which are young people aged 14-29.

Uncontrolled consumption of digital media from an unprecedented resource can be a source of danger to physical and mental health. It can provoke Internet addiction, interpersonal conflicts, inability to work in a team and lack of cooperation (that’s why emotional intelligence, teambuilding and soft skills are the most popular personality growth courses).

Currently, there are several problem areas that impede the reduction of risk factors for the physical and mental health of adolescents and youth as the main consumers of media content. Firstly, the lack and fragmentation of scientific research does not allow proving the harmful effects of digital technology on the human development process. Secondly, the inadequate access to Internet resources in the digital age can also be regarded as a child's disadvantage in terms of social inequality.

Thirdly, gaps in legislation, conflict of interests between providers, businesses, and advertisers pursuing their own commercial goals often create situations of high social risk related to youth's access to undesirable media content, for example, calls for extremism, aggression, suicide, etc.

Fourthly, poor Internet literacy of parents and educators compared with modern teenagers and youth prevents the development of adequate technologies for early detection, prevention and assistance to minors who become real or potential victims of cybercrime, which requires additional interdisciplinary research.

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Distance learning from students' view: sociological analysis

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Abstract

The effectiveness of the use of digital technologies, which began to be introduced into the universities educational process since the late 90s, is currently beyond doubt. Both the students and the teaching staff of educational institutions appreciated the opportunity to increase the degree of visibility of individual courses, to diversify the forms and methods of teaching and control. The changes also affected the forms of distance education: e-learning is successfully gaining the position of the traditional one. In order to determine the attitude of students to DL and to the possibility of using it in the educational process of the university, we conducted a questionnaire survey of students of identical training directions, forms of study and course of 4 universities in Moscow and Novorossiysk. The questionnaire included questions about attitudes towards DL, existing DL experience, its "pros" and "cons", degree of satisfaction with the process and learning outcomes. The article presents some of the research results.An important result of the study is the fact that a number of negative aspects of DL, noted in scientific research, are not taken into account or adequately assessed by students, for example, information security associated with the use of personal data, the effect of electric fields during long-term work with computer; in some cases, respondents note the poor quality of the study of teaching materials, the complexity of the language, which indicates the need for serious preparation of teaching materials, on the one hand, and the improvement of teaching methods, on the other.

Keywords: distance education, students, sociological analysis

1 Introduction

The effectiveness of the use of digital technologies, which began to be introduced into the educational process of the university since the late 90s, is currently beyond doubt. Both the students and the teaching staff of educational institutions appreciated the opportunity to increase the degree of visibility of individual courses, to diversify the forms and methods of teaching and control. The changes also affected the forms of distance education: e-learning is successfully gaining the position of the traditional one [2].

The requirements of the Federal State Educational Standards (FSES) include the formation of an electronic information and educational environment by the university, and the arising question concerns motivation, the level of preparation of potential students for innovative forms of acquiring knowledge, the appropriate ratio of tradition and innovative forms in the educational process.

2 Theoretical aspects of development of distance education in Russian Federation

Distance learning has received an impetus to development since 1997 (order No 1050 of the Ministry of Education of the Russian Federation), and after two decades we have the opportunity to assess the pros and cons of putting this system into practice. When assessing the "pros" and "cons" of modern DL, the following are more often singled out as the "advantages": the opportunity to study in remote educational institutions, the availability of additional education for various social groups of the population, the independence of training, the flexibility of the work schedule, savings in education costs, but as "disadvantageses": lack or insufficient quality of technical equipment and software products, lack of conditions for “live” communication in interpersonal communication, inadapted educational materials (teaching materials, etc.) to distance education courses [1].

The coronavirus infection, which hit all countries of the world, including Russia, and the subsequent quarantine measures, have highlighted a number of urgent problems in the use of electronic devices, especially in the field of distance learning. Distance learning in force majeure conditions of self-isolation required the use of exclusively digital technologies with the absolutely impossible use of the classical classroom form [2].

Many higher educational institutions used online learning before, but total education in this mode was used only by institutions or companies providing additional education.

3 Research of students' attitudes towards distance learning technologies

In order to determine the attitude of students to DL and to the possibility of using it in the educational process of the university, we conducted a questionnaire survey of students of identical training directions, forms of study and course of 4 universities in Moscow and Novorossiysk. The questionnaire included questions about attitudes towards DL, existing DL experience, its "pros" and "cons", degree of satisfaction with the process and learning outcomes. The article presents some of the research results.

The study has showed that the transition to distance learning for students was not difficult: only 3,1% of them did not have access to the Internet. Moreover, the absolute majority was well equipped with various technical means: 72,9% used gadgets, 64,6% - laptops, 18,3% - stationary computers. The traditional “freeze” in social networks during the pre-quarantine period dropped sharply (0,4% of all respondents), while they were most interested in information (84%), cultural and educational (76,9%) and educational and educational (46, 3%) resources. During the breaks, they preferred entertainment (78.2%) and sports information (18,8%). Nevertheless, despite the fairly quick adaptation to distance learning, almost half of the respondents (48,9%) indicated a decrease in the level of motivation for learning, and an increase in motivation was noted only by 14.4%.

Among the difficulties that students faced on the "remote", 76,9% identified an increase in the number of tasks for independent work and 36,1% noted the "rejection" of virtual communication with the teacher. Almost a third of the respondents (29,7%) saw distance education as an opportunity to study in a virtual classroom non-stop at a convenient time and place; 20,5% noted a great opportunity to establish a direct connection with teachers in an online format; 28,8% considered online contests of lectures and practical classes convenient. However, a significant part (36,7%) noted that this form of education is not acceptable for them: only 7% would like to study exclusively online (remotely), 62% preferred the traditional form (classroom lessons); and 44,5% considered it necessary to combine both of these forms. 42,35% were ready to take the exam session online by videoconference, and 41,5%, as usual - in the audience, answering questions about tickets; 37,6% expressed a desire to be tested in the classroom.

More than half of the students (62,8%) noted that distance learning solves problems only in force majeure circumstances, a fifth (20,5%) did not see any advantages in it, and 45,4% expressed concern that it would worsen the quality education. At the same time, studying at a "remote location" taught some of the students to use their working time more rationally (27,9%) and opened up new opportunities for self-development (16,6%), but in general 66,8% of first-year students were unanimous in their opinion that the distance form greatly increases the load on students, but for 18,3% it did not change anything in this regard, and they worked in their usual study mode; 5,2% considered that their workload had decreased, and 10,9% could not determine whether their workload had increased or, conversely, decreased.

The most popular educational tools for students in a pandemic were: e-mail – 76,9%; ZOOM – 74,7%; special university platforms – 43,6%; WhatsApp – 40,6%; YouTube – 16,2%.

To the question: "Would you like to continue studying at a university in a distance form in the future?", most of the respondents (62,3%) answered negatively, 21,8%. did not decide on the answer and only for 18,3% it turned out to be attractive.

Conclusion

Summarizing what has been said, we note that with a generally prevailing positive attitude towards distance learning, about 4/5 of students cannot rely on their own experience, as a result of which their ideas about distance learning and its forms, as well as assessments of various aspects of DL, differ from the point of view of students with experience of distance learning. As a result of acquaintance with DL, students begin to assess positively the effectiveness of the organization of the educational process, while the assessment remains negative in relation to the quality of technical support, the internal state of the student and the conditions for the development of the personality of the subject of education. Evaluation of distance learning by students with experience of remote educational practice shows that a number of negative aspects of DL, noted in scientific research, are not taken into account or not adequately assessed by them, for example, information security associated with the use of personal data, the impact of electrical fields during prolonged work with a computer; in some cases, the respondents note the poor quality of the study of teaching materials, the complexity of the language, which indicates the need for serious preparation of teaching materials, on the one hand, and the improvement of teaching methods, on the other. Some of the students are not ready for distance learning nowadays and prefer traditional ones [3].

Today the world is changing, people are changing, education must also change. The future belongs to a modern IT infrastructure and a high-quality university online educational resource that allows you to study both in conjunction with a teacher and independently. The combination of digital technologies and the classical form of education, compulsory communication with the teaching staff will adequately meet all today's and future challenges.

It is assumed that it is not timely to talk about a massive transition to distance learning. An effective form of learning could be technology that combines traditional education with separate forms of distance learning (at the student's choice), i.e. mixed, part-time, training.

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E-learning Technologies in Russian Higher Education System in a pandemic of COVID-19: Who is Guilty and What to Do?

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Abstract

The article is devoted to the issue of functioning higher education system in Russia during a pandemic of COVID-19 which has covered most of the countries in the world, and led to different changes in all spheres of people' lives, including higher education system. The purpose of the study is the critical view on the quality of university education, making stress on some problems, caused by poor preparedness of all participants of educational process: university administration, faculty, students, etc. to an unexpected situation. Despite the fact that modern youth actively use the advantages of the Internet for learning, development, recreation, communication and leisure, nevertheless, most of them faced many problems in mastering basic educational programs using e-learning technologies. Among others: difficulties managing time, which resulted in chronic academic failure and violation of the deadlines for completing assignments; the only computer with Internet access for all family members (siblings of school age; parents, working remotely); inequality in education due to the low quality of the Internet connection, undeveloped infrastructure especially in rural areas of the country; inadequate level of using e-learning technologies of academic staff in educational process.

Keywords: Russian Higher Education System, Pandemic of COVID-19, E-learning, Problems and Perspectives

1. Introduction

A pandemic of COVID-19, firstly recorded in Wuhan (China) in December 2019, and covered most countries in the world, has led to changes in all spheres, including education system. In this regard, since March 2020, distance computer technologies have been introduced as a main tool at all levels of Russian education system.

According to the methodological recommendations of the Ministry of Science and Higher Education of the Russian Federation, universities, based on their capabilities and resources, must develop conditions for the implementation of e-learning in the educational process. Based on the Art. 16 of Federal Law No. 273 "About Education in the Russian Federation", "... distance learning technologies are educational technologies implemented mainly with the use of information and telecommunication networks with indirect (at a distance) interaction between students and teachers" (About education in the Russian Federation, 2012).

2. Data and Methodology

2.1 Methods and Materials

The purpose of the study was to take a critical look at the situation of the emergency implementation of e-learning technologies in Russian higher education system (based on the example of Saratov National Research University named after N.G. Chernyshevsky) because of the pandemic caused by the coronavirus infection COVID-19, which had a great influence on all participants of the educational process – the university administration, staff, faculty, and students.

The study was carried out in March-August 2020 in Saratov National Research University named after N.G. Chernyshevsky. The main methods of study were participant observation and focus group methods. Participant observation is a qualitative research method which has been used in a variety of disciplines as a tool for collecting data in which the researcher not only observes the research participants, but also actively engages in the research's activities. Observations enable the researcher to describe existing situations, providing a "written photograph" of the situation under study (Erlandson, et. al, 1993). C. Marshall and G.B. Rossman define observation as "the systematic description of events, behaviors, and artifacts in the social setting chosen for study" (Marshall and Rossman, 2006).

At present, the method of participant observation as a sociological tool of qualitative research, unfortunately, is in little demand by sociologists in comparison with quantitative research methods, despite the fact that it was developed by the American sociologist E.K. Lindeman in 1933 and described in his book “Dynamic Social Research” (Madge, 1962). Later this method was repeatedly used in foreign, less often in Russian empirical studies. Thus, on its basis, a unique ethnographic material was collected, regarding life of American homeless men in the 1920s (Anderson, 1923) or life of the average American town (Lind & Lind, 1927).

In domestic science, the method of participant observation was used to study the values of soviet workers (Olshansky, 2002); the relationship between the team and the individual (Novikova, 2010); peculiarities of age and individual development of adolescents in grades 5-8 (Elkonin and Dragunova, 1967).

In the conditions of self-isolation caused by the pandemic, every participant of the educational process could become an observer, who had an opportunity to follow the development of the situation “here and now”, to record changes, moods, creation of new social practices and forms of interaction between different levels of the educational system, difficulties and ways of their overcoming. That is why this method was chosen for the research for collecting information, which allowed the researcher as a direct participant in the educational process, familiar with the internal structure and content of the higher education system, to form the opinion about the events taking place. In order to obtain information in the process of participant observation, free interviews, the method of natural situations were used for data analysis.

Focus groups were held on the online platform Zoom, where participants had the opportunity to express their points of view on the advantages and limitations of online training, the difficulties that hinder the effective assimilation of getting knowledge by students, current problems and collectively find an acceptable solution for their subsequent elimination. During the study, three separate focus groups were organized: the first with the representatives of the administration staff, including deans of faculties and heads of departments (n = 6); the second group was consisted of representatives of the faculty (n = 15); the third contained 1-4 year undergraduate students of humanitarian faculties (n = 12). The duration of each session was about two hours.

The sample of the first and the second group was formed from the university staff aged 30-60; the average work experience was 28 years. The participation was voluntarily. Three days before the session each participant of the focus group received the list of questions which had to be discussed in order to be well prepared.

The quota sample of students was carried out according to several criteria: age, gender, nationality, type of settlement, social status of parental family; course of study, including students combining work and study or other types of activity. As a result, the student focus group contained students aged 18-23, boys (n = 7) and girls (n = 8), by nationality: Russians and Turkmen; representatives of middle and low resource families; by type of settlement: urban and rural; combining work and study or study and other types of activity (volunteering).

3. Results and Discussion

Because of the pandemic, all face-to-face classes at the university, including lectures, practical and laboratory classes, were urgently moved to the online environment. To organize the educational process, Saratov State University, like most other Russian universities, turned to such e-learning technologies as LMS-platforms designed for posting educational content and monitoring of students’ progress; webinar services that allow university staff to broadcast online lectures in real time, conduct practical/ seminar classes, give advises students on current issues such as completing essays, coursework; create groups in social networks and messengers (Viber, WhatsApp, Instagram, etc.) to post relevant information, clarify difficult questions that are immediately available to all participants of the educational process; using e-mail to send additional training materials, feedback from a teacher and students, in case of difficulties with attaching completed files on the online platform, etc.

According to the Ministry of Education and Science of the Russian Federation, in conditions of self-isolation, about 80 % of Russian universities have completely switched to the electronic format of working with students (The Ministry of Education and Science, 2020). Unfortunately, not all universities were ready for this radical restructuring of the educational process based on objectively different levels of information infrastructure development, provision of disciplines with electronic educational resources and the readiness of faculty to use digital platforms and services in teaching.

According to IPOboard, in 2014 the volume of the domestic distance education market was estimated at 9.3 billion rubles; the average annual growth rate was 16.9%. At the same time, according to experts, the Russian e-learning market lags behind western markets by 5-7 years (Sinelnikov et al, 2016).

The school education system was in an even more critical situation; according to the Ministry of Education of the Russian Federation, schools could provide e-learning for no more than 25% of schoolchildren due to differences in epidemiological situation in the Russian regions, schools' resources and infrastructure, qualifications of teachers, etc.

In this regard, the rapid transition from traditional to distance education has given rise to a number of problems, especially for small universities and branches of leading universities, located in Russian regions: firstly, some of them did not have their own IT infrastructure to ensure an effective learning process, so they faced to the need to create their own online platform in a short period of time or conclude the agreement with external organizations; secondly, filling on-line platform, regularly updating its content, posting high-quality online courses (as a rule, the development of one online course takes about 6-9 months on average); thirdly, providing teachers' online skills training to enhance their knowledge to adjust educational materials, give assignments and check students' works.

University teachers had to organize the educational process through distance learning technologies more independently, relying on previously acquired knowledge and computer skills, since the number of technical personnel in the information technology department was small, and who could provide the prevention and rapid elimination of cardinal failures in the system.

In addition, the educational, methodological, organizational load on the administrative apparatus (deans, heads of departments), staff, and faculty had increased unprecedentedly. They were faced with the need not only to prepare and conduct lectures and student assignments, fulfill the electronic training system in an emergency, but also to solve organizational and methodological issues related to explaining to students new requirements for completing assignments in e learning; organizing access to electronic library resources, giving advices and instructions to eliminate difficulties in educational process, etc. The most helpful resources allowed to bring update information to all stakeholders were groups in social networks (Vkontakte, Odnoklassniki, Facebook, Instagram, etc.) and instant messengers (Viber, WhatsApp).

Of course, most big universities with well developed infrastructure which have already developed and successfully used distance learning technologies before the pandemic along with other forms of education found themselves in a more advantageous situation, which routine work was not changed so much.

Despite the fact that modern youth actively use Internet for learning, development, recreation, communication and leisure, nevertheless, about a third of students noted difficulties in mastering basic educational programs using e-learning technologies.

During the focus group session students named the following reasons for dissatisfaction with the distance education. Firstly, the lack of a clear division of time for study and rest during the period of self-isolation, the need to independently determine the work regime, procrastination, all these factors became the reasons for irrational time management, which presupposes the skills and abilities of rational use and distribution of time, prioritization, and the formation of sustainable motivation for learning. The consequence of this was chronic academic failure and violation of the deadlines for completing tasks; high stress levels; chronic fatigue; dissatisfaction with the education system of a quarter of student audience.

Secondly, some students noted the presence of one laptop or a computer with Internet access for all family members (siblings of school age; parents, working on-line), that created a priority in the performance of work, and provoked family conflicts, tension in interpersonal marital and child-parent relationship.

Thirdly, the decline in the quality of education of students from families with low socio-economic status (incomplete, large, low-resource) was aggravated by the lack of home computer or laptop, which is why homework was carried out using a mobile phone, making the learning process time-consuming, ineffective, destructively affecting the physical and mental health of the student.

Fourth, the poor quality of the Internet connection, especially in rural areas, did not allow students to receive and send completed assignments on time. For this it was necessary initially to "find" a place with the strongest signal, often outside the house (on a hill, near the TV antenna, etc.), in order to send homework from a mobile phone via social networks, messengers or e-mail.

Fifthly, unemployment caused by the pandemic led to a decrease in income, a restriction on the consumption of food and services, which negatively affected the quality of life of most Russian families, made impossible paying utility bills, including Internet, which created additional difficulties for students.

Foreign students, studying at Saratov State University, who were unable to travel to their homeland due to the pandemic, used their own electronic gadgets as well as university resources such as computer classes, access to Wi-Fi, to continue their education. The main difficulties they had were language difficulties, socio-cultural adaptation, restrictions on face-to-face interpersonal interaction with tutors and faculty members regarding developing skills and knowledge of work in the e-learning system.

At the same time, despite the whole conglomerate of problems caused by the urgent restructuring of the education system at all its levels, it is possible to highlight a number of advantages of e-learning, which might be used in further professional activities.

In particular, holding meetings using webinars, especially in large cities, with high traffic congestion, long distances, was recognized as successful by the overwhelming majority of representatives of the administrative apparatus and the teaching staff.

A number of teachers noted an increase in the level of computer knowledge and practical skills, which will be used in the future for self-development and increasing professional efficiency.

In terms of students, two-thirds of the them pointed out the successful combination of online learning with work employment; the opportunity to "attend" on-line lectures and practical classes as well as repeatedly refer to the video material at a convenient time of the day.

Nonresident students drew attention to a reduction in the costs associated with living expenses in another city, such as utility bills, meals, and transportation. Some of the students, especially freshmen, experienced a feeling of relief after returning to their parental family, where they were able to get rid of some of the household chores of cleaning, cooking, buying food, etc., which they had to do while living on their own in another city. Also freshmen in comparison with senior students, noted as an advantage an increase in the intensity of contacts with parents, siblings and other relatives during the period of self-isolation, which is explained by the period of social adaptation to new conditions of study and living, as well as the degree of responsibility for independently decision making.

4. Conclusion

The urgent introduction of distance technologies into the educational process of a number of Russian higher educational institutions, including small universities and branches of leading universities in connection with the pandemic COVID-19, can be described as a stressful situation for all subjects of education – administration, faculty, and students, which negatively affected the quality of education and attitude towards online learning.

The results of the study using qualitative methods indicate the different readiness of Russian universities to use e-learning technologies in the educational process, especially in small educational institutions and branches of leading universities; underestimation of their role and place in the educational process by the administration and faculty members, which, ultimately, aggravates the social inequality in education for students living in different regions of the country and types of settlements. In this regard, a thorough assessment of the current situation is necessary, the identification and elimination its causes, the adoption of not only short-term, but also long-term measures to normalize the educational process, taking into account future possible risks.

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