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Vol. 10

E-learning and Smart Learning Environment for the Preparation of New Generation Specialists

Scientific Editor

Eugenia Smyrnova-Trybulska

Katowice – Cieszyn 2018

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University of Silesia in Katowice,
Faculty of Ethnology and Sciences
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INTRODUCTION

The theme of the conference is: *“E-learning and Smart Learning Environment for the Preparation of New Generation Specialists*”.

The eco society, the knowledge society, the digital society are transforming into an intelligent society. It is built on “smart” work, which is done by “intelligent” government and business representatives, based on “intelligent” infrastructure and “intelligent” citizens, playing a key role in creating culture. In addition, the priority is the development of such industries as smart transport, smart health, smart energy, smart food, etc., which will eventually lead to the creation of a smart world. SMARTs will play a special role in the preparation of new-generation specialists, in which e-learning and personalized learning will have priority positions. In an intelligent society, technologies, previously based on information and knowledge, are transformed into technologies based on interaction, cooperation, exchange of experiences – smart technologies. Citizens, new generation specialists, turn their activities into “intelligent” and implement innovative changes in management strategies. This means that society needs more creative and open thinking persons, so that human dignity, based on flexibility and originality, is a priority. The most important issue is the training of staff with creative, creative potential, able to work and think in the new world. (Smyrnova-Trybulska 2018).

The monograph *“E-learning and Smart Learning Environment for the Preparation of New Generation Specialists”* includes articles based on the best papers prepared and presented by authors from nine European countries and from more than twenty universities during the scientific conference entitled ”Theoretical and Practical Aspects of Distance Learning”, subtitled: “*E-learning and Smart Learning Environment for the Preparation of New Generation Specialists*”, which was held on 15-16 October 2018, organized by the Faculty of Ethnology and Sciences of Education in Cieszyn, University of Silesia in Katowice, Poland.

The speakers from University of Extremadura (Spain), Linnaeus University in Kalmar (Sweden), the Comenius University in Bratislava (Slovakia), Plovdiv University “Paisii Hilendarski” (Bulgaria), Lisbon Lusiada University (Portugal), Kirchlische Pedagogische Hochschule, Vienna (Austria), Borys Grinchenko Kyiv University (Ukraine), Gdańsk Technical University (Poland), Herzen State Pedagogical University of Russia, St. Petersburg (Russia), Peoples’ Friendship University of Russia (RUDN University), (Russia), Jagiellonian University (Poland), Warsaw University (Poland), Silesian University in Opava (Czech Republic), Jesuit University of Philosophy and Education "Ignatianum", Cracow, Poland, Slovak University of Agriculture in Nitra (Slovakia), University of Silesia in Katowice (Poland), University of Defence in Brno (Czech Republic), Kostiantyn Ushynsky South Ukrainian National Pedagogical University (Ukraine), Rzeszów University of Technology (Poland), Maria Curie-Skłodowska University in Lublin

(Poland), Lublin University of Technology (Poland), Mykhailo Drahomanov National Pedagogical University, Kyiv, (Ukraine), Kazimierz Wielki University in Bydgoszcz (Poland), Taras Shevchenko National University "Chernihiv Collegium" (Ukraine), University of Ostrava (Czech Republic), Cracow Pedagogical University (Poland), University of Social Sciences and Humanities in Warsaw (Poland), Dniprovsk State Technical University (Ukraine), Poznań University of Medical Sciences (Poland), Warsaw University of Technology, (Poland), Higher School of Education of the Polytechnic Institute of Santarem (Portugal), Adam Mickiewicz University in Poznań, (Poland), University of Social Sciences and Humanities in Warsaw (Poland), Ternopil University (Ukraine), Federal Research Center "Computer Science and Control" of the Russian Academy of Sciences, (Russia), State Higher Vocational School in Krosno, (Poland) and other educational institutions delivered lectures providing insights into interesting studies, presented their recent research results and discussed about their further scientific work.

The authors include experts, well-known scholars, young researchers, highly trained academic lecturers with long experience in the field of e-learning, PhD students, distance course developers, authors of multimedia teaching materials, designers of websites and educational sites.

I am convinced that the monograph will be an interesting and valuable publication, describing the theoretical, methodological and practical issues in the field of the use of e-learning for societal needs, offering proposals of solutions to certain important problems and showing the road to further work in this field, allowing for exchange of experiences of scholars from various universities from many European countries and other countries of the world.

This book includes a sequence of responses to numerous questions that have not been answered yet. The papers of the authors included in the monograph are an attempt at providing such answers. The aspects and problems discussed in the materials include the following:

1. E-environment and Cyberspace E-environment of the University

- SMARTer Education – Preparing a New Generation of E-learning Specialists
- Smart-Universities
- Smart Technology in education
- E-learning in a sustainable society
- Internet of things

2. Effective development of teachers' skills in the area of ICT and e-learning

- Computer training for prospective and practicing teachers in the area ICT and e-learning
- Teachers' and learners' competences in distance learning and computer science

Publishing this monograph is a good example of expanding and strengthening international cooperation. I am very grateful for valuable remarks and suggestions which contributed to the quality of the publication. Here I especially want to thank Ryszard Kalamarz and Andrzej Szczurek for their assistance in editing this publication. Also, I would like to say 'thank you' to the authors for the preparation and permission to publish their articles. I wish all readers a pleasant read. Thank you.

Eugenia Smyrnova-Trybulska

Smyrnova-Trybulska, E. (2018). Technologie informacyjno-komunikacyjne i e-learning we współczesnej edukacji [Information and communication technologies and e-learning in modern education], Katowice: University of Silesia Press

I. E-LEARNING AND SMART LEARNING ENVIRONMENT FOR THE PREPARING OF NEW GENERATION SPECIALISTS

TRAINING IN DIGITAL LITERACY FOR LABOUR MARKET: E-LEARNING FOR YOUNG PEOPLE WITH DISABILITIES

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Abstract: *The present paper consists in demonstrating a good practice experience on how distance learning can be a beneficial learning aspect for young people with disabilities through the implementation of an innovative training course in digital literacy for the labour market. Therefore, it presents the structural thought behind the development of the training, the adopted e-learning model and how these elements provided an adapted and flexible pedagogical environment for the aforementioned target group.*

Keywords: E-learning for the disabled; Digital literacy; Innovative training course; Labour market; Digital platform

INTRODUCTION

The limitation of young students with disabilities is still an upcoming challenge towards nowadays society. In fact, according to Eurostat and the European Health and Social Integration Survey (EHSIS) latest statistics, there are around 70 million people with disabilities aged 15 and over across Europe (Eurostat, 2015). Only 11% of these completed the tertiary level of education or, in other words, attended higher education training. These numbers are alarming, the more that most of these young people are early leavers or dropouts within the Higher Education system. This statement is verified since the target group suffers from high disparity when compared with regular higher education students. This is mostly common to happen because the former group have barriers to accessing higher education courses. The factors that lead to this disparity are mainly personal ones, such as low self-esteem, disadvantaged backgrounds and other discriminatory aspects that young people with disabilities suffer from. In addition, there are also other key factors such as the limitations that are brought by longstanding health problems, e.g. the Down syndrome, or Trisomy 21. Besides this initial analysis the World Report on Disability emphasises the importance of providing education and training that would allow a broader building training capacity and the introduction of adapted curricular content in order to reduce the disparity between regular students and those with disabilities (WHO, 2011). In addition to the several pinpointed barriers and analysis there is also another important issue that needs to be addressed, which is the digital literacy competences of young people with disabilities. Currently it is important to have, at least, basic knowledge in ICT (Information and Communication Technologies) skills to be integrated towards the digital society. Once again, for people with disabilities having a basic set of skills of digital competencies is an opportunity to become more independent, self-aware and even competitive towards regular individuals. For young people with disabilities the concept of "independence" is one of the most perceived aspects. Henceforth, the use of pedagogical and learning models such as e-learning these perceptions could become a daily reality generating new opportunities in their social, professional and digital contexts (Mikołajewska & Mikołajewski, 2011). Hereupon, it is important to understand that all these identified challenges are clusters under a specific frame. This frame corresponds to a set of several European priorities identified by the European Disability Strategy 2010-2020 which is a programme adopted by the European Union. This specific action is focused on eliminating barriers in the fields of accessibility, participation, equality, employment, education and training, social protection, health and external action. As for the field of education and training, it is intended to promote inclusive education and lifelong learning for young people with disabilities allowing them equal access to quality education (EC, 2010).

Therefore, to address and combine the identified European priorities and challenges this paper will present an innovative solution which consisted in a higher education training offer in digital literacy for the labour market. This training covers either the basic concepts of ICT and the integration of young students with disabilities towards the labour market with the use of distance learning. Thus, this section will make it possible to understand the choice of e-learning as pedagogical model and its benefits for the training of the young students with disabilities. In addition, it also includes an in-depth analysis of the methodological process and the different steps of development: background, idea, target group, resources, tests and final adjustments. Finally, it will discuss the potential of e-learning and the different impact levels with regard to different contexts: accessibility; flexibility; interoperability; cost efficiency and technology.

1. EXPERIMENTAL CONTEXT: OVERVIEW

1.1 The training Digital Literacy for Labour Market

Before any kind of analysis or explanation of what was developed and implemented in the context of digital literacy competencies, labour market inclusion and the connection with distance teaching resources it is important to mention in which context this experience was conducted. This training was originally established by a partnership between two Spanish institutions (Autonomous University of Madrid and Prodis Foundation) that since 2002 have been conducting a specific training programme for young people with disabilities (Gasset & Herrero, 2016). This programme is structured in two different formats: the *Avanzas* programme and the *Promentor* programme. The *Avanzas* programme is responsible for the initial integration of students with disabilities into higher education contexts providing the required support for the early access of these students. The other is *Promentor,* which follows the *Avanzas* and is responsible for the integration of young students with disabilities towards higher education (e.g. Universities). However, this context was only identified in Spain and in other remote countries such as Canada or Australia. Therefore, a team was assembled which comprised higher education's institutions, companies, governmental organizations and other entities that decided to implement this type of training offer for young people with disabilities in Portugal.

It is the responsibility of higher education institutions to institute inclusion policies and to eliminate exclusion actions, valuing activities based on respect for diversity, considering the role they play in throughout the history of society. At present, the access of young people with SEN to higher education is one of the greatest challenges to the inclusive education system in Portugal. In the transition from compulsory education to higher education, students with special needs lose all support structure put at the disposal of the Ministry of Education, for primary and secondary education. In teaching support for students with special needs is, with rare exceptions, too fragile.

According to the Final Report of the Working Group on Special Needs in Science, Technology and Higher Education (GT-NECTES) of November 2017, the framework of students with Intellectual and Developmental Difficulty (IDD) in higher education is one of the topics that has generated a great deal of discussion at present, resulting in the following recommendation: to carry out a study on the subject, in which the possibility of HEIs providing non-degree training to this group of students is measured. This recommendation ponders the experience of other countries, so this possibility should also be considered in Portugal.

That said, one of the aspects to be considered about this training is that it does not provide a higher degree diploma, despite being held at an Higher Education Institution (HEI), However, it allows for a professional certificate and integration in a paid internship. Nevertheless, in the structuring phase and given the political and pedagogical restrictions it was understood that the training in "Digital Literacy for the Labour Market" would not directly benefit from academic progression. It was created for the purpose of empowering young people with disabilities with a set of personal, labour and digital skills that give them more opportunities in their daily life and in the different social contexts (job market, entrepreneurship, etc.). Thus, this training presents itself as a unique and innovative training offer in Portugal, including a diversified programme of learning content and the possibility of attending in E-learning format.

In line with this framework, it also addressed the need to increase the number of students in technologies, since according to the results of the National Survey on the support granted to students with special educational needs in higher education by area of study, it is pointed out that 24% of students with SEN are attending courses in Law, Social Sciences and Services, 17% in Technologies and 14% in Economics, Management and Accounting (Pires, Pinheiro & Oliveira, 2014). It should also be noted that this training was proposed and is included in several strategic axis such as the National Reading Plan 2017 Strategic Plan for Science, Technology and Education in the point of Education for Inclusion. This training is then a way of responding to the need to make higher education accessible to all.

1.2 Aims of the Training in Digital Literacy for Labour Market

The training is aimed at young people with intellectual and developmental difficulties with a degree of incapacity equal to or greater than 60%. It is an innovative and supportive program, the most important feature of which is that it is the first model of inclusive education in the context of higher education for the intellectually disabled. This makes it a reference and training model for other experiences, its main characteristic being the personal development, well-being and social and labour inclusion from the higher education environment.

Lastly, this training has the following fundamental objectives:

a) To apply autonomously the concepts, theories and principles acquired in solving problems and decisions, in new work environments, or in unfamiliar environments;

b) To acquire social-labour skills promote growth as full citizens;

c) To respond to requirements and perform tasks appropriately with the combination of cognitive skills and practices, knowledge, motivation, values, attitudes and emotions;

d) To facilitate the acquisition of skills in the use of digital literacy to effectively solve problems and perform tasks using different tools in the work context;

e) To facilitate the acquisition of flexibility, understood as an ability to adapt to change and as a prelude to the critical capacity to analyse the work itself;

f) To maintain enthusiasm for lifelong training;

g) To facilitate the acquisition of the necessary training in order to enable young people to compete for different offers (adapted for people with intellectual disabilities) and obtain employment in public administration agencies;

h) To increase disabled people's active participation in the university environment, putting into practice a value system that promotes coexistence through satisfactory interpersonal relationships.

2. METHODOLOGICAL CONTEXT: OVERVIEW

2.1 The E-learning methodological process

What has already been explained is the idea behind the training in digital literacy for labour market and which aspects this course covered in the social, pedagogical, professional and digital inclusion of young students with disabilities. Nevertheless, it is important to understand how the e-learning processes fit as one of the learning models for this training. The e-learning methodology in this training offer was introduced as an interactive method of education allowing the use of several digital media (video, image, sound, rich text, games, etc). The possibility of using e-learning technologies for the learning process is an opportunity to empower students with different levels of disability, since distance learning can be seen as an enriching and stimulating environment (Kelly, Phipps & Swift, 2004) for different types of learning processes. Therefore, a synergy was developed between the technology and pedagogy by combining these two elements into the concept of a Web-based Virtual Learning Environment (VLE) (Kelly, Phipps & Swift, 2004). In this case, a web platform was developed that permitted a wide range of activities which involved adapted learning modules, flexible guidelines, video tutorials, audio tutorials, step-by-step educational contents and digital applications. Therefore, in terms of definition this platform can be compared with a combination of a Moodle virtual space or a community of practice in online learning, such as the Coursera platform. However, this platform has its own components for an adapted and flexible training via e-learning.

Thus, this e-learning platform allowed the young students with disabilities a set of interactive, adapted and flexible possibilities since they could learn by having a computer or tablet and internet connection. Therefore, this digital solution enhanced other practices being these:

a) The possibility of home education for those who have reduced mobility or less opportunities to personally attend the higher education institution;

b) The possibility of enrolling in several learning units or educational modules, since this training is divided into two years – four semesters it has different contents which cover social, labour and technological competences;

c) The flexibility of having content adapted to the interests of the students;

d) Access to a wide range of multimedia learning resources like explanatory videos, tutorials, guidelines, audio exercises, digital games and other elements;

e) The usability, interoperability and accessibility of the platform and integrated e-modules being able to be personalized or individually taken by any student with disabilities.

Having identified the abovementioned practices it is important to mention that e-learning is a process, a way of learning, and not an individual event to occur (Kelly, Phipps & Swift, 2004). The described aspects in this paper are defined as an E-learning experience which is capable of providing a flexible learning to different types of disability. It is not only a web-based platform but an illustration of an innovative and adapted pedagogical context that allows a big range of young people with disabilities to learn at their own pace.

As it was previously mentioned, this training offer has several electronic learning modules or e-modules, including: (i) Communication and customer service; (ii) Development of values; (iii) English; (iv) Atelier accounting; (v) Literacy in Information Technology and Business Communication; (vi) Business organisation; (vii) Professional Profile Construction; (viii) Business Skills Development; (ix) Introduction to Learning Concepts; (x) Emotional Development; (xi) Motor Skills Development; (xii) Quality of life; (xiii) Information Management and Data Handling; (xiv) History, Culture and Art and (xv) Labour Relationships. This wide range of e-modules is justified since they cover several aspects of fundamental training for young people with disabilities, e.g. the social, communication, cultural, technological, professional and pedagogical contexts. The way it functions towards the e-learning web platforms is that each of these modules has an adapted guideline with a step-by-step content tutorial and supporting audio/video, this way reaching several types of learning disabilities. Besides these elements, there is also a set of pedagogical and methodological guidelines that support the development of the e-modules for each student to know what do to, how to do and to address possible doubts. In addition, there is also an online forum for specific questions or doubts that may appear. Concerning the multimedia resources, all the videos are narrated and have subtitles. Besides this, they also have a model explaining step-by-step what actions need to be followed in order to complete tasks. For example, in the e-module related to "(v) Literacy in Information Technology and Business Communication" there is a human figure explaining how to work with a computer, peripherals, browse the internet, conduct basic search, etc.

2.2 The chain of events of the methodological process

After this explanation it is possible to understand that the methodological approach behind the e-learning is mainly an adaptive, flexible and interactive. Specifically, one which allows the pedagogical enhancement of either the learners with disabilities but also the trainers interact with them and who are responsible for administration and support on the e-learning platform. That said, the importance of having accessible e-Learning guidelines for each e-module or learning step is one of the most important features in distance learning. It is not only a chance to provide personalized and adapted content but also to make such guidelines available in place to quickly address any problem, decision or the inaccessibility of any other e-learning tools, which is an highly recommended practice (Fichten et al., 2009).

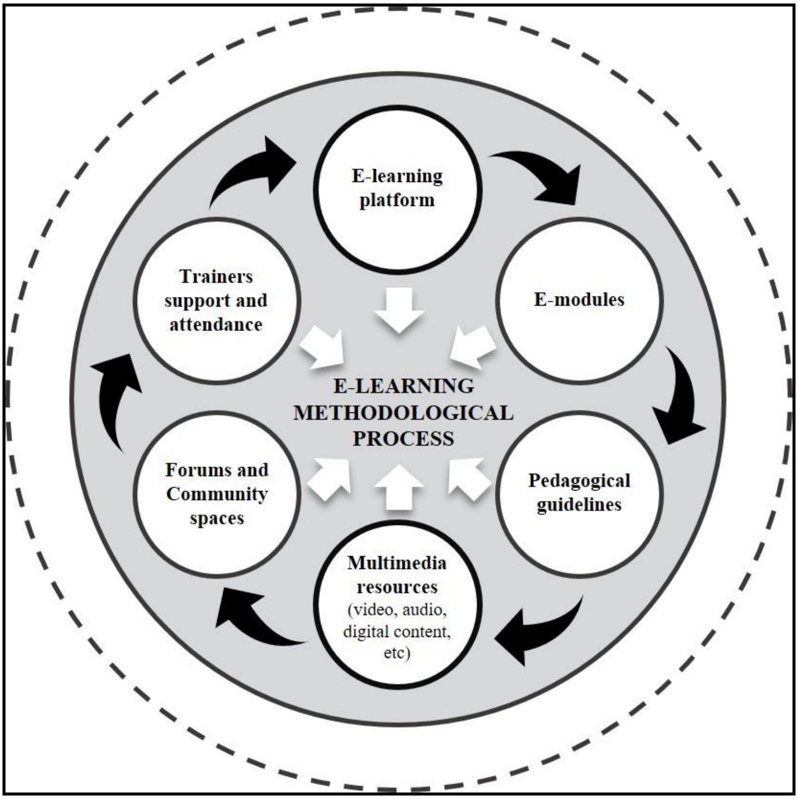

Figure 1. E-learning methodological chain of process

Source: Own work based on Mikołajewska & Mikołajewski, 2011

As it is possible to perceive in the figure 1 above, the methodological process followed a circular sequence which started by having an E-learning platform. The platform involved several e-modules that were supported by pedagogical guidelines. All the developed content found in the platform featured different multimedia resources, including video, audio, step-by-step tutorials, image and other digital media to address all the needs of students with disabilities. In addition, there are also forums and community spaces to promote discussion and interaction between trainees and trainers. Lastly, it is important to mention that the implementation of e-learning technologies allowed trainers to give continuous and monitored support as well as personalized attendance to each one of the students with disabilities providing adapted solutions to the needs of each student.

Thus, thanks to the analysis of the scheme it is also possible to understand that the process is linked and dependable on each previous element, since e-learning formats like this one are either asynchronous or synchronous in terms of communication tools and a chain of events. Moreover, following an idea of ontology-based e-learning system architecture (Nganji, Brayshaw & Tompsett, 2011) it is important to mention that this methodological process presents information and presentation components, knowledge representation components and even information retrieval components as well as management components. Therefore, it allows broader personalization, adaptation and flexibility to benefit from the pedagogical aspects of the e-learning format induced in the training offer. It was realised specifically by presenting alternative formats for the learning materials, accommodating different learning styles and levels of acquiring knowledge and still provide a vast range of accessible learning resources (Nganji, Brayshaw & Tompsett, 2011).

3. OTHER RELEVANT ASPECTS

In this section there will be addressed some other aspects that were considered relevant. One of them it is about the use of digital games as learning aids within the e-learning platform. It was perceived that young students with disabilities had a more enjoyable experience when some of the activities included digital games, e.g. Making digital puzzles (matching images with sentences or words) or guessing which activity was presented (e.g. a profession, lifestyle, props or other aspects related to the labour market. These exercises were sometimes included in several e-modules and demonstrated a high level of approval within the students. Other important aspect was the use of tablets instead personal computers or laptops. It seemed that for some of the students who suffered from physical disabilities that the tablets were easier for them to use when interacting with the platform and the digital media, since it allowed touch and increased interaction. The use of tablets in e-learning scenarios could be even more useful since it presents an opportunity for a multipoint interaction in which objects can be “felt” with all fingers (Hollier, 2004). Therefore, presenting the idea that the student emerged in the interaction between the e-learning platform, digital media and content.

CONCLUSION

In conclusion the importance of distance learning promotes a set of solutions and resources for people with disabilities or with disadvantaged backgrounds to have the opportunity to acknowledge and develop personal, social, professional, pedagogical and technological skills. Moreover, the fact that E-learning serves as an alternative to face-to-face teaching breaking down some of the barriers that many of these young people with disabilities suffer (discrimination, academic inequality, professional and social devaluation, etc.) and allows an even greater added value. In addition, it enables an educational format which is highly capable, credible, accessible, flexible and adapted to different target groups with disabilities. Another positive aspect that can be concluded is that these types of E-learning platforms integrate a diverse set of multimedia resources, integrating learning guides and tutorials that support each activity or task to be developed. It is also possible to conclude that this type of solution does not only benefit trainers and trainees, but also the community inherent in this type of process, i.e. parents, other educational institutions and even non-governmental organizations.

As for the constraints to this type of project they were mainly economic factors which initially were considered high, since the cost of maintaining an e-learning platform of this type can, sometimes, cause some financial damage to the institutions that promote this type of initiatives. Then, there are also other organisational problems since some of the students do not meet the social and technological conditions to join this type of training, requiring a strengthening in pedagogical efforts to support the proper implementation of this type of course.

As for improvements, we refer to the fact of expandability since this experience addressed a set of actions which are outlined as priorities by the European Commission to make education and training more inclusive. Although this good practice has been implemented at a national level and has had a certain type of impact on organizations, stakeholders, policy makers and other advisors, it is crucial that these initiatives become strategies to be adopted at an international level to generate a sustainable impact between institutions, trainers, trainees and other stakeholders. In fact, e-learning as a form of distance learning and integrating element of young people with disabilities has an enormous potential to become the training model of choice.

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TALENTED AND INEPT STUDENTS AND SMART LEARNING

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Abstract**:** *The greatest deficits of soft skills are characteristic of* talented *and* inept *students. The purpose of this paper is to analyse content of educational sites devoted to use smart technologies in education. It was hypothesized that authors do not use words such as:* able, clever, talented*, or* inept*. The search of the content was conducted and the data was analysed statistically and assessed critically with the use of teachers' professional judgment. The result showed that when owners and authors of online educational websites promote new teaching technologies and devices they do not refer to* gifted *or* inept *students.*

Keywords: smart learning, educational sites, WebQuest, talented student, inept student.

INTRODUCTION

Talented and inept students cause teachers similar problems. Both categories of students often have problems with communicating with the environment due to excessive use of the Internet. Both require individual approach, that is, teacher's additional time. Number of publications are devoted to ways working with such students.

But these publications not always take into account possibility of individual approach to utilising potential of new teaching technologies (or: SET, it means Smart Educational Technologies) and new methods of work in digital environment, e.g. e-portfolios, WebQuests, online courses. While, these technologies and methods are especially useful in teaching such students, because they allow for: archiving and recognizing their achievements, documenting their skills' development, searching for additional teaching materials, reviewing their knowledge, doing and repeating exercises, and individualizing work with them.

That is why producers could take into consideration needs of talented and inept students, same gaining additional market, while developing digital devices and software. Similarly, in didactic publications dedicated to working with talented and inept students, authors could include didactic proposals related to the use of the digital environment.

Does it happen? Do software producers and didactics recognize the needs of teachers and talented and inept students in digital environment? This study attempts to find answers to these questions.

1. SET: PERSONALIZATION AND COLLABORATION

In the following text Smart Educational Technologies (SET) are defined as electronic devices (such as smartphones, tablets and notebooks), their software, policies and procedures directed at achieving educational aims of school based and external education and life-long learning.

The use of SET is recommended not only for average but above all for *talented* (Olszewski-Kubilius & Lee 2004; Wallace 2006; Thomson 2010; Housand & Housand 2012) and *inept* (Flynn 2014) students. Both groups show the biggest deficiencies in soft skills. The able ones do not integrate with their peers who are unable to keep up with their interests and passions. The unskilled ones are often ridiculed so they try to impress their peers in ways which are not always socially acceptable. Both groups, therefore, need educational materials tailored to their needs, individualized and personalized working methods, along with communication technologies and tools which would enable communication and collaboration. This is due to two reasons:

1. Need for socialization
2. Connectivist nature of modern learning.

The digital learning environment creates many opportunities for student collaboration, individualization and personalization of learning. It is needed for both: *talented* and *inept* students. According to George Siemens [c]*onnectivism is a theory of describing how things happen in a digital age* (Siemens 2006: 30) and teaching with technology *respects diverse talents and ways of learning* (Siemens 2009: 15). Thanks to the Information and Communication Technologies, it is possible to use teaching methods and tools such as:

1. Online course.
2. MOOCs.
3. *WebQuest*.
4. *E-portfolio* and *virtual notebook* which can be kept with the use of the tools provided on sites such as: “Blogger”, “Evernote”, “Google Keep”, “Google Sites”, “One Note”, “Padlet”, “Zoho”.

Education is not only about developing hard, i.e. measurable, skills but also soft, interpersonal skills i.e. psychophysical features and social skills allowing a person to plan their work and to collaborate with others.

The teacher chooses methods of work with their students. However, it can be said that teachers are less willing than students to use digital technologies. Because of that teaching does not meet the students' needs. Meanwhile, didactic work using digital technologies can be individualized more than teaching in which a traditional approach is used; it is able to satisfy unique needs of both *talented* and *inept* students. SET-based teaching materials could, therefore, appeal to the needs of *talented* and *inept* students

2. AIM, HYPOTHESIS AND METHODS

The aim of this study was to examine if and how the SET technologies are being recommended in educational materials for working with *talented* and *inept* students.

It was hypothesized that *promotion of the SET does not specify if the use of proposed materials are intended for working with talented or inept students*.

In order to check validity of this hypothesis, a qualitative thematic analysis was carried out, because this research tool for identifying, analysing, and reporting patterns (themes) provides a rich and detailed account of the data (Braun & Clarke 2006: 6). For this purpose texts from 10 websites and documents promoting SET as well as of 5 publications on working with *gifted* and *inept* students were collected.

The Google Web Search engine had been set up in advanced resource search mode in the appropriate language and country. Then the following words were introduced: *smart educational technology* (or respectively: *smart pedagogisk teknologi* in Norwegian, *intelligente Bildungstechnologie* in German, smart pædagogisk teknologi in Danish). The text that appeared in the highest position was selected for the analysis. Such criteria for content selection caused that analysed were heterogenous texts, not always about SET, but being real-life examples of way of introducing new technologies or SET to education in different countries. They often illustrated national cooperation of educational, governmental and commercial entities.

The texts were saved in Word or PDF format and stored in the corresponding working folders. Then the analysis of the vocabulary and collocations of those websites, books and documents was performed in order to find sentences containing the words: *able, accomplished, capable, clever, gifted, proficient, talented, inept* and their collocations and counterparts in other languages (e.g. in Polish *utalentowany, zdolny, słaby*) and to analyse contexts in which they were used. On the other hand, in didactic materials on working with *talented* and *inept* students words *digital, e-portfolio, Internet, multimedia, WebQuest, virtual notebook* were searched for and the way of using them was analysed. Quantitative research was therefore complemented with qualitative analysis.

In order to triangulate the results, the professional judgement was utilised. The professionals included teachers who participated in the training course held on 29 May 2018 in Nowy Sącz and on 13 June 2018 in Bochnia as part of the implementation of the *Malopolska Educational Cloud* project. In Nowy Sącz:

1. Group I: Barbara Brzozowska-Batko (II LO in Nowy Sącz, Mathematics online, barbara.brzozowskabatko@gmail.com), Elżbieta Lankof-Klewar (I LO in Nowy Sącz, Mathematics online, elankof@wp.pl), Bogdan Potoniec (II LO in Nowy Sącz, Mathematics online, bogdan.potoniec@gmail.com), Katarzyna Jermakowicz (I LO in Nowy Sącz, jermakowiczka@gmail.com).
2. Group II: Iwona Kita (II LO in Nowy Sącz, English language, irkita@o2.pl), Ewelina Krupa (II LO in Nowy Sącz, French language, ewelinakrupa1234@gmail.com), Katarzyna Socha (II LO in Nowy Sącz, Biology k.socha@gmail.com), Kamila Kamińska (I LO in Nowy Sącz, Biology, kamila.bozek@gmail.com), Krystyna Łatka (I LO in Nowy Sącz, Mathematics, krysialatka@gmail.com).

In Bochnia worked English language teachers from the Stanisław Staszic No. 1 School Complex in Bochnia supervised by:

1. Group I Barbara Satoła-Śliwa (bsatola@interia.pl).
2. Group II Edyta Kurtyka (edytakurtyka82@gmail.com).
3. Group III Konrad Kozłowski (kentra747@hotmail.com).
4. Group IV by Joanna Bieżychudek (biezychudek@poczta.onet.pl).

The coupling of document analysis with professional judgement allowed for combining two different ways of data presentation.

Finally, there were drawn conclusions on distributing the SET-based teaching methods in working with *talented* and *inept* students.

3. RESEARCH MATERIAL

Publications on SET as well as presenting methods of working with *talented* and *inept* students were the subject of the analysis.

Research material included:

1. Texts from 5 websites dedicated to educational tools and technologies (Table 1).

2. Content of 5 documents on SET published on websites based in countries with education rated as the highest by the *Human Development Report 2016* (United Nations Development Program 2016: 230) i.e. Norway, Australia, Switzerland, Germany, Denmark (Table 2). Search for these documents was conducted by typing into the search engine the phrases: *smart pedagogisk teknologi, smart educational technologies, intelligente Bildungstechnologien, intelligente uddannelsesteknologier.*
3. Content of 5 documents published on Polish websites dedicated to working with *gifted* and *inept* students (Table 3). These were found after the search terms *praca z uczniem zdolnym* (*working with a gifted student*), *praca z uczniem słabym* (*working with inept student*) had been entered into the search engine. The publications were prepared by authors of various categories, e.g. teachers, educators and educational institutions.

Every text was saved in Word or PDF format as a separate document and tagged with the author and website name (Table 1, Table 2, Table 3).

Table 1.

The SET associated websites analysed (accessed on 7 July 2018).

Website	Address
"WebQuest.Org"	http://webquest.org
"Wszystko o metodzie WebQuest"	http://webquest-metoda.blogspot.com
"Blogger"	https://www.blogger.com
"Padlet"	https://pl.padlet.com
"Evernote"	https://evernote.com

Source: Own work

Table 2.

The SET associated documents analysed (accessed on 7 July 2018).

Country	Author, title	Address
Norway	Inspiria Science Center *Smart og enkel teknologi for læring*	http://www.inspiria.no/?itemid=3001
Australia	State Government of Victoria *What is smart technology for the smart classroom?*	http://www.education.vic.gov.au/Documents/about/news/archive/7ensmarttech.pdf
Switzerland	Venturelab *Neues EdTech Vertical: Kickstart Accelerator heisst Startups im Bereich Bildungstechnologie willkommen*	https://www.venturelab.ch/Neues-EdTech-Vertical-Kickstart-Accelerator-heisst-Startups-im-Bereich-Bildungstechnologie-willkommen
Germany	Nationaler IT-Gipfel *Smarte Bildungsräume. Positionspapier der*	https://deutschland-intelligent-vernetzt.org/app/uploads/2016/11/FG2_Smarte_Bildungsraeume_web_20161

	Expertengruppen Intelligente Bildungsnetze und Smart Cities / Smart Regions	1.pdf
Denmark	Morten Greve *10 teknologier, der ændrer vores verden de næste 10 år*	https://www.dr.dk/nyheder/viden/tech/10-teknologier-der-aendrer-vores-verden-de-naeste-10-aar

Source: Own work

Table 3.

Polish publications analysed (accessed on 7 July 2018).

Author, title	Address
Czekaj-Kotynia, K. (Ed.). *Nowoczesne metody dydaktyczne w procesie kształcenia*	http://kompetencje.org/materialy/zst/nowoczesne-metody-dydaktyczne.pdf
Sobańska-Jędrych, J., Karpeta, B., Torenc, M. *Rozwijanie zdolności językowych na lekcji języka obcego*	https://www.ore.edu.pl/2014/12/poradniki-2/
Gawlica, I., Czekan S., Gawlica, M. *Procedura pracy z uczniem zdolnym*	http://www.sp17zabrze.szkolnastrona.pl/container/Procedura%20pracy%20z%20uczniem%20zdolnym.pdf
Limont, W., Cieślikowska, J., Jastrzębska, D. (Eds.). *Zdolni w szkole, czyli o zagrożeniach i możliwościach rozwojowych uczniów zdolnych. Poradnik dla nauczycieli i wychowawców*	https://www.ore.edu.pl/2014/12/poradniki-2
Ośrodek Rozwoju Edukacji *Wybrane metody i formy pracy z uczniem zdolnym*	https://www.ore.edu.pl/2014/12/metody-i-formy-pracy-z-uczniem-zdolnym

Source: Own work

4. LIMITATIONS

Searching documents for words suggesting how to use SET with a *talented* or an *inept* student is only partially objective because:

1. Some materials have been disregarded due to technical problems such as presence of Flash presentations in their content (e.g. Merrick 2016).
2. Some authors associated the presented SET tools with personalization of teaching which may be applicable also to working with *talented* or *inept* students.
3. Some presented tools were applied to specific didactic situations, but it was not specified whether they were applicable to teaching *talented* or *inept* students.

4. The teacher is able to adapt didactic tools to the needs of *talented* and *inept* students, so mentions of those in presentations on didactic methods and SET tools were treated as irrelevant.

5. RESULTS OF ANALYSIS

5.1.Usage of the words: *able, accomplished, capable, clever, gifted, proficient, talented, inept.*

5.1.1.Sites presenting the SET methods and tools

5.1.1.1.The "WebQuest.org" site

Majority of search terms were found on the „WebQuest.org" website. Since 2005 teachers from various countries have placed onto this website thousands of examples of use of this method. The search terms were found by means of the website search engine. Next, the context of their use was examined. *Accomplished* and *gifted* turned out to be the most popular words. However, only the latter appeared consistently in didactic contexts. It was used in the module titles suitable for students at different stages of their education, ranging from Grade 3 to school-leaving students and professionals: *A WebQuest for Teaching Gifted Students, Gifted Boys, Gifted Girls, Instructional Strategies for Gifted Learners, Instructional Strategies for Gifted Learners* and so on. It can be concluded that teachers, the authors of the proposed activities, believed that such actions had a potential of forming *gifted* students. However, they did not address *inept* students.

Other sought words often appeared in contexts that do not relate to students' characteristics, e.g.: *Mission Accomplished!*, *Most Accomplished President*, *California Missions: Mission Accomplished?*, *Author Study: An In-depth Look into the Lives of Accomplished Authors*, *capable of achieving, China's talented Dynasties: Tang and Song Achievements*, *talented athletes*, *talented artists*. The word *weak* was connected with body activities, for example: *Seven Days Without Exercise Makes One Weak.* The term *poor* appeared consistently in economic and social contexts, for example: *What is Poverty and Who are the Poor?, Being Poor in Tudor England, How will we bury poor Uncle Albert?, Pudgy Peggy's Poor Plan, Exploring The Link Between Nutrition and Poor Academic Performance, How Peer Pressure Could Lead To Poor Decision Making Than Can Affect The Rest Of Your Life.* There is no mention of *inept* students.

Teachers using their professional judgement (Group II, Nowy Sącz), having analysed the content of this site, concluded: *it has some didactic potential; it can assist in creating tasks for talented and inept students* (*posiada walory dydaktyczne, może służyć pomocą przy tworzeniu zadań dla uczniów zdolnych / słabych*). It shows that contemporary Polish teachers did not find on the „WebQuest.org" website ready-made proposals for working with *talented* or *inept* students. However, didactic materials published on the site may inspire teachers to create their own *WebQuests*.

5.1.1.2.The "Everything about the WebQuest Method" ("Wszystko o Metodzie WebQuest") website

The Polish website was designed by 3rd year students of Polish Philology as part of Information Technology course coordinated by Sabina Furgoł. Similarly to the website discussed above, it presents the methods and some examples of tutorials.

The term *gifted* occurs once only – in the subject of tutorials *Metoda webquest w pracy z uczniami zdolnymi* (*The webquest method in working with gifted students*). However, the hyperlink to this resource is inactive. Other search words were not found.

Having analysed the content of the site using their professional judgement, the teachers (Group I, Nowy Sącz) concluded: *The extensive material published on the website provides general information about working with a student, however it does not specifically address a gifted or an inept student* (*Udostępniony obszerny materiał zawiera informacje ogólne o pracy z uczniem, bez zwrócenia uwagi na ucznia zdolnego i słabego*).

5.1.1.3.The "Blogger" website

The website is not so much educational but commercial in its nature. That can explain lack of search terms applicable to *talented* and *inept* students. However, the following sentence was noticed: *blogspot.com will serve you the country service that corresponds to your location. and all existing blogspot ccTLD domains will redirect to blogspot.com. This will help simplify URLs for international audiences* („Blogger"). This suggests that the intended users of this website run by Google are international corporations, not students.

5.1.1.4.The "Padlet" website

The site, like the previous one, is commercial in nature. No search didactic terms were found on this website. It was developed by website designers who perceive students not in terms of their individual characteristics but in terms of mere commercial users and numbers of times the website was accessed: *New students join? Give them automatic access to lessons and plans and other stuff you have created. Give administrators and teachers rights to see student work* („Padlet"). The website giving the teacher an option of creating *e-portfolio*, as if it was not a tool suitable also for modern day students, suggests that the website designers are lacking knowledge of contemporary educational realities: *Create beautiful reports and portfolios for students - by year, class, or subject* („Padlet").

The design of the tool does not hinder its use by *talented* and *inept* students. However, it limits its popularity in educational contexts.

5.1.1.5.“Evernote”

The search terms did not appear in educational contexts, although the application is offered for sale, also for students. Students were offered to share, review and present notes, scan and search documents etc. The application, however, is primarily business orientated. This is suggested by phrases such as: *As a project manager, Sandro was thus able to address the most challenging aspects presented by large-scale projects* and *Thanks to Evernote Business, we were finally able to bring company knowledge to the people, your team is capable of dreaming up* („Evernote“). The *Evernote Business* version of the product is the most functional but also its price is the highest.

5.1.1.6.Conclusion

The use of search words was correlated with the size of resources, type of ownership, predicted users and professions of the authors of the website. Therefore the analysed texts revealed cultural and educational context in which search words or their synonyms and collocations were used. Only the first two of the presented websites, developed by the teachers and the educators, present SET in the context of personalized education. On the other hand, the way programmers present tools as useful for SET brings them down to a lucrative business offer. They perceive school as a place of one-way knowledge transfer because this is how they remembered it from their school years. Therefore, they are unable to satisfy the needs of the modern educational market with products they offer.

Language of the sellers offering similar products and coming from similar cultural background occurred to be alike. It communicates corporations’ striving for global technologicalisation of education without sufficient supporting it by offering didactic guidelines.

Table 4 summarizes didactic terms appearing in the contents of the researched websites presenting the SET methods and tools.

Table 4.

Didactic terms on websites presenting the SET methods and tools

Website	***able / zdolny***	***accomplished***	***capable***	***clever***	***gifted***	***talented / utalentowany***	***proficient***	***inept / słaby***
“WebQuest.Org”	0	20	6	1	20	6	0	0
“Wszystko o metodzie WebQuest”	1	-	-	-	-	0	-	0
“Blogger”	0	0	0	0	0	0	0	0
“Padlet”	0	0	0	0	0	0	0	0
“Evernote”	0	0	0	0	0	0	0	0

Source: Own work

5.1.2.Materials published on the websites based in the countries with education rated as the highest in UN ratings

5.1.2.1.Norway

The article concerns a breakfast seminar organized 15 April 2015 by the INSPIRIA Science Center, NHO and Abelia in the Østfold district for 150 teachers and school principals. Analysed coverage refers to the *intelligent and easy learning technology* that utilizes games, simulations and enables personalization of teaching. This technology was presented to representatives of the education and the business sector during the scientific and didactic seminar which shows integration of these two sectors in Norway. The search terms that were used in the text occurred not in didactic contexts but in reference to the technological advancement e.g.: *smart og enkel teknologi* (*smart and simple technology*), *smartteleforner* (*smart phones*). But in countries with high competences of teachers (such as Norway, Australia) mentioning *talented, inept* or *needing a lot of attention and motivation* students in texts about new technologies in school is unnecessary.

5.1.2.2.Australia

The analysed publication was prepared in 2010 by the Victoria State Government. It addresses educational applications of: *Ultranet, digital and flip cameras, interactive whiteboards and dozens of software programs and online resources* (...) *blogs, wikis* (...) *web apps such as Google Docs* (...) *online learning portfolio* (...) *online learning activities* (Victoria State Government 2010).

The search terms were not found in the text of the publication. However, the accuracy of the presented SET applications should be appreciated, especially since the article was created in 2010, when the SET development only just started with the wide spread of social media. By that time, the Internet was utilised for educational purposes in the Australian schools and students from 1575 schools worked together and commented on their work using digital devices. Teachers posted tasks and published grades on the platform, and parents monitored progress of their children.

5.1.2.3.Switzerland

The text refers to the Swiss *Kickstart Accelerator* program developed at the Ecole Polytechnique Fédérale de Lausanne dedicated to the use of start-ups in education. It was implemented in 2017 with the support of EdTech as part of the *Das firmenübergreifende Startup-Förderprogramm* program. As an incentive, the top 10 companies received scholarships, awards and established cooperation with EdTech, investors, experts, mentors and business partners.

Search terms did not appear in didactic contexts in the text but phrases like *Fähigkeit der Region* (*the capacity of the Region*), *die besten Startup-Talente* (*the best startup talents*) (Venturelab 2017) were encountered. This does not necessarily mean that the program does not apply to *talented* and *inept* students. The lack of wording referring to those two categories of students could be due to the size of the document – it consists of approximately 7500 characters only.

It is worth noting that the implementation of the presented program became possible thanks to the co-operation between academic, industrial and governmental entities. The program correlates with the high quality of education and innovation in a country where educational technology is booming.

5.1.2.4. Germany

The *Smarte Bildungsraume (intelligent educational spaces)* document developed by the Nationale IT-Gipfel referes to the Interacting Smart Cities/Regions and Smart Education Networks in selected regions of Germany, to digitalization of education and qualification, including Cisco Networking Academy, Open Pop University and to MOOCS. The authors concluded that social well-being is balanced where digitalization is utilised and where, secondary to that, educational opportunities are maximised.

The authors mentioned the acquisition of skills (*Fähigkeiten erwerben*) (p. 4) through the use of IT, as well as the acquisition of competences needed for finding employment (*Kompetenzen für Beschäftigungsfähigkeit*) (p. 13) thanks to Cisco Networking Academy. It was also reported that German universities, having developed very *talented* (*Hochbegabten*) students, are offering distance education courses for extraordinarily *talented* and also for *inept* students (*überdurchschnittlich begabte und unterforderte Schülerinnen und Schüler*) (p. 11). The former ones often do not complete their university courses due to problems with commuting to the university or with unsuitable MOOC program.

It can be said that the authors of the document correctly linked the use of the SET with the education of *gifted* and *inept* students seeing in new technologies a chance of development for both. Paying attention to *inept* students is rooted in the German pedagogical tradition focused on helping. On the other hand, promoting development of the *talented* students is conditioned by the needs of the highly advanced German economy. This kind of document could have been created only in case of cooperation of the business and academic bodies. The academic entities were represented, among others, by Prof. Dr habil. Christoph Igel (Deutsches Forschungszentrum für Künstliche Intelligenz GmbH), Prof. Dr Bernd Krämer (FernUniversität in Hagen), Prof. Dr Daniela Niklas (Otto-Friedrich Universität Bamberg), Prof. Dr Sigfried Stiehl (Universität Hamburg).

5.1.2.5. Denmark

The analysed text was posted on the website of the Danish Internet TV DR. It was, therefore, written by a journalist, not by a pedagogue. It applies to the latest technologies including the Artificial Intelligence, biometric sensors, Internet of Things, quantum computers, cyborgs, brain-computer interfaces, robots and drones, self-propelled cars, Virtual Reality, Augmented Reality, and Mixed Reality. However, these technologies were not linked to education or, more importantly, to the categories of *talented* or *inept* students. Nonetheless, they are being utilised in education and will certainly be so in the future.

5.1.2.6. Conclusions

Table 5.

Didactic terms from the websites based in the countries with education rated as the highest by the United Nations

Country, author, title	***able***	***accomplished***	***capable***	***clever***	***gifted***	***proficient***	***talented***	***inept***
Norway: Inspiria Science Center *Smart og enkel teknologi for læring*[1]	0	0	0	0	0	0	0	0
Australia: Victoria State Government of *What is smart technology for the smart classroom?*	0	0	0	0	0	0	0	0
Switzerland: Venturelab *Neues EdTech Vertical: Kickstart Accele-rator heisst Startups im Bereich Bildungstechnologie willkommen*[2]	0	0	0	0	0	0	0	0
Germany: Nationaler IT-Gipfel *Smarte Bildungsräume. Positionspapier der Expertengruppen Intelligente Bildungsnetze und Smart Cities / Smart Regions*	2	0	0	4	0	0	0	2
Dennmark: Morten Greve *10 teknologier, der ændrer vores verden de næste 10 år*[3]	0	0	0	0	0	0	0	0

Source: Own work

The analysed texts were in majority of the cases promotional. That explains why positive connotations and terms associated with the education of *gifted* students were used in them, while *inept* students were rarely referred to.

The search terms characterizing students were associated mainly with the technological aspects of teaching and not with educational process or methods of teaching, and the more not with working with *a gifted* or *an inept* student.

[1] In Norway respectively: *stand, oppnådd, dyktig, smart*, *begavet*, *talentfull*, *fattig*, *udugelig*.
[2] In central Switzerland and Germany respectively: *fähig, vollendet, klug, begabt, talentiert, arm*, *ungeschickt*.
[3] In Dennmark respectively: *stand, gennemført, klog, begavet, talentfuld, fattig, svag*.

Table 5. lists analysed texts from the websites based in the countries with education rated as the highest by the United Nations taking into account the occurrence of didactic search terms related to working with a *talented* or an *inept* student.

5.1.3.Publications about *talented* and *inept* students and the SET

5.1.3.1. *Modern didactic methods?*

The collective monograph *Nowoczesne metody dydaktyczne w procesie kształcenia (Modern didactic methods in the education process*) (2013) was developed as part of the implementation of a project co-financed by the European Union under the European Social Fund (*Priority IX - Development of education and competences in regions, Measure 9.2. Improvement of the attractiveness and quality of vocational education*). The education process was positioned in the realities of the digital advancement. This is evidenced by the fact that the word *Internet* was used 46 times in the text and the reference to the digital education system was made 9 times (mainly to the e-journals). However, there was no mention of *inept, talented* or *gifted* students. Only in one instance there was a mention of the development of *skills needed for group work, presentation of one's work and self-assessment of own activities* (*zdolności związanych z kooperacją w grupie, prezentacją wyników swojej pracy, samooceną podejmowanych działań*) (p. 56). It can be said that the authors noticed a correlation between advanced technology, digital methods, didactic tools (e.g. blog, WebQuest, e-experience, computer didactic programs) and the individualization of education. Tailoring education to the needs of a given student was possible thanks to practical application of these technologies – the cited project referred to vocational training. However, the subject has not been expanded further.

Having analysed the monograph, using their professional judgement, the teachers (Group I, Nowy Sącz) stated: *The extensive material published does not contain any information on how to work with a gifted or an inept student* (*Udostępniony obszerny materiał nie zawiera żadnych informacji na temat pracy z uczniem zdolnym i słabym).* This suggests that they had expected that the publication about modern didactic methods would offer some guidelines regarding working with a *gifted* and an *inept* student, but they found none.

5.1.3.2. *Developing language skills?*

The digital brochure *Rozwijanie zdolności językowych na lekcji języka obcego* (*Developing language skills during foreign language lessons*) (2013) was prepared as part of the project *Opracowanie i wdrożenie kompleksowego systemu pracy z uczniem zdolnym* (*Development and implementation of a comprehensive work system with a gifted student*). The topic caused that the term *gifted* was frequently used in the book. Nonetheless, ways of working with an *inept* student were not addressed.

The authors placed teaching in the realities of the Internet. Most often, however, they placed the Internet content on a par with the library resources or the encyclopaedia (pp. 35, 43, 48, 55, 57, 60, 66) even though they suggested using the Internet for completing a project by the students (pp. 36, 49). They proposed publishing students' work on a website (pp. 44, 62), posting opinions on an online forum (p. 50), and designing a website (p. 61). The Internet is, therefore, seen in terms of Web 1.0, i.e. as a unidirectional communication. The use of social media, working together with the students, e.g. using the *WebQuest* method, running an *e-portfolio*, *virtual notebook*, or posting teaching materials and interactive exercises by the teacher was not postulated. The word *interactive* was not found in the text.

It can be said that the authors have linked the digital learning environment and the education of the *gifted* students with the Internet in a way that is obsolete. Nevertheless, the brochure is still available on the website of the Education Development Centre and, therefore, the outdated ways of teaching are being promoted.

The teachers (Group I, Bochnia), having analysed the contents of the booklet using their professional judgement, stated, among others: *No references to publishing on the Internet* (*Brak odniesień co do publikowania w Sieci*). It seems that the author's referring three times to posting materials on the Internet by the students was not enough for teachers. The teachers' search for methodical guidance on publishing opinions by students, the list of the foreseeable hardships and benefits of doing so, information on copyright laws, as well as didactic examples of such publications on the Internet, hyperlinks to such materials etc. Meanwhile, the hyperlinks mentioned in the booklet were often outdated, which is discouraging for the readers.

5.1.3.3. Working with a *gifted* student?

Irena Gawlica, Sylwia Czekan and Magdalena Gawlica in their six-page long publication titled *Procedura pracy z uczniem zdolnym* (*The procedure on working with a gifted student*) codified the procedure which was adopted for the implementation in the No. 17 Primary School in Zabrze in 2008. No words referring to the digital teaching environment were found in the text.

It can be said that the publication is, therefore, outdated. It would discredit the modern school if it did not contain the date it was created because it moves the teaching ten years back. The publication was created before the development of social and mobile media, both of which play an important role in the modern day education.

These days it is impossible to ignore the digital environment in the teaching of *talented* students. However, probably overloading the teachers with administrative and reporting duties was the reason why the document has not been updated. Most likely, the teachers of the above mentioned school are referring to the digital era in education (and not only with relation to working with a *gifted* student).

Having analysed the contents of this document using their professional judgement, the teachers (Group II, Bochnia) stated, among others: *the material does not* *contain any guidelines on publishing on the Internet by gifted students* (*materiał nie zawiera wskazówek co do publikacji w Sieci przez uczniów zdolnych*). In 2018, students publish freely on social media. According to the teachers participating in the project on developing skills of taking advantage of the digital era, not developing those skills in the most *talented* students is unacceptable.

5.1.3.4. Gifted ones at school?

Published in 2012 by Ośrodek Rozwoju Edukacji (Center for Education Development) the collective monograph entitled *Zdolni w szkole, czyli o zagrożeniach i możliwościach rozwojowych uczniów zdolnych. Poradnik dla nauczycieli i wychowawców* (*Gifted ones at school, or about developmental dangers and opportunities of the talented students. Guide for teachers and educators*) was edited by Wiesława Limont, Joanna Cieślikowska and Dominika Jastrzębska. The authors referred to the use of the Internet resources as well as the publication of materials and bulletins in the Web by the school and the university students (pp. 73-74, 152), establishing an Internet radio (p. 67), conducting astronomical observations on the Internet (p. 67), creating websites and programming (pp. 169, 171-172).

Interestingly, the authors did not propose that the teachers should contribute to the didactic resources and possibilities of the Internet. They only mentioned the need of supplementing the school website (p. 79). The authors perceive the Internet as a tool of reproduction on a par with photography, film and television (p. 132). They consider communicating over the Internet (pp. 169, 171) to be a dangerous antithesis of direct interpersonal relations (p. 111). The authors mentioned not a single teaching method which would be specific to the digital environment.

Educating *talented* students in the manner proposed in the book would not be adequate to the needs of modern students. The non-updated publication promotes outdated teaching methods and discredits the Centre for Education Development as an educational institution.

The teachers interested in taking advantage of the digital era in teaching (Group III, Bochnia), having analysed the content of this monograph, utilising their professional judgement, voiced a very harsh opinion:

> *Unfortunately, there are no hyperlinks to the paragraphs we are interested in. References and bibliography are presented all too professionally; mainly academic papers are referenced which are not very helpful in providing information on how to work with a gifted student but present just dry data (nonetheless, consistent, with the title of the publication: "dangers and opportunities" and not "ways of working"). Publication dates of referenced materials up to the publication time. In the entire work, several projects were described. Projects are the only method of teaching presented in the publication (apart from some information on how to create a bulletin). Not a single word on the use of modern teaching methods. Waste of time.*
>
> (*niestety brak hiperlinków pozwalających przeskoczyć do interesujących nas fragmentów. Odniesienia i bibliografia wykonana aż nazbyt profesjonalnie, są to*

prace naukowe, niezbyt przekazujące przydatne wskazówki jeśli chodzi o pracę z uczniem zdolnym, a jedynie suche dane zgodne zresztą z tytułem publikacji: "zagrożenia i możliwości", a nie "sposoby pracy". Bibliografia praktycznie do czasu publikacji. W całej pracy zostało opisane kilka projektów, jest to właściwie jedyna metoda opisywana w pracy (plus tworzenie gazetki), praktycznie ani słowa o wykorzystaniu nowoczesnych metod. Strata czasu).

5.1.3.5. Methods and forms of working with a *gifted* student?

Published on 19 December 2014 by Ośrodek Rozwoju Edukacji (Centre for Education Development) presentation entitled *Wybrane metody i formy pracy z uczniem zdolnym* (*Selected methods and forms of working with a gifted student*) was created in 2009 in cooperation with Centralny Oddział Doskonalenia Nauczycieli (The Central Department of Teachers' Development). In the presentation, the Internet was mentioned only once and even more so, in the context of promoting successes of the *gifted* students (screen 30). The presentation does not contain any references to the digital learning environment. It could have been updated at the time of publication on the website run by an educational institution, so at least it would not promote an obsolete ways of teaching *talented* students.

The teachers participating in the implementation of the Malopolska Educational Cloud project, having read this presentation, stated: *Lack of information on publishing on the Internet.* They seemed to be expecting to find current (and the simplest) didactic guidelines in the publication available on a website run by a recognised educational institution. The teachers from Nowy Sącz were surprised encountering problems with opening the document and with the fact that it had not been updated so far.

5.1.3.6. Conclusions

Table 6. lists a number of times the words related to the digital learning environment appeared in the analysed publications. The most common of these words is the *Internet*. It turned out that not even once a reference was made to teaching methods in a digital environment, such as *e-portfolio*. *WebQuest* was discussed only in one of the publications analysed. This means that in the analysed didactic publications prepared by employees of Polish educational institutions working with a *gifted* student SET are not frequently enough mentioned.

Table 6.

Words related to SET in publications on working with a *gifted* or *inept* student

Author, title	*cyfrowy*	*digitalny*	*elektroniczny*	*e-portfolio*	*Internet*	*multimedia*	*Web Quest*	*wirtualny*

Nowoczesne metody dydaktyczne w procesie kształcenia (*Modern didactic methods in the educational process*), Ed. Katarzyna Czekaj-Kotynia	1	0	8	0	46	11	29	0
JoannaSobańska-Jędrych, Beata Karpeta, Marta Torenc *Rozwijanie zdolności językowych na lekcji języka obcego* (*Developing language skills during a foreign language lesson*)	0	1	0	0	13	2	0	0
Gawlica Irena, Sylwia Czekan, Magdalena Gawlica *Procedura pracy z uczniem zdolnym* (*Procedure of working with a gifted student*)	0	0	0	0	0	0	0	0
Zdolni w szkole, czyli o zagrożeniach i możliwościach rozwojowych uczniów zdolnych. Poradnik dla nauczycieli i wychowawców (*Gifted learners at school, or about developmental dangers and abilities of talented students. A guide for teachers and educators*), Ed. Wiesława Limont, Joanna Cieślikowska,Dominika Jastrzębska	9	1	7	0	35	6	0	8
Ośrodek Rozwoju Edukacji *Wybrane metody i formy pracy z uczniem zdolnym* (*Selected methods and types of working with a gifted student*)	0	0	0	0	1	0	0	0
Total	10	2	15	0	95	19	29	8

Source: Own work

CONCLUSIONS AND RECOMMENDATIONS

The analysis of suggestions on working with a *gifted* or *inept* student, presented in the SET related educational documents, confirmed that they often serve the mere presentation of tools and do not provide teachers with didactic guidelines on how to work with a *gifted* student or an *inept* student. This is due to the technologisation of contemporary teaching.

The hypothesis that *promotion of SET is not linked to the use of SET in working with a talented or inept student* proved to be partially true in relation to the researched material. Some teachers, the authors of suggestions and didactic proposals posted on the Internet, are able to link the presentation of SET to the methods of working with *talented* and *inept* students in the digital environment. On the other hand, when the employees of companies involved in the production of digital tools are the authors of the texts, they focus on promoting their products and services primarily to businessmen, although the products they offer could be useful also school and university students. For comparison, educational institutions often publish obsolete materials. Often suggested methods on working with *talented* and *inept* students presented in such publications disregard the advancement of the modern digital environment represented by Web 2.0 or Web 3.0.

It can be stated that the authors of the educational websites and the Internet documents, while discussing SET, use a similar language regardless of their academic discipline, the problem they address, their age, gender, country of origin or cultural background. This common language, which is developing worldwide, enables the transfer of technological advancement. However, the need for transfer of experience and didactic research results which would integrate the educational and research community still remains. It is recommended that publications about SET take into account specific needs of *gifted* and *inept* students.

One can say, according to Ludwig Wittgenstein, *the limits of my language mean the limits of my world* (Wittgenstein 2010: 74). Not using the words *able, accomplished, capable, clever, gifted, proficient, talented, inept* in publications about SET and the words *digital, e-portfolio, WebQuest, virtual* in publications about *talented* and *inept* students is most likely to limit the utilisation of the digital learning environment for didactic purposes. There is need for educational materials linking SET with working with a *talented* and an *inept* student that is the need for publications prepared by didactics and teachers and not by programmers, web designers or representatives of the world of business.

Further studies on vocabulary used on educational websites can be conducted as part of the Distance Learning research. SET ought to be effectively used for equalizing educational opportunities, individualizing education and economic development. Countries which achieved economic successes in recent decades (e.g. China, South Korea, Singapore, Thailand) had implemented national educational policies, including working with *gifted* children (Markelow 2009).

Studies have shown that about 38% of students with learning difficulties are *able* (Bereźnicki 2015: 256). Potential of *talented* students should not be wasted. It is especially valuable in developing countries threatened by *brain drain* that is by emigration of school and university students and professionals educated at the expense of society, *talented* and having high educational and professional expectations. If they had the opportunity, they could solve many problems of their communities and countries.

Therefore, the binding of SET technology to the education of gifted students (and the ones who need a lot of attention and motivation) is needed especially in developing countries.

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IMPACT OF DIGITAL STORYTELLING IN STUDENTS´ SATISFACTION, MEASURED THROUGH SEEQ QUESTIONNAIRE

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Abstract: *This paper describes the evolution of satisfaction indexes, measured among students attending the course Security of Information taught as part of two fields of studies: Computer Engineering and Telematics Engineering at the University of Extremadura. This degree of satisfaction has been continuously measured by means of a SEEQ questionnaire from the academic year 2012/2013 until the recently completed one, 2017/2018. As a new change, implemented in the last two academic years, the practice of Digital Storytelling has been included as a teaching-learning technique for specific topics. Therefore, this research aims to reflect its influence on the measured indexes and assess whether the introduction of learning technique manages to increase student satisfaction.*

Keywords: Digital Storytelling; SEEQ questionnaire; teaching changes, higher education.

INTRODUCTION

The research experiment detailed in this article is based on the introduction of a practice known as Digital Storytelling for teaching certain concepts or parts of a higher education programme module. Specifically, it has been carried out in the subject of Information Security (Arias Masa, 2018), which is taught simultaneously in the third year of the Degree in Computer Engineering in Information Technology (GIITI, Grado en Ingeniería Informática en Tecnologías de la Información) and in the fourth year of the Degree of Telematics Engineering (GIT, Grado en Ingeniería Telemética) in the University Center of Merida belonging to the University of Extremadura. It is a module with a distribution of 4.5 theoretical credits, 1.5 credits for practical and 0.3 credits of follow-up activities, scheduled tutorials or tutorials known as "ECTS Tutorials" (European Credit Transfer System). The latter correspond to 3 hours face to face sessions for each working group, created at the beginning of course. The process for forming groups will be discussed later.

Though there is enough evidence that Digital Storytelling helps to improve traditional skills development, mainly speaking and writing along with researching, collaborative tasks, technological skills, (Alcantud-Díaz, A, Ricart Vayá, & Gregori-Signes, 2014), (Hung, Hwang, & Huang, 2011), (Benedyk & Furniss, 2011), it is still recommended to collect more data to measure the impact that this practice has on student learning, motivation and engagement (Barrett, 2005).

In fact, there are already several investigations that this research team has developed on the use of Digital Storytelling (DST) in higher education, as detailed in Martin Espada, Mass Arias, Traver Becerra, Contreras Vas & Cube Delgado (2017) or Martin Espada, Arias Mass cube Delgado, et al. (2017). In particular, we want to highlight the study which was published in Arias Masa, Martin Espada, Traver Becerra, Contreras Vas, & Cubo Delgado (2017), where the introduction of DST in the subject syllabus was analyzed. The Digital Story (DS), as the goal of the DST project, was developed on the topic Block Cipher (Block cipher is a key module of the information security programme; it is an algorithm for data ciphering in which a block of plaintext is treated as a whole and used to produce a ciphertext block of equal length). In the study it was concluded that the inclusion of DST practice can help to improve the teaching-learning process in some categories, namely "Enthusiasm", "Organization", "Personal Attitude" and "Testing". This research article aims to go a step further than now we can make a comparison between two measures blocks. One of them collects data from 4 courses where traditional teaching was given, not including any Digital Storytelling practice, facing a block of two courses data in which DST has been used as a learning technique for specific topics of the subject.

1. OBJECTIVES

The main objective raised in Martin Espada, Arias Masa, Traver Becerra, et al. (2017) was to get students to become active participants in the teaching-learning process, being essential parts of it, from the first day of attendance on the course. In this research, the objective is still the same, but it is amplified by finding those specific categories from the SEEQ satisfaction questionnaire which are enhanced when DST is added as a practice.

2. METHODS OF DST PRACTICE ASSESSMENT

While there are numerous definitions of DST, there is little controversy about what it is. In short, it can be defined as storytelling supported by multimedia elements (images, audio, music, text, etc.) and actions (transitions, acceleration, etc.)

(Chung, 2007). The possibilities offered by new technologies today make us think in a new language, or rather, in new forms of expression and communication, which is evident in the current boom related to speech and multimedia communication products (PowerPoints cartoons, memes, videos, etc.). Some author (Handler Miller, n.d.) defines as a new genre, quoted by Carmen Gregori-Signes (Signes, 2010).

This research article assesses whether students have perceived this educational change, consisting in introducing DST practice for understanding some complex concepts, and if it implies an improvement of the teaching-learning process, regarding the students' perception from previous courses, in which this learning practice was not used on any of the topics of the same subject.

The use of this practice has been introduced as an experimental activity included in the ECTS Tutorials in the last two courses. To do this, four working groups of four or five members have been formed by selecting students randomly in the first ECTS Tutorial meeting. All groups have developed its digital story based on the same subject, concretely "Block Cipher" in the course 2016-2017 and “AES encryption” (AES stands for Advanced Encryption Standard; it is a particular case of block cipher, symmetric, that is, it uses the same key for ciphering and deciphering, applying four different mathematical functions recursively for doing it; it is the most widely used encryption algorithm) in the last course, in December of 2018. The result of the three months process in both courses was the DS itself, developed independently by each group, and displayed to their classmates.

The process described in this article is part of an extended research project on DST uses in higher education. In fact, various methods have been used to evaluate the development and evolution of students' knowledge, and skills associated with this activity throughout the academic years.

- Methods and techniques based on Pathfinder Associative Networks (Casas, 2002);
- Data collected from students´ entries about the selected topic in open format, clear text without any guided question from the teaching team, in each ECTS tutorial, which has been assessed by qualitative analysis methodology using WebQDA software (WebQDA, 2017);
- The SEEQ questionnaire itself, which is described in this work, whose data have been analyzed with STATA Software Release 15;
- Finally, a satisfaction survey on the practice of Digital Storytelling as a technique for enhancing the teaching-learning process.

In overall view, the research project aimed to get a validation process as complete as possible for this experimental practice in higher education.

3. SEEQ QUESTIONNAIRE

In higher education, it is increasingly common to use students´ opinion collected through surveys to assess teaching process. However, what is not yet widely implemented is the use of this questionnaire data as a tool for assessing and enhancing continuously the teaching process for an extended period of time. Thus, it allows to add small changes to a stable structure and measure its direct effects on survey answers and, therefore, on the teaching-learning process.

In order to analyze satisfaction results, an adaptation of the aforementioned SEEQ questionnaire, created by Hernert Marsh in 1970 and updated in 1982, has been used to analyze teaching, considering a series of factors. Each of them consists of several questions, which are scored on a Likert scale from 1 to 5 (strongly disagree, disagree, disagree or disagree, agree and strongly agree).

The selection of the SEEQ questionnaire stems from the fact that it has the described advantages (Matés & Bouzada, 2010), which are: psychometric properties (Marsh, 1984), its widespread use in universities around the world and the large amount of research material for each item improvement (Matés & Bouzada, 2010).

Table 1.

SEEQ Questionnaire Categories

Category	Name
C1	Learning
C2	Enthusiasm
C3	Organization
C4	Group interaction
C5	Personal attitude
C6	Exams
C7	Bibliography
C8	Overview

Source: Own work

In this adaptation of a SEEQ questionnaire, the research team has used eight categories or dimensions as may be seen in Table 1, for a total of 35 questions. In the first seven categories, a five-point Likert scale is used. In the eighth category, referred to as "Overview", data is collected through open questions, in order to get students' free opinions and let them provide additional information not collected in the previous questions, according to them. The detailed analysis of this latter category is not performed in this work.

The previously adapted SEEQ questionnaire has been applied anonymously through Google Forms web application (Lorca Montoya, Carrera, & Casanovas Catala, 2016). This method allows students to answer when they desire from the moment when the questionnaire is available and it has the obvious advantage of providing rapid feedback to the teaching team. The questionnaire is available from the time when students have their final grades and their corresponding certificates, until two weeks later approximately. The objective of this extended period is to provoke their reflection as unbiased as possible on the survey questions. It is accessible via direct link from the Moodle virtual classroom, which is used for teaching the programme modules.

This questionnaire has been conducted on an ongoing basis since the academic year 2012/13, when the subject of Information Security was given for the first time as a module in the undergraduate degrees in Telematics Engineering and in Computer Science Engineering, jointly taught. The basic goal of this permanent survey is to keep a record of assessment data. Also, and more important, it is aimed to compare students' perceptions about the teaching process during each academic year with the previous ones. Therefore, it can be seen how the methodological changes that are gradually implemented affect students' opinions, mainly in relation to the ECTS activities. Some results have already been published in various forums (Morze, Makhachashvili & Zhyltsov, 2016).

In this paper, teaching improvement is analyzed in detail, collecting overall students' opinions after introducing the use of DST practice (Robin, 2008) in ECTS activities and content summaries, which have been introduced gradually by the teaching staff in each lesson. In this research work, two academic years implementing both described changes are analyzed. Therefore, at the moment of writing this paper, the sample space contains more than 100 answers collected over different academic courses. Thus, in this study it can be compared data from the 2012/13, 2013/14, 2014/15 and 2015/16 academic years, when DST practice was not yet implemented in ECTS tutorials to data collected from students in the 2016/17 and 2017/18 courses, in which DST practice has been definitely introduced.

The results of the SEEQ questionnaire application to analyze teaching improvement when implementation of DST practice takes place, with data collected from 2016/17 course students were published in the conference "12th Iberian Conference on Information Systems and Technologies" (Mass Arias et al., 2017). Then, they were subsequently confirmed for publishing in the "Journal on Advances in Theoretical and Applied Informatics" (Martin Espada, Mass Arias, Becerra Traver, et al., 2017).

With the data collected from this academic year, from students who have taken the 2017-18 course, we can have more data to gain more reliability, as it will be discussed in the following sections.

4. ANALYSIS OF RESULTS

For the analysis of results we have used the software STATA © Release 15 (LLC & StataCorp, 2018), which allows ease and effective analysis of data. Besides, it permits to develop small programs or scripts in order to be reused for similar analysis in the future, when additional data may be added.

A first glimpse of the results shown in Figure 1 is enough to see how data are segmented into two groups of students: students who have done digital Storytelling practice and students who have not. In all categories, it can be seen that there is an increase in the average. Nevertheless, in order to determine whether such increases are significant or not, further statistical analysis must be done.

Variable	Grupos	Obs	Mean	Std. Dev.	Min	Max
C1_Aprendi~e	Without DST	67	3.794.776	.8811208	1	5
C1_Aprendi~e	With DST	33	4.098.485	.7498422	2	5
C2_Entusia~o	Without DST	62	3.552.419	1.020.424	1	5
C2_Entusia~o	With DST	33	4	.7629097	1.75	5
C3_Organiz~n	Without DST	66	3.363.636	.927343	1	5
C3_Organiz~n	With DST	33	3.909.091	.7202923	2.5	5
C4_Interac~o	Without DST	65	3.934.615	.85041	1	5
C4_Interac~o	With DST	33	4.234.848	.6432929	2.25	5
C5_Actitud~l	Without DST	60	3.935.417	.9038793	1	5
C5_Actitud~l	With DST	33	4.367.424	.5153308	3	5
C6_Examenes	Without DST	66	3.878.788	.9032446	1	5
C6_Examenes	With DST	33	4.383.838	.4648865	3.333.333	5
C7_Bibliog~a	Without DST	65	3.376.923	1.082.643	1	5
C7_Bibliog~a	With DST	33	3.909.091	.7337249	3	5

Figure 1. T test for independent samples in groups without DST courses and courses with DST

Source: Own work

First, the **null hypothesis (H_0)** is defined, which represents the claim that implementing Digital Storytelling practice in ECTS tutorial does not improve the teaching-learning process. And the **alternative hypothesis (H_1)** is then defined as well stating that there is some degree of relationship or reliance when Digital Storytelling practice is implemented as a task of the syllabus with an effective improvement in the teaching-learning process (Hurtado & Silvente, 2012). Then tests of homogeneity of variance and normality are performed, prior to a detailed statistical test. According to Mercado, Macías, & Bernardi (2012), assumptions to make parametric comparisons of k means are:

1. The samples must be selected randomly and independently of k populations
2. Distributions inside the population of the random variables whose means are compared are normal in each of the groups.
3. Standard deviations of the variable in each of the populations are equal to each other.

In this study, the first point is always true as samples are independent. It must be remembered that all data correspond to different courses and different students, gathered in one group with students' opinions from courses where Digital Storytelling practice was not implemented and the other group with the rest of students' opinions who developed digital stories as ECTS tutorial tasks, as described before.

For the second condition, we can use different tests to prove the normality of sample data. As we are using STATA© Software, we can use various methods to determine whether or not a distribution is normal, namely:

- *Swilk.* This command performs the Shapiro-Wilk test of normality, which gives information about the degree of agreement between the normal distribution plot and the expected straight line. This test is appropriate for a sample size between 7 and 2000.
- *Sfrancia*. This command performs Shapiro-Francia W test, which is also intended for a sample size between 5 and 5000.
- *Ksmirnov.* It performs the Kolmogorov-Smirnov test, which is a non-parametric one that determines the goodness of fit between two probability distributions.
- *Sktest.* This test is based on the kurtosis (curvature) and the skewness (lack of symmetry) of the variable.

For the third assumption, it should be checked homoscedasticity (same variance). It can be done by applying the Levene test or any of its variants.

4.1. Normality test

As previously mentioned, Shapiro-Wilk test can be applied to assess the normality of samples. When using STATA© Software, the command is *swilk variable* where the null hypothesis H_0 is: *The variable has a normal distribution*. The results by categories obtained are shown in Figure 2, where two categories have been underlined and printed in bold text. They are Organization and Bibliography, whose z value is greater than 0.05 (It must be said that Prob>z is one of STATA's strange shorthand habits; it can be found in the output from numerous commands;

it does not mean that a probability is larger than z, but (in the line for C1_Aprendi~e) that - if the null-hypothesis of normality is true - the probability of z being 4.339 or more extreme, is < 0.00001), whereby the null hypothesis of normality in these two cases is rejected and therefore data not follow a normal distribution. Unlike, the null hypothesis H_0 is accepted for all other categories, as they follow a normal distribution.

```
                Shapiro-Wilk W test for normal data
Variable |  Obs  W  V  z  Prob>z
C1_Aprendi~e | 100 0.91438 7.069 4.339 0.00001
C2_Entusia~o | 95 0.93605 5.059 3.586 0.00017
C3_Organiz~n | 99 0.98285 1.404 0.753 0.22574
C4_Interac~o | 98 0.92477 6.108 4.010 0.00003
C5_Actitud~l | 93 0.84678 11.909 5.474 0.00000
C6_Examenes | 99 0.87967 9.852 5.072 0.00000
C7_Bibliog~a | 98 0.98406 1.294 0.571 0.28413
```

Figure 2. Screen capture for execution of Shapiro-Wilk normality Test with STATA® Software

Source: Own work

4.2. Homogeneity of Variances

The assumption of equality of variance, also known as homoscedasticity assumption, considers that the variance is constant (unchanged) for each value of a given factor, i.e., different groups. In our case, the groups are the set of students who have completed the DST activities and the rest, arranged in a group with those cases who learned mainly on master-class basis, in which the teacher explains topics in a traditional way.

Table 2.

Summary of equality of variances for each category according to the test

Category	Name	H0: Equal Variances	Significance value of sdtest
C1	Learning	**It is accepted**	0.3188
C2	Enthusiasm	**It is accepted**	0.757
C3	Organization	**It is accepted**	0.1191
C4	Group interaction	**It is accepted**	0.0862
C5	Personal attitude	It is rejected	0.0009
C6	exams	It is rejected	0,001
C7	Bibliography	It is rejected	0.0180
C8	Overview	It is accepted	0.3188

Source: Own work

It is aimed to compare means in independent samples from populations with unknown variances. Therefore, before comparing means, it is necessary to make a variance or standard deviation comparison, and this can be done with the command sdtest variable1, by (variable group) (In STATA software, sdtest is the command for variance-comparison test). For this case, the null hypothesis is "The variances are equal." The results of this command are summarized in Table 2.

Summary of equality of variances for each category according to the test

Based on these results, it would be possible to make a comparison of means bearing in mind those categories where the standard deviations are equal or different. For STATA© Software, in the first case, when standard deviation is equal, *the ttest variable1, by (variable group)* command is executed. In the second case, where the variance is not the same, the *ttest variable1, by (variable group) unequal* command must be run. A summary of results after executing these commands for the seven categories under consideration can be seen in Table 3. In it, output of these commands are summarized and it can be seen when the null hypothesis of the equal means is accepted and when is rejected.

Table 3.

Summary of equality means for each category

Category	Name	H_0: Equal Variances	Significance value of sdtest
C1	**Learning**	**It is accepted**	0.09
C2	Enthusiasm	It is rejected	0.02
C3	Organization	It is rejected	0,003
C4	**Group interaction**	**It is accepted**	0.07
C5	Personal attitude	It is rejected	0.0042
C6	exams	It is rejected	0.0004
C7	Bibliography	It is rejected	0.0007

Source: Own work

In the Table 3, it has been underlined the cases where acceptance of the null hypothesis of equal means, particularly for C1 and C4 (Learning and Group Interaction) categories. It indicates that, although there is an increase in means from the group of students that had done DST practices for learning, it cannot be concluded that this improvement is directly related to these practical activities. However, besides this test, it is also necessary that the samples meet the requirement of normality, discussed in the next section.

4.3. Non-parametric tests

Since there are data sets that do not follow normal distributions, as determined by Saphiro-Wilk test, and some categories do not meet the assumption of equal variances, nonparametric tests must be applied. In this case, "U" test of Mann-Whitney, which was proposed by Wilcoxon in 1945 (Wilcoxon, 1945) should be applied. In this test, the null hypothesis states that the mathematical expectations of both populations are equal. Sample size can be different. It does not require any other assumption about the sample distribution and therefore it can be used with discrete or ordinal variables, like the rest of non-parametric tests.

Using STATA© software, the *ranksum* command is used, and output for the seven categories under study are summarized and shown in Figure 3. A summary of the Z-values output of each category is also shown.

```
H0: C1_Apr ~ e (ConDST == No) = C1_Apr ~ e (ConDST == Si)
 z = 1,720 Prob> | z | = 0.0854
H0: C2_Ent ~ o (== ConDST No) = C2_Ent ~ o (ConDST == Si)
 z = 2067 Prob> | z | = 0.0387
H0: C3_Org ~ n (ConDST == No) = C3_Org ~ n (ConDST == Si)
 z = 2774 Prob> | z | = 0.0055
H0: C4_Int ~ o (== ConDST No) = C4_Int ~ o (ConDST == Si)
 z = 1646 Prob> | z | = 0.0998
H0: C5_Act ~ l (ConDST == No) = C5_Act ~ l (ConDST == Si)
 z = 2336 Prob> | z | = 0.0195
H0: C6_Exa ~ s (ConDST == No) = C6_Exa ~ s (ConDST == Si)
 z = 2691 Prob> | z | = 0.0071
H0: C7_Bib ~ a (ConDST == No) = C7_Bib ~ a (ConDST == Si)
 z = 2364 Prob> | z | = 0.0181
```

Figure 3. Screen capture for summary of equality of variance for each category

Source: Own work

When the Z-value is less than -1.95 or greater than 1.95, and consequently when the absolute value | z | is less than 0.05, the null hypothesis H_0 is rejected, and hence the alternative hypothesis is accepted. Therefore, we can indicate that the mean increase in categories C2, C3, C5, C6 and C7 are statistically significant, due to the introduction of DST practice in the teaching-learning process of the subject. It must be said that those categories are the same as the ones that met the value condition for homogeneity of variance as shown in Figure 2. Then it could not be concluded that this evidence was true according to the normality test and therefore the non-parametric test has been performed.

Table 4.

Summary of results from 2016-17 and 2017-18 courses surveys

Category	Name	course 2016-17 no improvement	course 2017-18 no improvement
C1	Learning		

C2	Enthusiasm	Yes	Yes
C3	Organization	Yes	Yes
C4	Group interaction		
C5	Personal attitude	Yes	Yes
C6	Exams	Yes	Yes
C7	Bibliography		Yes

Source: Own work

If the results of this research study are compared to the results of the previous one (Martin Espada, Mass Arias, Becerra Traver, et al., 2017), it turns out they are exactly the same, but with the addition of the category "Bibliography", as shown in Table 4. Besides, mean increase is statistically significant for those answers to the SEEQ questionnaire questions from students who have worked on some Digital Storytelling projects, as in the 2016-17 and 2017-18 academic years. All this is shown in Figure 4, where it can be seen that the most valued categories are Personal and Testing Attitude.

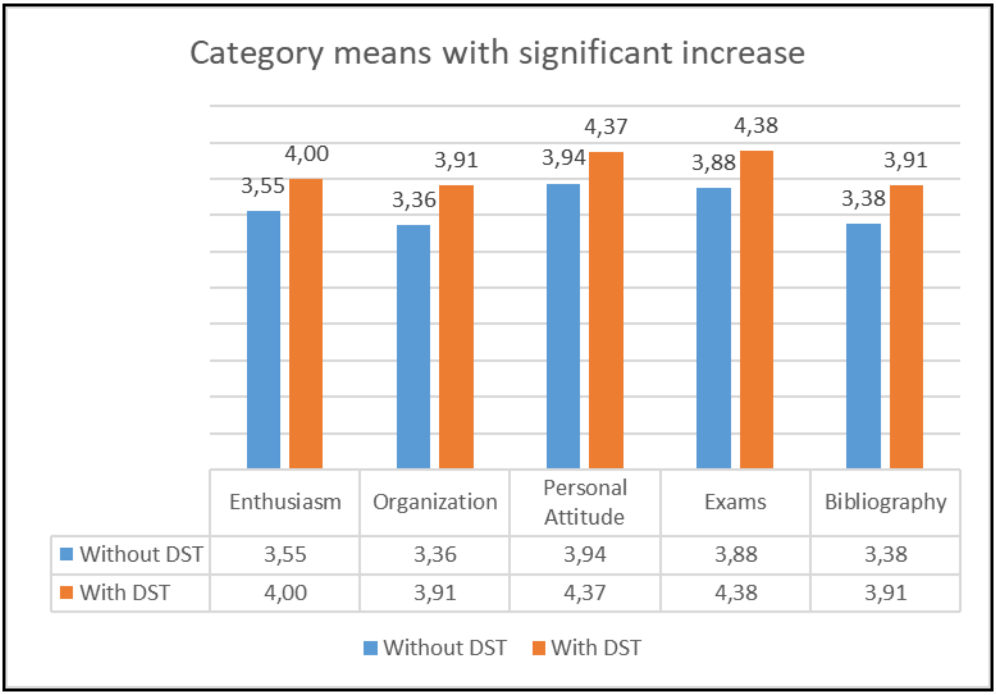

Figure 4. Means comparison, by categories: students working on DST projects versus the rest

Source: Own work

In addition, when plotted in a graph (see Figure 5) the absolute value of increase for those categories on which it can be considered as statistically significant, it can be seen that categories "Organization" and "Bibliography" have the highest increase. This cannot be a surprise because, on the one hand the category "Bibliography" was not included among categories in the last year study, thus it is easy to have a statistically significant increase related to the results from previous courses. In addition, this increase can be directly related to DST practice, as bibliography must be fully updated and organized to execute each phase of such projects.

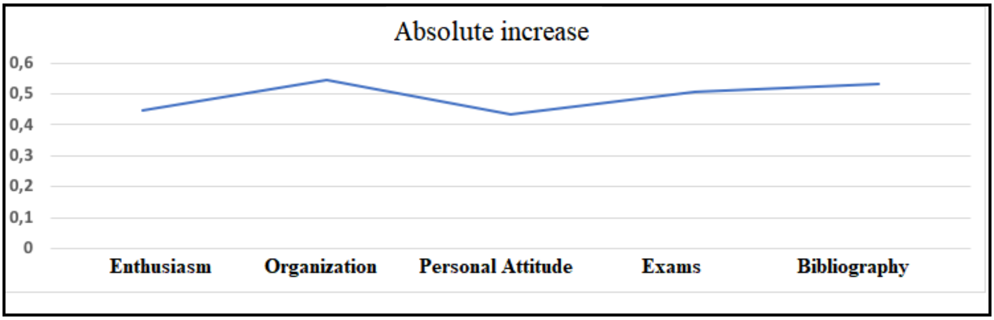

Figure 5. Absolute values of increase for each category
Source: Own work

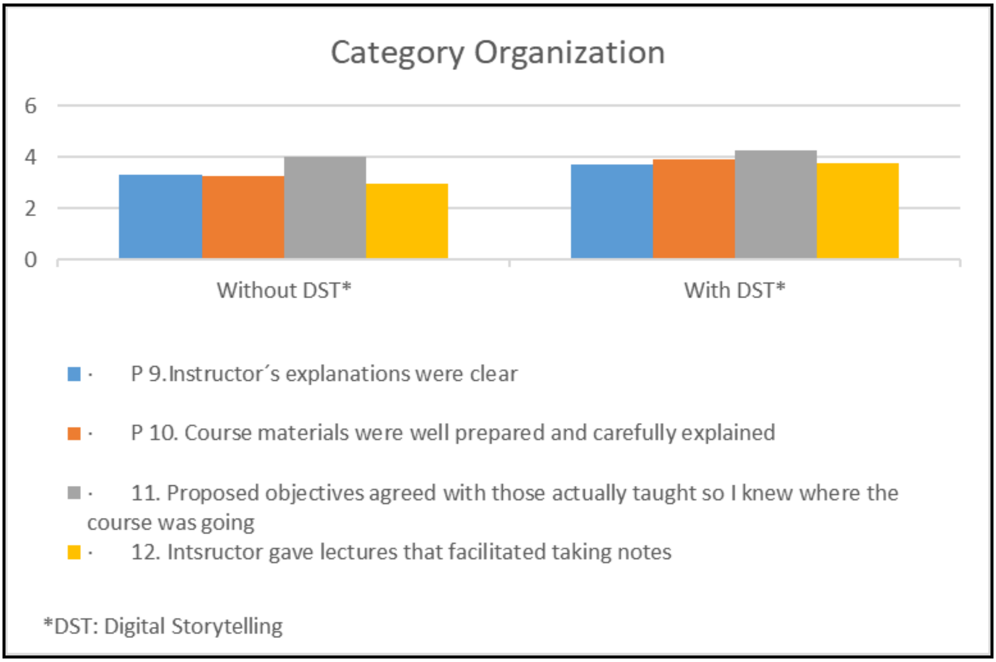

Figure 6. Report on the means of the questions answers that form the category "Organization"
Source: Own work

The other category that also has greater increase is that one named “Organization”. This category is also obtained from the SEEQ questionnaire questions and values for answers are represented in the Figure 6. In it, absolute value and its increase are shown for each of the four questions that are grouped under this category, both for the group of students who have developed DST projects (33 students) as for the rest (67 students). In this figure, it can be seen that the question number 11, asking on whether the objectives are met, is assigned the highest score. It can be said that the teaching staff is very pleased, as scores approximating to 5 and compliance is very important, since it is somewhat expected.

Finally, both categories, which do not achieve a statistically meaningful increase of means, are “Learning” and “Interaction with the group” when comparing students´ opinions, grouped as mentioned above (depending on their learning process). Both show an increase of means, although not statistically significant. However, it can be proved that there is still an increase in the values for each question that is asked, as shown in Figure 7. In there, it can be seen that both categories present mean values near the value 4. As working on 5 points Likert scale, it can be considered a very good score for engineering degree.

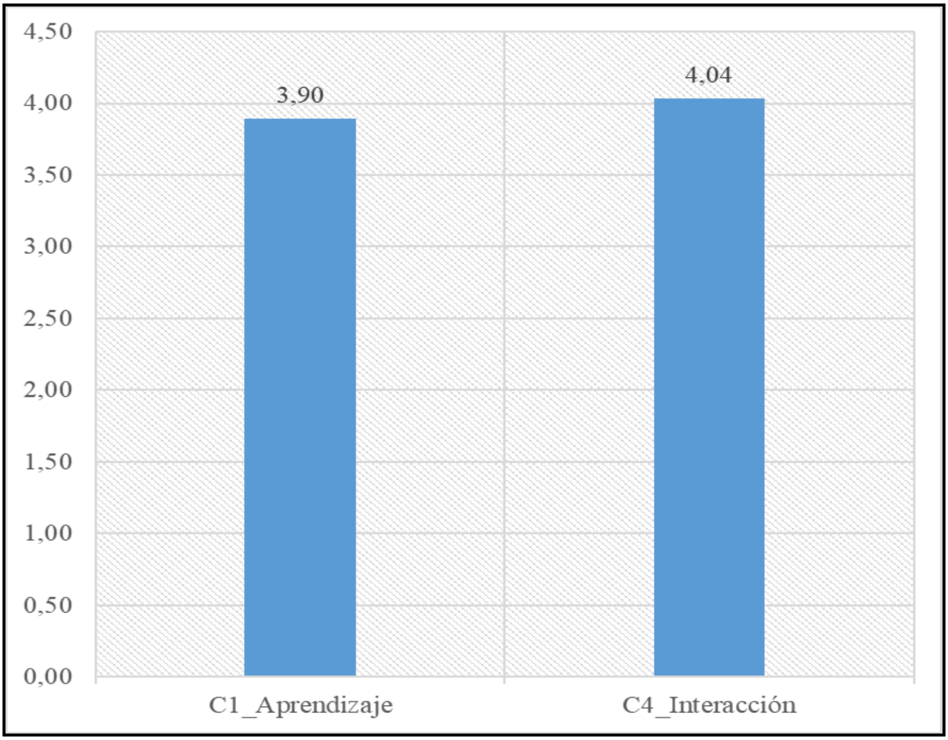

Figure 7. Report on the value of means for questions that form the category “Learning” and “Personal interaction”
Source: Own work

CONCLUSIONS

In this paper, students' opinions from 2016/17 and 2017/18 academic years have been assessed, compared to students' opinions from previous years, starting in the 2012/13 course. The study has been carried out in the programme for Information Security (Arias Masa, Juan, 2017) through the previously validated SEEQ questionnaire (Matés & Bouzada, 2010). Then, the random means of each category have been statistically analyzed, distinguishing those categories where one can indicate a significant mean increase for the last two academic years, concluding that the reason for it can be the incorporation of Digital Storytelling practice as a methodological change in the teaching-learning process.

On the other hand, the introduction of these activities has been tested as a pilot research project within the IRNet (IRNet, 2017) which some collaborative authors of this document belong. From the results of this experience, several additional tests based on DST practice have been currently launched in various engineering programmes, namely Interconnect Systems, and Computer Networks, with the aim of measuring the learning impact of such activities in higher education.

Accordingly, as shown in Figure 4 and Figure 7, all means of the measured categories are above the central value, and in most cases around the value 4. The SEEQ questionnaire displays this good trend in the teacher's attitude in general and this encourages the teaching team to keep moving this way in the forthcoming academic years.

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SMART UNIVERSITY IN SMART SOCIETY – SOME TRENDS

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Abstract: *It is one of the responsibilities of universities to develop students' work readiness. A smart university, as part of a smart city, is no longer limited to providing technologies inside and outside classrooms. Such a general scenario and the preceding statement confirms the thesis at the basis of this study: there is a need for a change of the current model of the modern university from smart to smarter. E-learning is a global category and all kinds of institutions need highly qualified specialists and staff that can handle different working cultures and have an international open-minded perspective. In the last part of the article the author describes an example of an innovative MA Programme for preparing new generation specialists.*

Keywords: smart society, smart environment, smart university, new generation specialists

INTRODUCTION

The development of communication channels and means of communication and information exchange is leading to a new world of the "evolutionary spiral", the transformation of the information society into what is nowadays commonly referred to as smart society. Such a policy, a strategy to be adopted at the international level, is now perceived as the only possible solution in the modern world. An intelligent society more accurately expresses the intention to improve all aspects of human life, using ICT in new industries.

This policy has become a model for the United States - a leader in the online world, as well as for European countries, Japan, Korea and many other countries. A smart society is a new quality of society, in which properly supported equipment, services provided and access to the Internet lead to qualitative changes in the interaction of subjects, which allows for achieving new results - social, economic and other benefits. This is the next stage in the development of the so-called information society in which we live today.

The Internet blurs the boundaries of the economy, society and industry, changing the rules of the game, increasing the likelihood of risk as well as new opportunities. Smart is the property of an object, characterized by the integration of two or more elements in this object that were not previously connected. This is done via the Internet, for example a smart TV, a smart house, a smartphone. Smart technology will lead to the development of labour mobility: in education, in the service of the state, and in many other areas of employment (Tihomirova 2012).

The use of technological devices has changed the way the individual interacts with the university environment. A study (Nuzzaci, La Vecchia 2012) analysed the use of intelligent technologies as a link between people and their university environment, illustrating important problems in various fields and technological systems, as well as the use of information and communication devices used at universities, in the context of teaching-learning to improve the quality of higher education and personal cultural life. The authors ask the question: when does the university become "intelligent"? It is not enough for universities to define themselves as intelligent places. Addressing major challenges, they must face up to the challenge of becoming strong and intelligent in reality not only thanks to intelligent systems, but also as a smart, knowledgeable university community that provides high quality education and research. (Nuzzaci, La Vecchia 2012).

1. BACKGROUND AND TAXONOMY OF SMART

There are several fields of activity which are described in literature in relation to the term *Smart City*: industry, education, participation, technical infrastructure, various ‘soft factors’; in Giffinger (2007: 10-11) six characteristics are identified as a roof for the further elaboration of smart cities which should incorporate the findings but also allow for an inclusion of additional factors, such as: *Smart Economy, Smart People, Smart Governance, Smart Mobility, Smart Environment, Smart Living*.

Research, design, and development of smart universities, smart education, smart classrooms, smart learning environments, smart pedagogy, smart learning and academic analytics, and related topics became the main themes of various pioneering international and national studies, events and projects, governmental and corporate initiatives, institutional agendas, and strategic plans (Heinemann, Uskov 2018).

A study (Heinemann, Uskov 2018) presents the outcomes of an ongoing project aimed at a systematic literature review and creative analysis of professional publications available in those areas. The premise is that the outcomes of the systematic creative analysis performed will enable researchers to identify the most effective and well-thought ideas, approaches, developed software and hardware systems, technical platforms, smart features and smartness levels, and best practices for the next evolutionary generation of a university—a smart university. The Smart Maturity Model presented can be viewed as an evolutionary approach for a traditional university to progress to various levels of the maturity of smart university.

According to experts: “Education in a smart environment supported by smart technologies, making use of smart tools and smart devices, can be considered smart education... . In this respect, we observe that novel technologies have been widely adopted in schools and especially at universities, which, in many cases, exploit cloud and grid computing, Next Generation Network (NGN) services and portable devices, with advanced applications in highly interactive frameworks ... smart education is just the upper layer, though the most visible one, and other aspects must be considered, such as: (1) communication; social interaction; (3) transport; (4) management (administration and courses); (5) wellness (safety and health); (6) governance; (7) energy management; (8) data storage and delivery; (9) knowledge sharing; (10) IT infrastructure; (11) Environment." (Coccoli et al., 2014: pp. 1004).

The concept presented by Tikhomirov, Dneprovskaya (2015) is as follows: "Intelligent University is a concept that includes a comprehensive modernization of all educational processes. [...] Intelligent education is able to reach a new university where the use of ICT and the activities of lecturers lead to a completely new variety of processes and results of educational, research, commercial and other activities, university activities. [...] The Smart concept in education entails the emergence of technologies such as smart boards, smart screens and wireless internet access from anywhere. "(Tikhomirov, Dneprovskaya 2015: 4).

“Smart University is a concept that involves a comprehensive modernization of all educational processes. ... The *smart education* is able to provide a new university, where a set of ICT and faculty leads to an entirely new quality of the processes and outcomes of the educational, research, commercial and other university activities. ... The concept of *Smart* in education area entails the emergence of technologies such as smart boards, smart screens and wireless Internet access from everywhere”. (Tikhomirov, Dneprovskaya 2015: 4).

Ecosociety, the knowledge society, the digital society are transforming into an intelligent society. It is built on "smart" work, which is done by "intelligent" government and business representatives, based on "intelligent" infrastructure and "intelligent" citizens, playing a key role in creating intelligent culture. In addition, the priority is the development of such industries as smart transport, smart health, smart energy, smart food, etc., which will eventually lead to the creation of a smart world.

Hwang (2014) presented a concept of intelligent learning environments that can be considered as a learning environment supported by technology. They introduce adaptations and provide appropriate support (for example tips, feedback or helpful tools) at the right places and at the right time for individual students' needs, which can be determined by analysing their educational behaviour, results, as well as the online and real context in which they are located.

L.F. Kwok (2015) defines Smart, *intelligent campus (i-campus)* as "… a new paradigm of thinking pertaining to a holistic intelligent campus environment which encompasses at least, but not limited to, several themes of campus intelligence, such as holistic e-learning, social networking and communications for work collaboration, green and ICT sustainability with intelligent sensor management systems, protective and preventative health care, smart building management with automated security control and surveillance, and visible campus governance and reporting".

A smart university is part of a smart city. A smart university is defined as "a platform that acquires and delivers foundational data to drive the analysis and improvement of the teaching & learning environment" (Roth-Berghofer, 2013). It is suggested that "a smart university should have tools, similar to those suggested in the European Competence Framework (ECF) framework, to build educational profiles and consequently, curricula and courses that both adhere to the standards required by the scientific and professional communities (e.g., IEEE, ACM)" (Coccoli, Guercio, Maresca, Stanganelli 2014).

In a smart society, technologies, previously based on information and knowledge, are transformed into technologies based on interaction, cooperation, exchange of experiences - smart technologies. Citizens, new generation specialists, turn their activities into "smart" and implement innovative changes in management strategies. This means that society needs more creative and open thinking, so that human dignity, based on flexibility and originality, is a priority. The most important issue is the training of staff with creative, creative potential, able to work and think in the new world. Therefore, the ability to quickly and efficiently find and use information is essential to be considered an intelligent person who has the necessary information competences.

A specialist who has no practical skills to work in social networks with electronic sources and who cannot develop her/his knowledge base will be ineffective and therefore will not be desirable (Tihomirova 2012).

In (Kwok, Hui 2018) the role of e-portfolio for Smart Life Long Learning is described. Experts, in particular, stressed that "a smart university, as part of a smart city, is no longer limited to providing technologies inside and outside classrooms". The authors discuss "how a smart university may facilitate self-regulated learning of learners through the introduction of personal development e-Portfolio, which assists learners in planning their development path and reflecting upon their own learning. An implementation example in the City University of Hong Kong is reviewed. Also, the way of extending it to lifelong and professional development is discussed." (Kwok, Hui 2018: pp. 327)

Figure 1 illustrates the main components of a smart university (SMU).

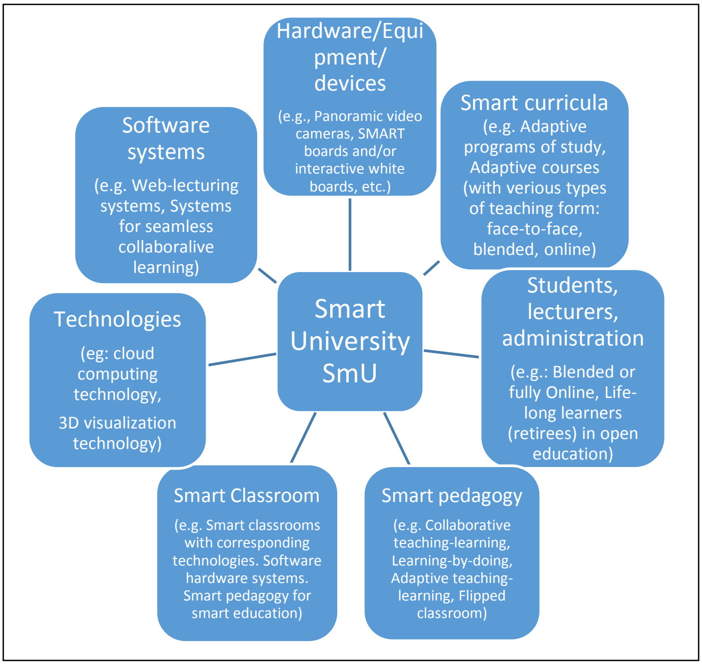

Figure 1. Smart university (SMU) main components

Source: Own work based on Uskov et al. (2016).

Preparing a specialist who has professional skills and habits in a smart society is a task for the smart university. This is a university where the use of a complex (set) of technological innovations and the Internet by trained people leads to a new, appropriate intelligent society, to improvements in the quality of educational, scientific and research, commercial, social processes as well as other activities. According to the Europe 2020 document, "Intelligent development means achieving better results in the field of:

• education (encouraging to study, study and improve qualifications);

• scientific research / innovation (creation of new products and services that would have an impact on accelerating economic growth and employment and would help in solving social problems);

• a digital society (use of information and communication technologies)." (http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/smart-growth/index_en.htm [accessed: 12/02/2017). EU goals for ensuring smart development include:

• increasing the total level of public and private investment to 3% of EU GDP, as well as ensuring better conditions for R&D and innovation;

• increasing the employment rate of women and men aged 20-64 to 75% by 2020 as a result of introducing more people to the labour market, especially women, youth, the elderly, low-skilled workers and legal immigrants;

• ensuring a better level of education;

• lowering the percentage of early school leavers to below 10%;

• striving, by at least 40% of people aged 30-34, to have a university degree (or equivalent) (http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/smart-growth/index_en.htm [accessed on 11.01.2017]).

The EU documents present an agenda of activities. The EU will support smart development through three flagship initiatives:

1. The Digital Agenda for Europe - creating a digital single market based on fast and ultra-fast internet and on applications interoperability:

- until 2013: broadband Internet access for everyone;
- by 2020: access for all to connections with a much higher data transmission speed (30 Mb/s and more);
- by 2020: access to lines with speeds above 100 Mb/s for at least 50% of European households.

2. Innovation Union:

- using R&D and innovation to address the most serious problems that our society faces, such as climate change, energy efficiency and resource efficiency, health protection and demographic change;
- strengthening each element of the innovation process, from initial research projects to the commercial use of their results.

3. Mobile youth:

- making it easier for students and trainees to study abroad;
- better preparation of young people to start on the labour market;
- improving the results and increasing the attractiveness of European universities;
- improvement of all levels of education and training (high academic level, equal opportunities).

There are arguments and justification why Europe needs smart development. Europe's lower growth compared to its major competitors is largely due to the differences in performance levels caused in part by:

- lower level of investment in research and development and innovation;
- insufficient use of information and communication technologies;
- difficult access for some groups of society to innovation.

Here are some examples:

- European companies currently only have a 25% share in the world market of information and communication technologies worth EUR 2 billion.
- The slow introduction of high speed Internet access has a negative impact on the European potential for innovation, the dissemination of knowledge and the distribution of goods and services, and also leads to the isolation of rural areas.

Unfortunately, we cannot provide very optimistic data on the level of education of today's young people. About 25% of European school pupils cannot read well. Too many young people are dropping out without any qualifications. Admittedly, statistics on people who acquire qualifications at the secondary level seem to be more optimistic, but these qualifications often do not match the market needs. Only a third of Europeans aged 25-34 have a university degree (40% in the United States, over 50% in Japan). European universities occupy weak positions in world rankings - only 2 of them were on the top 20 list (see the Shanghai ARWU ranking).

2. CURRENT AND FUTURE TRENDS IN EDUCATION

To conclude this brief analysis of related works, we mention the reports published by the New Media Consortium (NMC) ((http://nmc.org)), which contain interesting outlooks on trends in education and a perspective timeline for their adoption. For example, the 2012 edition (L. Johnson, S. Adams, M. Cummins, NMC Horizon report: 2012 higher education edition, 2012) predicted the success of mobile apps and tablet computing within one year or less, game-based learning and learning analytics adoption was indicated on a two to three years horizon, while gesture-based computing and the Internet of the Things (IoT) on a four to five years horizon. We still need time to see whether these estimates will be fully realized or not.

In the 2013 edition (Johnson et. al, 2013), the main focus was on the success of Massive Open Online Courses (MOOC) in one year and new issues are 3D printing and wearable technology on a four to five years horizon.

The current 2014 edition (Johnson et. al, 2014) highlights the key trends that are driving changes in higher education in the next years. Among these is the growing ubiquity of social media, the integration of online, hybrid and collaborative learning environments, the rise of data-driven learning and assessment, the shift from students as consumers to students as creators (a shift that will mark the definitive evolution of online learning). It is worth noting that in this work, the authors indicate the *"low digital fluency of faculty"* and the *"lack of rewards for teaching"* as challenges to be solved. (Coccoli, Guercio, Maresca, Stanganelli, 2014, pp. 1005)

This general scenario and these preceding statements confirm the thesis at the basis of this study: there is a need for the change of the current model of the modern university from smart to smarter. Table 1 helps to analyse Report 2012-2017 and compare Key Trends and Challenges Accelerating Technology Adoption in Higher Education

Table 1:

Key Trends and Challenges Accelerating Technology Adoption in Higher Education

	2012	2013	2014	2015	2016	2017
Key Trends Accelerating Technology Adoption in Higher Education						
Long-Term Trends: Driving Ed Tech adoption in higher education for five or more years			Agile Approaches to Change Evolution of Online Learning	Advancing Cultures of Change and Innovation Increasing Cross-Institution Collaboration	Advancing Cultures of Innovation Rethinking How Institutions Work	Advancing Cultures of Innovation Deeper Learning Approaches
Mid-Term Trends: Driving Ed Tech adoption in higher education for three to five years			Rise of Data-Driven Learning and Assessment Shift from Students as Consumers to Students as Creators	Growing Focus on Measuring Learning Proliferation of Open Educational Resources	Redesigning Learning Spaces Shift to Deeper Learning Approaches	Growing Focus on Measuring Learning Redesigning Learning Spaces
Short-Term Trends: Driving Ed Tech adoption in higher education for the next one to two years			Growing Ubiquity of Social Media Integration of Online, Hybrid, and Collaborative Learning	Increasing Use of Blended Learning Redesigning Learning Spaces	Growing Focus on Measuring Learning Increasing Use of Blended Learning Designs	Blended Learning Designs Collaborative Learning

Significant Challenges Impeding Technology Adoption in Higher Education						
Solvable Challenges: Those that we understand and know how to solve			Low Digital Fluency of Faculty Relative Lack of Rewards for Teaching	Blending Formal and Informal Learning Improving Digital Literacy	Blending Formal and Informal Learning Improving Digital Literacy	Improving Digital Literacy Integrating Formal and Informal Learning
Difficult Challenges: Those we understand but for which solutions are elusive			Competition from New Models of Education Scaling Teaching Innovations	Personalizing Learning Teaching Complex Thinking	Competing Models of Education Personalizing Learning	Achievement Gap Advancing Digital Equity
Wicked Challenges: Those that are complex to even define, much less address			Expanding Access Keeping Education Relevant	Competing Models of Education Rewarding Teaching	Balancing Our Connected and Unconnected Lives Keeping Education Relevant	Managing Knowledge Obsolescence Rethinking the Roles of Educators
Important Developments in Educational Technology for Higher Education						
Time-to-Adoption Horizon: One Year or Less	Mobile Apps Tablet Computing	Massively Open Online Courses Tablet Computing	Flipped Classroom Learning Analytics	Bring Your Own Device (BYOD) Flipped Classroom	Bring Your Own Device (BYOD) Learning Analytics and Adaptive Learning	**Adaptive Learning Technologies** **Mobile Learning**
Time-to-Adoption Horizon: Two to Three Years	Game-Based Learning Learning Analytics	Games and Gamification Learning Analytics	3D Printing Games and Gamification	Makerspaces Wearable Technology	Augmented and Virtual Reality Makerspaces	**The Internet of Things** **Next-Generation LMS**
Time-to-Adoption Horizon: Four to	Gesture-Based Computin	3D Printing Wearable Technology	Quantified Self Virtual	Adaptive Learning Technologie	Affective Computing Robotics	**Artificial Intelligence** **Natural**

Five Years	g Internet of Things	Assistants	s The Internet of Things	**User Interfaces**

Source: Own work based on NMC Horizon Report: 2012-2017 Higher Education Edition

3. THE PREPARATION OF NEW GENERATION SPECIALISTS IN CONDITIONS OF AND FOR SMART SOCIETY

Innovative MA Programme "E-learning in Cultural Diversity"

Developing the innovative MA Programme "E-learning in Cultural Diversity" has several causes and conditioning factors:

1) Expectations of the labor market
2) Formal and legal changes
3) Positive experience in different countries
4) International cooperation, International projects (in particular, IRNet)
5) Expectations and interests from future students

The programme focuses on the development of competences in such areas as e-learning, leadership, intercultural and multicultural skills in the conditions of internationalisation and digitalisation of society. Students will acquire new competences, develop their entrepreneurial digital skills and produce high quality results which can be shared and serve as encouragement for further practice.

The programme involves the following scientific areas: 1. Social Sciences and Humanities (communication networks, media and information society to support the surroundings of heterogeneous groups); 2. Information Science and Engineering (e-learning, user modelling and collaborative systems); 3. Economic Sciences (competitiveness, management, innovation, research and development). The multidisciplinary design of this master course implies an integrated approach to follow the objectives and mission of the programme, defining the choice of partners in the process with convergence and complementarity in nature. Partners were selected based on their proficiency in the various domains.

The need analysis leading to the design of the MA course proposal rests upon four main factors:

1. Documents and statistics produced by the EU, to which various national documents are added that identify priority areas (Jobs, ICT and Learning, Environment, Cultural Diversity) important for employability and where predictions are made about future needs (gaps between demand and supply);

2. Knowledge about students' population has stimulated interest in working together, exchanging experiences and practices;

3. Connection between the market needs and the student's expectations;

4. Opinions stated by stakeholders (partners from study centres and the business world) who were asked to give opinions on the design of the programme curriculum.

The programme is not exclusively focused on ICT as an end but is based on ICT both as means and tools to help build knowledge in any area, particularly in Europe's priority areas, keeping in mind society's sustainability and well-being.

The programme is innovative as it encourages students to look at society and environment, namely by stressing the importance of the past and re-using good ideas and practices.

"Cultural diversity" is another item, stressed as inclusion, that is considered in its broader sense, not only in respect of gender differences or disadvantaged citizens. It is the capacity for valuing the primacy of accessibility and usability to reach everybody. "Promoting through education an awareness of the positive value of cultural diversity and improving to this end both curriculum design and teacher education." (UNESCO 2002).

The ideas for the proposed innovative course are presented in a few fields:

– the graduate obtains a deep interdisciplinary knowledge and adequate skills within the module groups of humanities and social sciences,

– the curriculum subjects will employ the modern IT and ICT for more individualised educational process in e-learning and blended learning mode. Also planned is national and international mobility of lecturers and students,

– a vital role in preparing students for future jobs plays tutoring connected with practical usage of skills.

The Faculty of Ethnology and Educational Science (US) has been cooperating for many years, *inter alia*, with the local environment, with the community of teachers and numerous institutions. This has allowed for tracking the labour market, social needs, employers' and students' expectations. The established cooperation, monitoring graduates' careers and other activities have been performed in formal and informal dimensions. These include panel meetings with graduates as well as their participation in conferences and meetings, individual relations and contacts of employees with graduates working in educational institutions, contact with companies and enterprises. All these forms are to monitor the changing educational, economic and social needs in digital technologies in the conditions of globalisation, internationalisation, mobility and creation of intercultural and cross-cultural environment.

1. *'Theoretical and practical aspects in distance learning* conference (www.dlcc.us.edu.pl).

The most important activities in the recent years (2009-2017) in the field of needs analysis of the labour market, monitoring the career paths and diagnosis of education effects include an annual international conference entitled: 'Theory and practice of distance education' (www.dlcc.us.edu.pl). The most important conclusion from the special sessions is the fulfilment of the basic qualification requirements needed by the graduates. It is connecting work with e-learning in educational institutions and private enterprises. This formal requirement is only the beginning of supplementation of competences.

2. Evaluation survey for students, teachers, employees of companies, public institutions and non-public institutions.

The survey conducted in 2014-2015 included a description of the proposal in a new field of study. The survey was conducted in three voivodships: Śląskie, Opolskie and Małopolskie. Most of the respondents expressed a positive opinion and showed interest in the participation in the studies.

3. One of the goals and results of IRNet international project (www.irnet.us.edu.pl) is the development and implementation of an **interdisciplinary programme** supporting development of modern tools and **methods** in the information and communication technology (ICT) for pedagogic science and distance education as well as development of pedagogy in the context of intercultural competences in the **countries of the European Union**, **Australia, Russia** and **Ukraine**.

Organisations in which the students will study E-learning in Cultural Diversity include:

- educational institutions (schools, education offices, teacher excellence centres);
- distance education centres of public and non-public universities;
- state or private companies rendering educational & consulting services;
- training departments of various business sectors;
- training departments of public administration institutions;
- companies dealing with development of distance courses.

Employability and improved career prospects. E-learning management, digital competences, inter-, multi-cultural competences are one of the key areas the digital recovery of Europe should be based upon. The SMART institution Roadmap identifies as one of the high development areas and enables to address the major modern institutions (educational institutions as well as companies), challenges and opportunities, and it highlights the leadership in the development, adaptation and commercialisation and speeding up of the innovation processes linked to these specific issues as critical for the sustainability of European digital environment. E-learning is one of the key technologies that will underpin the development of Open educational environment in Europe. E-learning is a global category and all kinds of institutions need highly qualified specialist and staff that can handle different working cultures and have an international open-minded perspective.

CONCLUSIONS

A smart university could be considered a complementary system of several categories, in particular, *Smart Hardware, Smart pedagogy, Smart curricula, Competent Students, lecturers, administration, Smart Classroom, Technologies, Software systems.* Although some authors think that "Currently, universities can be regarded as smart universities, as they profitably use available technologies to improve their performance and to enhance the quality of their graduates" (Coccoli et al, 2014), simultaneously they require improvement and further development, first of all by taking into account the student's personal expectations and needs. For example, at a smarter university the ultimate technological solutions foster collaboration and cooperation among individuals. On the one hand, it is necessary to create conditions for effective study and development, to face challenges, and on the other hand, to create and prepare new generation specialists, new directions for functioning in a new smart society and smart environment that is just being created.

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A CASE STUDY OF ETHICAL ISSUES AFFECTING THE IMPLEMENTATION OF E-LEARNING IN A CROSS-CONTINENTAL - EURO-AFRICAN UNIVERSITY

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Abstract: *This article explores ethical issues related to the field of e-learning in the context of a Euro-African University. Given the nature of the topic, this study aims to develop theory into practice pertaining to e-learning implementation in a particular higher education institution with multiple campuses in Portugal and Angola. Finally, we seek to introduce a criticism of the mainstream literature gaps on ethical sensitivity and emphasis on practical insights involving international collaboration. The empirical evidence emerged within Lusíada universities' context, since an e-university project was implemented. Despite the organisational strategic interest, its development outlines remarkably diverse intermediate results, which this study grasps through a comparative cross-continental environment. Consequently, ethical sensitivities need a closer look that should highlight differences across institutions and countries, and furthermore help to shed light on new issues that may be of special relevance, as for instance privacy and copyright.*

Keywords: Higher education; ethics; e-learning; cross-continental university

INTRODUCTION

E-learning promotes the existence of e-University as a strategic response to a novel educational context (MacKeogh, 2008). The generality of e-learning definitions entail a formal scope of educational design that the new learning environments challenge in a continuum of thought, from "technology" at one end to "social" at the other. However, ICT development must cherish the ethical values as a precondition for social development, but the current literature seems to neglect an important discussion: to examine issues on the overlap of ethical quandaries related to e-learning implementation, namely across a comparative cross-continental environment.

This study is conducted in the context of Lusíada Universities, such as cross-continental - Euro-African "Lusíada University" trademark. The unique characteristics of "Lusíada Universities" represent an international co-operation agreement between higher education institutions in several countries to share the "Lusíada" trademark, as well as its pedagogic project. Lusíada campuses are located in Portugal (Lisbon, Oporto and Famalicão), Angola (Luanda, Benguela and Cabinda), Cape Verde (Praia), São Tomé and Príncipe (São Tomé) (Figure 1).

Figure 1. Lusíada University campuses

Source: Lusíada University Website (2011)

The concept of the Portuguese e-University government project involves the implementation of the most advanced computer technologies and electronic communications, namely e-learning platforms. Lusíada Universities joined the national funding initiative for electronic universities, called the e-U Virtual Campus project, which is characterised by:

- high investments in network infrastructures such as wireless;
- software for managing learning environment platforms (MLE);
- library (similar to OPAC);

- learning tools (similar to VLE);

The e-U Virtual Campus project (electronic university) was launched by the Portuguese Government covering the funding of the European e-Learning Action Plan through UMIC (Agency for the Knowledge Society), which promoted the development of services, contents, applications and mobile communication networks for students, teachers and researchers in higher education institutions. Unfortunately, no funding existed in or for the African context. The importance of e-learning is recognised by the Lusiada Universities as a way to promote organisational innovation in their institutions of both continents of Europe and Africa; in fact, the project started in 2001 in Portugal and in 2004 in Angola. The last milestone that this study explores comprises the idea of developing technological solutions and a curriculum that integrate ethical sensitivities.

1. BACKGROUND

The implementation of e-learning at the traditional universities has been discussed by several authors (e.g. Goodfellow, and Lea, 2007; Ali, Uppal, and Gulliver, 2018) confirming that it makes a crucial contribution to the higher education mission. To ensure the successful use of ICT in educational systems, UNESCO (2004a) acknowledges several policy frameworks about: strategic utilisation of ICT in schools; technological infrastructure; curriculum; pedagogy and content development; professional development; monitoring and supervision. These issues require further study due to the following:

- global versus local perspective of e-learning: global learning environments reproduce ethical and social impacts regarding knowledge creation, storage and distribution within higher education contexts (Silva, Alvarez & Rogerson, 2011);
- digital divide: ICT produces more inequality, and if technology is a prerequisite for achieving high quality education then policy makers and university leaders have to develop efficient strategies to overcome this problem (Oliver, 2007);
- complexity: this is the most important feature of our society according to philosophers (Heylighen, Cilliers & Gershenson, 2007); therefore, e-learning, culture and ethics as “human constructs” are complex.

Appropriate project management of e-learning systems should be used to implement successful cross-border delivery, and their potential contribution to social justice avoiding aims tainted by individual and group utopian projects (Gray, 2008). E-Learning systems allow an individual to access content from another country within the comfort of his or her own residence (Munawar, Munawar, and Cukier, 2011), but e-learning systems don't always solve all our problems - social justice is based on the concepts of human rights and equality.

From the ethical point of view, internationalisation should contribute to an institutional culture which values diversity. Critical dimensions need to be identified regarding collaborative culture typology (size, scope, nature of integration and intensity) for inter-organisational co-operation on funding, production of content and knowledge, changes in resource allocation dependencies, and ongoing expansion in opportunities for information exchange and communication.

1.1. Dimensions of e-learning

The e-learning literature is vast and multi-faceted due to its wide analytical spectrum. According to Wentling et al. (2000), "E-learning is the acquisition and use of knowledge distributed and facilitated primarily by electronic means. This form of learning currently depends on networks and computers but will likely evolve into systems consisting of a variety of channels (e.g., wireless, satellite), and technologies (e.g., cellular phones, PDA's) as they are developed and adopted" (p. 5). It is not possible to understand what consensual components involve e-learning, and if having any change in one of these, impacts the whole system implementation. In that sense, it is essential to understand the global perspectives of e-learning intervention, which needs a multi-stringed approach (Andersson & Grönlund, 2009) and the interplay of e-learning system implementation barriers (Ali, Uppal, and Gulliver, 2018).

Moreover, the e-learning implementation at university settings is a complex task, which starts with a strategy for developing the basic technical infrastructure. According to Blinco, Mason, McLean, and Wilson (2004, p. 2), this "infrastructure often describes a bottom layer of an architectural description or diagram, indicating network hardware components, communications processes, services and protocols". Throughout this assumption it is vital to shed some light over what are the issues in a "bottom layer". First of all, it needs a comprehensive ethical and technical analysis to determine how technology should be applied. In addition, several dilemmas can emerge to apply a global open source solution (like Moodle), or to analyse concurrent vendor proposals (global services and protocols, or local suppliers). In other words, Star and Rudledger (1996) point out that "an infrastructure occurs when the tension between local and global is resolved… used in a natural, ready-to-hand fashion" (p.114).

Finally, in the e-learning higher education paradigm, learning "with" interactive technologies establishes a certain intellectual affiliation between students and technologies. Instead of using technologies to guide students through prearranged interactions, students may use technologies that function as "the mindful engagement of students". Implementing a balanced approach is needed to avoid strategies that ignore technology tools, or, on the other hand, fixating too much attention on technology for e-learning. A possible solution was found in Rakoczi, Herbst and Reichl (2010) since these authors see videoconferencing as the CMC tool that is closest to face-to-face communication, enabling high levels of interaction and facilitating personal feelings (e.g. social presence and perceived privacy).

1.2. Ethics

According to the Ancient Greeks, ethics is a branch of philosophy that deals with what is considered right or wrong, and even at a simplest level it is related to the behaviours that should be adopted in every communal human activity within the moral domain. In the academic environment, the codes of ethics are influenced by diverse personal as well as situational variables (Remišová, and Lašáková, 2012).

Ethical considerations in e-learning are derived from both communication ethics and instructional ethics (Toprak et al., 2010), or according to Gearhart (2015) have internal ethical issues and ethical concerns coming from outside the program. Moreover, the internationalization of campus and community is simultaneously a chance and a challenge that higher education institutions ought to deal today. Even so, it is crucial to develop international normative rules for ethical education knowledge distribution, which is in line with Olsen's (2009) political glocalism: putting humanity's collective requirements ahead of vested interests' short term desires, humanity's collective priorities ahead of politicians' short term ambitions, and humanity's local needs and priorities equally balanced with global ones.

Different cultures have different perceptions of what constitute an ethical consideration, and it is not easy to acknowledge dilemmas, which arise between two such different positions as "Routine Ethics", that make computer ethics trivial, and "Cultural Relativism" that can make ethics impossible on a global scale (Moor, 2004). So the use of ethics requires knowledge of ethical theories and persuasive discussion skills regarding cultural issues. As an example, how can we deal with the concepts of privacy and security if the use of ethics as a means of ensuring security has limitations? Jonas (1985, as cited in Stamatellos, 2007: 1) argues that because technology changes the human condition and affects life at local and global levels, it engages humanity in a new perspective of ethics.

Portugal and Angola share the same official natural language (Portuguese) and several aspects of culture as a result of over 500 years of colonisation, but it is not enough to avoid the necessary comparisons. Also, social development usually initiates ethical changes in cultures; for instance, it may reduce a culture's tolerance for corruption and bribery. This too can be critical in managing the research focusing on links between Portugal and Angola, since the need to adapt to the lack of a cultural consensus and the increased ethical differences, which is consistent with what Heaton (1998: 263) calls "a dynamic mix of national/geographic, organisational, and professional or disciplinary elements in constant interaction with one another".

In addition, ethical questions arise when different interests of individuals conflict, and thus there is need for a higher level of principles that are fair to the rights of all concerned, and this is why ethics in a learning environment denotes sensitivity to multicultural understanding, tolerance and civility. For example, lecturers and students view behaviour differently with regard to ethics. In fact, what is considered the right behaviour is generally an individual decision that can be shaped by one's view of ethics, and an ethical point of view is susceptible to different meanings and several interpretations (Oakley and Singh, 2016). Or, according to Macfarlane (2004) the lecturers that effectively use Moodle "perhaps demand possession of a final virtue, that of a generosity of spirit or an individual disposition to spend time helping individual students, preparing learning and teaching materials, giving feedback, writing references and many other time-consuming but materially unrewarded aspects of university teaching" (p.159). This virtuousness creates social value beyond mere self-interested benefit, which produces benefit to others regardless of reciprocity or reward.

Following other perspectives, some relationships were established: privacy versus surveillance, personal data versus identity, integrity and honesty, and economic interests versus a threat to the moral integrity (Stahl, 2004). Or, Khan (2005: 293) classifies ethical dimensions in e-learning as:

- Social and political influence: institutional barriers to implementation;
- Cultural diversity: ambiguity and cultural miscommunication;
- Bias: fact-based or non-controversial content;
- Geographical diversity: time zones and synchronous versus asynchronous use;
- Learner diversity: different learning styles;
- Digital divide: access to the Internet, information accessibility, literacy, etc.;
- Etiquette: standards of considerate behaviour, harassment and defamation;
- Legal issues: copyright law, privacy regulations, plagiarism punishment, etc.

n specific aspects, this scenario is enhanced further due to the tightening of copyright and other ownership restrictions through international treaties and regulations, or multiple data sources of personal data (Moodle utilisation) in which individuals are identified and a direct quote would endanger their privacy of communication (Vidaković, Arsenijević, and Bulatović. 2011).

2. RESEARCH APPROACH

It is interesting that literature devoted to e-learning pays little regard to empirical studies about ethical dilemmas throughout the implementation of e-learning in dissimilar geographical locations, particularly to a comparison between two countries from different continents like Portugal and Angola. Against this backdrop, Lusíada Universities act as case studies (example of higher education internationalisation) for the e-learning project which is a shared technological solution; also the researchers' role may promote change in the strategy of the project. The distinctive organisational settings of the Lusíada Universities, provide an environment to investigate the ethical and cultural impact in an e-learning project. The basis for this claim acknowledges three main issues:

- Name - "Lusíada University" represents an international co-operation agreement between higher education institutions in several countries to share the "Lusíada" trademark, as well as the pedagogic project;
- Context - these organisations have campuses in Portugal (Lisbon and Oporto) and Angola (Luanda and Benguela), allowing a realistic cross-cultural comparison;
- E-learning project - its importance is recognised by the Portuguese and Angolan higher education institutions as a way to promote organisational innovation and share of the course curricula;

Understanding the trade-off between planning and current ethical practices it is vital to promote an effective e-learning project in Lusíada Universities, despite its multiple geographical locations. Considering the longer academic experience of the Lusiada Universities in Portugal and their lecturers, the Lusiada Universities in Angola asked for a strong collaboration in terms of course contents and also face to face teaching what caused a constant travelling of the Portuguese professors. In this scenario, Fenwick (2003) describes collaborative experience as "…joining others in a shared community of experience whose meaning is constructed together amid conversation and joint action." (p. 13). However, Dillenbourg et al. (1995) make a distinction between collaboration and co-operation, defining collaboration as "...mutual engagement of participants in a coordinated effort to solve the problem together", and co-operation as work "...accomplished by the division of labour among participants, as an activity where each person is responsible for a portion of the problem solving". For example, the use of chat and forum on the e-learning platform Moodle can contribute to the enhancement of "dialogue as curriculum" (Sorensen & Ó Murchú, 2006), nevertheless the lack of its use by students reduces the importance of e-learning to the participation and production of digital resources. On this, the researchers as lecturers faced a plethora of constraints when designing and implementing courses. For example pursuing the institutional obligations, the curriculum, or the set of available e-learning tools, while social presence should be created to enhance both student satisfaction, perceptions of learning, and retention, and expand learning experience with ongoing communication, process, and collegiality (McCracken, 2002), constantly producing new ways of supporting collaboration, interaction, personalisation and delivery (Sigala, 2007).

In spite of a similarity among data sources and analytical dimensions, it is important to highlight each dimension. Silverman (2017) states that observation is fundamental to comprehend a different culture and after understanding participants' categories, open-ended queries to a small and representative group is adequate (sample). The audio and video recordings, as well as the transcription process, are critical procedures to acknowledge participants' speech, and understand their language. Walsham (1995) states that in an interpretive case study, it is important to detail the research sites and the reasons for choosing them, the number of people who were interviewed, what hierarchical or professional position they are in, other data sources, and over what period the research was conducted. The choice concerning Lusíada universities is well documented in the research context, and the researchers have interviewed students, lecturers and staff (managers and IT staff) beyond his daily observations (jottings and diary) and remaining documents (organisational, governmental and institutional).

3. EMPIRICAL RESULTS

It was observed that the e-learning project has, since 2001, been referred to in several formal internal Lusíada University's documents (Project SLICE), and also external ones, for instance the self-evaluation report (EUA, 2009). The main objectives of the project are to improve teaching quality and broaden the access to education, and promote the availability of institutional documents electronically, as an appealing strategy for student attendance. The e-learning platform Moodle is still used to carry the content of the traditional classes, retaining value-added related to access, privacy and security compared with the use of shared folders (map of network drivers). Another concern related to accessibility and interoperability rules was evidenced in formal documents connected with the e-U project certification of W3C and SCORM rules.

Moreover, there is an evidence of the responsibility of the curriculum to fit ethics in earlier than the last year of the course. At the Lusíada Universities of Lisbon and Oporto there is a course unit "Ethics" which has been common to all undergraduation courses since the Bologna process was implemented. The lecturer gives the same programme and lessons to all undergraduation courses together whether students are from it, management, economics or any other science. This is a critical aspect for the computer science courses, because the emphasis of the curriculum should be based on computer ethics issues. It was also noticed that when the researchers as lecturers address the students on several ethical principles, even if informally, they show no knowledge of the issues, justified by the fact that they will only study this subject on the 3rd year of their courses. Thus, in some form, they justify their attitudes towards plagiarism, cheating, copyright, privacy, and so on by way of their own unfamiliarity with these ethical issues. Based on these empirical findings, the researchers have assumed that the success of the e-learning project of the Lusiada Universities should take in consideration as a priority the cultural disparities between both countries and strengthen the ethical principles that all the stakeholders should observe as the next section details.

3.1. Privacy

In Portugal, Lusiada University adhered to the Microsoft Live@edu project in 2009, transferring e-mail accounts management to Microsoft. One ethical dilemma was the safeguard of privacy of the students' data (although the Lusíada database was legally registered by the Portuguese Data Protection Authority (CNPD)), versus the added value services (more availability, more space, more storage, etc.) and the security guaranteed by Microsoft, given that this project is based on cloud computing technologies. Furthermore, a privacy problem emerged on self-service printing system because the detailed report that the equipment produces, sometimes appears available for everyone, including personal data. In terms of the users, their concerns with security and Privacy diverge.

In the classroom few concerns about privacy were evidenced by the students, with many logins staying open after lecturers and students had left the room. There is, however, a law that incriminates illegal acts in the accessing of personal data (username and password are personal, not transferable, for the knowledge and exclusive use of the user). The appropriate relationship between rights and duties is clearly critical. Any understanding of this relationship will be informed by social and cultural circumstances. In addition, digital library services provided online some videorecorded lessons. This raises ethical dilemmas of informed consent and lack of privacy.

Another note points out the fact, as stated above, that students – as well as teachers – do not log out before leaving a classroom, enabling others to see their personal content. Lusíada University reserves the right to change its Privacy policy at any time, without notice, to adapt it to new legal requirements (National Personal Data Protection Act, Law No. 67/98), but no reference to the Privacy policy appears on any of the Lusíada Universities' website.

In Angola the IT strategy was planned to change from free use of computers to the implementation of a minimal security with private personal logins created for students on the local server. In a focus group, it has been confirmed that there are no personal or private passwords. Security issues identified were clearly related to password policy.

Another concern for privacy was observed in a document titled "Rules for using ICT rooms" (in Lisbon, but nonexistent in Angola) delivered to students upon enrolment.

3.2 Copyright and intellectual property

Some dilemmas were shown in order to consider intellectual property from the "e-Learning point of view". The first one revealed that taking illegal photocopies makes no difference, while the other values the digital protection. The comparison between the use of a digital copy (scanning to e-learning) and photocopying was also commented.

In Lisbon, there is a self-service integrated system that allows printing, photocopying and scanning of content, exactly the same as one in Oporto, but nonexistent in Angola. However, the availability of scanning (digitisation) threw up some ethical dilemmas related to copyright. Digital rights management is a complex topic and requires careful management. It involves aspects of copyright law, contracts, payments, and windows of use and reuse.

This is a problem related specifically to e-learning because in Moodle content becomes associated with the trademark of Lusíada University. Some teachers do not agree to the treatment of the issue of copyright here in the same way as with photocopying, stating that what they give to students or what students succeed in getting from the web is as a result of no institutional interference, unlike Content placed on Moodle which becomes associated with the logo of the University. The comparison between using digital methods (scanning) and photocopy was also observed by teachers (seminars on e-learning).

On the other hand, the availability of personal pages of students and lecturers out of the Internet raises the issue of who is responsible for their contents... copyright violations reported by FCCN (Portuguese Foundation for Science and Technology) (filtering of online educational content) are an example of what can happen if we open over the network... with the logs could not identify who it was! It was observed that in legal terms, the Internet service provider filters the contents and issues warnings to the University regarding copyright infringement.

Concerning the digital library services and also the internet page, it was found that this service offered on the internet pages of all subjects programs, and content provided by lecturers, and also some videotaped lessons. So, these facts raise ethical dilemmas that can be addressed with regard to distribution of the content of videos, in the face of copyright.

A student in Portugal reported that copyright infringement is easily avoidable in face of the huge amount of articles available on the Internet with free access, thus preventing the purchase or the photocopies of books. As for the copyright, it will constitute an example of good practice to be followed by the universities, setting specific negotiation and written authorizations to be obtained from the lecturers, researchers or employees in any capacity of the institution to the inclusion of their works in e-learning platforms.

Nevertheless, crimes of counterfeiting, plagiarism or unfair competition are provided respectively in the Code of Copyright and Related Rights (approved by Decree 63/85 in 14:03) and Article 260 of the Code of Industrial Property. However, lecturers need to be ethiculturally sensitive with the nationality of students, if they are to assess in an ethical manner when responding to issues of plagiarism from an international point of view.

In Angola a student focus group and one manager confirmed the problem they encounter with the high cost of books, which locally may justify the violation of copyrights.

Despite the fact that Angolan law protects authors' rights (Law n.4/90 - Author's Rights and Relate, 1990) in terms of the infringements of copyright that occur daily, so far the results are not visible because plagiarism, copying, playback image and sound are made with total impunity (AngolaPress news, Culture, July 28th 2009).

An informal note shows Angola’s requests to “Lusiada Universities” in Portugal, photocopies of course units content (books, lecture notes, PowerPoint presentations, exams, etc.) without any concern about the author's rights. It should be recalled that the co-operation protocol between Lusíada Universities does not justify this request and the use of illegal photocopies.

Several other problems were found relating to licensing software even for administrative or academic use. For instance, the Microsoft campus agreements signed in Portugal are not valid for the Lusíada University of Angola, because the localisation comes under other geographic reseller (usually in South Africa). Furthermore, several participants commented that in the Angolan society software piracy is widespread. Perhaps African Ubuntu ethics influence this scenario (Capurro, 2013), but from the point of view of Western ethics it might be said that in terms of deontological theory the act of copying software is always wrong, whilst in utilitarian theory it is justified if it has a beneficial effect on a society as a whole.

4. DISCUSSION

The free e-learning platform Moodle was chosen for all Lusíada Universities in Portugal and Angola, but the implementation plan remains to be completed namely in Angola not on account of the opportunity costs but as a result of different organisational cultures (evidence based on the type of the leadership environment). Despite the organisational strategic interest in e-learning to support the cross-continental environment, its constant reevaluation introduced never-ending ethical dilemmas. The credibility of ethics for global point of view of the institution should be committed to Lusíada Universities. As regards the political dimension it is possible to acknowledge significant social dilemmas such as unequal regulatory procedures and funding (e-Europe Action Plan) in both countries. Nevertheless, the previous organisational environment as well as the existing co-operation protocol between these universities is a strategy to diminish the existing gap in knowledge between the Lusíada Universities in Portugal and Angola.

The use of the e-learning platform Moodle for placing online content of the traditional classes showed only added value related to access, privacy, and security. The lecturers can make content available only for students who must take the respective access rights for course units, while the use of the shared folder allows content to be accessible to be read by all lecturers and students. The use of the e-learning platform Moodle has an added value related to issues of access, privacy and security in comparison with the use of the shared folder where some content remained. On the other hand, the protection of copyright and plagiarism has been referenced as important for e-learning implementation.

Regarding copyright and neighbouring rights observed comparatively in Portugal and Angola (UNESCO, 2008), it was verified that there was a historical similarity until the nineties, when the Portuguese laws were altered and adapted to European directives. The analysis made by the World Economic Forum's (2011) Global Competitiveness Report confirmed other factors of relevance between Portugal and Angola, for instance the infrastructures (electrical energy in Angola is a serious constraint), and property rights (Portugal ranks 41 but Angola does not even make part of the list!).

In addition, the use of internet in Angola remains very problematic, as it is slow and very expensive; it is necessary to be very patient to get information mainly from the heavy sites with a lot of images. On the other hand, a growing use of notebooks was remarked upon, often without great concern with subjects of safety or privacy (sometimes the password can be obtained in an informal way). A formal policy for ICT security was not found. In Portugal there are customised logins, although some people forget to log out when finished using the computer in the classroom, enabling others to see their personal content. Privacy is not considered very valuable, i.e., in Portugal, absolute control interferes with privacy and autonomy demands (logins) and is sometimes neglected; in Angola there is a unique login to start every computer.

Finally, a critical issue emerges because Lusíada Universities computing professionals are not trained to have explicit practice of ethical guidelines, but accept their social responsibilities.

CONCLUSION

While the fact that Lusíada Universities being established as Euro-African cross-continental environment both in Portugal and in Angola gives a considerable value for launching an e-education cross-cultural experience, it can be assumed by this case study that a critical strategy should be considered and implemented with the claim that e-learning will become globally accepted.

However, as stated in this document several ethical dilemmas emerged in the implementation process. The issues of privacy and copyright assumed a special relevance in the whole process. The research showed that the students, both in Portugal or Angola, had a general ignorance about privacy, and they had not received any formal training related to information ethics within their course units. For example, as referred before, in Portugal, although there are strict rules for the secure individual access to computers, people (students and sometimes also teachers) often forget to log out when finished using the computer in the classroom, enabling others to see their personal content, showing a complete unawareness of the basic security access to computers whereas on the other hand, in Angola, there are no personalised logins. Everyone has access to the computer systems with the same access code. A policy of formal security was not found.

In what concerns plagiarism, cheating and copyright violations are commonly acknowledged both in Portugal and in Angola. While some lecturers revealed the difficulty in the detection of these problems due to the lack of an anti-plagiarism tool, the students' different views are related to internet access, namely the high bandwidth in Portugal that enables numerous downloads (trouble with digital copies).

Finally and based on the empirical findings of this case study, the researchers have assumed that the success of the e-learning project of the Lusiada Universities should consider as a priority the cultural disparities between both countries and strengthen the ethical principles that all the stakeholders should observe. This could only be possible with a strong training action near students and teachers on the dangers and threats of not fulfilling the basic principles of security which lead to unethical problems in the access and use of any e-learning system.

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SMARTer EDUCATION - PREPARING A NEW GENERATION OF UNIVERSITY AND COLLEGE TEACHERS

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Abstract: *Incorporating online resources and activities into a college or university course curriculum requires educators to acquire appropriate knowledge and develop skills necessary to supervise the educational process in a smart, i.e. technologically-rich and pedagogically innovative, environment. A move towards interactive, collaborative and active learning structured around e-learning components and Internet tools involves training teachers to gain comprehensive ICT and pedagogical competencies necessary for handling new education modes. The ideas presented in the paper are supported by opinions and attitudes expressed by staff from three higher education institutions, each with a different focus on technology and technology-based career paths: Poznan University of Medical Sciences (Poland), West College Scotland (United Kingdom) and Gdańsk University of Technology (Poland) in a survey conducted in 2017 and 2018.*

Keywords: teachers, e-learning, online resources, web-enhanced classes, ICT and pedagogical competencies, ICT

INTRODUCTION

Research into the character of smart, i.e. technologically-rich and pedagogically innovative, education that has been conducted over the last decade has shown that new environments supported by online tools allow creating smarter courses that better satisfy the needs of Generation Z (Kirkwood, Price 2013; Zhu1, Yu and Riezebos 2016, Smyrnova-Trybulska 2016, Smyrnova-Trybulska 2017). With the emergence of new, more interactive web-based systems, instructivist teaching is gradually being replaced with student-centred paradigms, which more effectively engage course participants in learning experiences. New ways of knowledge and skills development through multi-layered interactions between and among teachers, course participants, course content as well as course structure and various smart technologies lead to very successful outcomes both from the teacher's and students' perspective. Innovative environments structured around pedagogies that incorporate Web 2.0 technology into the educational process provide a variety of methods and tools to build mental models in a smarter, more engaging, and, as research shows, more effective way than traditional, face-to-face classrooms (Seppälä, Yajima 2017).

However, the synergy that can be gained from smart, web-based education, which is highly interactive, personalised, collaborative, adaptive and technologically rich (Tikhomirov, Dneprovskaya, Yankovskaya 2015; Zhu, Yu, Riezebos 2016), can only be attained by staff who are equipped with appropriate knowledge about instructional design and understanding of its character. To be able to work effectively, university and college teachers should possess adequate pedagogical and ICT skills to supervise the learning process in such an environment (Mokwa-Tarnowska 2015; Morze, Kuzminska, Liakh 2017a; Roszak, Kołodziejczak 2017b; Smyrnova-Trybulska 2017). They can acquire them through self-education and/or training delivered by experienced online pedagogy and ICT specialists.

The paper aims to show how post-secondary school teachers and academics who are either involved in e-learning and web-enhanced teaching or are interested in developing an online component to upgrade the curricula of their courses perceive Internet-based classes and whether they will be able to provide smart teaching. Moreover, it tends to analyse what experience they have and what types of online interactions they would like their students to get involved in. The competencies necessary for educators to develop and run a smarter online programme are also addressed.

The comparative research presented in this paper targeted staff with a varied level of ICT skills, ranging from advanced to basic, who came from Poznan University of Medical Sciences (PUMS), Gdansk University of Technology (GUT) and West College Scotland (WCS). The presented hypotheses are supported by survey results and discussions with the staff. The data were collected from June 2017 to May 2018. The research on teachers and academics' understanding of the nature of web-based education is in its initial stage (Noskova et al. 2017a). The findings achieved so far have clearly identified a range of areas that must be targeted to make online education a successful endeavour. One of them is competencies required to provide quality online education, and another one is willingness to deliver such programmes (Mokwa-Tarnowska 2015; Roszak, Kołodziejczak, Ren-Kurc, Kowalewski 2013).

1. COMPETENCIES TO DEVELOP AND RUN SMARTER, WEB-ENHANCED CLASSES

Enhancing education with online technologies can be beneficial for all the stakeholders – the institution, its staff and students. It creates a wide variety of opportunities that raise the quality of teaching, which in turn improves student outcomes and adds to the college's and university's reputation and recognition. High teaching standards should address teacher attitudes, pedagogical practices and skills that can support various needs and expectations digitally-minded students have (Noskova et al 2017a).

To work efficiently in a smart, technology-rich environment, course suppliers, instructional designers and online pedagogy specialists need to have competencies necessary to supervise the learning process which by nature is different from that in a traditional setting (Roszak, Kołodziejczak, Kowalewski, Ren-Kurc 2014; Kołodziejczak, Roszak, Kowalewski, Ren-Kurc, Bręborowicz 2015). Performing specialised tasks (Morze, Kuzminska 2017; Roszak, Kołodziejczak 2017b) requires staff to be able to handle multimedia and interactive components as the majority of web-enhanced materials now contain multi-format resources and activities. Thus, not only course developers, but also teachers who want to work with online materials must have adequate ICT skills. There are a number of technological competencies needed to develop engaging courses. They include: familiarity with technologies for streamlining software developers' work and machine communication; ability to use content creation technologies, online publication methods, as well as graphics and multimedia tools; and capability of learning group management in an LMS. Without specialised knowledge and considerable experience in those areas, further-education and academic teachers will not be skilful enough to use all the functionalities of the environment in which they work to its full potential.

But not only do educators need to develop their ICT competencies, they also must improve their pedagogical skills to be able to support their students so that they can meet the course aims and objectives. The areas of special expertise involve: stimulation of students to engage in the learning process (Becker et al. 2017; O'Callaghan, Neumann, Jones, Creed 2017), hard and soft skills development supervision, knowledge and skills evaluation, understanding of affordances of Internet tools to produce pedagogically well-designed web-enhanced resources and activities, as well as creating a community of learners

(Mokwa-Tarnowska 2017a, Mokwa-Tarnowska 2017b; Noskova, Pavlova, Yakovleva 2017).

ICT and pedagogical skills are not separate competencies when it comes to developing and supervising smarter online educational environments and Internet technology-based tasks to support traditional face-to-face classes. They are interconnected and inseparable. The teachers' ability to use advanced setting options and create multimedia educational materials can result in providing students with excellent resources and collaborative opportunities within a well-functioning community of learners. There is a wide variety of engagement levels for teachers and students on an online or blended course. They increase their experiences, but to achieve synergy from such education and education that benefits all participants, teachers must possess integrated ICT and pedagogical skills (Koohang, Riley, Smith, Schreurs 2009; Krajka 2012; Allen 2016)

Even the best Web 2.0 technology supported materials from a technical point of view, prepared by highly qualified ITC specialists who can apply innovative solutions and use modern, state-of-the-art technologies, are likely to be ineffective and cause a number of problems if their creators lack expertise and experience in online pedagogy. On the one hand, this may contribute to a high drop-out rate resulting from the environment not being pedagogically supportive enough and not well supervised (Mokwa-Tarnowska 2017b). On the other hand, a lack of the teacher's proficiency in ICT may lead to students developing a negative attitude towards e-learning and web-enhanced traditional courses. Thus, instructional designers who specialise in innovative pedagogies, and who do not possess advanced technical skills, should be supported by ITC specialists who are able to develop a well-functioning environment and tailor it to the pedagogical paradigm that will meet the learners' needs and the course aims and objectives. If instructional design does not include pre-emptive or responsive tutor support, learning outcomes may not be as assumed during the preliminary development phase (Krajka 2012; Kołodziejczak, Roszak, Kowalewski, Ren-Kurc, Bręborowicz 2015; Allen 2016).

Because technology-based environments are constantly developing, a great emphasis should be placed on the continuous improvement of educators' qualifications in teaching methods and technologies most effective in e-learning, blended learning and web-enhanced learning (Kołodziejczak, Roszak, Kowalewski, Ren-Kurc, Bręborowicz 2015; Roszak, Kołodziejczak 2017b). This means that courses for university staff must target various fields of expertise, helping their attendees to upgrade their skills and develop professionally to be able to address growing and changing demands and deliver smarter education. A range of training routes, for advanced academics, intermediate users and inexperienced staff willing to become online tutors, need to emphasise good practice in education, technology and innovation. If training courses are run by experienced educators and ITC specialists, they can also help staff become themselves self-directed learners who will be willing to continuously upgrade their skills and knowledge.

2. DATA COLLECTION AND ANALYSIS

Background. Poznan University of Medical Sciences (PUMS, Poland) is a leading Polish medical university that employs just under 1500 academics. The university's total student enrolment is 7000 students, including nearly 1,000 international undergraduates (Centre for Medical Education in English). In 2010 the Department of Pathophysiology and the Department of Computer Science and Statistics made available an exam platform to deliver online tests in pathophysiology and started implementing e-learning in university education.

Gdańsk University of Technology (GUT, Poland) has a domestic and worldwide reputation of being a significant scientific centre. Its nine faculties give opportunities to create a superior climate for intellectual and personal growth. They provide education for more than 25000 students offering undergraduate, postgraduate and doctoral courses. The total number of academics amounts to approximately 1200.

At PUMS and GUT, blended-learning and web-supported traditional classes aim to enhance student learning experiences. Both institutions offer traditional courses supplemented by online components, their inclusion into curriculum depends on course type and faculty's involvement in online ventures.

Created in 2013 by the merger of Clydebank College, Reid Kerr College in Paisley and James Watt College in Greenock, West College Scotland (WCS, United Kingdom) is a further education institution with 30000 students and 1200 staff, which makes it one of the liveliest educational institutions in Scotland. The college promotes distance learning and extends course offer by adding web-based components developed by its experienced and devoted staff from the Technology and Innovation Unit. Microsoft has accepted West College Scotland as a Microsoft Showcase School.

Participants. The quantitative research whose results are presented in this paper involved surveys carried out in June and July 2017, and May 2018. It can be assumed that the composition of the study group (n=124) is quite homogeneous with respect to many factors: intellectual capacity, interest in innovative learning and quality teaching, and teaching experience. The respondents' ICT skills necessary to develop online materials differ substantially and depend on their qualifications. At Gdańsk University of Technology (n=44) eighteen respondents are ESP teachers, twenty six academics are science and engineering degree holders. Poznan University of Medical Sciences respondents consist of professors, assistant professors, senior lecturers, and assistants, all of them are academic teachers and none of them are clinicians (n=75). West College Scotland staff are teachers (n=5).

Statistical analysis. The data are presented as percentages or medians, interquartile ranges (lower quartile, upper quartile), minimum and maximum values, as appropriate. For comparison of the groups, the Mann-Whitney U test was applied. The nominal data were analysed with the Chi-squared test or the Fisher-Freeman-Halton test. All the results were considered significant at $p<0.05$. Statistical analyses were performed with STATISTICA 12.0 PL (StatSoft Polska, Kraków, Poland) and StatXact 11.0 (Cytel Inc., Cambridge, MA, USA).

3. RESULTS AND DISCUSSION

A two-stage analysis was conducted to clarify the findings. The first one involved a comparison of all the data collected at the three targeted institutions. The second one focused on a comparative analysis of the opinions expressed by the staff from the two Polish universities – GUT, which offers courses in science, technology and business, and PUMS, whose course curricula are structured around non-technical and non-ICT subjects. The questionnaire, the same for the two universities and the college, included 15 closed-ended and 6 open-ended questions. The analysis provided below is based on the answers to 8 close-ended questions which can be divided into four categories, labelled as follows:

- TEACHING IN AN ONLINE ENVIRONMENT – online tutor or supervisor of online collaborative projects (question 5 and 13) (Table 1);
- USING ONLINE EDUCATIONAL MATERIALS – web-enhanced traditional classes and blended learning, frequency of use in post-secondary school education (question 6 and 7) (Table 2);
- USING DIFFERENT TYPES OF E-LEARNING MATERIALS – division into resources and activities and willingness to use either type (question 10 and 12) (Table 3, Figure 1);
- DEVELOPING ONLINE AND E-LEARNING EDUCATIONAL MATERIALS – online resources and activities in web-enhanced traditional classes, as well as in e-learning and blended learning (question 8, 9) (Table 4).

Answers to other questions included in the questionnaire will be further researched and discussed in a different paper.

3.1. Teaching in an online environment

The analysis of the data concerning the first category related to working in an online environment has not shown any significant differences between the three educational institutions: PUMS, GUT and WCS ($p>0.05$, Table 1). The experience of the teachers from the targeted institutions as online tutors is not substantial – only 13.6%-25% of the respondents declared to possess it (question 5). Another question where similar responses were given was question 13. Only 20%-25% of the teachers stated that they had experience being a supervisor of online collaborative projects.

Table 1

Analysis of the first category (question 5 and 13)

Teaching in an online environment **No. Question**	*CB	PUMS n=75	GUT n=44	WCS n=4	p-value
5. Have you ever been an online tutor? YES [%]	3	17.3%	13.6%	25%	0.654
	2			-	0.595
13. Have you ever supervised online collaborative projects with your students? YES [%]	3	20.0%	22.7%	25%	0.923
	2			-	0.724

*CB=Comparison between the institutions. If p>0.05, there is no significant difference between the institutions.

Source: Own work

Regardless of the character of the institution the respondents work for and the subjects they teach, it can be stated that they lack sufficient experience teaching in an online environment to be able to supervise online collaboration effectively. In order for the staff to get prepared for such challenges, different ways to raise pedagogic competencies in teaching web-supported and e-learning classes should be provided. Legal and organizational regulations as well as appropriate IT infrastructure, which support online work, are necessary.

3.2. Using online educational materials

The analysis of the data concerning the use of online and e-learning materials (questions 6 and 7) has shown significant differences between the institutions ($p<0.05$, table 2). *It indicates more frequent use of educational electronic materials at GUT (technology university) than at PUMS and WCS, where education is not structured around ICT subjects*. Almost all GUT staff use online (93.2%) and e-learning (84.1%) materials to support traditional classes, unlike at PUMS, where the figures are lower and amount to 68.5% and 42.5% respectively. In the case of e-learning materials, there are significant differences between PUMS and WCS ($p=0.013$, $p<0.05$), however, p-value is at the limit of significance (0.05), one of the reasons being a small sample size from WCS. Thus, further research should be conducted.

Table 2

Analysis of the second category (question 6 and 7)

Using online educational materials **No. Question**	CB	PUMS n=73	GUT n=44	WCS n=5	p-value	Interpretation
6. Have you ever supplemented your face-to-face classes with e-learning materials? (e.g. online course materials that students could use either inside or outside class) YES [%]	3	42.5%	84.1%	100%	**<0.001**	Difference between PUMS vs. GUT (p<0.001), PUMS vs WCS (p=0.013)
	2			-	**<0.001**	Difference
7. Have you ever supplemented your face-to-face classes with web-enhanced activities? (e,g, using resources available online to enhance your lesson)? YES [%]	3	68.5%	93.2%	50.0% (n=4)	**0.002**	Difference between PUMS vs GUT (p=0.002), GUT vs WCS (p=0.007)
	2			-	**0.002**	Difference

Source: Own work

The research has shown that traditional, face-to-face classes conducted by the academic and college staff, regardless of the institution's specialization, are supplemented and supported by online and e-learning materials. Therefore, it can be concluded that the staff have the teaching potential that may inspire them to take the next step which is creating their own electronic materials and conducting full-time e-learning courses. The awareness of the value of electronic materials is important, and the research has shown that this awareness is increasing, which is related to greater knowledge about and experience in e-learning and online learning, as well as willingness to work in a smart learning environment (Noskova et al. 2017a).

3.3. Using different types of e-learning materials

An online course contains resources, which are text-, picture- and/or multimedia-based pages, and activities, which involve individual and/or collaborative tasks actively engaging students in different interactions. The distinction between them is often not clear-cut – they can be interconnected to a great extent, depending on course type, aims and objectives, as well as subject matter (Conrad, Donaldson 2011; Mokwa-Tarnowska 2017b).

Having analysed the data from the third category, i.e., using different types of e-learning materials, we can notice that the higher education institutions do not significantly differ in terms of using e-learning materials developed by somebody else (p>0.05, table 3, question 10). Using such materials is becoming more frequent, regardless of the teacher's specialization (25%-72.7%). A detailed analysis of electronic materials, divided into resources and activities, has not shown any differences between the three institutions either (question 10a and 10b). Nevertheless, it has to be stressed that a lower number of teachers declared to use online activities, 0%-38.6%, in comparison with the general results obtained after the analysis of the question 10 responses ($p<0.05$). Using resources was more popular (25%-54.6%.), and the figures are comparable with the overall response to question 10 ($p>0.05$).

Table 3

Analysis of the third category (question 10 and 12)

Using e-learning materials **No. Question**	CB	PUMS n=74	GUT n=44	WCS n=4	p-value
10. Have you used e-learning materials developed by somebody else? YES [%]	3	58.1%	72.7%	25%	0.073
	2			-	0.111
10a. RESOURCES YES [%]	3	49.3% n=69	54.6%	25%	0.529
	2			-	0.585
10b. ACTIVITIES YES [%]	3	37.7% n=69	38.6%	0%	0.410
	2			-	0.919
12. How often do you like to use e-learning materials? Scale: 0-4	2	*Me= 2 every month	Me=3 every 2-3 weeks	-	**0.005** Difference

*Me=Median. If p>0.05, there is no significant difference between the institutions.

Source: Own work

To generalise, regardless of the character of the institution, the teachers supplement their teaching with e-learning materials developed by somebody else. They use various resources and activities, which enable interaction, communication and cooperation. However, a further analysis of the frequency with which they would like to use e-learning materials has shown differences between GUT and PUMS ($p<0.05$). The WCS teachers did not provide any answers.

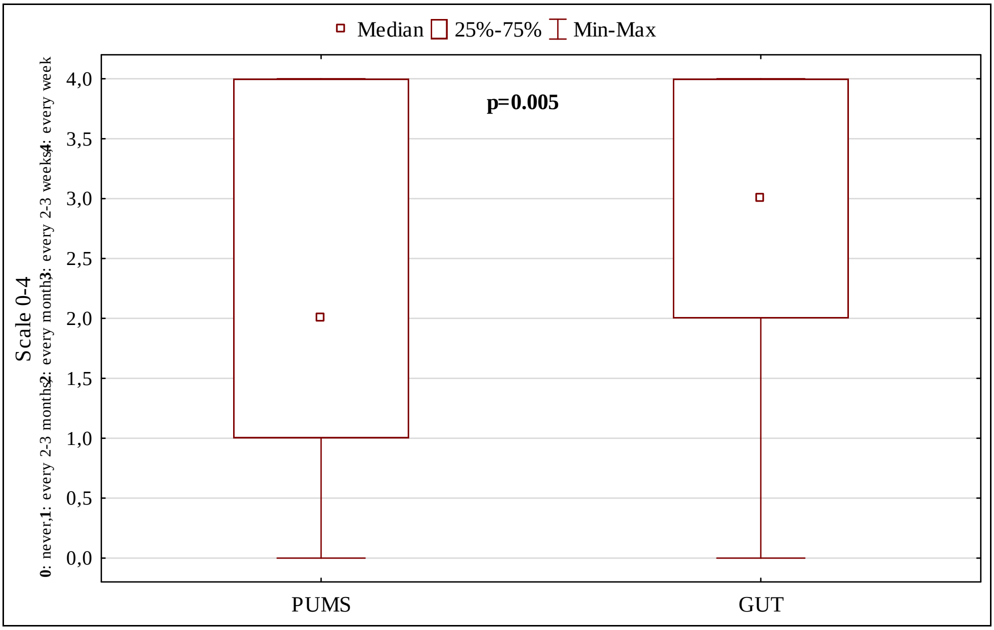

Figure 1. Comparison of answers to question 12 between PUMS and GUT

Source: Own work

The technology university lecturers want to apply e-learning materials more often than those of non-technical and non-ICT subjects (Figure 1). This difference may be related to a higher level of ICT competencies and willingness to use a technologically-rich environment for educational purposes in the case of the technology university versus fear of technologies in the teachers of non-ICT subjects from the non-technical institution. Regular trainings and technological support that may change such an attitude are required (Morze, Kuzminska, Liakh 2017a).

3.4. Developing online and e-learning educational materials

The analysis of the data from the fourth category, i.e., developing online and e-learning educational materials (Table 4), has shown significant differences ($p<0.05$) between GUT and PUMS. In two cases (question 9a, CB=3 and question 9b), despite no differences between the institutions ($p>0.05$), p-values are at the limit of significance (0.05) and the data can show a similar trend. The percentage of GUT employees who create e-learning/online resources and activities ranges from 43.2% to 56.8%, whereas at PUMS it falls between 25.4% and 27.4%. There are no significant differences between the number of the staff from the targeted institutions who develop resources and those who create activities. The results are consistent with those obtained from the analysis of questions 6, 7 and 12, and confirm the fact that technical institutions have an advantage over other non-technical ones. Nevertheless, the number of staff creating electronic materials at GUT is relatively low.

The research has shown that the staff rarely create their own electronic materials (category 4) and more often use e-learning materials developed by other authors (question 10, category 3). Moreover, they often supplement their face-to-face classes with electronic materials (category 2). However, their goal is only to support traditional classes and not to replace them with e-learning. Therefore, the staff may not have sufficient experience to become online tutors and supervise the educational process in an e-leasrning environment (category 1). ***It can be stated that lack of high-value electronic materials is one of the factors that curb the development of e-learning and smart learning environments.***

Table 4

Analysis of the fourth category (question 8, 9 – division into resources and activities)

Developing materials **No. Question**	CB	PUMS n=73	GUT n=44	WCS n=5	p-value	Interpretation
8a. Have you developed your own e-learning materials (RESOURCES)? YES [%]	3	26.1%	56.8%	40%	**0.003**	Difference between PUMS vs GUT (p<0.001)
	2			-	**0.001**	Difference
8b. ACTIVITIES YES [%]	3	27.4%	54.6%	20%	**0.007**	Difference between PUMS vs GUT (p=0.003)
	2			-	**0.003**	Difference
9a. Have you developed your own web-enhanced materials (RESOURCES) to use in class? YES [%]	3	25.4% n=71	45.5%	25% n=4	0.066	No difference
	2			-	**0.026**	Difference
9b. ACTIVITIES YES [%]	2	25.4% n=71	43.2%	0% n=4	0.053	No difference
	3			-	**0.047**	Difference

Source: Own work

The analysis of the 4th category has indicated that *the staff from the technical institution more often create their own electronic materials than those of non-ICT subjects from the non-technical ones. The respondents who create e-*

learning/online resources also develop e-learning/online activities, which is important for the quality of the teaching process.

What the research has shown is that the number of employees involved in developing online or e-learning materials, regardless of the institution's specialisation, is not satisfactory, and it should increase in the years to come. This can happen thanks to the new opportunities offered by e-learning and smarter learning environments. In order to increase this number, trainings focused on methodology of content creation (Mokwa-Tarnowska 2013; Durak, Ataizi 2016) and online pedagogy should be conducted, and teachers should be provided with IT support.

Moreover, lecturers and teachers should be financially remunerated for developing electronic materials. The process of creating smarter educational environments is time-consuming and not cost-effective in the short run (Roszak, Kołodziejczak 2017a). The learning materials must contain various types of multimedia and interactive elements (Roszak, Kołodziejczak, Ren-Kurc, Kowalewski 2013), which increases costs and working time, but it provides extraordinary potential for cost savings and effectiveness in the long run (Leszczyński, Charuta, Łaziuk, Gałązkowski, Wejnarski, Roszak, Kołodziejczak 2018). Purpose-designed educational materials guarantee better adaptation of content to meet teaching and learning needs (lower expenditures on proofreading, updating and maintenance).

In addition, online/e-learning content can be shared, which may be an incentive for educators to create multidisciplinary module-based resources of high substantive quality. This also shows that ***benefits from increasing the number of staff involved in online and e-learning content creation may be huge*** – staff will be active members of e-learning and smart learning environments, which in turn will help the institutions they work for compete with prestigious universities across Europe.

3.5. Summary of results

1. Electronic materials have significant impact on the quality of learning and teaching, and using them is necessary for a new generation of specialists. Electronic materials must contain various types of resources and activities to be effective in smarter learning environments.

2. Regular teacher training and support for those who want to create electronic materials and teach online are required. A single training session on how to teach online for a person who has no experience as a participant of an e-learning course is not effective.

3. Teachers and lecturers using online/e-learning materials developed by somebody else or supplementing face-to-face classes with online/e-learning materials are a great potential for the institution they work for, which will have impact on the development of e-learning and smarter learning environments.

They are more aware of and more experienced in how to develop knowledge and skills in an online and e-learning environment.

4. Educational institutions should invest in increasing the number of staff involved in the creation of electronic educational materials, which may inspire other staff to become online tutors or supervisors of online collaborative projects.
5. Technical universities and higher education institutions have advantage over non-technical ones in terms of ICT competencies of their staff and IT infrastructure, therefore, they should be more involved in building innovative learning environments.
6. Educational institutions should increase their staff's ICT and pedagogic competencies. Working in an e-learning and smart learning environment means collaborating in multidisciplinary teams.

CONCLUSION

Pedagogical and ICT competencies needed to develop and manage a smart, technology-enhanced learning environment, and supervise and support students working in it are often neglected and marginalized by decision-makers, lecturers and teachers. A lack of awareness of what can be achieved through well-designed web-based materials leads to improper implementation of new methods and techniques to be followed by creation of ineffective e-learning or blended learning courses.

A vast majority of academic and college staff in Poland and other countries have not yet had the opportunity to participate in any e-learning courses. Thus, for professionals who deliver classroom-based lectures, tutorials and workshops, it would be a valuable experience to immerse in educational programmes offered in an online environment. In this way they could gain hands-on experience and appropriate skills necessary to successfully engage in e-learning as developers and supervisors. Supported by a thorough introduction to online educational theory and practice, they would later be able to create materials tailored to their students' needs, monitor their progress and stimulate them to learn actively.

In the 21st century technological advances are broad, rapid and dynamic, which poses a number of challenges for educators. They have to reflect on their teaching continuously and self-direct their own development in order to be able to use a new, smart, i.e., technology-rich and pedagogically innovative, environment effectively. They need to identify areas for growth and improvement and upgrade their skills through self-education or training tailored to the needs and requirements of the new generation of students in smart and smarter learning environments.

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STUDY OF STUDENTS' EDUCATIONAL ACTIVITY STRATEGIES IN THE SOCIAL MEDIA ENVIRONMENT

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Abstract: *The paper reports a study of students' education activity strategies in the social media environment. The authors' approach is based on the following three-component structure of educational activity: the motivational, the pragmatic and the management components. The research proved that students have different profiles of the educational activity in the process of using social media. These profiles are based on the characteristics of the mentioned components of educational activity. In general, students do not apply the most productive strategies of educational activity in the social media environment that meet the requirements for teaching and self-education in the 21st century. The authors propose several directions for advancing students' educational activity.*

Keywords: educational activity, social media, students, ICT tools, digital environment.

INTRODUCTION

Education today successfully applies digital technologies and various practices lying within its context. Educational institutions are well equipped with devices, providing the access to the global network. Teachers tend to upgrade their ICT competences constantly, which leads to the expansion of new forms and methods of educational practices (e-learning, b-learning, online learning). However, the analysis of information and communication technologies (ICTs) progress and their impact on society, as well as the ideas of a smart society and a digital economy, shows that it is necessary to advance the process of professional development (Morze 2017). The need for advancement is explained by modern requirements for a specialist, a university graduate.

The advancing education theory presupposes the purposeful preparation of students for life and work in an informationally intensive environment that requires people to be responsible, flexible and ready for lifelong learning (Safavi 2018). Consequently, educational practices demand continuous enrichment and development. It is intended to combine the preparation of a new generation for the future with a meaningful today's life activity of students (Grishina 2017). For example, in the Russian professional standards of pedagogical activity, the implementation of e-learning, digital educational resources, research, project and other activities of students are declared as necessary skills for teachers (Register of professional standards of the Ministry of Labour of Russia).

The Horizon 2017 Report highlights the idea that "learning ecosystems must be agile enough to support the practices of the future. In using tools and platforms like LMS, educators have a desire to unbundle all of the components of a learning experience to remix open content and educational apps in unique and compelling ways" (p.2). This idea is consonant with the ecological systems theory of a psychologist Uri Bronfenbrenner (Bronfenbrenner 1979; Manning 2017). When a child develops, all the environments (systems) in which he or she is involved have a mutual influence: microsystem - the child's family; mesosystem – kindergarten, school, peers; exosystem - adult social organisations; macrosystem - cultural customs of the country, values, and resources. Similarly, for the professional development it is also necessary to create a set of conditions in the digital environment that will reflect the different levels (systems) of a learner's interactions – a specific practical competence, the ability to interact with others, the vision of the broad social context of various activities and consequences. However, today it is necessary not only to support development, but also to accelerate it. One of the directions of advancing education is the use of educational opportunities of social media.

What happens in the educational sphere? One of the answers is the expansion of the range of the opportunities for mastering educational programs and stimulating self-education through electronic environments and e-learning. In this context, very important is not merely the mastery of advanced ICT tools but also the acquisition of the progressive educational strategies such as self-directed learning, communicative learning, collaborative learning, critical thinking, experimental learning, etc. (Molonilo 2018). It is necessary to design educational resources, including digital resources, in such a way that all these requirements of future professional activity are reflected in students' academic activity. Therefore, it is necessary to use the up-to-date ICT tools, because they help learn how to act in the conditions of uncertainty and redundancy of information, how to study something new simultaneously with solving professional problems. Today social media are among the advanced developing technologies and they match students' information behaviour strategies (Noskova 2018).

Furthermore, it is necessary to study students' preferences, their expectations from those electronic tools that they intend to master. This will help, on the one hand, to take into account their request, needs, a level of readiness for independent work and a choice of different educational strategies. On the other hand, it will help to see the weaknesses that need special attention, e.g., not sufficiently productive learning strategies that they use, and create conditions for mastering strategies that are more advanced. Thus, students need conditions to master strategies that will be productive in the process of continuous learning: cooperation, teamwork, critical information analysis, distributed activities, mutual assistance, experience exchange, independence, reflection, and the ability to set goals for oneself or redefine goals set from the outside.

1. METHODS AND PROCEDURES OF THE STUDY

The main goal of the study was to analyse students' educational activity strategies in the social media environment. Educational activity is one of the main factors of professional development. Activity is considered a dynamic condition, which determines the possibility of forward movement and development. Educational activity includes the intensity and volume of human interaction with the environment, as well as the ability to set in-depth goals and objectives and to rise above the level of the requirements of a particular situation.

It is important that in the modern digital environment the proportion of personal activity increases. An example of such activity in the general social aspect can be the concept of a user-generated content based on social media. The concept of a "collaborative filtering" was introduced not just as an exchange of meaningful information through various communities, including network ones, but also as a tool for constructing predictions of the community members' preferences on the basis of their commonality in the evaluation of certain objects (Wang 2012). The economic effect of this phenomenon is proved, however, undoubtedly, the educational effect also exists - it is the development of knowledge sharing communities, with the effects of self-organisation (Patarakin 2017).

Based on the analysis of the generalised structure of human activity (the activity approach in psychology), the authors propose the following structure of educational activity in the context of the use of social media. It includes three main components:

• the motivational component (interest in the variety of activities with social media, the level of social media use skills, the awareness of the practical importance of social media tools in solving various types of problems - educational, professional, and life problems);

• the pragmatic component (independence and autonomy, orientation to the actions of the members of the group, preference for actions by patterns, orientation to the creative approach, orientation to the level of complexity, aspirations to discover something new, needs for mutual assistance);

• the management (and self-management) component (self-organisation, orientation to the maximum score, orientations to the position in the rating, orientations to the content reflection, requirements for a teacher's feedback, awareness of the portfolio objectives, needs for joint activities).

In order to receive information about students’ educational activity strategies in the social media environment, a questionnaire was prepared, which included questions on all three components of the educational activity. The questionnaire was made with the use of the Google Forms tool. The questions had several types of presentation. In most of the questions, it was suggested the respondents determine the significance of one or another aspect of educational activity on a five-point scale (1 point - never or almost never, 2 points - very rarely, 3 - rarely, 4 - quite often, 5 - very often or constantly). For example, “When preparing assignments, I would like to see examples of other students”, “I try to be creative”, “I would appreciate the teacher's comments on the results of my work”, etc. Several questions offered a choice of answers. For example, “Choose one of the options:

1) If difficulties arise during the study, I will overcome them independently; this will make study even more interesting for me;

2) If difficulties arise during the study, I will seek help from the teacher;

3) If difficulties arise during the study, I will ask other students for help;

4) If difficulties arise during the study, I will analyse how other students act and find a solution myself”.

The questions with the suggested answers were further analysed separately in terms of the qualitative analysis of students’ choice. It is important that the characteristics of educational activity were considered in the context of the application of social media. In general, the use of social media in educational practices was not something completely new to the respondents, as in the process of delivering their courses, teachers offer students various tasks that they can perform with the use of appropriate social media tools. For example, joint editing of documents based on Google services, creating mind maps, designing a personal website or a blog as an e-portfolio. Thus, having some experience, students could quite adequately assess their preferences. The sample of research included 245 respondents: bachelor students from the Herzen University (Russia). All respondents represented different directions of pedagogical education, e.g., future teachers of information technologies, art, music, foreign languages, and primary school teachers.

During the study, a hypothesis was put forward that students can have different profiles of educational activity in the process of using social media. These profiles are based on the characteristics of the motivational, pragmatic and management components of their learning activity. In general, students do not apply the most productive strategies of educational activity that meet the requirements for teaching and self-education in the 21st century.

2. ANALYSIS OF RESULTS

2.1 Cluster analysis of students' activity profiles

For the analysis of answers, methods of descriptive statistics were used, as well as the correlation analysis. To visualise the correlations between the variables studied, as well as to group them, the cluster analysis was used (Figures 1-3).

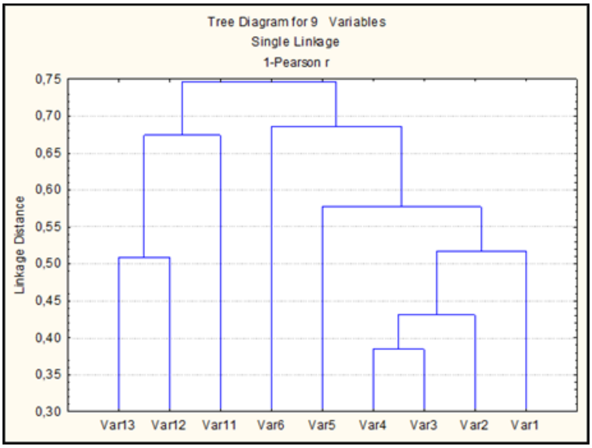

Figure 1. Motivational component of educational activity

Source: Own work

Variable 13 - Preferences in the content presentation format (text format)

Variable 12 - Preferences in the content presentation format (video format)

Variable 11 - Preferences in the content presentation format (screenshots with explanations)

Variable 6 - Self-reliance

Variable 5 - Awareness of social media practical importance in solving life problems

Variable 4 - Awareness of social media practical importance in solving professional problems

Variable 3 - Awareness of social media practical importance in solving educational problems

Variable 2 – Interest in social media

Variable 1 - Initial level of social media skills

Figure 1 shows that variables related to the motivational component of educational activity form two clusters. The first cluster comprises the variables: 13 and 12 (r = 0.49), and variable 11 is added to them at a higher distance. The variety of content representation forms was significant for the most of the students. For example, the rank “4” and “5” chose 73% of students for screenshots, 53% for video and 54% for texts.

The second cluster comprises variables 1-6. The closest relation is found between the variables 3 and 4 (r = 0.61); variable 2 merges at a higher distance. This means that the awareness of the possibilities of social media for solving educational and professional problems are closely linked, but the higher the interest in the application of social media is in general, the more the student is interested in mastering them for solving professional and educational problems. Thus, it can be concluded that in the proposed assignments it is important for students to see the meaning and the value for the ICT tools use in different types of activities. The variables 5 and 1 join at the highest distance of the association, which means that the initial level of social media skills, as well as their use for solving everyday problems do not have a decisive influence on their value for educational activity of students. However, this aspect should also be taken into account when designing assignments for students, since they can have an indirect effect on students’ activity.

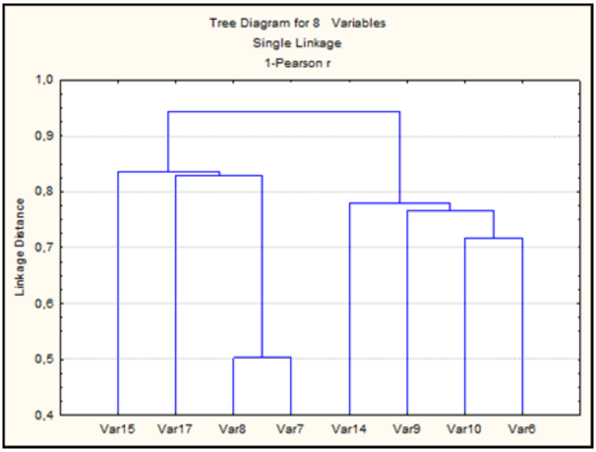

Figure 2. Pragmatic component of educational activity
Source: Own work

Variable 15- Needs for mutual assistance

Variable 17 - Needs for joint activities

Variable 8 - Needs for a pattern

Variable 7 - Orientations to the actions of group members

Variable 14 - Aspirations to discover something new

Variable 9 - Focus on creativity

Variable 10 - Orientations to the level of complexity

Variable 6 - Self-reliance

Figure 2 shows that the variables of the pragmatic component form two clusters. The first cluster includes the variables: 15, 17, 7 and 8. The most closely related variables are 7 and 8 (r = 0.49). Such close interrelations indicate several interesting aspects. On the one hand, students, apparently, are not ready to act independently. They want to see an example, a pattern, get some support, feedback from peers, etc. On the other hand, this shows their focus on social interaction, which is a good basis for the use of social media tools. After all, social media give all these opportunities – to work in a group, to share content, to give advice, to comment, and to see patterns. It can be assumed that at the initial stages of a new content study, social media tools can improve learning efficiency, due to their wide opportunities for interaction.

The second cluster is formed by the variables: 14, 9, 10 and 6. The closest interrelation is visible between the variables: 10 and 6 (r = 0.28). The variables: 9 and 14 join them at a farther distance. This agglomeration shows the features of interested and motivated students. If they are willing to work independently, they are ready to choose more difficult tasks, to discover new and to apply an individual, creative approach to the solutions of problems.

Accordingly, the analysis of the pragmatic component makes it possible to distinguish two profiles of students. The first profile is typical for students, initially not completely confident in their abilities, needing support, samples of completed assignments, opportunities to ask their peers for help. The second profile is typical of self-confident students, willing to work independently and to perform complex tasks with the elements of creativity. However, for this group, the vector of development can be the inclusion of them in the interactions with weaker students as consultants or as advisers for performing assignments.

20 - Orientations to a substantive reflection

19 - Orientations to the position in the rating

22 - Awareness of the portfolio importance

21 – Need for a teacher’s feedback

18 - Orientations to the maximum score

16 - Self-organisation

Figure 3 shows two clusters. The first cluster is formed by the variables 19 and 20 (r = 0.70). The second cluster comprises the variables: 22 and 21 (r = 0.43); they are joined by variable 18 and variable 16. Based on the presented peculiarities of the grouping of variables, it is possible to draw conclusions about the nature of the educational activity of students. For students who are interested in their own progress, success, the position in the rating, it is also important to understand the reasons for their status, score, and the position in the rating.

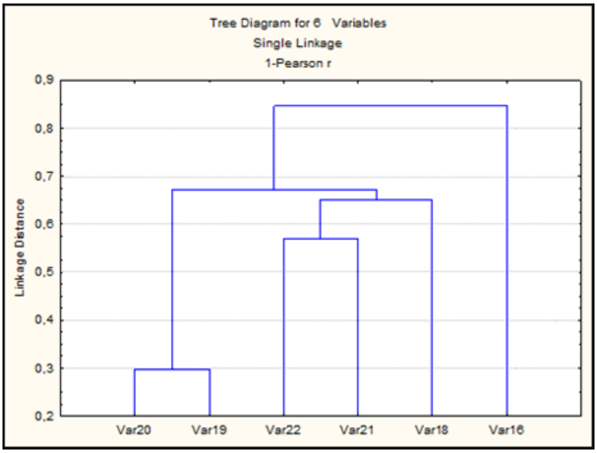

Figure 3. Management component of educational activity

Source: Own work

Accordingly, such students should be given the opportunity to implement this reflection. These opportunities are, primarily, formative assessment technologies that can be embedded in educational content (criteria for evaluating works, scales, criteria columns and tables, etc.) (Noskova 2016). At the same time, for students who are interested in applying the portfolio technology, feedback from the teacher is important (Cain 2018). It can be assumed that feedback from the teacher is important for students in terms of their wish to demonstrate their work, educational achievements, as well as to get some value judgments from a more experienced person. The connection of the variable "self-organisation" with the listed variables confirms that these features are characteristic of the motivated students who are able to plan their activities and manage time.

2.1 Additional features of educational activity

The analysis of answers to the questions with suggested variants showed additional features of students' educational activity. Firstly, most students prefer to choose easier tasks (75%), rather than more complex ones (25%). Secondly, half of the students expect to receive the majority of necessary knowledge and skills during the lessons (50%), a significant number of students are eager to work independently, in addition to classes to show their abilities (43%). Almost half of the respondents will ask for a teacher's help (48%), and 22% of the students will ask for their peers' help, 17% will monitor others, analyse, but find a solution on their own, 13% will act completely independently.

The majority of students (68%) tend to manage and distribute their time for fulfilling assignments, and 20% believe that the main thing is not to miss the deadline, 12% need a clear plan and supervision from their teacher.

49% of the students prefer to perform assignments in pairs with other students, counting on their support and cooperation. 45% of the respondents prefer to work individually. Only the remaining 4% are ready to work in a group, and only 2% are ready to assume the role of a leader of the group.

Thus, students’ preferences show that not all the strategies implemented by them are productive, especially in conditions of using the opportunities of social media, as well as the ideas of continuous education and self-development. In particular, the preference to get feedback only from the teacher, an inactive use of mutual assistance, occasional knowledge sharing with colleagues, and the lack of self-management – all these are the features of non-productive learning strategies.

CONCLUSION

The analysis of the answers obtained makes it possible to draw a number of conclusions about the specifics of students’ educational activity strategies in the social media environment.

Firstly, the results showed that the motivational aspect is crucial in the process of implementing a particular strategy of educational activity. The most significant for the development of students’ motivation is the awareness of the opportunities of social media for solving educational and professional problems. This understanding is more important than the initial level of social media skills or the experience of their use in everyday life. Consequently, tasks when students clearly see the practical outcome, the aspects of their new knowledge and skills application in the future, and the benefits come to the forefront.

Secondly, in the pragmatic aspect of students’ educational strategies, two alternative profiles can be identified. The first profile unites students who are initially not fully confident of their abilities, need support, samples of completed assignments, and opportunities to ask for help. The second profile unites confident students, aimed at independent work, ready to fulfil complex tasks with some elements of creativity. Therefore, in the process of preparing assignments for students in the electronic environment, with the use of social media, teachers should focus on these two students’ profiles. At the same time, the most promising for development is the transition to the third profile, which still was not completely identified in this research, but its outline can be drawn from the answers of the most advanced students. This is the transition of the most motivated and self-confident students from exclusively individual work to the group work as leaders, consultants and facilitators. In addition, the most outstanding and interesting students’ works can be included in the bank of the best examples for other students.

Thirdly, in the management aspect for students in general, it is important to see their position in the overall rating, as well as to receive feedback on the works performed. For students who are interested in their own progress, success, position in the rating, the possibility of understanding the reasons for their status and score is also important. Accordingly, such students should be given opportunities to implement this reflection using the technology of formative assessment. At the same time, a teacher's feedback is meaningful for students as an opportunity to get value judgments from a more experienced person. To realise this feedback productively we can suggest portfolio technologies.

Summing up, we can note that all the above listed, identified and described features of students' educational activity in the social media environment are very useful for teachers in the process of developing particular assignments, as well as electronic educational resources in general. The digital learning environment should be variable, and it is expedient that this variance should be based, on the one hand, on students' preferences, and on the other hand, should open opportunities for self-development, upgrade to a higher competences level, and mastering the most advanced strategies of educational activity.

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SECONDARY EDUCATION STUDENTS' TECHNOLOGY USE IN DIGITAL ENVIRONMENTS

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Abstract: *The aim of this study is to identify the uses of digital technologies by secondary school students and how they may change in regards to the different digital scenarios. Therefore, 78 secondary education students completed a Likert-scale questionnaire, providing information about their digital technology use and habits in a variety of areas. The results show that young people use a range of digital technologies in different scenarios and the social media used by students in free-time and study scenarios.*

Keywords: Digital Technologies, Secondary Education, Scenarios

INTRODUCTION

This Information and Knowledge Society (Castells, 2011) can be defined as an era of rapid technological advancements and digital revolution, where a lot of a person's daily activities take place in an online world, both personal and professional (Kolojytha et al., 2015). Digital technologies have transformed all aspects of our lifestyle and social customs (Cabero, 2008) and in consequence, educational systems and teachers are taking steps towards educating in the digital age. The rapid and progressive growth of digital technologies in the world (Kemp, 2017) has allowed for the development of new digital platforms, including social networks and applications that are very appealing and popular with young people as a means of interacting, searching for information and media, as well as communicating together (Arcilla & López, 2017; Noguera, 2015). Technology-based learning offers a range of educational prospects that would not arise from a traditional style classroom and can enhance educational contexts incorporating multimodal formats of information (Lee & Lee, 2018), complementing the course-book as the default tool for teaching (Kalyuga & Liu, 2015; Area et al., 2016). The endowment and the ease of access to digital technologies in education has led to a new set of digital learning scenarios (Wang, et al., 2009; Cobo & Moravec, 2011, Jones & Jo, 2004, van Hermelen, 2006;

Dabbagh & Nitsantas, 2011, Mikropoulos & Natsis, 2011) in which a person can use technology in order to select, share, solve problems on a personal, professional, social and academic level. In other words, young people have found new forms to relate, communicate, learn, satisfy their curiosity and have fun through the use of technology (Lobera & Rubio, 2015). From which, the learning process takes on a more connected (Siemens, 2005) informal, open-access role, accessible anywhere at any time (Gutiérrez & Mikiewicz, 2013). Previously, in Extremadura (Spain), there has been an increase in digitalizing schools. Internet connectivity during previous courses has risen to 93,3% in public primary schools and 98,4% in private and state-maintained schools (Secretariat Spanish Education Ministry, 2015). However, we still have to answer: How are students learning with technology? Therefore, the aim of this study is to describe the digital technology use of Secondary Education students in different digital scenarios.

1. EDUCATION AND SOCIAL MEDIA IN A DIGITAL AGE

The emergent and current generation, in regards to the use of technology and cognitive processing, have been classified with such terms as Millennials (Howe and Strauss, 2000), Digital Natives (Prensky, 2007, 2010), Knowmads (Cobo & Moravec, 2011) and New Millennium Learners as created by the New Media Consortium and Educause (2010), who also detail the changing ways that members of this generation learn, communicate, entertain themselves, work together, use technology to interact and seek out information. In addition, Prensky (2007, 2010) suggests that students are no longer the people our educational system was designed to teach.

The implications of the incorporation of technology in the teaching and learning process are more evident, as students are said to be accessing, managing, creating and sharing knowledge in dramatically different ways as their teachers often do, but also have radically new expectations regarding what a quality learning experience should be (Pedró, 2006). However, there are studies (Barak, 2018; Ng, 2012; Karimi, 2016; Margaryan et al., 2011) that question to what extent these digital natives really are, adept at using digital technology in everyday life and if they are cognitively different in comparison to previous generations (Kirschner & Bruyckere, 2017). Moreover, research shows that students frequently use ICT and social media for personal and leisure activities, however, they are quite limited when applying these tools in an educational setting. Teachers still have an opportunity to help their students navigate successfully through the promises and pitfalls of learning in the digital world. (Barak, 2018).

Other research studies conducted suggest that digital technologies and multimedia learning has a significant effect on a student's emotional and metacognitive ability, positively mediating the learner and their learning experience (Kalyuga & Liu, 2015; Park et al., 2015) and enables teachers to find new pedagogical approaches

(Beetham et al, 2009; Gutiérrez & Mikiewicz, 2013; Montrieux et al., 2015).

Digital Technologies impact learning and they aid in the process of communication and access to information as well as, increasing the quality of learning (Ozerbas & Erdogan, 2016). They complement educational contexts with a different kinds of information and formats. The teaching and learning process is no longer restricted to a classroom setting with a traditional outlook where the focal point is on the teaching process. The incorporation and improvement of digital technologies in education has led to a new set of Learning Scenarios (van Hermelen, 2006; Dabbagh & Nitsantas, 2011) where people can use technology in order to select, share, solve problems on a personal, professional, social and academic scale.

2. METHOD

The research follows a quantitative methodology with a descriptive design in which data will be addressed in a descriptive and explanatory way, in order to detail the social networks and digital technologies used by Secondary Education students from Extremadura (Spain), in academic and free-time settings during 2016. The total number of participants of the study is 78. In regards to sex, 53,85% are women and 46,15% are men. All participants are in the last year of Compulsory Education with ages ranged from 14-15 years old (42,31%), 16-17 years old (53.85%) and over 17 years old (3,85%).

The research instruments used to collect data on the use of Digital Scenarios is The Digital Scenarios Questionnaire (DSQ), constructed ensuing content validity via a group of experts and reliability with the statistical support of Cronbach's alpha, scoring (α =0,812) on the total of items of the instrument. The DSQ was a Likert-scale questionnaire, ranging from 5 (Always), 4 (Often), 3 (Sometimes), 2 (Hardly ever) to 1 (Never). It is made up of 46 items grouped into three dimensions with several sub-dimensions: I) Sociodemographic and Identification Data, II) Digital Technology Use (which was consequently subdivided into free-time, study and work-project use) and finally III) Device use (divided into free-time and classroom use).

3. RESULTS

The following data sets show which digital technologies and social media are favoured by Secondary Education students in their free time settings.

Table 1

Descriptive statistics on free time technology use

Free Time n=78	Mean	Median	Min	Max	Percentiles (25, 75)	
Facebook	1.64	1.00	1	5	1.00	2.00
Twitter	2.86	3.00	1	5	1.00	4.00
Instagram	4.13	5.00	1	5	4.00	5.00
Snapchat	3.76	5.00	1	5	2.00	5.00
IM	4.86	5.00	3	5	5.00	5.00
Vine	1.44	1.00	1	5	1.00	1.25
Periscope	1.45	1.00	1	5	1.00	1.00
Web Page	1.10	1.00	1	3	1.00	1.00
Virtual Environments	1.31	1.00	1	3	1.00	2.00
Videogames	2.77	3.00	1	5	1.00	4.00
Blog	1.74	1.00	1	5	1.00	2.00
Information Pages	3.18	3.00	1	5	3.00	4.00
Mean	2.52	2.67	1.33	3.42	2.23	2.83

Source: own work

As shown in the previous table, and the following graphs, the main tools used by students are Instant Messaging e.g. WhatsApp, Viber, Telegram (4.86), followed by Instagram (4.13), Snapchat (3.76) and Information Consultation Pages (3.18). The least used by these students are: Webpages (1.10), Virtual Environments (1.31), Vine (1.44) and Periscope (1.45). The following graphs show the data collected on the five most preferred digital technologies used in free-time scenarios:

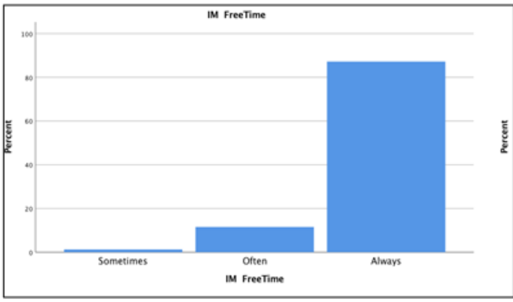

Figure 1: Instant messaging in free-time scenarios
Source: Own work

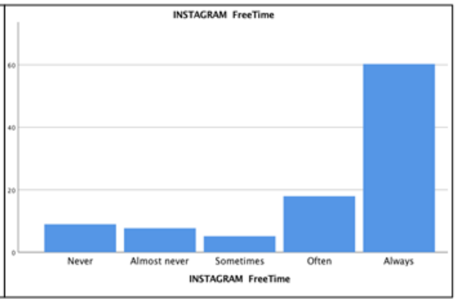

Figure 2: Instagram in free-time scenarios
Source: Own work

When asked about the use of Instant Messaging in participant’s free-time they answered the following: never (0%), almost never (0%), sometimes (1.28%), often (11.54%) and always (87.18%). Meanwhile, in regards to Instagram, indicated:

never (8.97%), almost never (7.69%), sometimes (5.12%), often (17.95%) and always (60.26%).

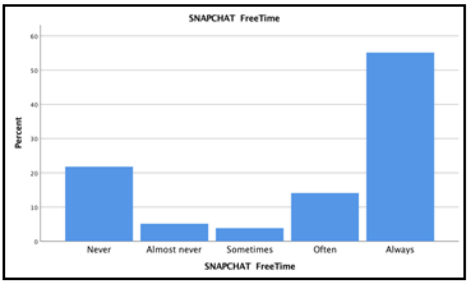

Figure 3: Snapchat in free-time scenarios
Source: Own work

Figure 4: Information Consultation Pages in free-time scenarios.
Source: own work

When asked about the use of Instagram in participant's free-time they answered the following:
never (21.79%), almost never (5.12%), sometimes (3.84%), often (14.10%) and always (55.13%).
Meanwhile, the use of information consultation pages was: never (8.97%), almost never (11.54%), sometimes (41.03%), often (29.49%) and always (8.97%).
In regards to participants' digital technology use in their study scenarios the data points out that the most preferred instruments are: Information Consultation Pages (3.99), Instant Messaging (3.40), Blogs (2.09) and Snapchat (1.77)

Table 2:
Descriptive statistics on study technology use

Descriptive Statistics							
Study technology use n=78	N valid	Mean	Median	Min	Max	Percentiles	
						25	75
Facebook	78	1.1	1.00	1	5	1.00	1.00
Twitter	78	1.22	1.00	1	4	1.00	1.00
Instagram	78	1.53	1.00	1	5	1.00	1.00
Snapchat	78	1.77	1.00	1	5	1.00	2.25
IM	78	3.40	4.00	1	5	3.00	4.00
Vine	78	1.03	1.00	1	3	1.00	1.00
Periscope	78	1.04	1.00	1	2	1.00	1.00
Web Page	78	1.14	1.00	1	5	1.00	1.00
Virtual Environments	78	1.63	1.00	1	5	1.00	2.00
Videogames	78	1.15	1.00	1	5	1.00	1.00
Blog	78	2.09	1.00	1	5	1.00	3.00
Information Pages	78	3.99	4.00	1	5	3.00	5.00
Mean	78	1.7606	1.7500	1.00	3.1667	1.4791	2.000

Source: own work

When asked about the use of Information and Consultation pages for study use, participants answered the following: never (3.84%), almost never (5.12%), sometimes (19.23%), often (32.05%) and always (39.74%). Meanwhile, in regards to Instant Messaging for study use, the results where: never (14.10%), almost never (7.69%), sometimes (25.64%), often (29.49%) and always (23.08%).

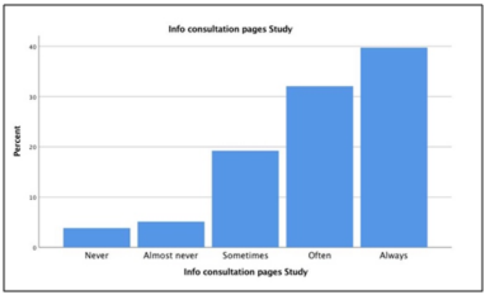

Figure 5: Information consultation pages in study
Source: own work

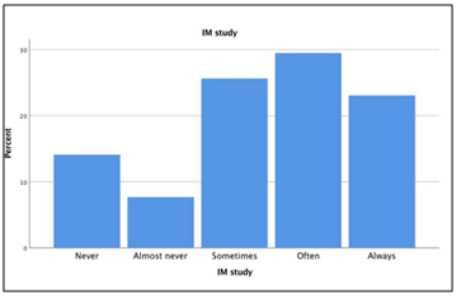

Figure 6: Instant Messaging in study
Source: own work

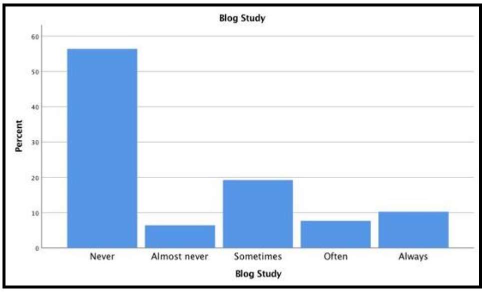

Figure 7: Blog in study
Source: own work

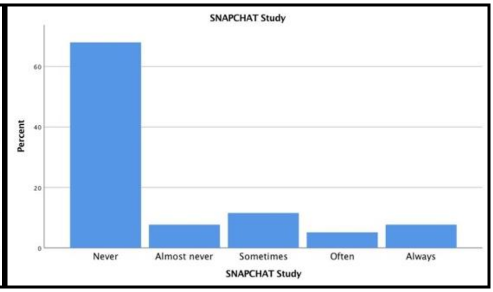

Figure 8: Snapchat in study
Source: own work

Meanwhile, the least used digital technologies were: Vine (1.03), Periscope (1.04) and lastly, videogames and Facebook (both on 1.15). The data also shows that students use technologies more in their free-time (1.519) than in their study scenarios (1.776).

CONCLUSION

The aim of this study was to describe the technology use of secondary school students in different their free-time and study scenarios. The results show that all students of this study use instant messaging and social media tools on a daily basis, in both academic and personal spaces. On the whole, students interact with more digital technologies and social media in their personal free-time than in study or academic settings, whilst also integrating more traditional Web 2.0. tools such as blogs, which partially coincides with some previous findings (Lenhart, Prucell, Smith & Zickuhr, 2010). In parallel students mainly use technology and the Internet for leisure needs and not so much in regards to educational aims. This could lead us to include more activities and scaffold students' use of technology for academic use as well as for social and free-time use, thus bridging the gap between formal and non-formal education and promote lifelong learning strategies along with the development of essential 21st century skills.

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DIRECTIONS OF THE EVOLUTION OF HIGHER EDUCATION

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Abstract: *Technological progress has irreversibly changed the approach to education, including higher education. New generations of students have different educational needs and requirements, which usually do not meet up to the level of university infrastructures and IT preparation of teaching staff. Currently, universities and lecturers can choose from a wide range of possibilities that change the way students are educated. There are many options available, such as mobile learning, multimedia-learning, Web 2.0-based learning, and teaching using extended and virtual reality. A move towards a smarter, technology-rich educational environment has been initiated by a number of top universities across the world, paving the way for new regional and national initiatives, and higher education institutions which face ongoing funding challenges. The paper presents an analysis of global trends in technology-enhanced academic education and indicates the potential of new teaching and learning environments to meet the needs of generation Z. It also discusses barriers to the implementation of innovative technologies in education provided by Polish universities.*

Keywords: higher education, mobile learning, multimedia learning, Web 2.0-based learning, virtual and augmented reality

INTRODUCTION

Generation X (generation of people born in the second half of the 20th century) is still an important core of university staff. These are currently professors, associate professors and senior lecturers. They remember times when the transfer of knowledge at the academic level was based on instructivist lectures, supported by available literature, that is, textbooks and scientific articles. A change in the approach to teaching methods and techniques requires generation X to overcome resistance and acquire necessary ICT competences. Young academics and PhD students representing generation Y have a much better opportunity to evolve as innovative professionals. They are familiar with digital technologies and are more open to changes in their approach to students.

Who are the current students? This is generation Z, also known as the online generation. They grew up in the world of modern technologies, which they consider indispensable tools for expanding knowledge and personal development. Their characteristic features are openness to other people and desire to build social relations. They are not afraid to independently search for knowledge on the Internet and share it with others. Because they are considered to be entrepreneurial and creative, they need education that satisfies their specific needs. An important, stimulating factor for generation Z is contact with peers both on the level of cooperation and competitiveness. When learning, they focus on a fast message and data, preferably in electronic and pictorial form (Rickes 2016). Generation Z is the force that shapes the approach to education. New delivery modes and new educational environments are being researched, and changes in curricula are a necessary response. With new technological possibilities, these changes will become even more pronounced (Mynbayeva, Sadvakassova, Akshalova 2018:9).

Free access to a huge amount of information and a quick jumping from topic to topic, characteristic of hypertext, triggers a reflexive superficial assessment of ideas. Images, visual associations and verbal minimalism are the attributes of modern times. A transition to symbols and pictograms is a natural result of communicating using digital communicators, where a compact form is required. Everyday encounters with digital media (computer and video games) cause quick fatigue and a loss of concentration during a traditional lesson. "Clip thinking", i.e., the inability to verbalize thoughts and a move away from the culture of the written word towards schemes, drawings and symbols as well as the incapability to concentrate on a subject for long time, is a characteristic feature of present day students (Berezovskaya and Shipunova 2015). The clash of the digital world and traditional university teaching causes discomfort in both lecturers and learners. That is why, it is so important to promote modern educational methods and the tools that technological progress offers.

The literature review presented in this paper and the authors' research conducted over the last three years aim to:

- analyse global trends in technology-enhanced academic education,
- understand the potential of new educational, technology-rich environments to teach the present and future generations of students,
- identify barriers to the implementation of technological advances in higher education.

The paper targets university and college staff who would like to make a move towards student-centred teaching enhanced by innovative technologies. The decision-making process may be difficult, time-consuming and costly because there are a vast number of online tools and advanced equipment. For teachers whose ICT skills are not well developed it will be overwhelming and affected by non-availability of sufficient knowledge and experience, which can discourage them from introducing novelty into their teaching. Moreover, universities are usually cautious when it comes to implementing new solutions and investing in technological innovations. The data collected during the research are meant to help decide how to build a technology-enhanced learning and teaching environment.

1. TECHNOLOGIES IN EDUCATION

Modern technologies have been changing every aspect of human life. Education is no exception and it should be paving the way for other areas. There are many possible ways to enhance academic education, but one thing is certain, each change must be structured around technological support. Any path entails specific costs and usually encounters impediments in the implementation phase. In addition, each technology has its advantages and disadvantages to consider in the decision making process.

The overview of modern technologies and tools presented in this article can support higher academic education and significantly influence its effectiveness. The authors focus on the opportunities for academic education offered by each option and indicate the barriers to its implementation in Polish universities.

1.1 Mobile learning (m-learning)

Mobile devices play an increasingly important role in education, especially in university education. Notebooks, smartphones, tablets and e-books offer quick access to information and interaction with other users. Applications for these devices allow their users not only to read content, but also to search for it and create it, which in turn influences students' learning styles and educational preferences. The convenience, flexibility, multimedia possibilities and interactivity of mobile devices make learning very attractive. This global trend has also reached Poland and has impacted education, including higher education. Many universities have created mobile versions of their websites and prepared teaching materials for mobile devices.

Although students still prefer laptops, the popularity of tablets, smartphones and e-book readers is constantly growing, and students are increasingly using them to have access to educational resources. There is little research in Poland on how students use mobile devices and applications for academic purposes (Leszczyński, Charuta, Gotlib, Kołodziejczak, Roszak, Zacharuk 2017; Bajorek, Gawroński 2018). Considering the results of research in more technologically advanced countries, it can be said that the popularity of mobile devices for educational purposes is growing very fast. According to EDUCAUSE Center for Analysis and Research (ECAR) many students prefer small and portable devices such as smartphones and tablets, and the number of such devices used for educational purposes has doubled in just one year (EDUCAUSE 2012). More than half of US students participating in the survey (N=1082) used mobile devices for academic purposes – 82% of tablet device owners said they used the device for academic purposes, while only 58% of small mobile device owners and 64 percent of e-book reader owners reported doing so (2013). The research results indicate that tablets are the most efficient mobile devices in the academic environment and mobile learning often takes place outside the traditional classroom.

Barriers: Because technological progress is much faster than changes in education systems, especially in teaching and learning strategies, the implementation of mobile devices for everyday academic education seems quite a challenge. If you add to this the need to provide support to students using such equipment and the need to constantly improve teacher competencies, such projects come at a high cost.

1.2 Multimedia learning

In today's world, no one denies the power of images – 65% of the population is visual (Bradford 2011), and the time of image processing by the human brain is only 13 milliseconds (Trafton 2014). In addition, about 30% of the population are audio learners and the remaining 5% of the population are so-called experiential learners – they learn by doing. Becoming aware of diversity in learning styles is the first step to the proper selection of educational means and methods. Basing teaching solely on the text, whether in written or oral form, leads to a rapid weariness of the recipient. The most appropriate approach is to provide materials in a variety of forms (e.g. online textbooks, video lectures, interactive exercises, simulations, animations) to support different student preferences (NMC Horizon Report 2015:16; Roszak, Kołodziejczak, Ren-Kurc, Kowalewski 2013).

According to research (Leszczyński, Charuta, Łaziuk, Gałązkowski, Wejnarski, Roszak, Kołodziejczak 2018; Scheiter, Wiebe, Holsanova 2009), multimedia learning benefits from the brain's ability to make connections between the verbal and the visual. The understanding thus achieved supports learning. This is important in today's and future classrooms, which should prepare students for challenges in the work context, where soft skills such as higher-level thinking, problem solving and collaborative ones are required. A large percentage of the human brain is dedicated to visual processing. Thus incorporating images, video and animations into a text helps increase its activity. This means that in a multimedia learning environment, students should process information more easily and more quickly identify and solve problems than in textbook-based classes. Moreover, learning through multimedia impacts students' moods. If they have a positive attitude towards such an environment, they learn better and tend to be more active. Student attention and retention increase.

Barriers: Nevertheless, it should be remembered that the preparation of multimedia materials is time-consuming and requires from the teacher an appropriate level of IT competencies (Kowalewski, Kołodziejczak, Roszak, Ren-Kurc 2013; Kołodziejczak, Roszak, Kowalewski, Ren-Kurc 2014; Roszak, Kołodziejczak 2017). In order for the resource to fulfil its educational role, it must also be structured around student-centred pedagogies (Andresen, Brink 2013). Therefore, the development of valuable multimedia materials, although very desirable, is a long-term process, requiring commitment, necessary substantive knowledge and the ability to use modern technologies. Due to the complexity and time-consuming nature of the undertaking, an interdisciplinary team responsible for substantive, pedagogical and technological aspects should be involved in developing new educational materials (Roszak, Kołodziejczak 2017).

1.3 E-textbooks

An e-textbook is a well-structured interactive multimedia learning material that meets different requirements. Besides being an educational resource, it provides various functionalities that allow students to verify their level of understanding, search for content and add notes. Moreover, it is available in many formats and for various devices, and it is published on educational portals. It is fully or partly printable, easy to expand and reorganize (Ren-Kurc, Kołodziejczak, Roszak and Kowalewski 2013). Its multimedia format substantially facilitates the development of knowledge (Szulc 2018).

In Poland, the governmental program "Digital school" has contributed to the development of e-educational resources such as free of charge e-textbooks. The first electronic textbooks were presented in September 2013, and in 2018 teachers could use 67 free e-textbooks available on www.epodreczniki.pl and other educational resources accessible on the textbook publishers' websites.

Unfortunately, in the case of academic textbooks, the changes are not so spectacular. First of all, an electronic version of a traditional textbook is often not an e-textbook. But if a university develops a kind of e-textbook, it is usually made available to their students on their portal or intranet. Moreover, commercial publications are not free and access to content is often temporary. Technologically and pedagogically, these textbooks are still closer to traditional books than to real e-textbooks.

An e-textbook, which, according to the authors, is worth disseminating, is the textbook “e-Physics. Basics of physics” by prof. Zbigniew Kąkol and dr. Jan Żukrowski (2017), available under the Creative Commons Poland license, Attribution-Non-commercial use - On the same conditions 4.0 (CC BY NC SA). It meets most of the requirements set for e-textbooks and is pedagogically sound.

In highly developed countries, especially in the USA, access to e-textbooks and other open license resources is easier. This is due to government and private sponsorship. Students can not only use e-textbooks (Jisc 2018), but also other educational resources accessible on portals (Lecturio 2018) such as: video lectures and images (MEDtube 2018), interactive materials and simulations (PhET Interactive Simulations 2018, WOLFRAM Demonstrations Project 2018), quizzes, databases, atlases (Kenhub 2018) and encyclopaedias (Scholarpedia 2018). Thanks to Internet access and knowledge of English, Polish students also have the possibility of using these resources.

Barriers: In the authors' opinion, the factors that constitute barriers to the creation of e-textbooks in Poland are: lack of appropriate IT competencies of academic staff (Ren-Kurc, Kołodziejczak, Roszak and Kowalewski 2013), time-consuming handbook preparation, lack of appropriate teacher remuneration, and IT and pedagogical support. The authors’ research carried out at medical universities show that the majority of e-textbooks have been created by their staff or have been commissioned. The universities that have their own e-textbooks positively assess their usefulness and highly evaluate e-textbooks offered by commercial publishing houses.

1.4 Web 2.0 tools-based learning

The term Web 2.0 was coined by DiNucci, and then popularized by O’Reilly at the Web 2.0 Conference in San Francisco in 2004 (O’Reilly 2016). It applies to the use of computer-mediated communication and networked digital media. It offers not only a wide range of possibilities for publication, but also encourages and supports digital artefact uploading and sharing. Web 2.0 environments provide different ways for self-representation, self-expression, reflection, collaboration, and knowledge building and sharing (Mokwa-Tarnowska 2017b) through, e.g., content remixing and repurposing, as well as networking and group activities (Crook, Cummings, Fisher, Graber, Harrison, Lewin, Logan, Luckin, Oliver 2008).

A number of factors has contributed to Web 2.0 technology being a breakthrough. These include: advancements in the technological infrastructure, increased Internet and broadband adoption, and user-friendly interfaces for navigating, archiving, communicating and collaborating on the web. There are many different categorizations of Web 2.0 tools. One of them, according to Crook et al. (2008), divides web-based activities as follows:

- media sharing,
- media manipulation and data/web mash ups,
- instant messaging, chat and conversational platforms,
- online games and virtual worlds,
- social networking,
- blogging,
- social bookmarking,
- recommender systems to aggregate and tag user preferences,
- collaborative editing tools,
- automatic notifications changes or updates.

The emergence of Web 2.0 tools has had an impact on education, and according to Steve Hargadon, "Web 2.0 is the future of education" (2008). New opportunities have emerged, especially in terms of cooperation, communication, efficiency and knowledge sharing that can serve many purposes both in traditional classroom teaching and e-learning. Constructivist (Green, Gredler 2002) ideas are gradually becoming more popular in web-based education, and a shift from knowledge being passed on to students towards knowledge being developed by students has been seen over the past ten years. Project-based learning (Mokwa-Tarnowska 2017a) supported by online tools has opened up new educational possibilities. Technologies have been seen as a means of enabling learners to take control of their learning and a means of enhancing the social dimensions of learning (Conole, Alevizou 2010:14). By structuring their own resources to suit their individual preferences, students now have the chance to increase creativity and flexibility within the curriculum.

Social networks enable new forms of communication and cooperation and are considered an important means of knowledge building through the exchange of views and co-creation. Communities in social networks, built initially on the basis of a family relationship or community of interest, have gradually evolved into more formal communities, such as student groups and professional networks. New technologies have facilitated counselling and support for peer groups in many ways and on a scale not seen before. For example, the ability to openly comment and criticize other people's work, a standard practice in the blogosphere, has been adapted for teaching and learning.

Although it is true that many younger learners have grown up in a technology-mediated environment, their skills may not be sufficient and they may not be able to use them effectively for educational purposes. Moreover, there is a wide spectrum of learners with different learning preferences and different willingness to engage with technologies. Furthermore, according to Edwige Simon (2008) integrating technology into teaching requires the combination of adequate technical skills and sound pedagogical foundations. This needs to be supported by an understanding that technology should never outstrip pedagogy.

There are both advantages and disadvantages of using Web 2.0 technology. The former include e.g. reduction of costs, easier and faster access to information whenever and wherever needed, sharing experiences and resources (blogs, microblogs, wikis, flickr, youtube) and low level of complexity necessary for Internet use.

Barriers: The use of Web 2.0 tools has several disadvantages, e.g., necessity of Internet access (especially a broadband connection), limited security or difficult selection process based on the number of available technologies (Grosseck 2009). Research shows (Benbunan-Fich, Arbaugh 2006; Cole 2009; Minocha 2009:34–37) that there are many questions and concerns about the implementation of Web 2.0 tools in education. These include: concerns as to whether students and teachers have the necessary skills to use these new technologies, uncertainty about the quality and effectiveness of Web 2.0 environments, and the need for changes in the pedagogical approach to the design, delivery and evaluation of curricula.

1.5 Virtual and augmented reality

1.5.1 Virtual Reality (VR)

The concept of *Virtual Reality* was created by Jaron Zepel Lanier, an American computer scientist, writer and composer. The most commonly quoted definition of VR is by Steve Bryson and Jaron Lanier (NASA):

> *"Virtual reality is the use of computer technology to create the effect of an interactive three-dimensional world in which the objects have a sense of spatial presence."*

Thanks to the high computing power of modern computers it has become possible to create realistic, real-time scenes and events and multi-sensory (audio-visual, tactile and even scent effects) user interaction with the computer in order to reflect realism and the maximum effect of immersion into the world of artificial reality.

Virtual worlds, or three-dimensional immersive environments in which we exist through our avatar, have been present in education since the beginning of their creation. Their popularity peaked around 2010, then it slowly dropped due to the dominance of www-based social networking sites. However, for the education sector VR has never lost its importance, some of the reasons being educators' interest in gamification (Topol, Kołodziejczak, Roszak, Dutkiewicz, Zych, Januszewski, Bręborowicz 2017; Topol 2013) and the possibility of combining VR technology with other technologies, e.g. with mobile technology. This tendency was foreseen by the NMC Horizon Report in 2016, which forecasted the development and growth of virtual and augmented reality educational applications in the next 2-3 years (2016, pp. 40-41). VR popularity among scientists and educators can be seen in the results obtained by Liu, Bhagat, Gao, Chang and Huang (2017), who compiled an overview of virtual reality research in education. A total of 975 documents were analysed, based on their publication patterns. The research shows that the USA, UK and Chinese Taipei are the top three most productive countries/regions that are involved in virtual reality research in education.

For many years, the best example of VR was the *Second Life* (SL) platform, which was made available in 2003 by Linden Research, Inc. Many aspects of human life are reflected in the SL platform, and the educational aspect holds an important place here. Particularly language and medical schools appreciate the educational value of this platform. Learning a foreign language in SL can lead to an increase in different skills, especially in people who cannot travel. Also, for students of emergency medical care and nursing, and doctors of various specialties, the possibility of training, acquiring professional competencies in a safe environment, far from patients, is an extraordinary educational experience. Research shows that learning in a VR environment provides positive stimuli, is attractive, addictive and effective (Nicholson, Chalk, Funnell, Daniel 2006; Skiba 2009; Trangenstein, Weiner, Gordon, McNew 2010). An important Polish application of SL is *Academia Electronica* established in 2007. In 2013 the Academy, highly estimated by the Jagiellonian University authorities, became a non-institutionalized part of the Institute of Philosophy and is a platform where teaching and scientific activities take place (Academia Electronica 2018).

VR offers many unique benefits when used in education. First and foremost, adapting VR into modern education means equipping teachers with a new tool expanding educational possibilities. With VR, they can enhance student experiences, motivate and stimulate them, as well as provide them with a hands-on experience (Bricken 1991).

At the beginning of 2014, a new VR trend (called a second wave of VR) that used the power and popularity of smartphones appeared. Google Cardboard goggles, for Android or iOS phones, could display VR wirelessly. This is how simple, inexpensive and wireless access to virtual worlds was born. The current, improved version of the goggles significantly reduces the risk of motion sickness caused by delayed movement, from which many first users suffered.

VR technology will be useful in a variety of educational fields, e.g., those with a need for a simulation or 3D presentation. They range from interactive environments designed to teach basic science in small labs to advanced higher education courses in, e.g., engineering, architecture and medicine. If it is cheaper and more accessible, it will be a necessary teaching and learning tool in the years to come. The way of building knowledge and skills during a virtual experience is something unique that cannot be found in education today. When used imaginatively and in a carefully thought-out way, VR can offer a wide variety of advantages for both educators and students (Hussein and Nätterdal 2015).

1.5.2 Augmented Reality (AR)

Augmented reality (AR) refers to a wide spectrum of technologies that project computer generated materials, such as text, images, and video, onto users' perceptions of the real world. Ronald Azuma (1997) mentions its three characteristics:

1. „the combination of real-world and virtual elements,
2. which are interactive in real-time, and which
3. are registered in 3D (i.e., the display of virtual objects or information is intrinsically tied to real-world location and orientation)."

AR technology is widely used in many fields, e.g. aviation, medicine, automotive, museology, training, marketing and tourism. AR is also used in areas that are directly or indirectly related to education, e.g. in medical sciences as a tool for medical training and simulation, in mechanical engineering, in architecture, interior design and science education. Thanks to enormous visualization possibilities, AR can be used to design complex technical devices, observe phenomena otherwise difficult or impossible to see, and it can be helpful in understanding abstract issues, e.g. concepts in mathematics, physics and geometry (Kęsy 2017). In addition, interaction with a virtual object can evoke positive emotions that stimulate curiosity and promote learning. AR books (books that allow displaying three-dimensional characters on each page or offer interactive experience) or AR games (learning by using games set in the real world and augmented with network data or games using marker technology), are just a few examples of the technology's huge educational possibilities.

1.5.3 Mixed Reality (MR)

A completely new quality of three-dimensional visualization is provided by a Microsoft device known as Microsoft *HoloLens*. It is a technology that has the potential to substantially change teaching and learning, research and entertainment. Devices such as Microsoft *HoloLens* have the ability to develop educational programmes in a mixed holographic reality (MR). Students can see, e.g., how human organs work, collaborate with fellow learners and experts regardless of their location, and see with the eyes of others – all in real time. They can learn geography through being immersed in what they are reading about. Because their brain believes that they are there, their response to such an experience is more emotional and they learn more holistically (Workman 2018). The Interactive Commons team is developing *HoloLens* applications for disciplines such as genetics, chemistry, art, dance, engineering, and palaeontology. Students are offered opportunities to see and experience things unavailable before, without leaving their own classrooms.

Barriers: Like with any new technology, there are also different concerns. Despite the unquestionable potential of VR/AM/MR in creating a unique, personalized and efficient educational environment, the greatest concerns are financing the implementation of technological innovations and ensuring a sufficient level of teachers' and students' ICT competences. According to the authors, the three challenges, cost, technological complexity and fear of advanced technology, may constrain their availability for educational purposes.

1.6 Reasons for building technologically-rich educational environments

The implementation of modern technologies in education is faster in countries where strategies for infrastructure investments, use of technology and promotion of e-learning in education are considered to be important factors, e.g. in Great Britain (HEFCE 2009). In the process of implementing innovative teaching methods, the motivation of the universities themselves is important. Usually the driving force behind these changes is competition for a student. By focusing on modern technologies, universities create a more effective teaching and learning environment and build communities of practice. An important initiative is to provide tools for creating academic social networks for students and employees along with a virtual educational environment supporting formal and informal education (Conole, Alevizou 2010:61-62).

Barriers: The use of technology, no matter how attractive it seems, must first and foremost be subordinate to educational goals. Teachers should have an influence on the choice of tools and educational environments. This approach will favourably affect their use in the future. What is also important is motivation behind decisions and reasons, and conviction that new environments will positively affect the learning outcomes.

2. SUMMARY OF RESULTS

To summarize, the analysis of the most interesting and promising technologies to support building smarter learning and teaching environments, enhanced by e-learning and online tools, has shown the likelihood of the following developments.

- The use of mobile devices and free ready-made software to support learning in a university context will increase significantly in the years ahead, which will result from their availability, popularity and affordability. However, overall implementation costs, including training sessions' costs and IT infrastructure costs, especially in the initial phase, can be high. Moreover, universities will have to restructure their course curricula.
- There is a growing interest in developing multimedia educational materials and interactive electronic textbooks to support traditional education in Poland, regardless of how expensive the production process is. The explanation lies in their high effectiveness and flexibility of use. The use of

such innovative resources is understood to improve the university reputation and competitiveness.

– Polish university staff willingly use Web 2.0 tools to enhance their traditional classes. They are perceived to be effective in developing engaging online activities and resources for both e-learning and web-supplemented face-to-face education. In addition, there is a wide variety of tools which are free, user-friendly and easy to implement, even by teachers who lack advanced ITC skills.
– The barrier to the immediate and widespread implementation of virtual and augmented reality in academic education is that they entail substantial implementation costs. Some universities in Poland are looking for the most cost-effective ways of implementing VR and AR to enhance their students learning experiences. Further technological advances may transform academic education in Poland and across the world, but whether VR and AR will define the education process is yet to be seen.
– Every university, college and faculty, depending on their vision, funding, infrastructure and staff competencies, can shape its development and approach to technology-based education. However, changes in delivery modes and course curricula are inevitable. As the developments presented in this article show, incorporating innovation into academic education is a slow and multi-stage process that requires a pedagogical paradigm change. An increase in funding and support for teaching staff will definitely open new opportunities for Polish universities and other higher education institutions if they are on the government's agenda. With their advantages and drawbacks, new technologies pose a challenge for educators, and the analysis provided in this article is believed to help them make rational and sensible decisions.

CONCLUSION

This article addresses technologies and tools that significantly affect or in the near future will affect the shape of academic education. Due to its scope some developments have not been discussed, e.g. the Open Educational Resources initiative.

The development of technology provides tools that irreversibly revolutionize approaches and methods in education. Each change has its advantages and disadvantages, and usually entails problems at the implementation stage. The major limitations to the evolution of academic education addressed in the article are costs, low level of teachers’ motivation and their insufficient ICT competences.

If Polish higher education institutions desire to compete with western universities, they must join the wave of change and adjust their educational methods and environments to meet new needs. Funding is a strategic factor in the development of Polish education. Innovative programmes can be financed by national and European programmes. It is possible to overcome the staff initial resistance to change through raising their knowledge about new technologies, i.e. through training and foreign internships, and by exposing them to interesting solutions and implementations. A positive attitude towards innovative learning environments affects motivation and commitment, and may lead to the improvement of teaching methods and tools. Sceptics of new technologies should be guided by the motto "The world only goes forward because of those who oppose it" (Johann Wolfgang Goethe).

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TOOLS AND APPROACHES FOR THE PREPARATION OF CYBER DEFENCE SPECIALISTS

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Abstract: *The paper deals with a problem of preparation of cyber defence specialists. Firstly, the necessary basic steps of the process are defined. Then some solution is offered. Finally, the future tasks are formulated. The main goal of the article is to contribute to the discussion about this problem area.*

Keywords: cyber defence, cyber safety, education, IT.

INTRODUCTION

The contemporary society is more and more dependent on cyber safety. Many countries are solving the problems connected with the upbringing and a suitable education of a number of highly needed and necessary new cyber defence specialists. The goal of the paper is to contribute to the discussion about this problem area. How to select a sufficient number of gifted students and what tools and approaches could be used are the main tasks of the preparation of cyber defence specialists, as well as of the paper. The author's point of view is based on the environment of the University of Defence, the Czech Republic. The research goals of the paper are: an analysis of open source data to the Czech National High School Cyber Security Competition, to suggest metrics for high school assessment in the cyber defence domain, to select the best Czech high schools in this domain, and to suggest a suitable approach to the cyber defence specialists' preparation. Available data sources analysis, knowledge synthesis, induction, deduction and comparison were used as the research methods. The author's own professional experience also played an important role in the formulation of the following text.

1. CYBER DEFENCE – BASIC INFORMATION

1.1 Cyber Defence in the Contemporary World

Cyber threats and attacks are becoming more common and sophisticated. Countries reinforce their capabilities for cyber education and training. They need to be prepared to defend its networks and operations against the growing sophistication of cyber threats and attacks. Four different national approaches to cyber defence are discussed in Giles, Hartmann (2015). The authors compare the advantages and drawbacks of Norway, Estonia, Germany and Sweden's national approach.

In 2013 the European Union (EU) published its "Cyber Security Strategy – An Open, Safe and Secure Cyberspace" (Röhrig, Smeaton 2014). Information exchange, training and research in cyber defence have become a necessity. The process requires trust and various forms of cooperation.

The important questions for solving are:

- To estimate from where the next cyber attacks will originate;
- What will be the attackers' motivation;
- What will be their target(s);
- How they will probably realize the cyber attacks.

It is necessary to keep in mind that cyber attacks appear capable of having strategic consequences. At the national and organizational levels, a good starting point is methodical risk management, including objective threat evaluation and careful resource allocation.

The pertinent questions include (Geers 2011):

- What is our critical infrastructure?
- Is it dependent on information technology?
- Is it connected to the Internet?
- Would its loss constitute a national security threat?
- Can we secure it or, failing that, take it off-line?

The application of a Corporate Defence Methodology will enhance the organizational resilience and robustness in face of cyber-attacks (NCSA 2017).

1.2 Cyber Defence in the Czech Republic

Cyber security and cyber defence are seriously solved also in the Czech Republic. Cyber security includes, in particular, preventive measures and reactive measures against attacked subjects in the case of cyber security incidents. Cyber defence uses offensive capabilities towards the source of the attack. It includes tightly specialized activities aimed at defending the state against serious attacks, which can no longer be dealt with common cyber security. Cyber defence assets are therefore deployed only in cases of considerable importance, they may also have an offensive character, but can only be used for defensive reasons.

Citizens of the Czech Republic can use the website (CyberSecurity.cz 2018). Its main goal is general awareness of cyber security and cyber defence. A very useful tool for education seems to be Cyber Security Glossary (Jirásek, Novák, Požár 2015).

The legislative framework for cyber security consists especially of:

- Law No. 181/2014 Col., on cyber security and change of some laws (Cyber Security Law);
- Law No. 205/2017 Col.;
- National Cyber Security Strategy of the Czech Republic for 2015-2020;
- Action Plan for the Strategy.

On May 13, 2014 the National Security Authority of the Czech Republic opened the National Cyber Security Centre in Brno.

On August 1, 2017 the National Cyber and Information Security Agency (NCISA 2017) was established as a competent national authority for the issues of cyber and information security. The main areas of activity of NCISA include:

- operation of the Government Computer Emergency Response Team (CERT) (GovCERT.CZ);
- cooperation with other Czech CERT® teams and Computer Security Incident Response Teams (CSIRTs);
- cooperation with international CERT® teams and CSIRTs;
- drafting of security standards for different categories of entities in the Czech Republic;
- support of education in the field of cyber security;
- research and development in the area of cyber security.

The current cyber defence tasks of the Ministry of Defence of the Czech Republic are discussed in Feix, Procházka (2017).

2. DEFINITION OF BASIC STEPS IN PREPARATION OF HUMAN SOURCES

2.1 Suitable Start of Preparation

When, how and what methods should be used is a difficult task which should be solved together with experts in the developmental psychology. The core basic preparation should be realized at the high schools, students and their teachers should be strongly motivated. The author believes that one of the excellent ways to raise high school students' motivation is a Cyber Security Competition.

2.2 Cyber Security Competition

The Czech National High School Cyber Security Competition could serve as a very good example of human resources suitable motivation. This competition is organized annually. In the school year 2018/2019 the AFCEA (Armed Forces Communication & Electronics Association) cyber security working group organizes the third competition of this type in the Czech Republic. The role of the main guarantor is played by NCISA.

The competition is divided into three rounds. The first round is done electronically in September and October, the second round electronically in January and February, and the third attendance final round in April. The competition can be attended only by students of high schools whose age is between 14 and 20 years at the time of the start of the competition in September. They must be registered on the portal of the competition.

The competitive test consists of questions divided into several categories. A certain number of points is assigned to each correct answer. A bad answer in the first round means a negative assessment of -0.25 to -1 point depending on the type of question. The aim is to get as many points as possible. The second round is only for competitors who win at least 20 % of the maximum number of points in the first round. A wrong answer in the second round means a negative assessment of -1 to -5 points depending on the type of question.

The third final round is a one day competition. It is for the best 6 boys and best 6 girls and next best competitors from the second round to the total number of 30 to 60 competitors. Among other things, the winners can be invited to the European final, where they can compete with other young people from 20 countries (European Cyber Security Challenge 2018).

Table 1.

Basic data to the first two years of the Czech National High School Cyber Security Competition

	Competition I 2016/2017	Competition II 2017/2018
The first round:		
– total number of students	1,067	3,061
– number of successful students	565	1,852
– number of high schools	162	86
The second round:		
– total number of students	286	588
– number of students with a good knowledge	74	81
The third round:		
– venue	Brno	Prague
	Masaryk University	Police Academy
– total number of students	29	36
– number of high schools	17	26
– points: 1st place / 15th place	118.0 / 41.2	447 / 220
European final:		

– venue	Malaga, Spain September 2017	London, U.K. October 2018
– total number of Czech students	10	not known yet

Source: Own work based on data from the Czech National High School Cyber Security Competition

2.3 Selection of gifted high school students in the field of cyber security and cyber defence

The Czech National High School Cyber Security Competition could serve as a starting point for searching new required human sources for the cyber security and cyber defence.

Suggested metrics for high school assessment in the cyber defence domain could be based on

- Participation in the first round of the competition – total number of students from every participating school;
- Successful participation in the first round (students who win at least 20 % points);
- Successful participation in the second round (e.g. students who win at least 1 point);
- Successful participation in the third round (e.g. students who win at least 1 point);
- Winners of the Czech final (e.g. best 15 students);
- Successful participation in the international competition (a special care and education should be prepared for these gifted students in the next years).

Table 2.

The best high schools in cyber security education in the Czech Republic according to the first two years of the Czech National High School Cyber Security Competition

High school	**Winners I 2016/2017**	**Winners II 2017/2018**
Církevní gymnázium Německého řádu, Olomouc		1
Gymnázium Boskovice Palackého náměstí 1	1	
Gymnázium Boženy Němcové, Hradec Králové		2
Gymnázium, Český Brod		1
Gymnázium Jihlava	1	1
Gymnázium Jiřího Ortena, Kutná Hora		1
Gymnázium Jiřího z Poděbrad, Poděbrady, Studentská 166	1	
Gymnázium J. S. Machara, Brandýs nad Labem - Stará		1

Boleslav		
Gymnázium J.Š.Baara, Domažlice		1
Gymnázium Otokara Březiny a Střední odborná škola Telč	**1**	
Hotelová škola, Obchodní akademie a Střední průmyslová škola, Teplice		1
Jazykové gymnázium Pavla Tigrida, Ostrava-Poruba, příspěvková organizace	1	
Smíchovská střední průmyslová škola, Praha 5		2
SPŠE a VOŠ Pardubice	2	1
Střední odborné učiliště elektrotechnické, Plzeň		1
Střední průmyslová škola na Proseku, Praha	**3**	**1**
Střední škola informatiky poštovnictví a finančnictví Brno, Čichnova 106	**4**	**1**
Vyšší odborná škola a Střední průmyslová škola Žďár nad Sázavou	1	
Total	**15**	**15**

Source: Own work based on data from the Czech National High School Cyber Security Competition

Table 2 gives information about the Czech high schools and their best 15 students in the first two the Czech National High School Cyber Security Competitions. From the author's point of view the best education in cyber security is provided especially at high schools written in bold.

3. POSSIBLE TOOLS AND APPROACHES

Possible tools and approaches which could lead to stated learning objectives in the field of cyber security and cyber defence, should be especially set according to the age and level of contemporary general knowledge of target groups. The most suitable tools could be a mixture of lectures and practical tasks solving with the use of modern technologies prepared in compliance with the age and current knowledge of listeners. The author thinks that it is possible to recognize four main target groups with specific focus as follows.

3.1 Primary Schools

The main focus should be on mathematics, physics, IT and communication basic terms.

3.2 High Schools

Mathematics and physics knowledge should be deepened. The focus should be on IT and communication technology, programming, computer and communication networks and memory devices.

3.3 Universities

Beside top-level hardware and software, the focus should also be on law framework for use of top-level IT and communication technology.

3.4 Life-long Learning

Seminars and lectures, professional courses on IT, communication, sharing information, cooperation of expert groups and recent technology trends should be permanently provided.

CONCLUSION

Cyber security and cyber defence is based not only on sophisticated technical devices and methods but especially on top-level educated human resources, who are capable of performing demanding tasks in the field of IT, communication and law. Acquired data from the first two years of the Czech National High School Cyber Security Competition enable to select required human sources, who could be raised to strong needed cyber security professionals. An analysis of the steps and methods used for the preparation of winners of the competitions can bring valuable information which can play an important role of an irreplaceable source of knowledge which should be carefully used and improved in the future education of cyber security and cyber defence specialists.

The research goals of the paper specified in the introduction part were fulfilled but they can be developed deeper in the future. The future main tasks seem to be:

- Improve the education in mathematics and physics at primary and secondary schools as a basis for successful education of future experts in cyber security and cyber defence.
- Motivate contemporary experts in cyber security and cyber defence for their contribution in education of new generation of professionals in this field.
- Support especially English language education as the main communication language in the field of cyber security and cyber defence.

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II. THEORETICAL, METHODOLOGICAL AND PRACTICAL ASPECTS OF DISTANCE LEARNING

CALL TRAINING IN RESOURCE-LIMITED CIRCUMSTANCES: STUDENT TEACHERS' PERSPECTIVES

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Abstract: *Computer Assisted Language Learning (CALL) has been used in foreign language instruction (Krajka, 2007; Kukulska-Hulme et al., 2015; Ferguson et al., 2017) and teacher development (Krajka, 2012) so extensively that it may be viewed as a mainstream solution (Motteram, 2013). However, not all educational settings are equipped for ICT-enhanced instruction. This paper discusses the initial findings of research into the applicability of a low-intensity-of-instruction, resource-limited, semester-long basic course in CALL to teacher education at university level, as reported by the students involved. Due to spatial limitations, the findings discussed here provide insight into the student teachers' views on the tools used, their eagerness to implement Web solutions in future teaching practices and their perceptions of the use of Web 2.0 tools in foreign language teaching at large. The remainder of the research results will be discussed in a forthcoming publication.*

Keywords: teacher education, CALL, limited resources, learner empowerment, student perspectives

INTRODUCTION

Due to the extensive promotion of the idea in professional literature, technology-enhanced foreign language teaching is a matter of fact, which finds confirmation not only in the numerous publications in the field, including both theoretical literature and accounts of actual practices (cf. Krajka, 2007; Kukulska-Hulme et al., 2015; Ferguson et al., 2017, Gajek, 2018) but also in the existence of numerous international professional organisations, such as APACALL, CALICO, EUROCALL and IATEFL(LTSIG), as well as the myriad of conferences devoted to an array of aspects of CALL, e.g. GLoCALL 2018 (https://glocall.org/), EUROCALL 2018 (https://www.jyu.fi/en/congress/eurocall2018) and WORLDCALL 2018 (http://worldcall5.org).

What is more, by dint of the years of practice, the status of CALL has apparently evolved so much that technology-based language teaching has changed "(…) from being a niche field practised by a few early adopters, to being mainstream" (Motteram, 2013, p. 6). However, it cannot be taken for granted that all educational settings are currently equipped for ICT-enhanced instruction.

At the turn of the millennium, Starr (2001) reported that a number of factors, e.g. lack of funding, impeded the uptake of Information and Communication Technology (ICT) in education at that time. Yet, despite the fact that almost another two decades have passed, so can it happen today, and although it no longer means complete lack of access to educational technology, it may mean limited accessibility or limited teaching and learning resources in particular contexts, including teacher education institutions, e.g. universities.

This adds up to the challenges faced by teacher educators, who – as it is demonstrated below – need to equip the student teachers they instruct with a vast array of competences and skills which are necessary for the effective implementation of technology-based language teaching practices at all levels of education – yet, it cannot constitute an excuse that would justify the abandonment of CALL training. This paper is an attempt to demonstrate how a university-level CALL course can be taught despite limited resources, and the low quantity and intensity of instruction.

At first, it discusses the competence-and-skill-oriented teaching objectives as well as applicable models of teacher education. Subsequently, it provides an overview of guidelines for training institutions in relation to the digital teaching skillset, as delineated in European educational policy documents. Finally, it reports on research into a resource-limited CALL course taught to postgraduate university students on a teacher education programme in Poland, whose initial findings reveal the student teachers' reflections on the tools used, their eagerness to use Web solutions in future teaching practices and their perspectives on the use of *Web 2.0* in foreign language instruction at large. Due to spatial limitations, findings relating to other aspects of the course in question, e.g. the course content and learning gains

– to name a few – are beyond the scope of this paper and will be reported on in a separate publication.

1. LANGUAGE TEACHER IN THE TECHNOLOGY-ENHANCED CLASSROOM – COMPETENCES AND SKILLS

There are a number of aspects involved in the competence of a foreign language teacher. If one adds to that technology as a teaching environment and a medium of classroom instruction, the range of skills becomes much wider. To think about teachers' perceptions of CALL training in a limited-resource context, one needs to review some existing frameworks of teacher skills.

1.1 Multiple literacies (multiliteracies)

Over the years, there has been a heated debate on what the Information Literacy of language teachers should actually comprise. Digital literacy can be subdivided into two areas: instrumental – encompassing hardware, software, didactics, pedagogy, ethics and axiology, and subject matter – the use of ICT in teaching a given subject. On the one hand, it has been stressed that basic computer literacy, such as comparable to the European Computer Driving Licence level (ECDL), is a prerequisite for an online teacher, supplemented by other practical skills as indicated in the seminal proposal of Gajek (2004):

- basic computer literacy, for instance within ECDL modules;
- media literacy, enabling teachers to use the Internet for personal and professional purposes;
- didactic awareness of the ways of using computers and the Internet in and out of class;
- ability to suit the new knowledge and skills to personal teaching style and students' needs;
- ability to evaluate electronic materials;
- necessary background for the preparation and selection of electronic language learning materials;
- necessary background for running classes at a distance through the text, voice and videoconferencing channels.

For Chapelle and Hegelheimer (2004), the language teacher of the 21st century needs to be equipped with a growing set of computer skills necessary to perform jobs and stay up to date with their profession, e.g. those relating to: spreadsheet applications (*MS Excel*), database applications (*MS Access* or *FileMaker Pro*), basic statistics (using *MS Excel*), and presentation tools (*MS PowerPoint*), as well as teaching and research applications (e.g. concordancing and screen capturing software).

The second important area of expertise is digital authoring, which is about creating online materials ranging from simple interactive quizzes through webpages to online courses (Amiri, 2000). Chapelle and Hegelheimer (2004) recommend that, as a minimum, teachers should be expected to have a basic understanding of webpage design and creation including inserting hyperlinks and links to media files. Designing Computer-Mediated Communication environments (chat rooms, bulletin boards, e-mail, electronic mailing lists, and whiteboards), setting up appropriate tasks, providing guidance and moderating exchanges are Web literacy components necessary for increasing learners' communicative competence through CMC. In Stevens' opinion (2007), CALL is no longer programmed instruction contained in wrapped multimedia software packages. Instead, technology-enhanced instruction should build on computer literacies that are transferable across the curriculum, resulting in the applications of commonly available technologies as daily solutions with which to address student needs.

Amiri (2000, p. 77) claims that teachers should be trained as both consumers and producers of digital materials, as "(…) the knowledge of programming is important for enabling language teachers to become involved in the design and development of computer-based materials". For Amiri (2000), IT training for language teachers needs to become more sophisticated, to encompass various aspects of IT, end-user programming, learning, instructional design and second language acquisition (SLA) theories, with teachers developing their own materials using programming environments such as *ToolBook, Director, HyperCard* or *Visual Basic*.

At the same time, online instructors need to exhibit the ability to present the subject matter in an attractive manner utilising technological tools, being well-familiarised with technical and educational problems and providing solutions in both areas to benefit the learners. This is the practical 'troubleshooting' level of Information Literacy, which does not involve dealing with learning environment building but rather focuses on the effective application of ready-made applications in specific learning contexts. This troubleshooting knowledge could go together with language lab-related expertise, as, according to Chapelle and Hegelheimer (2004), "(…) [f]uture teachers need to be aware of the factors involved in setting up and running a language lab to be prepared to influence positively the process of either establishing a language lab or of expanding an existing one" (p. 313).

Apart from basic technical expertise and digital authoring, Information Literacy is commonly supplemented or compensated with 'Web literacy' (Chapelle and Hegelheimer, 2004), i.e. the ability to know how to use the Internet as a resource for current authentic language materials in varied formats (text, audio, video, and image), find linguistic and other reference materials and develop interesting activities around the materials on these sites. Using the Internet encompasses not only searching for information and materials and evaluating Web-based materials, but also repurposing materials for student use, adapting or recontextualising online information if needed to suit particular learning environments or pedagogical designs (Chapelle & Hegelheimer, 2004).

It is possible to define the required level of Information Literacy of particular educational contexts in relation to educational objectives, "(…) intended behaviours which the student shall display at the end of some period of education" (Bloom, 1956, p. 16), relevant to information literacy competencies, e.g. intended behaviours *in the context of information literacy* which the student should be able to display at the end of some period of education (Vitolo & Coulston, 2002). The mapping of Bloom's taxonomy of educational objectives across the five areas of Information Literacy Competency, namely hardware (physical components of a system), software (instruction sequences for a system), data (static representations of system content), procedures (tasks and activities to be performed by people in conjunction with a system) and people (stakeholders of a system) was thoroughly discussed in Vitolo & Coulston (2002).

Fitzpatrick and Davies, in their seminal report *The Impact of New Information Technologies and Internet on the Teaching of Foreign Languages and the Role of Teachers of Foreign Languages*, commissioned by the Directorate General of Education and Culture (2003), make an important analysis of the redefinition of the role of the teacher in the technology-assisted environment, together with the reflection on what skills are needed in order to succeed. These are, most of all, technical, organisational, conceptual and mediation skills.

1. Technical Skills: the ability to cope with the most common problems arising from the use of computers, with no necessity for in-depth knowledge of the causes of such problems but rather effective troubleshooting behaviour.

2. Organisational Skills: conceptualisation, application, evaluation and dissemination of new organisational and pedagogic models of ICT implementation for language learning.

3. Conceptual Skills: the skills to design learning experiences and plan learners' encounters with the target language environment, finding a new balance of classroom power and rethinking the teaching philosophy, from the case of complete control of the means at the teacher's disposal to greater control of the teaching medium by the learner.

4. Mediation Skills: exposing students to the 'real world' of the target culture in an unrestricted, uncensored and uncontrolled way with new strategies and approaches for dealing with specimens of L2 culture to be learnt and practiced for successful accomplishment of some European policy objectives (e.g., Key Competences for Lifelong Learning – Wilczyńska, 2005; 2010).

Apart from the main areas of skills characterised above, the report also stresses the necessity of the possession of "new literacies" for successful execution of the role of teacher in the online environment (after Fitzpatrick & Davies, 2003, p. 14):

Scientific literacy: the ability to think scientifically in a world which is increasingly shaped by science and technology, the ability to apply a scientific perspective

Digital literacy: the ability to use ICT adequately and apply them in a principled way to the subject matter at hand;

Critical literacy: the ability to evaluate the credibility, usefulness and reliability of any given sources of information;

Linguistic literacy: the ability to recognise different genres as they develop, to track developments in use and usage and to adapt teaching materials and approach to changing situations;

Cultural literacy: the ability to observe and record changes in the society or societies of the target language together with implications for language teaching.

As this presentation shows, there are varied views on how deep teachers' expertise should be technology-wise, to what extent they are supposed to be consumers and producers of digital learning content, and what balance between technological, pedagogical and evaluative aspects should be achieved in the overall CALL training programme. What goes without saying, however, is that CALL training needs to encompass much more than just technical expertise. In fact, given a wide range of skills required of effective technology-skilled teachers and roles played by them in the technology-enhanced classroom, CALL teacher preparatory courses are an opportunity for intercultural, sociopedagogical or strategic activities.

1.2 CALL Teacher Development Models – from 'Skills Pyramid' to 'Continuum of Expertise'

The competences required by a CALL teacher, in particular an online tutor or instructor implementing language teaching in a distance or blended learning environment, are explicitly described by Hampel and Stickler (2005), whose *pyramid* model comprises seven skill levels covering technical expertise, knowledge of the affordances, socio-affective skills and subject knowledge. The skills "(…) build on one another, from the most general skills forming a fairly broad base to an apex of individual and personal styles" (p. 316), and in this model lower-level skills are to be achieved before the higher-level skills can come to fruition (Hauck & Stickler, 2006).

After the first level, encompassing basic technical skills, there comes contextual competence for particular software (or online applications), either Course Management Systems, Computer-Mediated Communication tools, social media platforms or production tools. It is essential to note that the very familiarity with some tools (level 2) is not synonymous with its effective implementation in the curriculum, as this requires an understanding of their affordances and constraints (level 3).

Further levels deal with the abilities to build interpersonal relations online (level 4 – 'online socialisation'), promoting social cohesion and enabling effective communication in the CMC mode (level 5 – 'facilitating communicative competence'). The final two levels, similarly to the first three, are universal no matter what particular technology or tool is to be used. Level 6 ('creativity and choice') encompasses innovative pedagogical applications of the selected technology, as well as the skill of evaluating and repurposing materials (Chapelle & Hegelheimer, 2004). The seventh and highest level of skills for online language teaching includes the ability to develop a "(…) personal teaching style, using media and materials to their best advantage, forming a rapport with [the] students and using the resources creatively to promote active and communicative language learning" (Hampel & Stickler, 2005, p. 319).

On the other hand, Compton's (2009) *Continuum of expertise* model originated primarily from the critique of Hampel and Stickler's (2005) *Pyramid skills* model. Compton argues that the skills necessary for a CALL teacher do not have to be acquired sequentially but concurrently, that some of the levels (like acquiring specific technical competence and dealing with constraints and possibilities) actually merge together and finally, that it is unrealistic to expect that only the teacher who reaches the last level is ready to teach online.

Thus, the framework for describing CALL teacher competences encompasses three major areas:

1) technology in online language teaching;
2) pedagogy of online language teaching;
3) evaluation of online language teaching.

Within each of these areas teacher skills can be described to fit one of the three levels of expertise: novice, proficient and expert. Not every language teacher needs to achieve the expert level in all the three areas – in some educational contexts the very technology can be at lower levels, but pedagogy comes first. On the other hand, in some other kinds of schools or courses evaluation skills for CALL materials, activated together with coursebook evaluation abilities, are in the foreground. Thus, it is important to state that limited expertise in one area does not exclude higher proficiency and greater sophistication of teaching in the others.

The first set, technological skills, relates to knowledge and ability to handle hardware and software issues. For novice teachers, the ability to turn on a computer, use a mouse and a basic knowledge of simple applications such as word-processing and the Internet are a starting point, followed by learning about the differences between asynchronous and synchronous technologies and being comfortable while using text/audio/video-based Computer-Mediated Communication. On the other hand, a technologically proficient teacher, according to Compton (2009), would also need to deal with the limitations of the chosen software and provide solutions to overcome them as well as adapt tools or recombine them to compensate for their limitations.

Compton's (2009) second category, pedagogical skills, refers to knowledge and ability to conduct and facilitate teaching and learning activities. At the novice level, the emphasis is on the teacher to acquire adequate information or knowledge; the expert level, however, centres around creative use knowledge and its application for designing new online materials and tasks, online socialisation and community building as well as assessment.

As regards evaluative skills, a novice teacher would need to possess the knowledge of CALL and/or online language learning tasks, software and course evaluation, while an expert teacher is able to conduct the evaluation process in an integrative way, by combining several methods of evaluation, as well as to identify the impact on learning outcomes based on their extensive knowledge of evaluative frameworks.

As evidenced by the frameworks summarised above – by no means all, as the list of competences and skills for teachers in CALL/MALL/online/blended learning classrooms is constantly expanding – it seems virtually impossible to cater for all of these areas in the teacher training programme, to take pre-service teachers from the novice to expert level in both technological, pedagogical and evaluative areas, or to make them acquire all the competences and literacies to the same level. Given the context in which the current research was based, namely low-intensity and resource limitations as the two major indicators of the instructional setup, it is inevitable that choices need to be made and foci need to be carefully established. Most importantly, capitalising on the technological expertise already possessed by student teachers (even if it means a mixed-technologically-ability class) and concentrating on the pedagogical and evaluative skills seems to be a sensible solution. In this respect, rather than adhering to the linear and sequential *pyramid* model (Stickler & Hampel, 2005) and expecting certain abilities to appear after some other ones, toning down instructor objectives and limiting oneself to developing critical and a creative pedagogical attitude towards teaching with technology would be the best option. Hence, Compton's (2009) *Continuum of expertise* seems more applicable with student teachers possessing varying levels of technological proficiency but a relatively equal and high level of pedagogical expertise.

2. TECHNOLOGY AND LANGUAGE TEACHERS – THE EUROPEAN POLICY PERSPECTIVE

Apart from sets of skills, competences, abilities and attitudes that are to be grasped by language teachers to be effective technology-enhanced educators, there are certain guidelines on what teacher training institutions should do in terms of digital teaching skillset. Such recommendations come from policy documents issued by the European law-makers, implementation tools developed for the Council of Europe by researchers and teachers as well as actual data revealed by European and national statistical offices. This perspective will be presented below.

2.1 European Portfolio for Student Teachers of Languages

Even though relatively little was said about teaching with technology skills in the major document marking the modern era of standardised language teaching and learning, namely the *Common European Framework of References for Languages – Learning, Teaching, Assessment* (Council of Europe, 2001), the skills necessary for harnessing technology to fit pedagogical purposes became an important part of the *European Portfolio for Student Teachers of Languages – EPOSTL* (Newby et al., 2007). This highly practical tool for individual teachers guides them in their professional development throughout their entire career and is an important contribution to defining didactic competences necessary for effective language teaching in the multicultural and digitised educational landscape of the 21st century.

The core of *EPOSTL* are the 193 descriptors of competences related to language teaching which comprise the self-assessment section. These descriptors may be regarded as a set of core competences which language teachers should strive to attain. The descriptors are grouped into seven categories: Assessment of learning, Independent learning, Conducting a lesson, Lesson planning, Context, Methodology and Resources. These represent areas in which teachers require knowledge and a variety of competences and need to make decisions related to teaching. Each heading has been sub-divided into more specific sub-areas of pedagogical expertise.

In terms of CALL pedagogical training, the most important descriptors are to be found in the area of Independent learning, under the sub-topic of "Virtual Learning Environments":

1) I can use various ICT resources (email, web sites, computer programs etc.);

2) I can advise learners on how to find and evaluate appropriate ICT resources (web sites, search engines. computer programs etc.);

3) I can initiate and facilitate various learning environments (learning platforms, discussion forums, web pages etc.).

However, the awareness of affordances and limitations of technology, together with potential advantages and drawbacks of computer/mobile-based teaching can also be found in the section "Institutional Resources and Constraints":

4) I can assess how I might use the resources available in my school (OHP, computers, library etc.);

5) I can recognise the organisational constraints and resource limitations existent at my school and adapt my teaching accordingly.

In the area of Methodology, the sub-section "Culture":

6) I can create opportunities for learners to explore the culture of target language communities out of class (Internet, emails etc).

In the area of Resources:

7) I can locate and select listening and reading materials appropriate for the needs of my learners from a variety of sources, such as literature, mass media and the Internet;

8) I can select and use ICT materials and activities in the classroom which are appropriate for my learners;

9) I can design ICT materials and activities appropriate for my learners;

10) I can guide learners to use the Internet for information retrieval;

11) I can use and critically assess ICT learning programs and platforms.

In the area of Conducting a Lesson, sub-section "Classroom Management":

12) I can manage and use instructional media efficiently (OHP, ICT, video etc.);

13) I can manage and use instructional media efficiently (OHP, ICT, video etc.).

As can be seen above, the philosophy laid down by *EPOSTL* clearly shows the major focus of CALL training of novice teachers mainly in the area of evaluation and learning management, without specific reference to particular tools, programs, websites or procedures. It is evident that regardless of how technologically-rich the educational contexts in which teachers actually reside are going to be, the same set of competences, as composed of the 13 descriptors above, is equally applicable. The same applies to technological provisions at teacher training institutions – regardless of how much time and technology is available for training – the 13 descriptors adding up to a technology-skilled teacher can be effectively developed by limiting the scope of technologies under focus.

2.2 European Profile for Language Teacher Education (EPLTE)

Another important source of guidance for CALL initial training is *European Profile for Language Teacher Education – EPLTE* (Kelly, Grenfell, 2004), which "presents a toolkit of 40 items which could be included in a teacher education programme to equip language teachers with the necessary skills and knowledge, as well as other professional competencies, to enhance their professional development and to lead to greater transparency and portability of qualifications" (p. 3). As the authors state themselves in the introduction to the volume, it is not a mandatory set of requirements for language teacher education, but rather a voluntary frame of reference for curriculum designers and teacher trainers to adapt to the local needs of language educators.

The *Profile* contains 40 items describing important elements in foreign language teacher education in Europe, subdivided into four sections:

1) Structure (items describing the different constituent parts of language teacher education),

2) Knowledge and Understanding (items relating to *what* trainee language teachers should know and understand about teaching and learning languages as a result of their initial and in-service teacher education),

3) Strategies and Skills (items relating to what trainee language teachers should *know how* to do in teaching and learning situations as teaching professionals),

4) Values (items relating to the values that trainee language teachers should be taught to promote in and through their language teaching).

Since the four sections are to be viewed holistically for a comprehensive and multi-faceted picture of a language educator for the 21st century, it is interesting to see to what extent technology-enhanced teaching is actually reflected in the final profile:

Table 1.

A language educator for the 21st century

Structure	**Knowledge and Understanding**	**Strategies and Skills**	**Values**
6. Participation in links with partners abroad, including visits, exchanges or ICT links	17. Training in information and communication technology for pedagogical use in the classroom	23. Training in the critical evaluation, development and practical application of teaching materials and resources	40. Training in the importance of life-long learning
13. Training in language teaching methodologies, and in state-of-the-art classroom techniques and activities	18. Training in information and communication technology for personal planning, organisation and resource discovery	26. Training in the development of independent language learning strategies	

Source: Own work

The major teacher training philosophy of *EPTLE* is laid down in item 17 and item 18 in the Knowledge and Understanding section. It is interesting that language educators should know how to integrate ICT into other teaching areas, use it as a resource and support – not an end in itself – promoting learner autonomy through expanding learning opportunities. Training should consist of a combination of technical skills in ICT and practical application of techniques to classroom teaching scenarios, which are to be taught through task-based learning approaches. Quite importantly, for the authors of the *Profile*, ICT is not an add-on or a reward for a good lesson but as integral learning. Thus, since trainees should learn how to use ICT to maximise a lesson's learning outcomes, the interest and enthusiasm of their learners will appear as a result of instructional procedures, not due to the very use of technology. At the same time, the importance of limitations of technology use, the need for having clearly outlined learning objectives and outcomes and training with ongoing reflection on the pedagogical values of ICT that is not focused merely on technical competence are the pillars of successful teacher development.

Apart from instructional use as exemplified in Item 17, the auxiliary role of technology in teacher practice is described in Item 18 (Training in information and communication technology for personal planning, organisation and resource discovery). The role of teacher educators is to show trainees the value of ICT for organising their own workload and schedules, retrieving and developing resources and archiving documentation. This entails, among others, skills in using word processing and data processing packages, online agendas and email, search engines, educational websites, interactive website forums, resources and databases.

Finally, technology-enhanced procedures are also present to some extent in other areas of teacher expertise shown in the table above. These find their practical implementation in the following techniques (extracted from *EPTLE*, 2004):

> 6. Trainee teachers are aware of the diverse ways to **communicate** and **exchange information** and **resources** with partners abroad. As well as visits to partner institutions, there are benefits from **written exchanges, e-twinning of institutions, interactive forums between institutions, email and video-conferencing.**
>
> 13. ICT is related to specific learning situations so that trainees learn about technical matters as well as ICT's practical application in the classroom. ICT should be used as an integral part of a lesson rather than an add-on to it. The value added by using it should always be clear.
>
> 23. Trainee teachers understand the role of different types of teaching materials and resources in their teaching. They are taught to apply them critically and effectively. The materials in question include **textbooks, authentic documents, video and tape cassettes, CD ROMs and online materials**.
>
> 26. Trainee teachers develop independent language learning strategies to improve their language competence and to be able to transfer these skills to their own learners. New learning environments such as **virtual resources, language centres**, multicultural learning environments as well as up to date **course books** and materials play a major role in developing independent language learning.
>
> 40. Trainee teachers are able to highlight the value of ongoing language learning outside an institutional context. Trainees are able to show

learners how to use **ICT** to maintain and improve their **language abilities** independently.

2.3. CEFR Companion Volume

The most important and most current offering of the European language policy which influences reflection on technology-related competences of language teachers is the Companion Volume to the Common European Framework of Reference for Languages (Council of Europe, 2017). Intended as a complement to CEFR, it represents another important step in a process that has been pursued by the Council of Europe since 1971. Since 2001 edition of CEFR there have been a number of requests made by language teaching professionals across Europe and beyond to complement the original illustrative scales with more descriptors. The 2017 edition contains the following components:

- A text explaining key aspects of the CEFR for teaching and learning;
- Updated versions of the 2001 scales (gaps filled: better description at A1 and the C-levels, new analytic scale for phonology);
- Descriptors for new areas: mediation (including reactions to creative text/literature), online interaction, and plurilingual/pluricultural competence;
- Examples for the mediation descriptors for the four domains public, personal, occupational, educational;
- A brief rationale for each descriptor scale (old as well as new);
- A brief account of the development project.

Out of these, the most important element for technology-skilled language educators is the new scale for online interaction, which shows what particular abilities learners should have at all the six levels (from A1 to C2) in order to effectively function in computer-mediated interactions with other learners, native and non-native speakers. Also, the paramount role of mediation and plurilingual competence in the Companion volume calls for greater reflection of teacher trainers on how to make future teachers ready for dealing with telecollaborative language instruction.

As the authors of the Companion Volume claim, online interaction is always mediated through a machine, which implies that it is unlikely ever to be exactly the same as face-to-face interaction. Online interaction is so different from traditional competence that it was impossible to capture its nature with the traditional competence scales focused on individual's speech or writing. On the one hand, in online interactions there is an availability of resources shared in real time; however, there may be misunderstandings which are not spotted (and corrected) immediately, as is often easier with face-to-face communication. The scale for online interaction deals with how interlocutors communicate in conversations and discussions to handle both serious issues and social exchanges. The topics that are conceptualized in the reference scales are as follows:

- instances of simultaneous (real time) and consecutive interaction, the latter giving time to prepare a draft and/or consult aids;
- participation in sustained interaction with one or more interlocutors;
- composing posts and contributions for others to respond to;
- comments (e.g. evaluative) on posts, comments and contributions of others;
- reactions to embedded media;
- the ability to include symbols, images, and other codes for making the message convey tone, stress and prosody, but also the affective/emotional side, irony etc.

Progression up the scale from A1 to C2 is reflected in the amount of awareness of the register needed in particular speech contexts, the understanding of the virtual spaces in which communication is taking place and the amount of guidance provided to the learner (Council of Europe, 2017, p. 93):

> A user/learner will struggle to interact successfully in an online meeting until he/she reaches the B levels, will be able to interact in a virtual 'classroom' at A2 only if carefully guided, and maybe can communicate only very superficially at A1 when posting and chatting in the 'café'. At the C levels, on the other hand, the user/learner can adapt his/her register and interaction style according to the virtual space he/she is in, adjusting his/her language appropriately to make his communication more effective.

It goes without saying that the ubiquitous nature of online interaction nowadays, with an inescapable role of social media in all walks of life, also requires an essential instructional focus in CALL initial teacher training.

3. NEW MEDIA IN ELT – A BASIC TEACHER TRAINING COURSE IN CALL IN STUDENTS' PERSPECTIVES: THE SURVEY STUDY

The research data obtained in the course of the present study were collected at the end of two consecutive editions of a university-level teacher education course in the implementation of digital technology in language instruction. The data collection was performed in June 2017 and in June 2018, which means that the study can be classified as cross-sectional in nature. The details of the research setting, including information about the research aims, research questions, procedures, as well as the results obtained are discussed below.

3.1. Research Questions and Aims

The aim of the study was to investigate student teachers‘ opinions on the potential outcomes of an attempt to implement limited Information and Communication Technology resources with a view to empowering them to use digital technology in their future teaching practices. The researchers involved in the study were particularly interested in the student teachers‘ voice on the usefulness of the ICT tools they had an opportunity to learn and work with and the course content, their stance on the use of Web-based language teaching, their perception of potential learning gains as well as deterrents which could possibly discourage them from practising ICT-enhanced language instruction as part of their professional practices after graduation.

Thus research was motivated by the following research questions:

- **RQ1:** How do the student teachers perceive the usefulness of the Web resources they worked with?
- **RQ2:** Do the student teachers feel eager to use Web tools in their teaching practices after graduation?
- **RQ3:** What are the student teachers' perceptions of the use of Web 2.0 tools for the purpose of foreign language teaching?
- **RQ4:** What do the student teachers see as deterrents which could discourage them from implementing CALL solutions?
- **RQ5:** How do the student teachers perceive the less obvious components of the course content?
- **RQ6:** What are the student teachers' perceptions of the learning mode and resulting learning gains that they claim to have benefited from?
- **RQ7:** How would the student teachers modify the course design, bearing in mind the limited quantity and intensity of instruction?

However, as it has been signalled before, due to space limitations, only the results of the study which provide answers to RQ1, RQ2 and RQ3 will be discussed in the remainder of this paper. Findings relating to RQ4, RQ5, RQ6 and RQ7 will be reported on in a forthcoming publication.

3.2. The Participants and the Instructional Context

The course under investigation was entitled New Media in English Language Teaching, and it was delivered as part of a post-graduate (MA) programme in English teacher/translator education at a middle-sized university located in the south-east of Poland. The course was taught in the summer semester of two consecutive academic years: 2016/2017 and 2017/2018 and involved 7 bi-weekly face-to-face meetings which spanned the entire semester. It was an *embedded technology* blended learning course (cf. Sharma & Barrett, 2007) in that digital technology was utilised in the very classroom. Yet, face-to-face instruction was also supplemented with an online component, delivered via a Moodle-based learning platform, whereby the students had an opportunity to consolidate their classroom work while working at home. Owing to the functionalities of the platform, e.g. the wealth of learning resources it offers (readings, videos, PowerPoint presentations, sample materials for analysis) and the activities it permits to design (forums, diaries, questionnaires, assignments), the course learning hours were considerably extended.

The teaching content was based on an original, purpose-designed syllabus which aimed to achieve the following goals:

- explore the nature of contemporary foreign language education: learner profile and learning needs;
- raise awareness of the methodology behind ICT-enhanced language teaching;
- examine Web 2.0 resources which lend themselves to Computer Assisted Language Learning (CALL);
- practise CALL materials design for the development of major language skills by implementing relevant methodological principles and ICT (Web) skills.

The course was student-oriented, with the student teachers confronting learning challenges on their own, in pair or groups. Thus, it may be stated that the learning involved a solid amount of peer-learning and peer-support, as the participants were free to interact and collaborate with – as well as assess – one another with a view to co-construing knowledge and developing relevant ICT and CALL skills, while the teacher's role was limited to that of an organiser, whose major task was to *occasion* (Kiraly, 2015) the development of the students' competence in CALL, and ICT.

It must be underlined that the it was a resource-limited course, particularly with regard to the availability of computers and Web connectivity. In the 2016/2017 edition of the course, the student teachers worked on individual desktop computers, running on the Windows XP operating system by Microsoft, with very little Random Access Memory (RAM), pre-installed Windows XP applications and Local Area Network (LAN), i.e. cable, Web connectivity available on only 4-6 of the 15 computers available in the classroom in each meeting. In the 2017/2018 edition the working conditions were modified in order to resolve the hardware/software problems, and the students worked on a Bring-Your-Own-Device (BYOD) basis. In effect, the students worked on Windows 8 and Windows 10 personal laptops and they all had Web connectivity ensured via portable Web modems or the Eduroam Wi-Fi network available at school. The results of the study may thus be helpful in designing foreign language teacher education courses in CALL at university level in resource-limited circumstances.

The participants of the project were 33 day students (N=33) in their second year of the postgraduate (MA) programme in English Language Teaching and Translation. 13 students (N=13) formed the group that participated in the 2016/2017 edition of the course in New Media in ELT, while 20 students (N=20) completed the 2017/2018 edition. The research sample was strongly dominated by females (N=32), with only one participant being male (N=1), which reflected the female-dominated nature of the profession. In terms of professional experience, the participants constituted a mixture of job-experienced and pre-experienced teachers of English as Foreign Language (EFL).

Each of the f2f meetings was devoted to a separate topic. The learning occurred in a flipped mode in that before each class the students needed to read up on the topic of the forthcoming meeting in order to explore the theoretical underpinnings of what they were subsequently to do in practical terms in the classroom and for homework. The actual course content is listed below, together with the Web resources which the student teachers worked with in and outside the classroom:

- Introduction to rapid changes in (ICT-enhanced) education and Web searching skills and strategies for teachers;
- ICT-enhanced listening (ESL Video and Audacity);
- ICT-enhanced speaking (Photobabble, Storyboard That);
- ICT-enhanced reading (Scavenger hunts, QuestGarden, Storyboard That);
- ICT-enhanced writing (Collaborative writing TitanPad/PrimaryPad], Storyboard);
- CALL materials evaluation and selection (evaluation criteria);
- Course round-up and feedback.

Each time, once the students explored the Web tools relevant to a given topic in the classroom via self-learning or collaboration, they were assigned a homework task to be completed individually, in pairs, or in groups of three which required them to use one of the newly-learnt tools in order to design a specific EFL learning activity. It was ensured through the task rubric that while designing their activities the participants needed to be guided by the methodology beyond the activity they prepared, not by the very technology used. That is why for each of the activities designed they had to tag it with basic specifications, including the teaching/learning goals, the target learner group (age and level of competence) and the timing. Additionally, they were also supposed to provide a written description of the procedure for task performance and append it with teachers' notes, which were supposed to highlight potential problems or vital steps in task preparation.

3.3. Research Instrument: The Structure of the Survey

The research data were collected by means of a survey which contained a combination of close-ended and open-ended questions, 20 in total. The questions fell into 7 question sets, corresponding to the main research questions cited above.

RQ1 was examined through Questions 1, 2, 3 and 4. Web resources were operationalised as both Web tools (e.g. ESL Video) and Web-based techniques (e.g. Scavenger Hunt). Questions 1 and 3 each contained a list of the Web resources, i.e. both Web tools and Web-based techniques, used during the New Media in ELT course and required the respondents to indicate which ones they found the most useful and the least useful, correspondingly. Questions 2 and 4 were both open-ended and they involved justifying responses given to Questions 1 and 3.

RQ2 was operationalised as Questions 5 and 6. Question 5 asked the respondents to state whether, having completed the course, they felt they would be using Web tools in their teaching practices, while Question 6 permitted the student teachers to motivate their responses.

RQ3 was broken down into Questions 7 and 8. They were both open-ended questions which helped the researchers examine the advantages (Q7) and disadvantages (Q8) of the use of Web tools in language teaching that the respondents perceived.

The remaining research questions, which are beyond the scope of this publication, will not be discussed in detail. Suffice it to say that RQ4 was investigated through a single survey question (Question 9); RQ5 was examined through Questions 10, 11, 12, 13, 14 and 15; RQ6 was represented in the survey by Questions 16, 17, 18 and 19; and RQ7 was operationalised as a single open-ended question (Q20).

3.3. Research Findings

The data obtained through close-ended questions were analysed quantitatively, while those obtained through open-ended questions were subject to qualitative analysis, with the caveat that in the case of the latter type of questions qualitative data were categorised and quantified whenever it was possible.

1. Student teachers' perceptions of the usefulness of the Web resources they worked with

The largest proportions of the respondents indicated that the most useful Web resources for them were: Storyboard That (63.6%) – a cloud-based service for designing online cartoons, ESL Video (57.6%) – an online service for creating audio-video quizzes, QuestGarden (42.4%) – an online platform for creating and publishing Webquests (cf. Dodge, 2000) and TitanPad/PrimaryPad (33.3%) – an online text editor permitting team writing in real time. A graphic illustration of the complete results is presented in Figure 1.

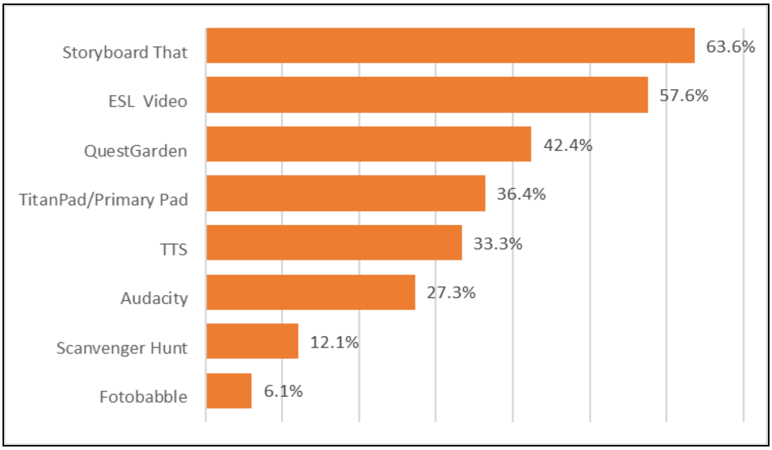

Figure 1. Most useful Web resources selected by student teachers (N=33)

Source: own work

However, it is also interesting to see how the responses were distributed within the two research sub-samples: (i) the group which used low quality computers in the 2016/2017 edition of the New Media in ELT course (LQ comps) and (ii) those who used their own devices in the 2017/2018 edition of the course (BYOD), which may indicate how the very hardware that the student teachers used may have affected their choices.

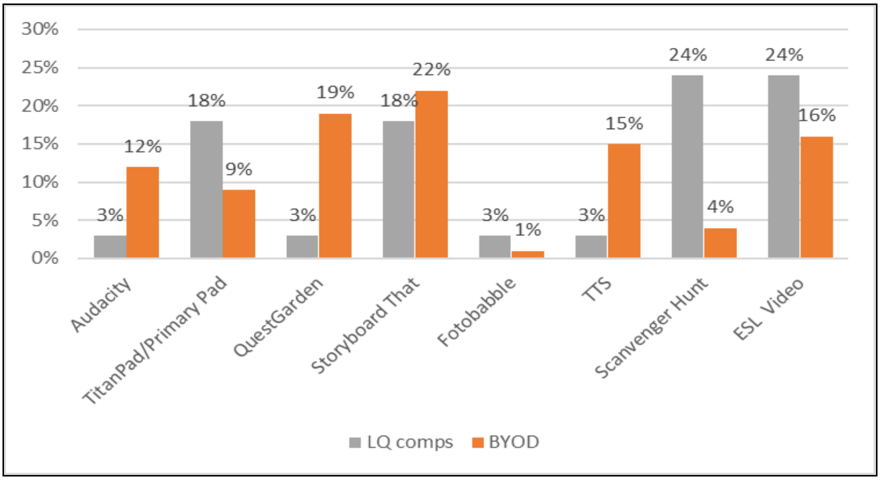

Figure 2. Most useful Web resources selected by student teachers in the LQ Comps group (N=13) and the BYOD group (N=20)

Source: own work

In the LQ Comps group, the Web resources selected most frequently as the most useful were: ESL Video (24%), Scavenger Hunt – a technique involving extensive Web searching (24%), Storyboard That (18%) and TitanPad/Primary Pad (18%), while in the BYOD group the tools selected most frequently were: Storyboard That (22%), QuestGarden (19%), ESL Video (16%) and Text-to-Speech – a service permitting the automated conversion of written text into spoken language (15%) (cf. Figure 2).

It can be observed that in both groups ESL Video and Storyboard That were among the resources deemed as the most useful. At the same time, the greatest discrepancy between the two groups occurred with regard to Text-to-Speech (12% difference), Audacity (9% difference) – an installable audio file editor, TitanPad/Primary Pad (9% difference) and ESL Video (8% difference).

The largest proportions of respondents selected the following tools as the least useful: Fotobabble (30.3%), Text-to-Speech (27.3%) and Audacity (15.2%). A graphic illustration of the complete results is presented in Figure 3.

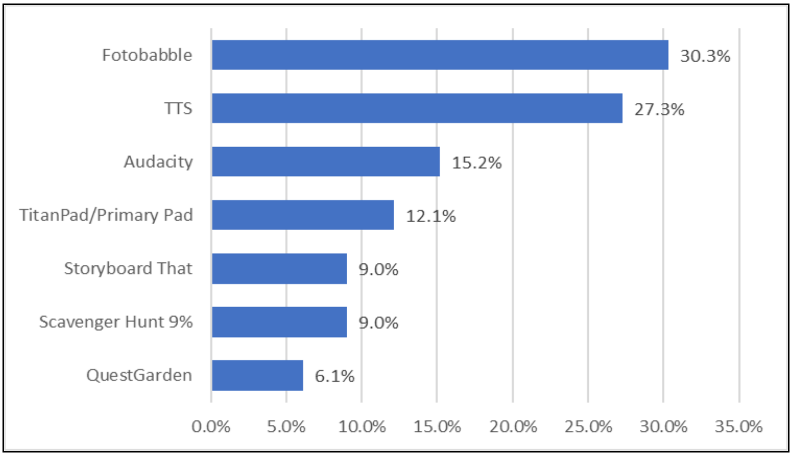

Figure 3. Least useful Web resources selected by student teachers

Source: own work

The distribution of responses in both groups was as follows: in the LQ Comps group, the Web resources selected most frequently as the least useful were: Fotobbable (33%), Text-to-Speech (29%), Storyboard That (18%) and Audacity (14%), while in the BYOD group the tools selected most frequently were: Scanvenger Hunt (28%), TitanPad (16%), Fotobabble (12%) and Text-to-Speech (12%). The complete results are illustrated graphically in Figure 4.

All in all, in response to Research Question 1, it can be stated that the student teachers examined considered as the most useful those resources that permitted the incorporation of multimedia (ESL Video and Storyboard That). What draws attention is the relatively little appreciation for the QuestGarden tool and a much more positive stance on the Scavenger Hunt technique in the group that used low quality computers during the class (LQ Comps). Both resources are similar in that they each require learners to perform online searching: guided and free, respectively. It might be hypothesised that the LQ Comps group displayed a much stronger preference for Scavenger Hunt, as preparing on online hunt does not require extensive use of ICT. Basically, it is enough for the teacher to prepare a list of questions to which learners will seek answers online, thus it is easy to prepare even on a low-quality computer. QuestGarden, however, requires the teacher to perform far more online searching – and use reliable technology – so that they can find, examine, validate and short-list a number of specific websites that learners will be expected to use for information searching in order to complete the task.

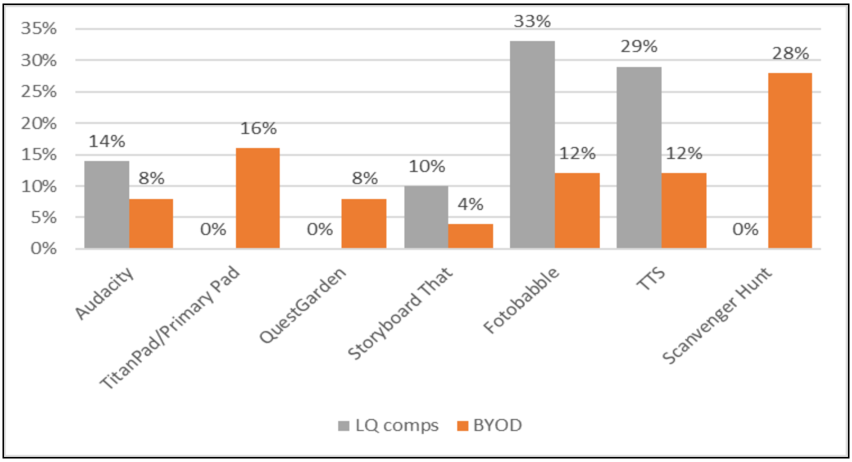

Figure 4. Least useful Web resources selected by student teachers in the LQ Comps group (N=13) and the BYOD group (N=20)

Source: own work

2. Eagerness to use Web tools in future

A vast majority of the respondents (93.9%) claimed that they were likely to use Web tools in their future teaching practices. Only two of them (6.1%) maintained they would not do so; both were members of the LQ Comps group. Among the various motives which they mentioned the ones that prevailed were: the power of Web tools to make lessons more interesting and enjoyable for learners (33.3%), the fact that the tools diversify lessons (21.2%), their potential versatility and suitability for a range of teaching objectives, including the development of various language skills (18.2%), and their power to motivate learners (21.2%). It merits a mention that 12.1% of the respondents stated that they had already witnessed the motivating effect of Web tools on students in their teaching to date. 15.2% of the respondents expressed the belief that Web tools were an indispensable teaching aids which constituted learners' natural environment and assisted the latter group in learning in a more natural way.

The other reasons for the use of Web tools in language teaching which the respondents cited included the power to: enhance learning at large, facilitate individual and collaborative work, supplement coursebook materials, increase the effectiveness of instruction, equip learners with skills useful for their jobs, support students with different educational needs, and increase learner involvement.

Interestingly enough, 15.2% of the students explicitly made the reservation that they would not utilise Web tools on a permanent basis due to the time required for task design, possible technical problems. They added that they would exercise restraint in the use of Web tools so that they could be used only if the technology available at school was adequate, and if the tools to be used were likely to truly facilitate the learning process.

The two students who stated that they would not use Web tools in their teaching practices motivated their decision with the claim that today's learners used computers to such a great extent outside school that they should be kept offline at school.

By and large, it may be stated that despite the technical issues and challenges faced by student teachers from both groups, a clear majority of them expressed eagerness to implement CALL solutions in their future teaching practices.

3. Perceptions of the use of Web tools for language teaching purposes

The respondents suggested a number of advantages and disadvantages which, in their opinion, characterise the utilisation of Web tools in language teaching.

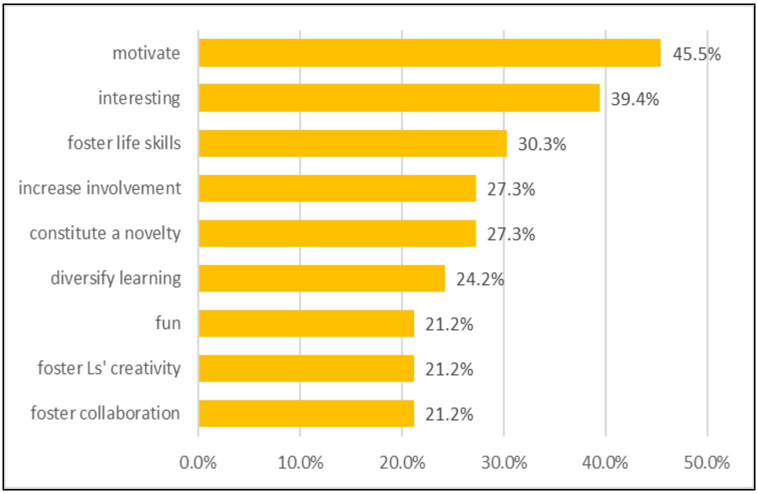

Figure 5. The most frequently cited advantages of the use of Web tools in language teaching (N=33)

Source: own work

Among the most frequently cited advantages were: the power of Web tools to: motivate learners (45.5%), and make lessons more interesting (39.4%), foster the development of an unspecified range of skills useful in learners' future lives (30.3%), increase involvement (27.3%), introduce innovation to the classroom routine (27.3%), diversify learning by involving learners in a range of learning modes (24.2%), make lessons an enjoyable experience (21.2%), foster learners' creativity (21.2%) and promote collaboration (21.2%) (cf. Figure 5).

The disadvantages which the respondents suggested constituted a much smaller group of characteristics, cited by visibly smaller proportions of the surveyed. A clear majority of those surveyed cited potential technical problems (66.7%), which could involve issues relating to Web connectivity, hardware and software problems as well as limited accessibility of online technology at school. Much smaller proportions of the student teachers also mentioned: unspecified limitations of particular Web tools (9.1%), the risk of health issues induced by the use of computers (9.1%), the time necessary to select and learn how to use specific Web resources (6.1%), and limited control over learners' activity during online tasks (6.1%) (cf. Figure 6).

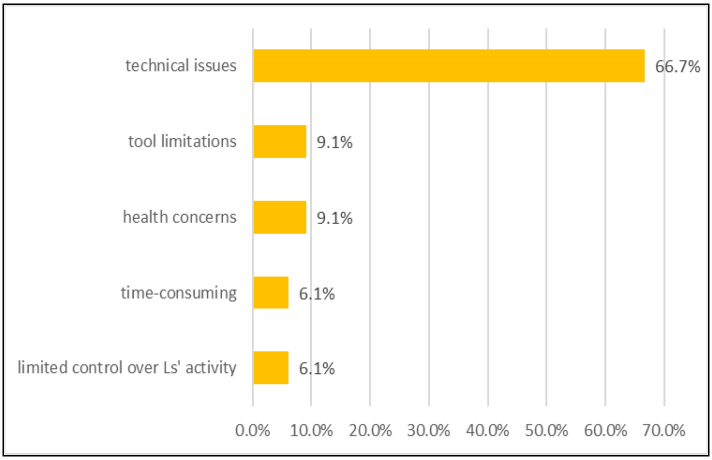

Figure 6. The most frequently cited disadvantages of the use of Web tools in language teaching (N=33)

Source: own work

An interesting picture of the student teachers' perceptions of Web tools surfaced when the greatest disparities were identified between the proportions of respondents who cited particular advantages and disadvantages (cf. Figure 7).

The largest disparity (42.9%) was observable between the proportion of respondents from the BYOD group (53.8%) and that of their colleagues from the LQ Comps group (15.4%) who claimed that Web tools saved teachers' and learners' time, thus potentially increasing the efficiency of the learning process. A similarly large disproportion (38.5%) was identified between the groups when their members stated that Web tools reduced learners' stress levels (46.2% in the BYOD group to 7.7% in the LQ Comps group).

Disproportions at the level of roughly 23% between the groups were also observed when their members maintained that Web tools were fun for learners (38.5% to

15.4%), they helped develop teachers' ICT skills (23.1% to 0%) and increased the complexity level of learning tasks (69.2% to 46.2%).

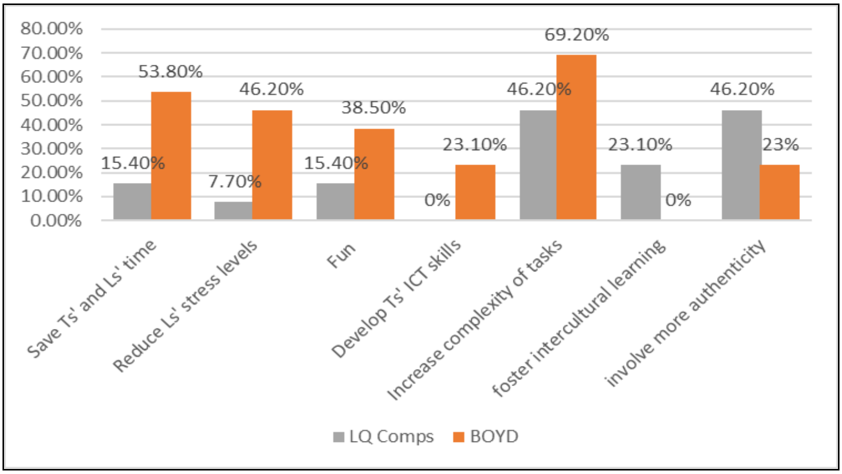

Figure 7. Largest disparities between the LQ Comps (N=13) and the BYOD group (N-20)

Source: own work

It is worth noticing that the realisations cited above occurred to larger proportions of the student teachers who used better quality equipment, i.e. those who worked on a Bring-Your-Own-Device basis. Consequently, it could be hypothesised that certain features of Web tools were more salient to those student teachers who did not struggle with basic technical issues during the course classes. Yet, this conclusion must be approached with caution as in two cases a disparity of roughly 23% – this time to the advantage of the LQ Comps group – was observed in another two cases: (i) when the students claimed that the use of Web tools fostered the development of intercultural learning (23.1% in the LQ Comps group to 0% in the BYOD group) and (ii) when they stated that Web-based tasks involved more authenticity (46.2% in the LQ Comps group to 23.1% in the BYOD group).

Overall, it seems that despite all the technical issues and challenges, the student teachers perceived the implementation of Web resources in a positive fashion and cited a range of potential advantages that Web-based teaching has. Paradoxically, the unfavourable conditions turned out to be beneficial in that they brought to the fore at least some of the problems that the use of Web resources may entail.

CONCLUSION

In the light of the research findings presented above, a number of conclusions emerge.

Firstly, it may be concluded that student teachers appear to tolerate technical problems if ICT resources permit them to design multimedia tasks (ESL Video, Storyboard That). It must be borne in mind, however, that the quality of equipment used in teacher education may affect student teachers' perceptions of particular resources, and while selecting CALL resources, they may later rely on ease of use rather than on the methodological merits of particular solutions.

Secondly, if the technology available in teacher education institutions does not necessarily meet expectations and actual needs, its quality must not be used as an excuse to reduce CALL training or exclude it from the study programme. As the results indicate, even the use of low quality computers and the necessity to deal with technical issues are likely to promote the idea of CALL among student teachers, and they do not seem to discourage teacher trainees from implementing CALL solutions in their own teaching practices after graduation.

Thirdly, it turns out that even unfavourable technical conditions lend themselves to increasing student teachers' awareness of the affordances that Web-based teaching offers. Despite obvious hardships, the student teachers noticed the motivational role of Web-based instruction, the interest it is likely to generate in learners and the facilitative role it has in the development of language and non-language skills. Paradoxically, the unfavourable conditions added to the learning gains in that they drew the student teachers' attention to potential challenges they may face while implementing CALL.

The remainder of the results, which are yet to be published, will yield insight into other aspects of the course under investigation, i.e. potential deterrents to student teachers' use of Web 2.0 in their professional practices, their reflections on the course content, the learning mode and the resulting learning gains as well as possible modifications to the course design.

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TECHNOLOGY AT WORK: REMOTE SUPERVISION OF TEACHING PRACTICE AT A SWEDISH UNIVERSITY

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Abstract: *This article describes how remote supervision of teacher trainees was set up and carried out during the period from autumn 2015 to autumn 2017. In the autumn of 2015 Linnaeus University in southern Sweden started an operation to remotely supervise teacher trainees doing one of their teaching practices outside Sweden. The operation entailed each teacher trainee being lent an iPad Mini, loaded with the apps they needed, so that they could record lesson elements on their teaching practice. These lesson elements were then uploaded to the university's Moodle platform and the trainees received formative assessment of their performance on an ongoing basis throughout their 5-week teaching practice.*

Keywords: remote supervision teaching practice

INTRODUCTION

Linnaeus University in south-eastern Sweden has chosen 'internationalisation' as one of the principles that should permeate the organisation. Students are thus encouraged to 'think internationally' throughout their studies and teacher trainees in particular are encouraged to both spend a semester at a partner university abroad and to carry out their third teaching practice (where the focus for primary and junior trainees is on teaching English) in a school abroad. When this practice was launched in autumn 2015, the challenge was to find a way of supervising trainees as they did their teaching practice abroad, since it was not practically or economically feasible to send a supervisor from the university to schools in places as far apart as Moshi in Tanzania and Florida. This teaching practice period is the third one in the programme for primary and junior teacher trainees where the focus is on teaching English, so the challenge was passed on to the English group of the Department for Languages in Kalmar. This article describes how the remote supervision operation was designed and has been carried out in the three years it has been running.

1. BACKGROUND AND DESIGN

1.1 The Origins of the Remote Supervision Organisation

In 2014 Dr Chris Allen from the English group assisted teachers at our partner university in Guayaquil, Ecuador (Casa Grande) with assessing the performance of trainees there who were studying the TKT course (Test of Knowledge of Teaching, a University of Cambridge professional qualification for teachers of English as a Foreign Language). The teachers in Guayaquil recorded practice lessons carried out by their trainees with iPhones and uploaded them to a Box server at Linnaeus University. Teachers at Swedish universities have Box accounts (https://www.box.com/en-gb/home) organised by SUNET (the Swedish University Network) with unlimited capacity, so this was the only practical way for the teachers in Ecuador to upload large video files. Dr Allen then made notes on the trainees' performance and held on-line discussions with his colleagues at Casa Grande about aspects of the performance.

1.2 Adaptations from the Casa Grande Experience

The team in Kalmar learned a lot from the experience with the Casa Grande project. Firstly, an iPhone is not the ideal hand-held camera to record an ongoing lesson. It is very difficult for the person filming to keep the iPhone still enough for long enough and when she moves around, it is also difficult to keep the focus on the 'action'. It was thus decided to invest in iPad Minis, which have a larger screen, thus making it easier for the person filming to take in more of the activity in the classroom and to hold the iPad Mini still to avoid a jerky picture. Even so, it was clear that the trainees would need practice with filming a whole room when the iPad Minis were handed over, despite their being quite sophisticated in their use of technology (they were mostly used to filming 'selfies').

It was clear too that a 15-30 minute recording was going to be too long for the purpose of remotely supervising teaching practice. Part of the problem was the time taken to upload the video file, especially from some of the locations the trainees were going to. Another problem was the time it would take to watch and then comment on the video clip. The supervisor of the trainees was given the standard seven 'clock-hours' [1] to supervise each trainee, which is the same allocation given if the trainee were to carry out her teaching practice locally. Since this operation was to become part of the standard practice of the programme, rather than a project with separate funding for a short period of time, it was important that the operation functioned under the same budgetary constraints as locally-based teaching practice supervision.

[1] 'Clock hours' is the amount of time allocated to each teaching and supervising activity on a teacher's time sheet. In practice the amount of actual contact time will be less than this in order to account for preparation and follow-up.

A long recording would also make it difficult to build an element of formative assessment into the operation, which was one of the preferred outcomes of the teacher training programme. It was thus decided to break the assessed lesson material down into four separate lesson elements which represented both elements you could expect to see in an English lesson and elements which would form a normal part of the overall assessment of the trainee as a teacher (not just a language teacher). These lesson elements were as follows:

- Lesson Element 1: A recording of the start of an English lesson, covering the initial presentation of the subject of the lesson and instructions to the class

- Lesson Element 2: Vocabulary/grammar/pronunciation teaching: presenting and teaching the particular vocabulary, structures and/or pronunciation being covered in the lesson

- Lesson Element 3: Monitoring pair/group work: supervising pair/group work and helping groups of pupils with specific language points

- Lesson Element 4: Rounding the lesson off: finishing the lesson, tying up loose ends, summarising what's been learned, preparing for the next set of activities

Each of these lesson elements was linked to the overall goals of the teaching practice assessment (see Chapter 1.3 below).

Since the Casa Grande project, SUNET had also signed an agreement with the Kaltura organisation (https://corp.kaltura.com) to provide each Swedish university with an unlimited capacity for streamed video. The Kaltura function was also now an integral part of our Moodle server, so that video could be uploaded by the trainees to Moodle pages quickly. This meant that each Lesson Element recording could be uploaded to an Assessment page on Moodle for that particular trainee. This in turn allowed the viewing of each recording to be restricted to just the supervisor and the trainee. It also allowed the supervisor to make extensive written comments on each Lesson Element, which would be made immediately available to the trainee. A template was devised to provide a standard format for comments on each recording:

Feedback on your Lesson Element

Summary

Planning

Execution

Miscellaneous

The Bottom Line …

1.3 Teaching Practice Organisation and Assessment at Linnaeus University

Teaching practice is seen as ‘school-based training’, so the mentor at the school is the person who ultimately makes the recommendation to the university about whether a particular trainee has passed her teaching practice or failed it. The job of the supervisor from the subject-teaching department is to provide a specialist judgement of the trainee’s performance in the subject, as well as confirming the judgement of the mentor. The mentor has a booklet describing the goals to be achieved during each period of teaching practice, some of which can be ‘demonstrated’ during a lesson, but some of which cannot. For example, one of the goals of the third teaching practice period (the one being remotely supervised in this case) is to demonstrate that a trainee can fit in the overall work of the school and another is to demonstrate that the trainee can liaise with the parents. Neither of these can be filmed!

At the end of the teaching practice period a meeting is held at the university where the assessment of the mentor and the judgements of the supervisor are compared by the Examiner, who sets the trainee’s final grade for the teaching practice period.

If a trainee is having difficulty during the teaching practice period, ideally a second visit by a supervisor takes place to see whether the advice the trainee has received from both supervisor or mentor is being followed. However, since most visits to locally-based trainees cannot take place until the third week of a four-week teaching practice period, there is often little time for development and improvement to take place. One advantage of the remote supervision organisation is that Lesson Elements begin to be uploaded and commented on from the very first week of the practice, so trainees have an opportunity to reflect on their own practice and receive ongoing feedback (See Sub-Chapter 2.3.2 below for further discussion of this point.)

1.4 Designing the iPad Mini Interface

When the iPad Minis had been purchased, the next task was to design the interface the students would use. It was decided to reduce the number of icons on the ‘front page’ of the iPad Mini and put any icons that were not going to be needed into folders on the second screen of the iPad, so that the student could scroll to that screen if needed.

From the ‘front page’ of the iPad Minis, the students can access Settings to connect their iPad Mini up to wifi, click on an icon to open the Moodle site, use Skype to contact their supervisor directly (or contact other people) and click on the Camera icon to start filming.

2. REMOTE SUPERVISION IN PRACTICE

2.1 Preparing the iPad Minis

When the iPad Minis are to be used for a new group of trainees, they first need to be checked to make sure that the previous users have not left any photographs or videos on the iPad. The fact that iPad Minis are designed around a user with an Apple ID also creates some complications for upgrading the various apps and operating systems to the latest versions. Our Edtech (Educational Technologist) first needs to log on to the iPad Mini as himself and then, when the iPad Mini is fully prepared for the new user, remove his Apple ID so that the new user can enter hers into the iPad Mini.

Finally, the iPad Minis are fully charged and a receipt is prepared so that the new user can sign for the iPad before she leaves Sweden.

2.2 Preparing the Trainees

The practical details of the trainees' stay in the school abroad are taken care of by other departments within the university. These include finding a school, arranging for vaccinations (if necessary), arranging for the trainees to be included on the Swedish state's travel insurance policy and booking flights. The trainees also attend a general orientation session about working in a school abroad.

The supervisor and the Edtech then meet the trainees to hand over their iPad Minis and a pack of materials they will need when they are away, including a copy of the Teaching Practice Assessment Booklet in English (unless the trainee is visiting a Swedish school abroad, in which case the standard Swedish version is provided) and details of the university's requirements for filming and uploading recordings of the Lesson Elements. This meeting finishes with practical recording sessions, so that the trainees learn how far away they will need the person filming to stand and the optimal camera angles to cover both 'whole room' filming and the filming of pair work and small group work, especially during the filming of Lesson Element 3 (see Chapter 1.2 above). The trainees often feel that 'they can do all this', since they are familiar with new technology, but the practical session is very useful for making sure that they really understand the need to create clear accounts of what is going on in the classroom.

2.3 Out in the Field

2.3.1 The Schools

We have sent trainees with iPad Minis to schools in Tanzania, Kenya, Florida, Majorca and the Canary Islands. The schools in Majorca and the Canary Islands are Swedish schools, which operate under the Swedish school curriculum, although the pupils in those schools have a much more diverse background than is found in schools in Sweden. It is common, for example, for the pupils to have only one Swedish-speaking parent and for them to use Spanish at home. They are also, naturally, not growing up in a Swedish cultural environment, so the trainees have to adapt their teaching to this environment by, for example, including materials in their English lessons which involve characters from well-known Swedish children's stories (but in English). These schools are, however, equipped in a very similar way to schools in Sweden and have good wifi capabilities. One consequence of this is that it is possible to have a joint meeting with the trainee, her mentor and the supervisor at the university via Skype towards the end of the period of teaching practice. The mentors are also very familiar with the teacher training system in Sweden (all of them have been trained at Swedish universities themselves), so little explanation of how a period of teaching practice is organised needs to be given.

The environments of the schools in Tanzania, Kenya and Florida are, of course, quite different from this. One of the common problems is that the mentors in the schools are not familiar with the requirement that the trainees need to work with pupils of the right ages. I.e. primary teacher trainees need to work with primary-aged pupils and junior trainees with junior-aged ones. Another problem was the very different disciplinary procedures in these schools. In Sweden it is illegal for an adult to strike a child, so the trainees going to these schools were initially shocked when teachers used a cane or an open hand to strike young children. The school in Florida had a team of uniformed armed guards who came and removed pupils seen as 'disruptive' from the classroom, which was also something of a shock to the Swedish trainee. In each case an urgent Skype call was made to the supervisor in Sweden shortly after the trainees' arrivals in the schools from the trainee's iPad Mini and measures were put in place to deal with the situation (the schools in Tanzania and Kenya, for example, agreed not to strike pupils *in front of the Swedish teacher trainees*).

In Tanzania and Kenya the trainees had to learn to cope with very large classes (50 to 75 pupils in each class) and a lack of the kinds of modern amenities they were used to, such as photocopiers and whiteboards. The pupils in those schools were being taught in a very competitive environment with frequent examinations which largely tested the pupils' abilities to memorise factual information. In the schools in both of these countries the trainees also needed to teach the pupils how to work together on a task (which was of great importance for Lesson Element), since they had never done so before. The blackboards the trainees worked with were often damaged, so board work skills were more important than they would be in Sweden.

2.3.2 The Trainees

There have nearly always been two trainees in each school (Florida and Kenya are the exceptions), so it has been possible for the trainee to be filmed by a colleague from Sweden. With few exceptions, the trainees have been prompt in uploading their films of Lesson Elements and have received detailed feedback within 24 hours. In most cases, it has been possible to see the formative effect of the feedback they have received on their performance with subsequent Lesson Elements.

In the schools in Kenya and Tanzania in particular the pupils became very excited at being filmed, although they slowly became accustomed to it during the first week. The trainees had also never seen themselves in front of a class, so nearly all of them made many more films of themselves at work than they uploaded. The trainees who did this all stated that the experience of seeing themselves at work aided their development as teachers greatly.

2.3.4 The Feedback

On a visit to a teacher trainee carrying out her teaching practice locally in Sweden, the supervisor watches one lesson and then has a feedback session with the trainee and her mentor which takes approximately 45 minutes. This feedback session covers every aspect of her English teaching and her performance in the school.

When this feedback is given remotely, in writing and in four sections, it is possible for the supervisor to make much more detailed observations about the trainee's performance, with specific references to the recording, which the trainee can go back and watch again, looking out for the specific piece of feedback. It is also much easier for the supervisor to refer to topics such as the overall shape of the lesson and detail of the trainee's feedback to her pupils in such a way that the trainee can reflect more deeply on it. It is very common that a trainee is under a lot of stress when she meets her supervisor face-to-face immediately after having delivered a one-off lesson. Under those circumstances reflection and deep analysis is much more difficult and the supervisor does not have the time or the access to course materials to be able to give detailed references to the textbooks the trainee used on her theoretical course.

Dr Chris Allen of Linnaeus University and Dr Stella Hadjistassou of the University of Cyprus analyse the feedback a group of remotely-supervised teacher trainees received in much more detail in an upcoming article in The ELT Journal entitled "Remote tutoring of pre-service EFL teachers using iPads".

On their return to Sweden the trainees meet their supervisor again, partly to return the iPads, but mostly to evaluate the experience of being remotely supervised together. In these sessions the trainees always mention the value of receiving such detailed feedback which is linked to a video recording they can go back and watch again. They also mention the way their own practice develops when they watch themselves on the iPads.

3. DISCUSSION

3.1 Aspects of the Design of the Remote Supervision Organisation

Part of the original brief to set up this remote supervision organisation was making the experience of being remotely supervised as similar as possible to the conventional way of supervising locally-based teaching practice. This brief has been adhered to as much as possible, but it is clear that there are some significant differences between remote supervision and the ‘standard’ way of supervising teaching practice. One of these differences is that the existence of clearly-defined Lesson Elements already provides a structure to the trainees’ lessons, which locally-based trainees have to devise for themselves. It is theoretically possible for a locally-based trainee to contact her supervisor in advance and ask for guidance on structuring her demonstration lesson, but this almost never happens. Trainees are nearly always too busy teaching and working in the school to contact the university for guidance on a particular lesson. The structure of the four Lesson Elements, on the other hand, gives a ready-made structure to a language lesson. The remotely-supervised trainees are also told at the initial meeting that they can either film the four Lesson Elements in the same lesson or can film different lessons where a particular Lesson Element appears. In nearly every case the trainees have chosen to split their filming of the Lesson Elements up over four weeks and four lessons. There are separate upload links for each Lesson Element on the Moodle site, but the trainees are not obliged to upload their films in order.

In the instructions remotely-supervised trainees receive each Lesson Element is also cross-referenced to the goals trainees have to achieve during the teaching practice period. This type of explicit link between the individual lesson and the overall goals is not given to locally-based trainees at present. There is no explicit reason for this, but locally-based trainees and remotely-supervised trainees work within different parts of the university’s organisation during their teaching practice period, so the locally-based trainees do not receive the same materials as their remotely-supervised colleagues (for example, the locally-based trainees only receive a Swedish version of the teaching practice booklet of goals which their mentors in the schools sign at the end of the teaching practice period - see Sub-Chapter 1.3 above).

There are also aspects of the experience of the remotely-supervised trainees which are difficult to assess, in particular the aspects which cannot be seen during a demonstration lesson. These include how the trainee fits in with the overall work of the school, how the trainee handles pastoral care of individual pupils and how the trainee liaises with the pupils’ parents. If the remotely-supervised trainee is placed at a Swedish school abroad - and particularly if the trainee, her mentor and the supervisor are able to have a meeting via Skype at the end of the teaching practice period - then these aspects can be discussed. The mentors in Florida, Kenya and Tanzania, however, are not familiar with the Swedish system of teaching practice supervision and many of these aspects of teaching practice could not be discussed. In Tanzania, for example, the schools are boarding schools, so neither the trainees nor the pupils even met the parents during the teaching practice period. One trainee in Kenya was even inspected by the Kenyan Department of Education, where aspects of the trainee such as deportment, hair care and clothing were assessed.

This assessment did not form any part of the university's assessment of the trainee, but it was something of a unique experience for a Swedish teacher trainee!

3.2 Personal Integrity

One aspect of filming pupils which is potentially difficult is the personal integrity of the pupils being filmed. In Swedish schools it is standard practice for parents to give their approval for their children to be filmed and they are allowed to control how the school uses pictures and film. For example, parents can refuse permission for any pictures or films to be placed on the school's web site or to be used in the school's publicity material. It has proved impossible in practice to obtain this permission from the parents of pupils at the schools chosen for remotely-supervised trainees. One of the problems is simply cultural: other countries do not have the same laws relating to personal integrity that Sweden does, so the schools find it difficult to understand the problem. In the case of Kenya and Tanzania, as stated above in Sub-Chapter 3.1, the schools are boarding schools, so it is impossible in practice to receive permission from the parents. This has caused certain problems for researchers wanting to use the raw materials from the remote-supervision organisation in their research (see Sub-Chapter 3.4 below).

3.3 Impact of the Remote Supervision Organisation on the University

The remote supervision organisation has functioned well for three years at time of writing and the fourth year is being prepared for. The concept of using iPad Minis to film trainees' performance has stimulated a great deal of interest within the rest of the teacher trainee programme at Linnaeus University and the practice has been incorporated into the school-based practice in other subjects. The regular teacher training programme at the Kalmar campus is now organised as a sandwich course, with trainees being attached to one of a consortium of local schools for one school year at a time. The trainees spend alternate weeks at the university and in school, so the in-school week is an ideal time for the trainees to film their performance. Subjects such as Leadership and English have also started using the Veo video-tagging system to give feedback on filmed performance (https://www.veo-group.com). (This video-tagging system is not suitable for remotely-supervised trainees because of the video formats involved.)

Another aspect of the remote supervision organisation which has attracted attention in other parts of the teacher training programme is the opportunity to allow students to carry out their teaching practice in other parts of Sweden. Normally trainees are sent to schools in the counties of Kalmar, Blekinge or Kronoberg, which already cover a large area in southern Sweden (approximately 300 kms by 200 kms). Some trainees, however, would like to carry out their teaching practice in more distant parts of Sweden or at times outside the standard teaching practice period (one example is a trainee who was selected for one of the Swedish Olympic athletics teams). Remote supervision could allow trainees like these to be accommodated more easily. There would also be cost implications for the university. Supervisors travelling to more far away schools are paid travelling expenses and these expenses start to match the running costs of an iPad Mini.

3.4 The Remote Supervision Organisation in Research

The raw material obtained from the remote-supervision organisation is currently being used in a number of research projects being run jointly by the University of Cyprus and Linnaeus University. The fact that the pupils who may appear on the films have not and cannot give their permission to be part of the research projects has caused problems for the researchers as they prepare articles for publications, since such articles may not meet the requirements for the ethical procedures used in the research projects. The trainees themselves are in a slightly different position, since they are in a position to give their consent for the materials to be used in research. Thus far, in consequence, the research has concentrated on the analysis of the written feedback given to trainees and this research will be published in the near future.

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THE INFLUENCE OF BIRTH ORDER ON THE RESULTS OF THE STATE E-TEST IN MATHEMATICS

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Abstract: *Many studies have shown that the birth order in the family can affect personality traits, the choice of career or even health. Based on the exam results and personal questionnaire gathered among a group of Polish school-aged children we have conducted a statistical analysis to prove that the birth order in the family is a key factor in shaping mathematical abilities, which are connected with mathematical and digital competences.*

Keywords: birth order, state test, school performance, mathematics education

INTRODUCTION

The importance of the birth order was recognized in the year 1918 by an Austrian psychologist, Alfred Adler, (see Adler, 2013). Consequently, Michael Grose revealed that the birth order had the most decisive impact on the creation of personality (see Grose (2003)). At present many studies have presented the effects of birth order in the family on educational attainment (see Black, Devereux, & Salvanes, 2005). In Hotz, & Pantano (2015) the authors provide robust empirical evidence that school performance of children declines with birth order. These findings are the basis for further research into the topic and checking whether the birth order in the family can also influence the performance in mathematics.

It is important according to Hejný et al. (2006) to respect individual character of every pupil in the class. For this reason findings in the research devoted to birth order of some pupils in the family can have substantive value for teacher in the class in specific subject or for class teacher. We will underline in our paper the influence of birth order of some pupils in the family for his/her results in mathematics education.

Worth noting is also the fact that the results presented in this paper differ from any other on this topic so far because this study is a longitudinal survey. Such a survey provides a reliable source of information on the influence of birth order on the scores in mathematics. For every student, we consider 3 scores at three different points in time. The first result is the mark in mathematics the student received at the end of the sixth grade (the result for the whole year), the second one is the result obtained in the exam taken at the end of the sixth grade, and the last one shows the result of the so-called "Diagnosis of mathematics" exam taken in the first year of middle school.

In accordance with Polish legal regulations, compulsory uniform examinations for all students of primary and secondary schools have been carried out for over 10 years. The exams are carried out at the following levels: K-6, K-9 and K-12. K-6 is a test at the end of primary school, K-9 assesses students after graduating from middle school, K-12 is taken at the end of secondary school. All of them are written examinations. K-6 consists of mathematics and the Polish language tests, whereas K-9 consists of three parts, one of the being mathematics. The condition for primary and middle school graduation is to take K-6 and K-9 exams respectively. Neither K-6 nor K-9 specifies a minimum score that a student should obtain in order to pass the exams. K-12 consists of three compulsory tests at a basic level, the Polish language, a selected modern language and mathematics as well, as at least one other subject at an extended level. In order to pass K-12 it is necessary to score at least 30% in each of the three compulsory parts. The results of the additional tests do not affect the final result.

The exams K-6, K-9, K-12 perform three basic functions:

1. They determine pass rates.
2. They provide a certificate of mathematics achieved by the examinee.
3. They are used as entrance exam to a higher level of education.

1. DIGITAL AND MATHEMATICAL COMPETENCES

Examination of children is more widespread nowadays in electronical form. The root is that the use of technology is slowly becoming a substantial part of today's education (see Hohenwarter, & Lavicza, 2010). Although due to the increased accessibility of affordable computing technologies in the 1980s and 90s it was predicted that computers would become rapidly integrated into mathematics teaching and learning (Kaput, 1992), technology uptake in schools has been considerably slow. The current expansion of technology use took a new unconventional direction: a bottom-up, community-based collaborative development, catalysed by Internet-based communities and increasingly available community-developed software packages.

During the past decades it has been demonstrated that a large number of enthusiasts can alter conventional thinking and models of development and innovation. The success of open source projects like Linux, Firefox, Moodle, and Wikipedia shows that collaboration and sharing can produce valuable resources in a variety of areas of life. For this reason this process in education supports digital and mathematical competences by the students and pupils.

According the document of the European Union Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning (see Recommendation, 2006) mathematical competence is the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations.

Building on a sound mastery of numeracy, the emphasis is on process and activity, as well as knowledge. Mathematical competence involves, to different degrees, the ability and willingness to use mathematical modes of thought (logical and spatial thinking) and presentation (formulas, models, constructs, graphs, charts).

Electronic examination supports digital competences by children. Many webpages and programs allows this kind of examination. One of these programs is Hot Potatoes (see Koreňová, 2015). Using ICT in education makes stronger constructionism approach. It enables the implementation of the process of teaching as a design, which is an entity of information elaboration developed into types of intelligent human thoughts, products and artifacts having mental, manual and expressive forms. The teaching process design is created by learning entities together with teaching entities - they play the roles of designers. These entities are protagonists in the active elaboration of information obtained from outside, and use the capacity to recognize and obtain relevant information and, at the same time, search for information on the teaching problem and the teaching topic. Experiments with selected mathematical syllabi, in combination with manipulation activities involving students, allow the subjects to change the perspective of viewing schoolwork - to also see (understand) it in other contexts (see Kostrub, 2017).

According Bianco, & Ulm (2010) ICT may improve mathematics education on different levels:

- ICT is supposed to improve students' understanding of mathematics. Dynamic constructions make mathematical processes visible: Configurations can be varied (nearly) continuously on the screen, functional relationships or invariants can be directly observed. It is possible in primary level combine these activities with manipulations with models (see Bayerl, & Žilková, 2016). With traditional media and static pictures the teacher can hope at best, that the student "sees" these mathematical processes in his mind's eye.

- ICT is seen as a tool to make mathematics education more authentic and realistic. Mathematics education often deals with very simplified, pseudo- realistic problems because data from real life are too complex to cope with by traditional media. However, the computer helps to tackle problems that require e.g. extensive numerical or algebraic calculations in secondary level.

- A further target area, which is often linked with digital media, concerns children's key competences. By working with ICT students are supposed to increase abilities of autonomous and cooperative learning. Digital media should foster communication and presentation competences as well as "computer literacy".

- Finally, digital media are supposed to serve as catalysts for innovations in mathematics education. By using ICT the way of teaching and learning mathematics should change in a substantial way. Mathematics education should become more inquiry- based, students should work in a self- organised way, self-responsibly and cooperatively. It supports communication and social competences developed by children (see Partová, 2011).

2. DATA AND METHODS

Between the years 2011 and 2014 there were about 350 000 students taking the K-6 examination in Poland. The data used in our analysis are taken from the research study „Diagnosis of mathematics" conducted in Poland between the years 2011 and 2014 (see Sakowicz, Mazur, Kusztelak, & Stańdo, 2012). The research involved 3,100 students from 120 Polish schools, which represented approximately 1% of the population of students in the years 2011 and 2014. The overall response rate was 40%.

In the study "Diagnosis of mathematics“ students' scores in the mathematical tests as well as a personal questionnaire were analysed. All the tests were computer-based and took place at a given location at a specific time. A specially designed system checked for correct solutions. A similar e-exam took place in Poland in 2009 (see Stańdo, 2011). The mathematical part of the "Diagnosis of mathematics" exam lasted 80 minutes and consisted of both 15 close- and 7 open-ended questions.

The test assesses the following areas of knowledge:

1. Reading comprehension of mathematical texts.
2. Performing simple calculations.
3. Reading, presenting, interpreting data in a form of tables, diagrams, graphs.
4. Perceiving geometric figures and performing simple geometric calculations.

5. Describing and modelling by using algebraic expressions, equations and inequalities.

6. Putting forward hypotheses, justification, seeing similarities, recursion, etc.

Now we would like to present some examples of the exercises from the mathematical part of the "Diagnosis of mathematics" study. In exercise 17 (see Figure 1), students are asked to use the given equations as well as algebraic operations on digits in decimal system in order to find the unknown digits.

Exercise 17. (Category 1)

In each operation, the letters A, B, C, D, and E represent the same numbers. Fill in the appropriate ones and discover what numbers are hidden under them if

$A + C = D,\ A \cdot A = A + A,\ C \cdot C = C : C.$

$C + A = \ldots \qquad D \cdot C = \ldots$

$$\begin{array}{r} ACA \\ +\ ABB \\ \hline E\ldots A \end{array}$$

$A = \ldots \quad B = \ldots \quad C = \ldots \quad D = \ldots \quad E = \ldots$

Figure 1. Exercise 17

Source: Own work

In exercise 19 (see Figure 2), one has to move points C and D so that the given figure becomes a square. Then, a student needs to calculate the area and perimeter of the figure.

Exercise 19. (Category 1)

Move with the points D and C so that the quadrilateral will be a square.

Calculate the area and perimeter of the square.

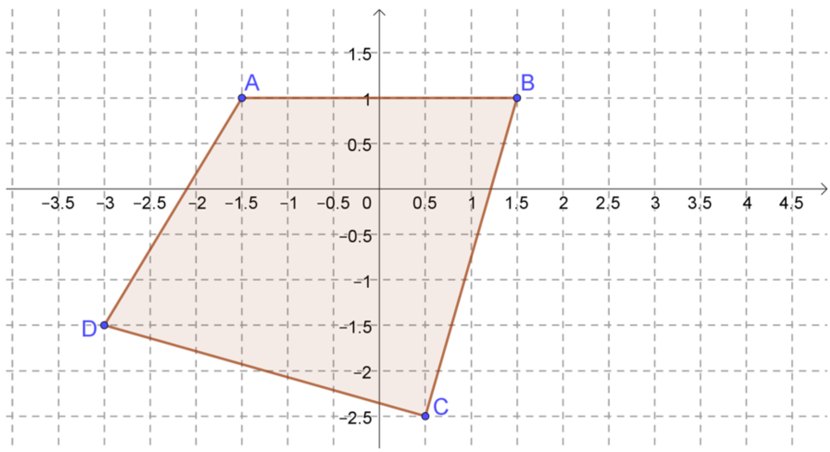


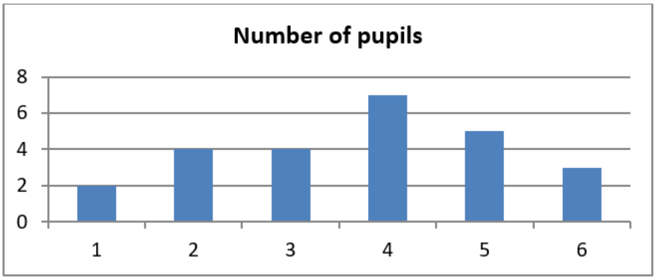
Figure 2. Exercise 19

Source: Own work

Exercise 22 (see Figure 3) presents a histogram of grades in mathematics. A student is asked to provide some statistics on the basis of the histogram, such as calculating the average or the percentage of the students with the best marks.

Exercise 22. (Category 1)

The following diagram presents the marks from the mathematics test in the first grade.



Give answers to following questions:

1. How many pupils wrote the test? ....
2. Which kind of mark have the biggest group of pupils? ...
3. Which percentage of the pupils obtain the mark “very good”? .... %
4. Is it possible, that more than one half of the pupils obtain the mark “good” or better? ...
5. The average value from the test is ...

Figure 3. Exercise 22

Source: Own work

Apart from the test scores, we analyse the following data collected from the questionnaire responses in the "Diagnosis of mathematics" study:

- the results of the examinations at the K-6 level,
- the birth order in the family,
- the marks in mathematics at the end of primary school represented on a 6-point scale.

On the basis of the report of the Ministry of National Education regarding the achievements of students graduating from primary school in Poland and the results of the students participating in the study, we get the following graph.

Next figure compares the general performance of the population of students in the final exam taken after the sixth grade with the results of K-6 examination reported in the questionnaire by the students participating in the "Diagnosis of mathematics" study (see Figure 4).

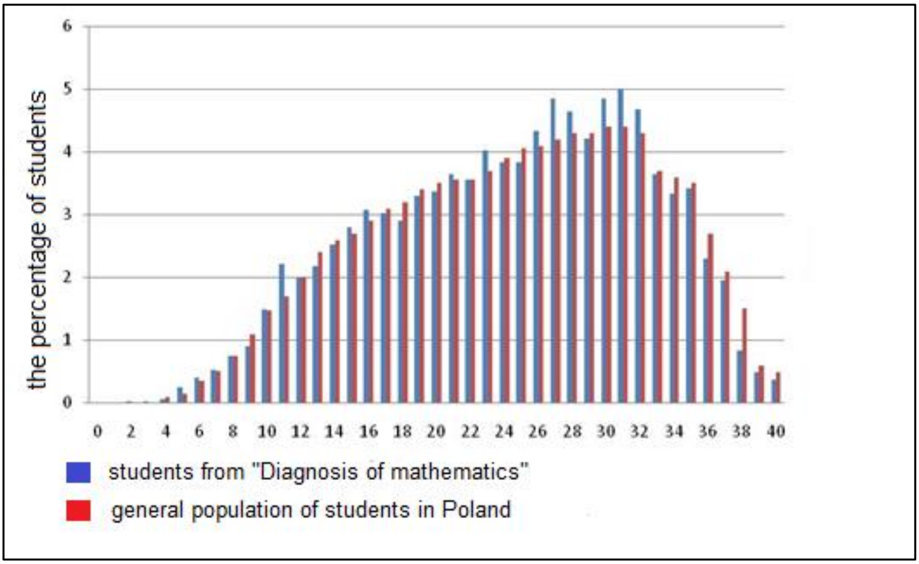


Figure 4. The number of points scored in the test taken at the end of the sixth grade

Source: Own research

The histograms in the figure above are very similar, which proves that the sample in the "Diagnosis of mathematics" study has been selected properly and can be a representative sample (see Figure 4).

3. STATISTICS ANALYSIS

3.1 Descriptive statistics

We have analysed a sample of 1,007 middle school students who obtained more than five points in the test and provided answers to the questions in the questionnaire. The students are divided into four groups according to the birth order in the family. The first subsample consists of 143 only children, the second one of 301 oldest children, the third of 194 middle children, and the last one of 369 youngest children. The last group of first born children is a union of only and the oldest children.

3.1.1 Descriptive statistics for the number of points obtained in the "Diagnosis of mathematics" study depending on birth order

Next table and figure show that the means and medians of points scored in the "Diagnosis of mathematics" exam by the only and oldest children are higher than the corresponding measures of central tendency in the groups of middle and youngest children (see Table 1 and Figure 5).

Table 1.

Descriptive statistics for mathematics exam in the "Diagnosis of mathematics" study

	no. of obs.	mean	median	mode	standard deviation	kurtosis	skewness
only child	143	21,59	22	25	6,74	-0,52	-0,11
oldest child	301	22,18	22	22	6,90	-0,43	-0,03
middle child	194	19,96	20	17	7,34	-0,45	0,26
youngest child	369	20,79	21	23	7,23	-0,52	0,11

Source: Own research

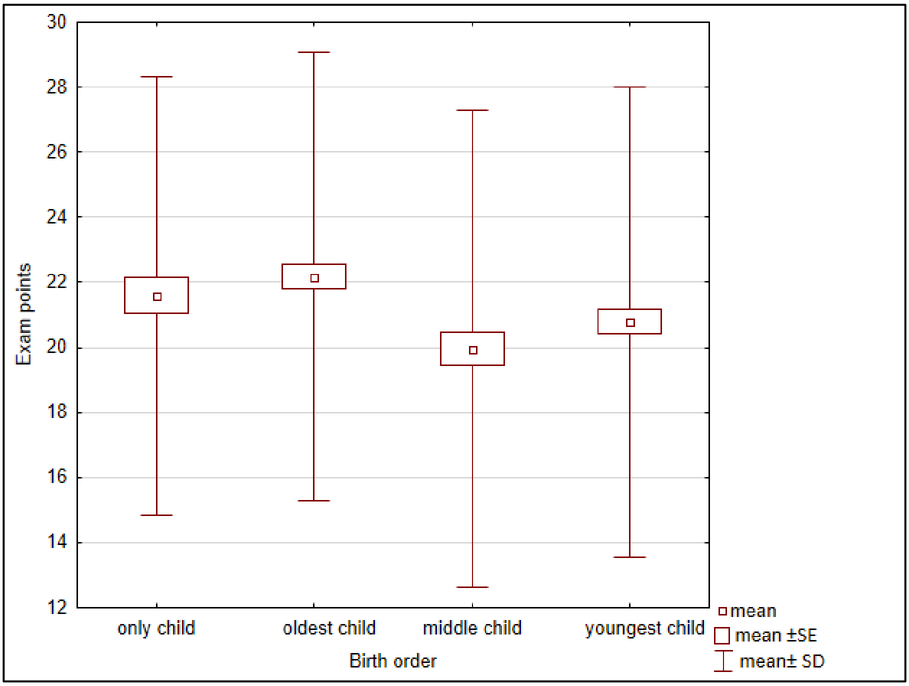


Figure 5. Descriptive statistics for mathematics exam in the "Diagnosis of mathematics" study

Source: Own research

In the group of oldest children all average measures of the exam points are equal to 22 and the distribution of point is symmetric. The distribution of the exam points from the samples of middle and youngest children have positive skewness, whereas for only children we have platykurtic distribution of the exam points.

3.1.2 Descriptive statistics for the number of points in the K-6 exam depending on birth order

Table 2.

Descriptive statistics for the K-6 exam

	no. of obs.	mean	median	mode	standard deviation	kurtosis	skewness
only child	143	26,30	27	26	7,00	-0,58	-0,51
oldest child	301	26,41	27	32	7,26	-0,33	-0,57
middle child	194	23,39	24	25	7,95	-0,76	-0,18
youngest child	369	24,83	26	26	7,41	-0,59	-0,39

Source: Own research

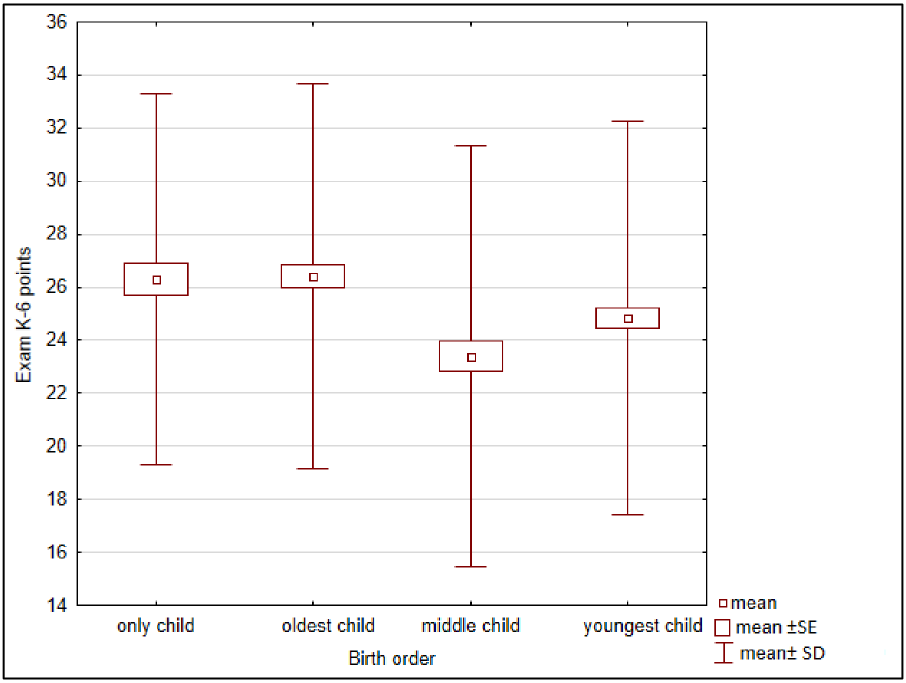


Figure 6. Descriptive statistics for mathematics exam in the "Diagnosis of mathematics" study

Source: Own research

The table and figure above show that the means of points obtained in the K-6 exam by firstborn children are significantly higher than the results of children who have older siblings (see Table 2 and Figure 6). It should also be noted that the medians for scores of the only and oldest children indicate that the firstborns achieved better results in the K-6 exam.

3.1.3 Descriptive statistics for the marks in mathematics at the end of primary school depending on birth order

Table 3.

Descriptive statistics for marks in mathematics at the end of primary school

	no. of obs.	mean	median	mode	standard deviation	kurtosis	skewness
only child	143	3,70	4	3	1,13	-1,00	0,03
oldest child	301	3,66	4	3	1,14	-0,94	0,05
middle child	194	3,41	3	4	1,10	-1,03	0,18
youngest child	369	3,48	3	3	1,13	-0,91	0,22

Source: Own research

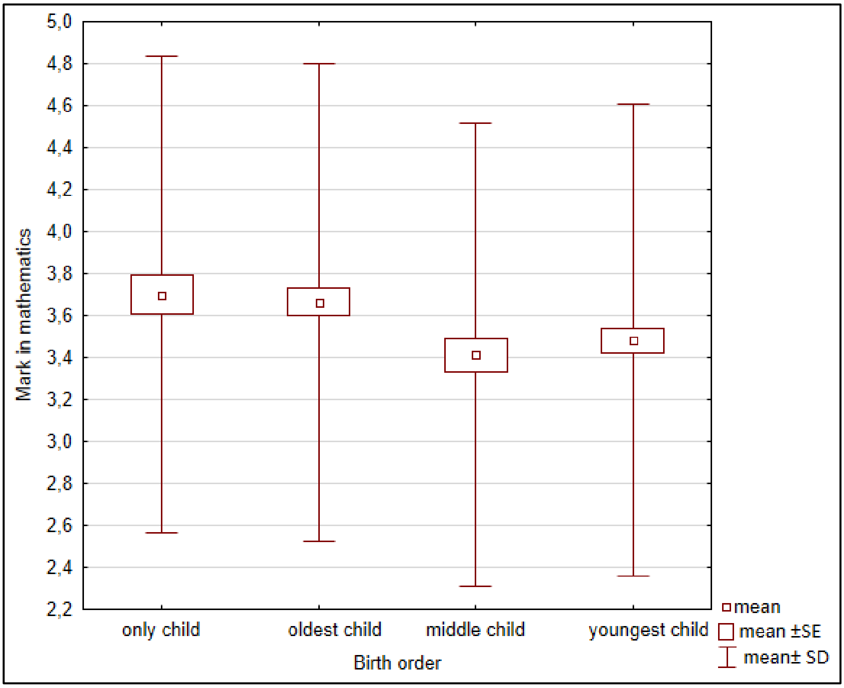


Figure 7. Box plot of marks in mathematics at the end of primary school

Source: Own research

As can be seen in Table 3 the medians of the points scored by firstborn children are equal to 4. This means that 50% of firstborn children obtained marks in mathematics greater than or equal to 4, while the medians of points scored by middle and youngest children are equal to 3. Figure 7 shows that the means of points of children who have older siblings are lower than the means of points of the firstborns.

3.2 Test results

The decision to reject the null hypothesis in hypothesis testing has a certain significance level determined by the investigator. We will denote it by α. Recall that α is the probability of rejecting the null hypothesis when it is true. For the purpose of our study we have assumed that α=0,05. The decisions taken at a lower level of significance are less susceptible to error and, therefore, are more reliable. In addition to the value of test statistics, the majority of statistical packages (including Statistica 10) calculate the value of the asymptotic significance, which is called the p-value (denoted by p). The interpretation of the test is as follows: if $p \leq \alpha$, then the reject the null hypothesis.

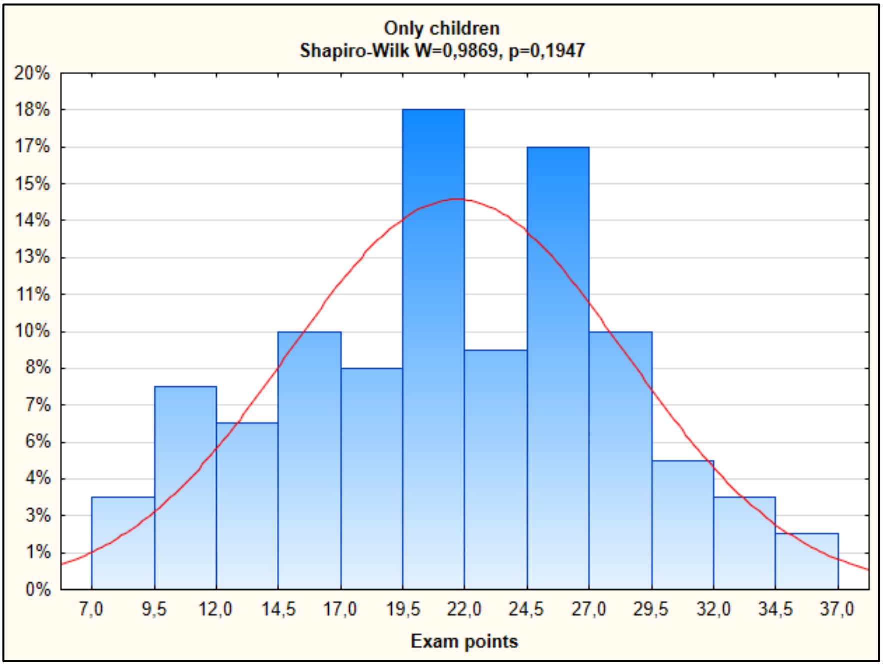


Figure 8. Histograms of mathematics exam in the "Diagnosis of mathematics" study for only children

Source: Own research

Figures from Figure 8 to Figure 15 show the histograms of the points scored in the mathematical exam in the "Diagnosis of mathematics" study and in the K-6 exam results for four groups of students as well as the results of a Shapiro-Wilk normality test.

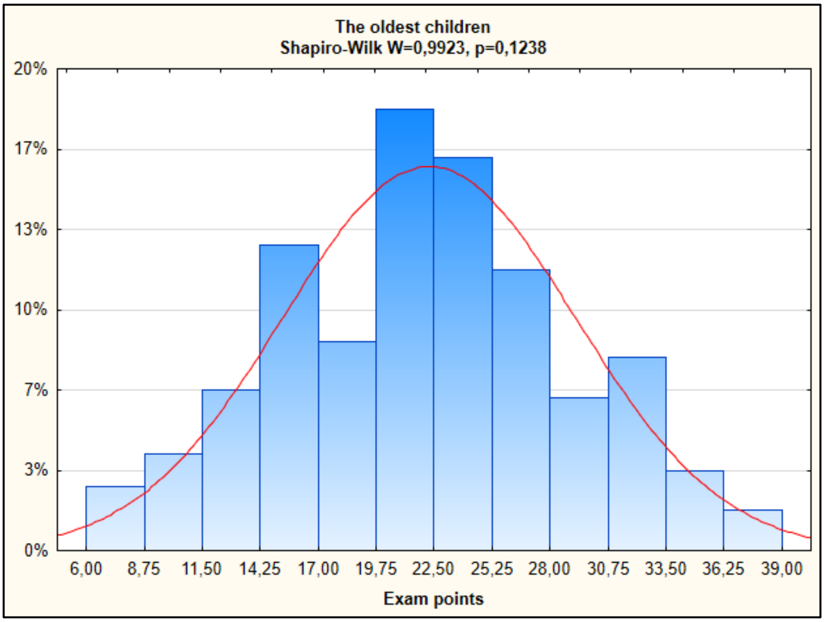


Figure 9. Histograms of mathematics exam in the "Diagnosis of mathematics" study for the oldest children

Source: Own research

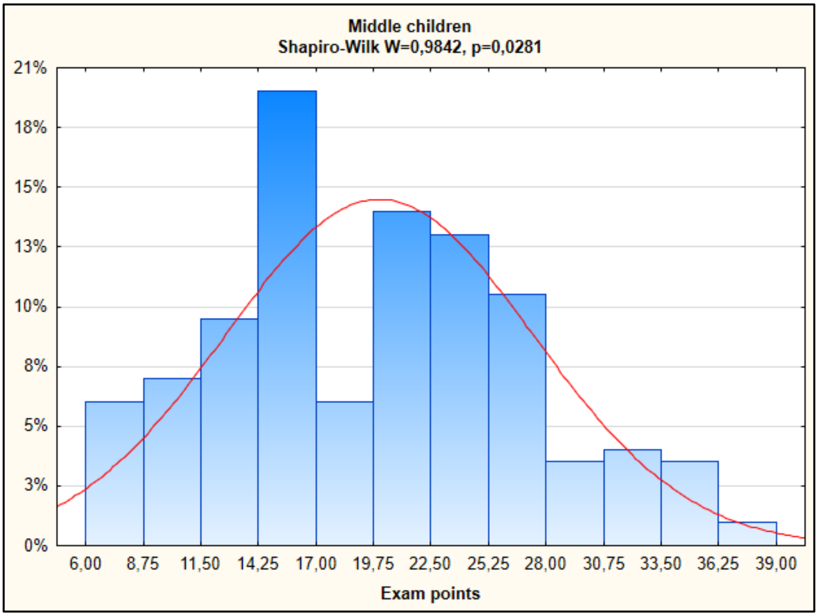


Figure 10. Histograms of mathematics exam in the "Diagnosis of mathematics" study for middle children

Source: Own research

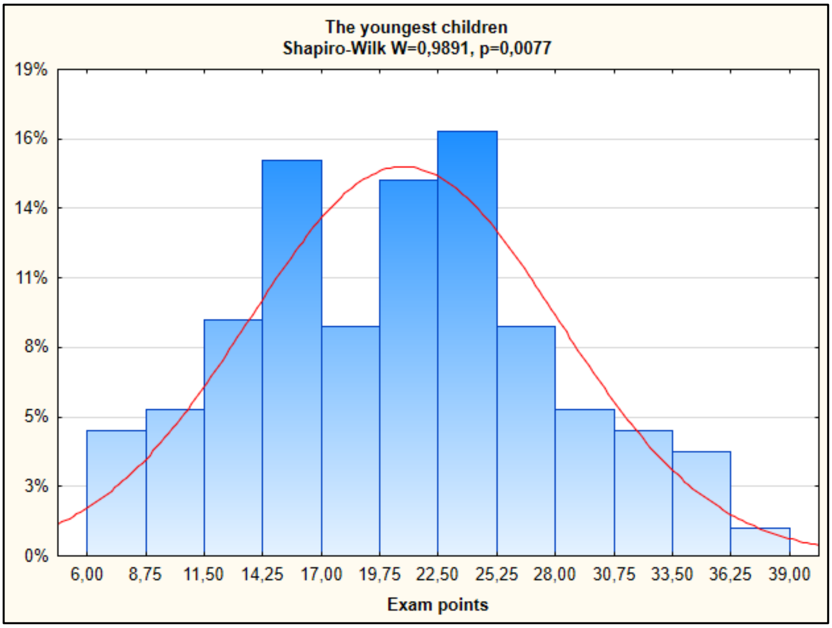


Figure 11. Histograms of mathematics exam in the "Diagnosis of mathematics" study for the youngest children

Source: Own research

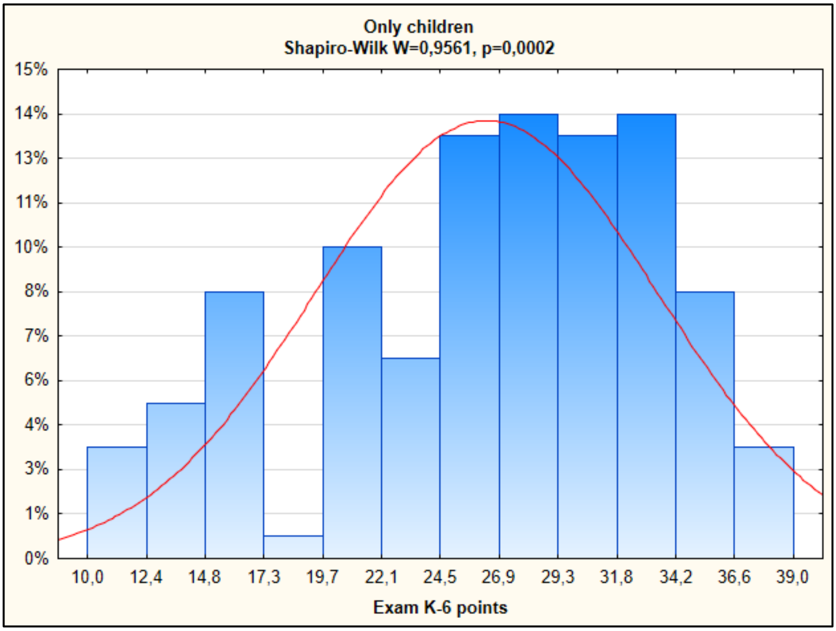


Figure 12. Histograms of the results in K-6 exam for only children

Source: Own research

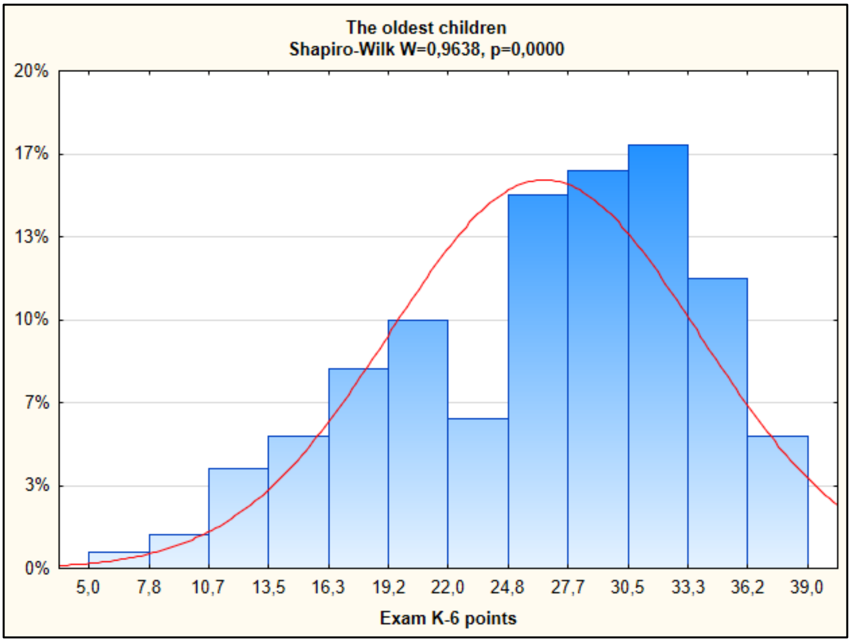


Figure 13. Histograms of the results in K-6 exam the oldest children

Source: Own research

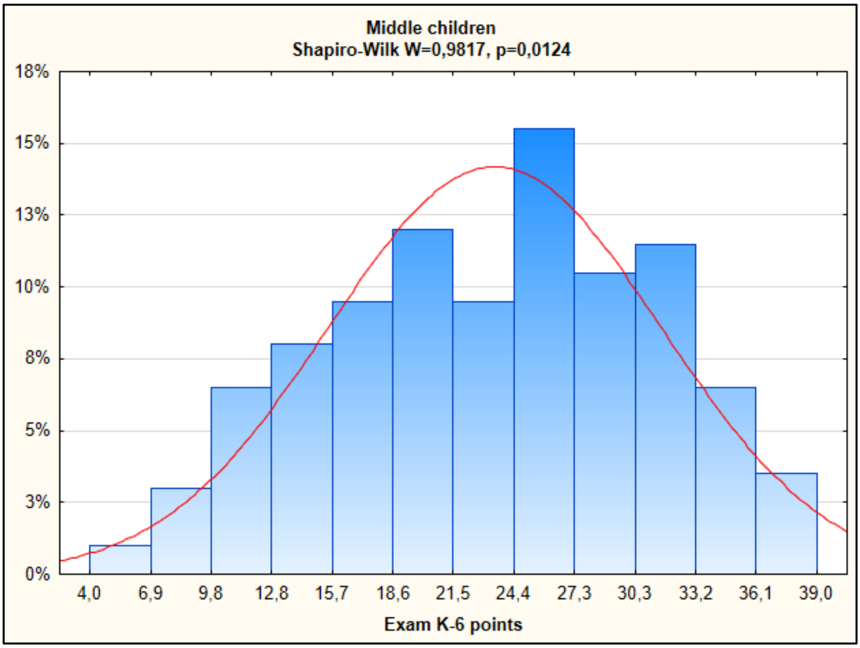


Figure 14. Histograms of the results in K-6 exam for middle children

Source: Own research

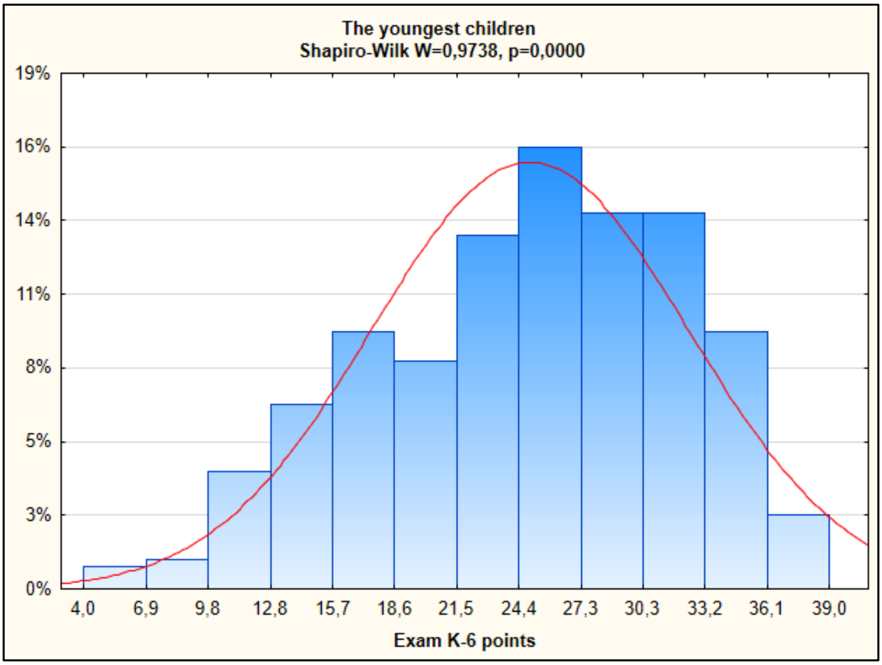


Figure 15. Histograms of the results in K-6 exam for the youngest children

Source: Own research

In Shapiro-Wilk test, the null hypothesis assumes the normality of probability distribution. Analysing the results of these tests at a significance level of 0,05, we reject the null hypothesis for the scores of the middle and youngest children in the "Diagnosis of mathematics" study. As for the K-6 exam, we reject the null hypothesis in all groups of students. At the end, we use the Shapiro-Wilk goodness of fit test. The result of goodness of fit test has shown that in order to check the relationship between the birth order and the achievements in mathematics we cannot use a parametric test.

Consequently, we use non-parametric statistical methods to check whether the distribution of the exam results in the "Diagnosis of mathematics" survey, the K-6 test results and the marks in mathematics of four populations of students coincide. To this end, we do not require any assumptions of probability distribution, the assumption of normality in particular. We apply the Kruskal-Wallis one-way analysis of variance by ranks to detect the differences between the populations (see page 645 in Aczel, & Sonderpandian, 2009, page 595 in Sheskin, 2000). The only requirement for the Kruskal-Wallis test is that the samples are random and the observations are independently drawn from the populations. The null hypothesis says that in all populations the analysed variables have the same distributions. Note that the nonparametric tests compare probability distributions, all their parameters in particular, i.e. the mean and the median. We confirm the Kruskal-Wallis test results use the median test (see page 67 in Aczel, & Sonderpandian, 2009), where the null hypothesis says that all populations have the same median.

We investigate the following hypotheses:

1. The birth order of children in the family has a significant impact on the results of the exam "Diagnosis of mathematics".

2. The number of points scored in the K-6 examination varies among the populations of the oldest, only, middle and youngest children.

3. The birth order of children in the family has a significant impact on the marks in mathematics at the end of primary school.

In the case of the rejection of null hypothesis based on the Kruskal-Wallis test we do not know which populations differ from other. In order to recognise the differences between the populations, we use multiple comparison test (also known as post-hoc tests). To this end, we use the Scheffe test (see page 376 in Aczel, & Sonderpandian, 2009). This test is the most conservative one. This means that we use it when we are less likely to reject the hypothesis of equality of means. The Scheffe test is recommended for the pairwise comparison method, where the sizes of samples are not equal in all of the groups.

Below we present the tests results and statistical analysis of all these hypotheses.

3.2.1 The test results of the number of points scored in the mathematical exam in "Diagnosis of mathematics" and the independent variable (grouping) of the birth order

Table 4.

Test of hypothesis results of mathematics exam in the "Diagnosis of mathematics"

Kruskal-Wallis test: $KW = 14{,}1572, p = 0{,}0027$

Median test: $general\ median = 21,\ \chi^2 = 11{,}3441, p = 0{,}0100$

Scheffe test (p-value for multiple comparisons test):

	only child	oldest child	middle child	youngest child
only child		0,884136	0,223418	0,723594
oldest child	0,884136		0,009355	0,097327
middle child	0,223418	0,009355		0,624905
youngest child	0,723594	0,097327	0,624905	

Source: Own research

The p-value of Kruskal-Walis test is equal to 0,0027. This means that we reject the null hypothesis about the distribution of the exam points for the population of only, oldest, middle and youngest children taken from the "Diagnosis of mathematics" study as they are identical. We show that the mean value of points scored in the mathematical exam in "Diagnosis of mathematics" depends on the birth order. The multiple comparison test shows that the largest difference occurs between the oldest and the middle children (p=0,009355).

3.2.2 The test results of the number of points obtained in the K-6 exam and the independent variable (grouping) of the birth order

Table 5.

Test results for the numbers of points in the K-6 exam

Kruskal-Wallis test: $KW = 22{,}38506, p = 0{,}0001$

Median test: $general\ median = 26,\ \chi^2 = 20{,}54580, p = 0{,}0001$

Scheffe test (p-value for multiple comparisons test):

	only child	oldest child	middle child	youngest child
only child		0,998987	0,005622	0,257806
oldest child	0,998987		0,000219	0,056056
middle child	0,005622	0,000219		0,188313
youngest child	0,257806	0,056056	0,188313	

Source: Own research

We reject the null hypothesis at the significance level of 0,05. A post-hoc test shows that there is a difference between the K-6 exam results of the only and middle children (p=0,005622) and the results of the oldest and middle children (p=0,000219).

3.2.3 The test results of the marks in mathematics at the end of primary school and the independent variable (grouping) of the birth order in the family

The p-value in the Kruskal-Wallis test is lower than 0,05. Therefore, we reject the null hypothesis. In the median test, the asymptotic significance is equal to 0,0525. Therefore, we reject the null hypothesis at a significance level of 0,1 (see Table 6).

We conclude that the distribution of marks in mathematics at the end of primary school for the populations of only, oldest, middle and youngest children is not the same.

Table 6.

Test results for marks in mathematics

Kruskal-Wallis test: $KW = 9{,}4892, p = 0{,}0234$

Median test: $general\ median = 4,\ \chi^2 = 7{,}7055, p = 0{,}0525$

Scheffe test (p-value for multiple comparisons test):

	only child	oldest child	middle child	youngest child
only child		0,992681	0,149092	0,281869
oldest child	0,992681		0,116831	0,228463
middle child	0,149092	0,116831		0,920761
youngest child	0,281869	0,228463	0,920761	

Source: Own research

However, the post-hoc Scheffe test has not shown any statistically significant differences between the birth order and the results in mathematics. This situation usually happens when the p-value is close to 0,05. It should also be noted that the K-6 and "Diagnosis of mathematics" exams have a uniform assessment for all of the students, in contrast to the marks in mathematics at the end of the sixth grade, which are given by each teacher individually and using their own criteria of evaluation.

4. DISCUSSION

The interaction between the pupil and the teacher has according to Hejný, et al. (2006) an influence on the educational process during mathematics lessons. If the teacher uses an authoritative style, then he don't respect the individuality of the pupil and his/her family situation. If the teacher uses a dialogical style, then he is able to make a deep investigation of possible reasons for the student's results during the mathematics lessons, in an empathetic way. Our research shows that birth order has an influence on pupils' results during the educational process. It leads mathematics teachers to make deeper diagnostics during their lessons. The class teacher can use results of this kind of research for more effective cooperation with parents of pupils in the class. Another application is to create groups of pupils in the class in the way that pupils in one group have a different birth order. The pupils in these groups can help each other not only in the process of obtaining new knowledge, but also in the process of socialisation.

CONCLUSION

This study has shown that there exists a clear correlation between the performance in mathematics and birth order. All three hypotheses posed in this study have been proven. The results of our research have shown that people who were born as the first child are often more successful in mathematics.

We have also shown that only and oldest children score significantly more points in mathematical exams and have better final marks in mathematics than middle and youngest children. It is also worth noting that there are no significant differences in mathematics achievement between the only and the oldest child. A genetic predisposition can have a major impact on the lack of differences between only and oldest children.

These findings must be respected by teachers in the educational process. If the teacher knows the birth order of a concrete pupil, he can adapt his approach in the educational process with this pupil. Some groups of these pupils need more time in the process of gaining knowledge or more attention on the part of the teacher. It is important to support the practice in families that older siblings teach and help younger siblings.

The tasks in tests can be given to children in electronic form, which allows for doing research in bigger samples. Testing and e-testing are new way of research in the development of mathematics key competences and abilities. This testing has importance for educational diagnostics.

We expect, that in future it will be possible to carry out research about dialogical or authoritative styles of teaching in mathematics education. Another possibility is studying pupils' learning styles. The important role has the successive and gestalt style of teaching (see Hejný, Novotná, & Stehlíková, 2004). Testing and e-testing is a useful tool for the diagnostic aspect of mathematics education.

Acknowledgements

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CHILDREN AND SMART TOYS IN MODERN LEARNING ENVIRONMENT

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Abstract:*In the era of dynamic development of new technologies, the real space and virtual space interpenetrate. The boundaries between them are blurring. This experience already affects very young children, for whom both environments seem to be a natural place of growing up. The progressive computerization of the play space contributes to the integration of the physical and digital world. Toys and their abilities are changing, they are more smart and interconnected. The way children play with them also changes. The aim of the study is to show the challenges parents and teachers face in creating and controlling the digital playing environment that would provide the child a full security and educational values.*

Keywords: smart toy, children, digital technologies, learning environment, learning through play

INTRODUCTION

One of the basic forms of human activity is play, and it concerns not only children but also teenagers of all ages. It is prevalent in the beginning stages of human development, however as time goes by, play is being perceived as spontaneous and selfless in adults - it transforms into actions that are more direct and takes shape as a form of entertainment or recreation.

1. THE ROLE OF PLAY IN THE GROWTH PROCESS OF THE MODERN CHILD

Play has many functions. Thanks to play, children better understand the surrounding world and its rules. Through experimentation they experience the physical reality, through observation and mimicking norms and rules of society, and they are prepared to play different roles in families, at schools or at work.

While playing, children learn logical thinking, train perceptiveness and visual-motor coordination (Brzezinska, Batkowski, Kaczmarsk, Włodarczyk, Zamecka, 2011).

Currently, many scientific studies emphasize the natural aptitude for learning of a young child through various forms of play. Neuroscientists emphasize that children have an enormous potential after they are born and they should get all the help they can get to reach their full potential. Those innate skills of learning are a reference point for shaping features such as curiosity, engagement, creativity, etc. Nurturing these skills is closely tied to the need of lifelong learning.

The word "play" itself has extensive meanings and can relate to many different situations experienced by a child. Play can thus have a casual nature of exploring the surroundings or can be completely channelled into organizational forms or ramifications. It can also impact the environment and surroundings (for example home, school, backyard).

In the report "What we mean by: Learning through play" prepared by the The LEGO Foundation, based on talks with experts, five features have been determined that describe learning by play. The first basic feature is being joyful and the pleasure that is generated by play, the next one is finding meaning in what they do, full engagement, shaping iterative thinking, formulating problems, experimentation, making hypotheses, etc.) as well as social interactions during play (*What we mean by: Learning through play*, 2017).

If children treat their actions as play they are more likely to engage in them and can develop certain skills faster as well as achieve success. By participating in group play they learn social behaviours, coworking with others and reaching mutual goals. Exploring the environment – copying and repeating actions by children, results in the expansion of their knowledge of the world and getting vital experience. Iterative play, however, contributes to shaping creative attitudes, innovative ways of thinking focused on problem solving. This happens because children are more prone to experiment with objects in their immediate environment, finding new, unheard functions. Unleashing creativity and openness is becoming one of the main goals of contemporary education (Whitebread, Neale, Jensen, Liu, Solis, Hopkins, Hirsh-Pasek, Zosh, 2017).

2. NEW TRENDS IN THE DEVELOPMENT OF TOYS

Toys understood as props used for play have accompanied humans since the dawn of time and undergo further transformations with technological advancements made in various areas of life. Today, with the abundance of advanced electronic devices and digital gadgets, these transformations take on a specific nature coming from the permeation of two worlds: digital and analog.

Modern toys have simultaneously become material artefacts and online media. There has also emerged a term "connected play" which points to the trans-medial and multi-modal nature of modern toys. In modern toys the line between what is online and offline has become blurred (Mascheroni, Holloway, 2017).

Dynamically evolving the Internet of Things enters the toy market intensively. The majority of so called "intelligent toys" are products of hybrid nature - they connect the physical object with a specially designed software and an entire virtual environment. To use these toys it is essential to exchange data between a child and a server or an internet platform (Chaudron, Di Gioia, Gemo, Holloway, Marsh, Mascheroni, Peter, Yamada-Rice, 2017).

Advanced electronic toys currently support Internet connection (for example WI-FI, bluetooth), they can also be equipped with various sensors that collect different kinds of data and explore their surroundings. More and more toys are also now "smart" because they allow to start a dialog with a child. New technologies also allow for an exchange of information with other toys. The term "intelligent toy" is understood as a toy equipped with electronic elements consisting of processors that run dedicated software that allow for the interaction with the user. Modern toys based on new digital technologies can also react to the young user's actions, identify verbal messages and respond to them. They can also be remotely controlled by a network infrastructure, for example smartphones or tablets equipped with dedicated software (Chaudron, Di Gioia, Gemo, Holloway, Marsh, Mascheroni, Peter, Yamada-Rice, 2017).

In the report Internet of Toys: A report on media and social discourses around young children and IoToys. The authors outlined three main types of toys equipped with dedicated software. The first group are toys that connect to the Internet. The second group consists of toys that simulate human interaction, for example dolls controlled by voice recognition tools. The third group - the most advanced one, includes toys, which can be programmed by the user, for example, they can complete actions not predefined by the manufacturer. For example, certain robots which can be controlled by children using certain applications, while writing their own programs (Mascheroni, Holloway, 2017).

It should also be noted that the outlined areas in this practice often permeate and supplement each other and in many cases it is hard to draw a clear line between them. The outlined groups, however, illustrate the observed trends in the domain of toy development very well.

For the past few years robot toys have become quite widespread. LEGO MINDSTORMS is one of the most popular toy series. Lego sets along with sensors and dedicated software allow the child to build their own robot and individually program it. On the other hand, Dash & Dot robots from Wonder Workshop go a step further. Thanks to built-in sensors they can react with voice, find objects, dance and sign. They can also be coded with graphical, intuitive applications suited for younger children on smartphones and tablets. (http://www.wonderpolska.pl/ product-pol-6-DASH.html).

Children usually like to collect action figures, especially their favourite heroes from popular cartoons and animated movies. The traditional form of toy takes on a new shape thanks to modern solutions. An example of this would be one of the characters from Star Wars - Droid BB – 8, which, using the Internet and a dedicated application that responds to voice commands, can move, execute pre-preprogrammed actions, play games, play recordings that resemble holograms, and even explore its surroundings and learn its topography (https://www.sphero.com/ starwars/bb8).

Robots can also take shape in the form of supercars (http://www.anki.com/en-us/overdrive which can be built, programmed, and equipped to fight others.

More often you can see toys based on Artificial Intelligence which are designed to engage in a dialog with a child. The Hello Barbie doll from Mattel can for example talk with a child in real time. It uses the Internet. After activating the system - pressing a specific button - it connects to the wireless home network, records the child's speech and sends it to the server. There, it is processed and analysed and then the system provides an answer which is sent back to the doll. The dedicated smartphone application allows the parents to constantly monitor the conversations between the Hello Barbie doll and their child, and the crucial data is stored on the phone that is used to connect with.

A specific type of toys which has great potential are 3D printers. They are already available for sale for the youngest users. Children take on the role of creators and inventors, wanting to materialize their ideas in practice. Using special applications they design objects and subsequently print them and check if they work. For example the da Vinci miniMaker printer is marketed as a STEAM toy, which not only boosts the development of the child's competences in the field of science, maths and arts but also can accompany the child for many years at later stages of education (https://www.xyzprinting.com/en-US/product/da-vinci-minimaker).

Trend analysis of the development of modern toys illustrates that one should not discount new digital forms of books for children. The digital revolution had a major impact on the diversification of the form of the modern book. Tablets, smartphones or ebook readers are becoming physical data carriers for electronic publishers. They allow for the selection of any form of book. Apart from physical publishing houses, we also have e-books and audiobooks. However, even traditional books may contain additional elements: QR codes or links that allow access to additional multimedia web resources. Specifically, Augmented Reality technologies have special features. It is a technology that allows to add a layer of digital information on top of a physical reality seen through a screen or a device. Interaction with objects in augmented reality takes place with different mobile devices, however they all require a physical object to present the information. Through 3D projections taking shape as virtual objects, that can additionally be supplemented with animation and sound, there emerges a new quality of experience - ability to consume a book through different means. For example in Alive! by Carlton Dinosaurs from the award-winning series Bring to Life, after scanning selected illustrations with a tablet or smartphone, children can see the described dinosaur models from different angles (https://www.carltonbooks.co.uk/ series/digital-magic-books).

Summarizing the debates concerning the new trends in the development of toys which can be now observed, it is worth to mention the new phenomenon of permeation of the real and artificial artefacts with the digital space, services, applications and internet resources. In modern toys these technologies are often their integral part and create a media platform that is part of a promotion of a product.

3. DIGITAL TOYS AS ELEMENTS OF THE MODERN EDUCATIONAL ENVIRONMENT

Simple, classic toys such as rattles, blocks, puzzles, which have been dominating children's bedrooms, allowed the children to become creators - subjects that control the course of the play. Today, however, the children are equipped with toys that repeatedly direct their way of play. They suggest, and often impose what and how they should play. They simultaneously determine the method of using a given toy. It can also be assumed that in some cases they program the behaviour and children’s methods of play. They do not inspire, instead they limit the development of imagination in a child. Moreover, modern electronic toys draw the attention of children and parents with attractive look, movement, lights and sound. Often they are heavily advertised in mass media. Traditional toys that are not promoted like that can be perceived as dull and uninteresting. Specialists warn that in the long term, this problem may have a major impact on the methods of play as well as the way the children learn. Certain criticisms point to the fact that it may also lead to negative consequences for the entire learning process (Levin, Rosenquest, 2001).

Manufacturers of technologically advanced toys promote them in media as having a major learning potential. This way of presenting products make the parents decide, despite high price, to buy them eagerly. There arises a question whether educational values in toys full of technologies are that valuable. Or rather they limit the cognitive abilities of children, hinder their innate aptitude for active play and creative thinking, or even destroy imagination. Despite the long term research, these questions are still viable (Levin, Rosenquest, 2001). The capabilities of the toys themselves and the media connected to them change very dynamically.

One of the major issues concerning families is the situation where children more eagerly choose activities available through digital media rather than traditional forms of play. When a child is stimulated with different incentives from the media they get used to that situation and treat it as typical. They also get used to the role of a passive consumer and expect to be entertained by the environment at all times. That is why it is so important to promote an active role, leaving a lot of flexibility in a child's play and allowing for spontaneous actions. The technology in the toy cannot overwhelm the child, rather it should expand its properties with additional features and, most importantly, allow to control the toy at all times.

The educational value of toys, games and applications used by children is very important. They should be based on the idea of problem solving and ensuring the ability of development and discovery through personal choices and innate curiosity, which results in actions such as searching, projecting and building. It also worth noting that while a child is discovering the surrounding world, it also explores the media environment in which it functions, and it reaches for new digital media and treats them as objects of play. A few-year-old is already able to use mobile devices such as smartphones and tablets. This can also be a chance to inspire the child to undertake creative actions, experiment with media messages or create own images, photos or videos using the available software.

On the other hand, many toy manufacturers underline that their products enter the educational stream of interdisciplinary STEAM, supporting sciences and arts (STEAM - Science, Technology, Engineering, Arts, Math). In the same way they meet the social demands in shaping future specialists that are currently in high demand, including programmers and engineers.

One of the pioneers and proponents of introducing the children to the world of technology and artificial intelligence was Seymour Papert - the inventor of the LOGO language. His goal was a complete overhaul of the practice of learning and educating, a departure from the method of passing on knowledge and switching to actively creating it. Just in the 60s, of the past century, the children could easily use a computer, only if the learning process would take place in a natural manner, similarly to the way in which the child learns basic activities such as speech. Based on the ideas of constructivism, he created the rules of constructionism. He said that the if the child engages in the creation of specific artefacts, the accompanying learning process becomes more effective. Digital technologies and the ability of self-learning play a crucial role in this process. S. Papert also pointed to the importance of indirect teaching, which also occurs during other activities. One of these activities is the free play of the child (Walat, 2017).

One of the crucial aspects of media-based smart toys is the security of the child in the digital world. Internet communication carries certain dangers concerning confidentiality and availability of sensitive information, such as personal data. Moreover, there is always a chance that hackers might take control of the device which the child is using – such cases have already been reported.

There are also groups of electronic gadgets which, apart from their basic function - which is to entertain, also have a guardian function. For example, smart watches, apart from typical functions - such as built-in games and applications for children and the ability to make calls with specific numbers, have extensive control options. A smartwatch can be equipped with GPS, a SOS signal button or alarm which turns on when a device is removed from the arm or when the device leaves a certain area. Based on the equivalents for adults it can also have additional features such as a torch, pedometer, or other advanced applications for monitoring sleep.

When using smart toys there are also certain legal regulations with new media. For example concerning unclear rules of possession. Similarly to solutions used in other fields, the owner of the software is usually the toy manufacturer, and the parents buying these toys are only licensees. Due to this fact, such software can be easily updated or modified by the manufacturer at any time, they can also change the conditions of use.

CONCLUSIONS

Evaluating the values of intelligent toys, it is worth mentioning the above contexts. Creating an environment that supports the development of a young child in the digital world is a challenge to the parents specifically. Kristy Goodwin, the author of the book *Raising your child in a digital world*, emphasizes on her blog that today children spend most of their time interacting with technology. They acquire digital competences much faster than motor skills, enabling them to effectively navigate the physical space and other basic literacies. That is why contact with new technologies did not replace hands-on experience. Introducing the child to the world of digital technologies is not an easy task, the parents do not have the necessary experience or elaborate norms of behaviour, especially where in many cases we encounter circulating opinions and myths which do not hold any substantiation in a wide range of scientific case studies.

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DESIGN OF EDUCATIONAL APPLETS FOR INCREASING CHILDREN'S ABILITIES TO RECOGNIZE PATTERNS

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Abstract: *The study is aimed to describe the process of creation (conception, design and implementation) of a collection of educational applets for the topic "repeating patterns" for children in preschool and young school age. The aim was to create applets which are simulating didactic tasks designed for finding a rule (core) in repeating patterns during pupils' game. Method Design Based Research was applied for development and implementation of interactive applets resulting in a collection of applets with grading tasks: a) identification of the pattern and ability to continue in the pattern (at different positions), b) finding a mistake in pattern and ability to correct it (using different ways), c) complete a missing sequence in the pattern (selecting from options). The applets are implemented through technologies html5, css3 and JavaScript without any additive browser plugins. The design and implementation reflects mathematical correctness and age suitableness as well as user comfort and simple schematic graphical design. The collection of applets is available on web page www.delmat.info (www.delmat.org).*

Keywords: applets, design, education, patterns, children.

INTRODUCTION

One of the areas of the research project "Optimization of mathematics teaching materials based on analysis of the current needs and abilities of pupils of younger school age" is also a topic devoted to patterns and structures. The aim of the problem solving process is to design, create and verify such interactive and educational materials, environments respectively, in which children may discover the rules, patterns and structures on their own. In this paper we describe the factors that influenced production of high-level design educational applets focused on the problems devoted to patterns. During this process the methodology of the applet's elaboration was created which included requirements of the content expertise, design of functionality and visual adaptation of the applets. Based on these materials, software developers constructed low-level design while implementing the applets.

The author's *pedagogical content knowledge* is the condition for creating high quality didactical educational materials (applets included). The term didactical content knowledge was specified by Shulman (1986) and it integrates two factors: content knowledge and pedagogical knowledge. Slavík, Janík, Najvar and Knecht (2017) claim that didactical content knowledge is a common interpretational framework that connects theoretical didactics and practical didactics. It was important to apply both of these components while designing high-level design educational applets. In the following paragraphs we will try to clarify the basics of the didactical theoretical-practical principles about patterns that were implemented into the applet design.

1. THE CONTENT PRINCIPLES OF PATTERN'S APPLETS

Mathematicians often search and subsequently use patterns in the problem solving process. Steen (1998) stated that mathematics is a "*science of patterns*". He also argued that mathematics is a theory based on relations among patterns and applications of mathematics that arise from observation and pattern adaptation. The patterns can be found in arithmetic, algebraic and also in geometric structures. Development of informatics or statistical sciences also provides arguments for searching and developing rules and dependencies. The process of rule searching or relation searching is a process, in which the generalisation as a basic predisposition for the development of abstract thinking is often applied. At the same time, working with patterns helps to develop the ability to predict and detect principles in situations in which it is not clear at the first sign. Experiences with patterns allow us to identify a system, order, arrangement or principle. Therefore, it is important to develop an ability to work with patterns already in pre-school and young school age of children at appropriate level. In order to make the problem solving interesting, playful and compelling for children and mathematically and didactically correct at the same time we have decided to design and implement educational applets with an aim to develop abilities of children to recognise the pattern.

According to Clements and Sarama (2014) "*patterning is the search for mathematical regularities and structures*". Patterning is a process in which children expand not only their knowledge but also the way of thinking. In mathematics we work with different types of patterns whereas the pattern is being made up of elements (objects) and a rule. If the elements of a pattern are numbers, for example, we speak of number patterns; if the elements of pattern are pictures, we speak of image patterns and so on. The rule determines, for example, whether it is a repeating pattern in which the sequence of elements repeats itself or it is a growing pattern in which dynamic growth applies for some of the sequence's elements, perhaps even it is a recursive pattern in which the rule determines that following elements are made of the previous elements and so on. However, in this study we will only deal with fundamentals and the applications of repeating patterns.

A repeating pattern is a sequence of components that arises from a cyclically repeating core of pattern. The core of pattern is made of sequence of repeating components consisting of items (e.g. shapes, colours, numbers). The core must be clearly identifiable. Many patterns are created by a combination of different components but they can have the same fundamental essence. For example, a repeating number pattern (1, 2, 1, 2, 1, 2, ...) and a repeating shape pattern (triangle, circle, triangle, circle, triangle, circle, ...) or a repeating colour pattern (red, blue, red, blue, red, blue, …) are of the same type. In these cases the same rule of alternation of two components is applied. We mark this type of pattern by using symbols (ABABAB), therefore, the core has the length of two (AB). A different type of repeating pattern consists of two elements as well for example (ABBABBABB). In this pattern the core consists of a sequence (ABB) and its length is three. For a pre-school children or younger school aged children these two introduced samples are not equally demanding. The hierarchy of pattern complexity has been investigated by many authors (Orton (Eds.), 2005; Clemson and Clemson, 1994; Desli and Gaitaneri, 2017; Gadzichowski, 2012, Skoumpourdi, 2013) from many different perspectives considering different criteria. There is a consistency in all of the available research results claiming that the simplest linear repeating pattern for children is the type of pattern (ABABAB). Three years old and older children are able to identify this type of pattern (sometimes even earlier). The researchers try to define the appropriate degree of difficulty with consideration to cognitive theories. Therefore, it is evident that the scale of difficulty varies according to the author. Threlfall (in Orton (Eds.), 2005) forms a sequence of the tasks according to the level of difficulty of a repeating pattern originally designed by Vitz and Todd (1967): (AB), (AAABBB), (AABB), (AAB), (AAAB), (ABC), (AAABBBCCC), (AABBCC), (ACCCBCCC), (AAABC), (AABC), (AABBC).

The level of difficulty is not only dependent on the number of the objects and the length of the core of the objects but on the complexity of the rule as well. For example, from the sequence mentioned above, ABC, AABBCC and AAABC patterns contain three elements but are not of the same level of difficulty. The length of the core AABBCC is bigger than the length of the core in AAABC pattern, however, the shorter pattern is more difficult.

The level of difficulty is also influenced by environment and material that the pattern is made of. Our long-term observations showed differences between work with 3D objects, printed handouts and virtual objects. Children, who work with real objects (cubes, tokens and so on) and discover the pattern, have a tendency to continue without end. In other words, they often continue if there is a space to continue. However, children using printed handout continue only until there is no longer any empty space on the handout. From the point of view of rule discovery and ability to continue with the pattern discovery tasks in virtual space are the least open. This is partly due to production application rules and partly due to technical constrains. While discovering the rule automatic control is often a help to the problem solver. This way the child is not confronted by its own control, which can become a limiting factor. On the other hand, feedback about the success of the solver is a motivating satisfaction for the child.

Another factor of the pattern difficulty is formulation of the task. Previous characteristics of the difficulty were linked to the formulation of the given task such as: "observe and repeat"; "observe, find the rule and continue" that are the simplest. More difficult and more open at the same time is the task "find a mistake and correct it". Also difficult but not because of the openness are tasks such as "fill in the missing element" or "choose, which sequence has to be completed".

There are more types of tasks for the work with patterns. Also, there are more situations and environments in which activities with patterns can be implemented with a different character such as auditory or kinetic etc. As showed above, it is clear that there is a number of different possibilities of how to arrange a collection of tasks on repeating patterns. The most important ambition of ours was to achieve the consistency of our proposal of educational applets with current needs, abilities and interest of children of younger school age. Thus, the content structure of applets should be considering the needs of children from the cognitive and affective point of view. Moreover, it should be reflecting potentially different level of thinking of children.

2. TECHNICAL NOTES ON PATTERN'S APPLETS

Our requirements for designing the applets related to their technical solution were mainly based on the free accessibility of applets for mobile education, intuitive user-friendliness for younger children, and integrability into an existing project website (www.delmat.org, www.delmat.info). In brief, we will describe the characteristics of applets implementation in terms of the basic software principals.

The term "applet" was originally used in connection to Java Applets. Dynamic changes and development of the Internet browsers, especially HTML and CSS, gradually eliminate usage of input components such as Java or Flash respectively. That is because of their dependence on other technologies and because they are not usable on all, especially mobile, platforms. In this case the term applet was used purposefully as the work area of the task has clear boundaries on the web page with dedicated functionality and the remaining parts are shared and similar in most cases. The aims of the project required the wildest possible usability even on devices that limit the above-standard requirements for hardware and software equipment in the school environment.

The chosen software solution uses the newest versions CSS, HTML and JavaScript in both two and three-dimensional animations in a way that most of the browsers nowadays and in the future can accurately display all of the applets with the tasks without extensive code interventions. The exceptions are browsers of Microsoft because of the incompatible implementation of the World Wide Web Consortium (W3C) standards. Since it is not a native application, no installation/ update is required. The web portal can be continually complemented with new tasks and language mutations. The applets are optimised in terms of data transfers over the Internet. If the criteria changes the web page itself does not reload, however, the pictures (icons) change. The same rule applies when the browser size changes or the mobile device (tablet) rotates - the web page dynamically changes the visual input without downloading data from the Internet (responsive design). The applets were graphically and functionally unified for standard computers (monitor/mouse/trackpad), touch-screen devices that keep gestures, switches and some components depending on another principle (mouse clicks, mouse double clicks, right mouse button and so on.)

With regards to the target group of children in pre-school and younger school age, that often use mobile devices, applets use the "drag" & "drop" principle. Chosen control method is not only natural but also does not distract attention from the desired goal. Concentration retention is a subordinate design that is set minimalistic to schematic, without disturbing moments, extreme amounts of colour, components, and things such as "clickable" active elements. The aim of these attributes is to enable a child to concentrate for as long as possible on the mathematical essence of problem solving. In other words, we have tried to reduce any potential noise such as exaggerated animation or other disturbing phenomena that could possibly distract children.

3. METHODOLOGY OF THE RESEARCH

3.1 Research paradigm: educational design research

We have applied Design Based Research (DBR) to design, develop, and verify interactive learning applets. DBR uses qualitative, quantitative and mixed methods. If research is applied in education, we may speak of educational design research. According to McKenney and Reeves (2014) "*educational design research is a genre of research in which the iterative development of solutions to practical and complex educational problems provides the setting for scientific inquiry*". David (2007) claims that the aim of DBR is to uncover the relationships between the theory of education, proposed artefact and practice. This method of research is according to Anderson and Shattuck (2012) a practical method of research that can overcome the gap between theory and practice. The DBR method is based on a cyclical repetition of the intervention and its improvement until it is effective. This process is usually long-term, as confirmed by Pool and Laubscher (2016). There are several models and approaches to how DBR is implemented. The type of artefact, the conditions in which it will be verified can influence the choice of the model. Reinking and Bradly (2008) claimed that DBR is a suitable methodology for educational research and they focused on the questions concerning the use of intervention in education (e.g. how to use intervention in the classroom, what practical, methodological or ethical obstacles can arise, what is the potential of intervention etc.). Based on their analysis of existing DBR models and the underlying DBR theoretical framework in education, McKenney and Reeves (2012) created a generic model of education design research (Figure 1).

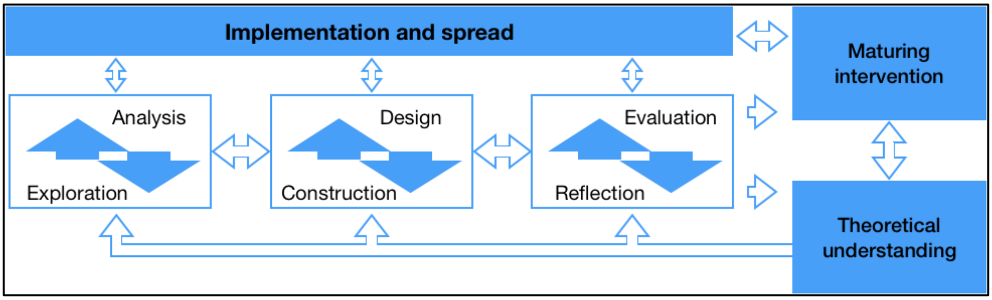


Figure 1. Generic model of educational design research according to McKenney and Reeves (2012)

Source: Own work based on McKenney and Reeves (2012)

The model consists of three main phases (analysis/exploration, design/construction and evaluation/reflection) arranged in a cyclic iterative structure that have a double reach: both theoretical and practical. This basic general model was most suited to our research goals, therefore became a paradigm for designing and verifying educational applets in order to increase a child's abilities to recognise patterns.

The method of educational research design enabled our prototype applications to be improved to their present form. Even the fact, that the development process has begun in 2008, it has not been completed yet and current applets are currently being verified. In the process of maturing intervention individual case studies are constantly being processes and important findings are selected to be included into new applet design.

3.2 The applet development process: I. phase of educational design research

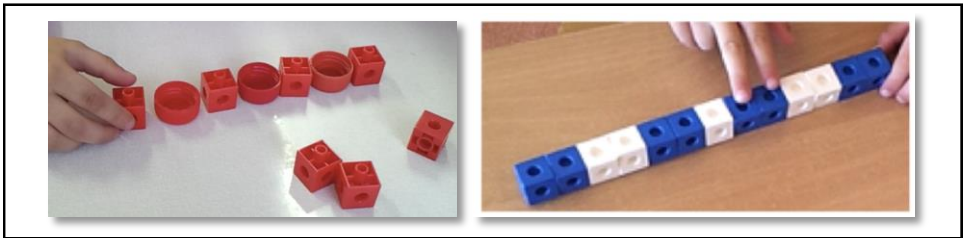


Figure 2a, 2b. Exploration: a process of creation of patterns via manipulatives

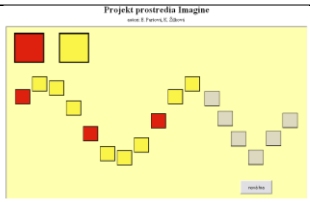
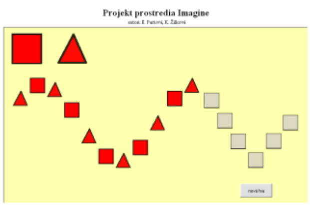
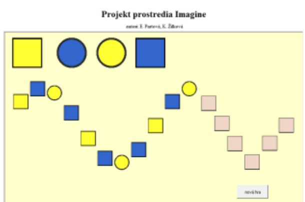
Source: Own work

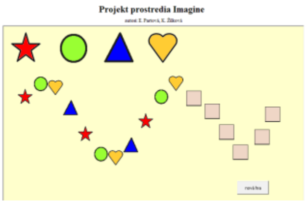
Based on our theoretical framework about repeating patterns (e.g. Orton, 2005; Clemson and Clemson, 1994) and also based on our multiple observations of pre-school children working with real objects (Figures 2a, 2b) we have made first four prototype applets (APP01 – APP04) in Imagine Logo environment in 2008. They were designed for pre-school and younger school aged children.

Imagine Logo is an object-oriented children's programming language controlled by events. The essence of designing applets was work with turtles, which are elementary objects of Logo. The linear repeating pattern was generated in applets using multiple turtles with assigned geometrical shape. The applets were controlled by the "drag and drop" method. Each applet used a different number of elements and colours, so the basis of each applet was unique. This approach enabled to verify not only the difficulty of individual patterns from the core of pattern points of view, but also from the recognition of colour and shape point of view. Significant attributes, which characterise prototype applets, and principles on which basis they were implemented, are shown in the table (Table 1).

Table 1.

Summary of applets in Imagine Logo focused on the patterns

Label	**Graphical view**	**Types of objects**	**Rule of a pattern**	**Core of a pattern**
APP01		square, triangle, circle	***1 shape 2 colours*** - pattern made of same shapes and alternation of two colours	*AB* *ABB* *ABBB* *AABB*
APP02		square, triangle, circle	***2 shapes 1 colour*** -pattern made of 1 colour and alternation of two shapes	*AB* *ABB* *ABBB* *AABB*
APP03		square, triangle, circle	***2 shapes 2 colours*** -pattern made of two shapes in two colours with random alternation of colour and shape	*AB, ABB,* *ABBB,AABB,* *ABC,* *AABC, ABAC,* *ABCA, ABBC,* *ABCB, ACBB,*

				ABCD,
APP04		triangle, circle, heart star	***4 shapes 4 colours*** -pattern made of 4 shapes of different colours, each shape had constant colour	*AB, ABB* *ABBB, AABB* *ABC* *AABC, ABAC* *ABCA, ABBC* *ABCB, ACBB* *ABCD*

Source: Own work

In applets it was not possible to set the level of difficulty of tasks according to the type of pattern. The first four elements of the pattern were generated randomly and the rest part of the pattern was their repetition. Therefore, it was not possible to modify the choice of task to the abilities of a child. The only way to do that was to generate another task and the teacher has to decide whether the task is appropriate for the child or not. We did not assume individual work of children with applets and we expected teachers' intervention not only in the choice of task but also in the exploration of a child's strategy through problem solving.

During verification of applets we identified some of the children's strategies and found out that the preference for shape or colour is not the same for all children. The difficulty of applets APP01 and APP02 was approximately on the same level. It was sufficient for children to follow only alternation in colours in APP01 (e.g. "red, yellow, yellow, red, yellow, yellow, ...") or in shapes in APP02 (e.g. "triangle, square, triangle, square, ..."). Solving tasks generated in APP03 was for children more difficult because they had to follow not only one criterium, but two criteria at the same time (e.g. "yellow square, blue square, yellow circle, yellow square, blue square, yellow circle, … "). In spite of the fact that the way patterns in applets were generated enabled to work with easier patterns applied in APP01 and APP02 also within APP03, for example, "yellow circle, blue square, yellow circle, blue, square, ...", which is a pattern with a core (AB). Applet APP04 enabled to generate all types of patterns as applet APP03 where the difference was only in the objects the pattern consisted of. Applets APP03 and APP04 were approximately on the same level of difficulty.

Most frequently computers and interactive boards were used in further verification of prototype applets APP01-APP04. At the same time new tasks were tested and we observed children as they were solving them, particularly via haptic manipulation (Figure 3) with real objects (Partová and Žilková, 2016a; 2016b). Results of our observations became the basis for input conditions for further analysis, preparation and creation of new applets.

Figure 3. Working with patterns through manipulatives at the end of I. phase and beginning of II. phase of research

Source: Own work

3.3 The applet development process: II. phase of educational design research

New analysis and design of applets were determined not only by educational (didactic) factors but also by technological changes and development of ICT means. The goal was to create applets that would enable mobile learning. At the same time we wanted to create not only more attractive environment but also care about the factor of concentration of a child on the content and the factor of elimination of potential disturbing elements. The result is collection of applets available on web page www.delmat.info (www.delmat.org).

New applets became prototypes for further research. It is a collection of five complex and content expanded applets (Figure 4) divided into three packages according to the type of task:

1. *Identification of the pattern and ability to continue in the pattern (at different positions)* – applet PAT1: http://www.delmat.info/a/3/;
2. *finding a mistake on pattern and ability to correct it (using different patterns)* – applets:
    a. PAT2 (by deleting an object): http://www.delmat.info/a/4a/,
    b. PAT3 (by covering an object with the right one): http://www.delmat.info/a/4b/;
    c. PAT4 (by inserting an object): http://www.delmat.info/a/4c/;
3. *complete missing sequence in the pattern (selecting from options)* – applet PAT5: http://www.delmat.info/a/5/.

The structure of applets enables to reflect the needs, abilities and interests of children on different levels that may be regulated by the choice of parameters of every task.

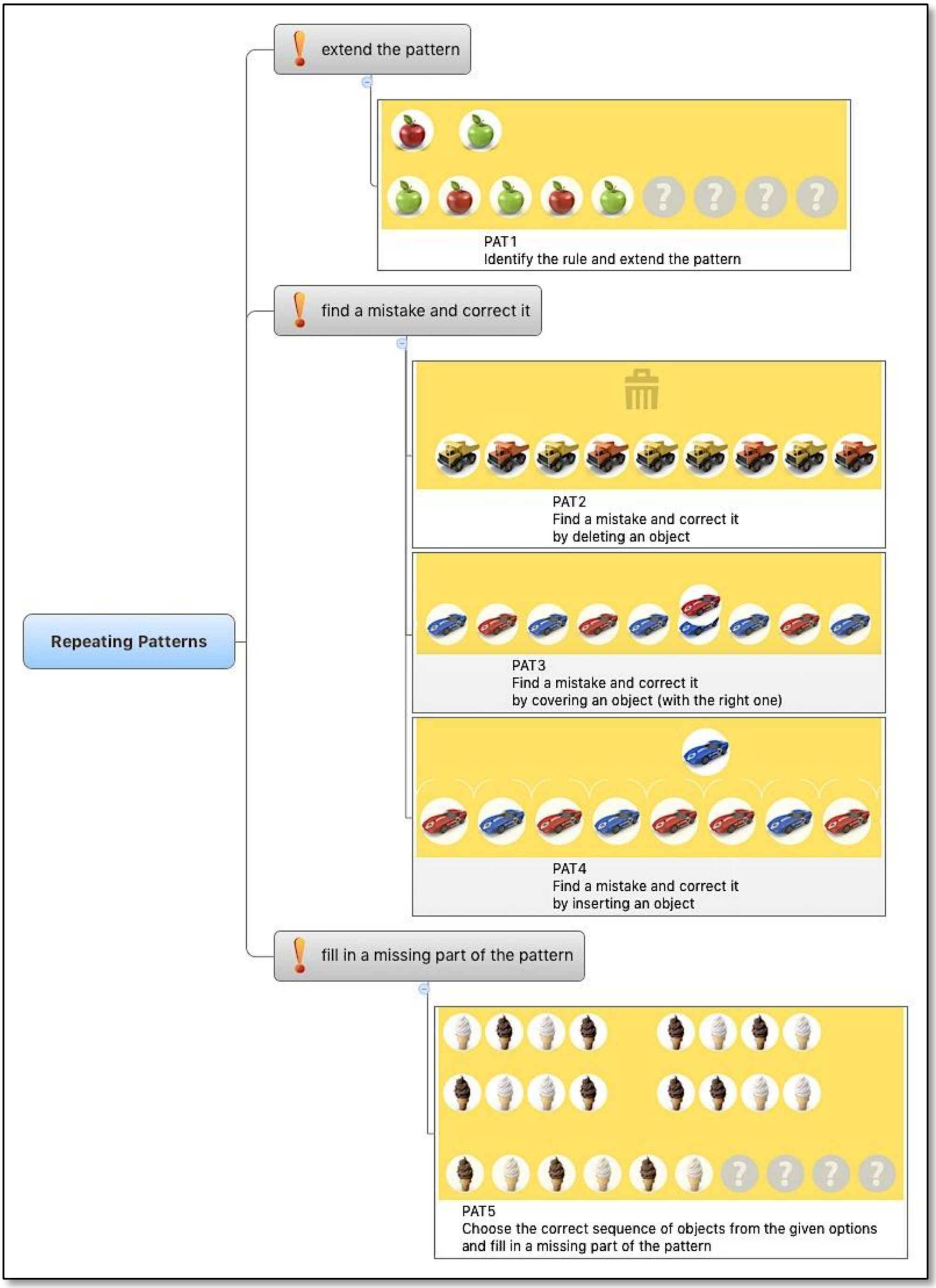


Figure 4. Categorization of tasks in collection of applets: Repeating Patterns

Source: Own work

A wide range of types of assignments, objects and complexity of a pattern eliminates limits of virtual environment presented above. The patterns are therefore generated according to the user predetermined parameters from which the common for all applets are:

- *difficulty of a pattern* – the pattern is generated according to the type of a pattern from these possibilities: AB, ABB, AABB, ABBB;
- *property (criteria) of a pattern* – the rule of alternation of elements in pattern is according to one of the properties: colour, shape, size;
- *objects of a pattern* – user may choose elements the pattern consists of: pictures of real objects, iconic (schematic) pictures, planar shapes, spatial shapes;
- *position of a pattern* – the pattern is generated horizontally or vertically;
- *form of a pattern* – the pattern may be displayed in a line or as a tilde.

Generation of tasks in applets enables to simulate relatively large amount of variable tasks. If we take into consideration, for example, only 4 possibilities of choice of difficulty of a pattern, 3 possibilities of choice of property and 4 possibilities of choice of object types then the applet may generate 48 different types of tasks. If we add to them another combination of other parameters, the number of tasks increases. Also for this reason we consider newly created applets more complex than the prototypes.

The phase of verification of applets is still in progress. However, based on the results already processed we identified some characteristic features connected with environment of applets. Respondents (children in preschool and young school age) worked with applets on different media: interactive board, laptop, tablet and smart phone.

In the sphere of technical manipulation with different media we observed a couple of curiosities. Working on an interactive board involves orientation on much greater area than a notebook, book or tablet. Despite that it was comfortable for the children. We observed the distance between the board and a child in the process of finding a rule and preference of digital pen over hand while moving the objects. Working on laptops did not require moving from the screen. Respondents manipulated with objects with the use of mouse or a finger (if the touch screen was available). In this case using finger appeared to be an easier way than using the mouse. Respondents who worked on tablets chose to work with a finger or digital pen according to their age that is probably caused by the development of fine motor skills.

In the cognitive area so far we have considered most significant the fact that our doubts with prompt feedback were not confirmed. Children identified easier patterns too soon, so they did not have to count on the trial and error method and they accepted feedback as confirmation of their work. In more complex patterns, where more possibilities of "answer" occurred, the trial and error method was more attractive but only for a short period of time. After that majority of children considered it a boring substitution and they started to find a rule.

In the area of a motivational impact we found out in all cases already processed that the applets aroused interest in children. It can be confirmed by their declarations, such as: "why don't we do it at school", "give us more such tasks".

The whole collection of applets (Figure 4) aimed at repeating patterns forms a research tool for quantitative and qualitative verification of their effectivity in terms of needs, interests and abilities of children. Besides verification of the existing applets we will focus on creation of more difficult applets in the next phases. Increase in difficulty will be ensured not only by an increase in the number of objects, length of the core of a pattern but also by increase in complexity of a rule according to the existing theoretical basis and published research papers.

CONCLUSION

Educational design research does not have only an easy structure as was stated in the theoretical basis (Figure 1). McKenney a Reeves (2012) expanded their generic model by smaller cycles of different length within individual phases of research (analysis/exploration; design/construction; evaluation/reflection). These cycles are called micro-, meso- and macrocycles. The course of our research corresponded with this conception because it was necessary to verify results continuously within each cycle and each phase, correct changes based on verification, design and implement new elements again and so on. The process is spiral, it requires permanent analysis, constructions and evaluations. At the moment the phase of evaluation and reflection of new applets PAT1 – PAT5 is in process (Partová and Žilková, 2017a, 2017b, 2017c, 2017d, 2017e). We investigate the influence of the effectivity of applets on increase in the children's ability to discover the rule in a pattern and to apply it. By that we want to reflect needs of children in young school age in the context of development of their mathematical competences, generalization, the use of analogies, algorithmisation, finding relations and creating schemas in particular. At the same time we detect interests and preferences of children within individual applets in terms of chosen parameters of tasks. The goal is to achieve an inner motivation to solve children's problems with patterns and support their autonomy in problem solving. We also draw from the results of a study by Fox (2005) who regards activities with repeating patterns as productive learning occurrences. Results of the case studies they realized showed that "*children initiated activities that explored repeating patterns, pattern language, and the elements of linear patterns*". Based on our evaluation processes and individual case studies with children of young school age we assume that the interactive educational applets have potential not only to support inner motivation of children, but also increase in their abilities to recognize and to apply the pattern.

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APPLICATION OF E-LEARNING FOR THE DEVELOPMENT OF FOREIGN LANGUAGE TEACHERS BASED ON A COURSE *DEUTSCH LEHREN LERNEN*

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Abstract: *Forms of e-learning are being applied not only in education but are also being gradually implemented in the area of teacher development, including these of foreign language teachers. One of the leading institutions in this area is Goethe-Institut - a well-known and recognised cultural institution, acting on behalf of the Federal Ministry of Foreign Affairs of the Federal Republic of Germany as a public benefit association. As a tutor of Goethe-Institut courses, the author presents her experience of running, since 2015, many editions of a qualifying course Deutsch Lehren Lernen (DLL). Based on Stufflebeam's (2007) CIPP evaluation model key aspects of the DLL-course are discussed such as: the conditioning of implementations and the target group; the selection of content and the learning progression; assessment and evaluation tools, and in particular, the role and tasks of the tutor, because in the context of successful e-teaching, the tutor fulfils specific tasks, becoming a consultant who accompanies and supports the learning process. Also the results of the evaluation questionnaires and the participants opinions gained through direct communication are discussed. In the author's assessment, the DLL-course – although not without certain flaws and shortcomings – can be an example of good practice in the use of e-learning in teacher development.*

Keywords: pedeutology, teacher development, action research; ICT, e-learning

INTRODUCTION

The Goethe-Institut is a well-known and recognised cultural institution, acting on behalf of the Federal Ministry of Foreign Affairs of the Federal Republic of Germany as a public benefit association with headquarters in Munich. Established in 1951, the institute now has 136 branches and 11 contact offices in 92 countries, carrying out a wide range of tasks in the field of foreign cultural policy. The

Institute's main objectives are to strengthen the position of the German language among other foreign languages, to provide broad access to information and knowledge about Germany, to disseminate German culture, to promote cultural exchange as well as to develop cooperation in the field of education.

An important area of the Goethe-Institut's activity over the last few years has been the systematic expansion of its digital offers, including, among others, applications for mobile devices, games, social media applications and course elements run on distance learning platforms. In terms of professional training, the Goethe-Institut also offers a comprehensive qualification programme and developmental courses for teachers of German as a foreign language, implemented in individual countries, in Germany and as in the case of *DLL Methodik und Didaktik* in the form of distance learning. More detailed information can be obtained from the website http://www.goethe.de/lrn/prj/for/kur/mud/deindex.htm.

1. GENERAL COURSE CHARACTERISTICS

The *DLL Methodik und Didaktik* course consists of six modules, comprising three phases: Phase I includes module *DLL3 - Deutsch als fremde Sprache* and module *DLL2 - Wie lernt man die Fremdsprache Deutsch;* Phase II consists of module *DLL6 - Curriculare Vorgaben und Unterrichtsplanung* and module *DLL4 - Aufgaben, Übungen und Interaktion*; Phase III consists of module DLL5 - *Lernmaterialien und Medien* and module *DLL1 - Lehrkompetenz und Unterrichtsgestaltung.* After completion of all phases, the participants, at a time convenient to them, write a final exam which is to be carried out on a specially designed test platform. The final test lasts 60 minutes and covers a total of 60 tasks (mostly in the form of single or multiple-choice questions). Test participant may repeat the test once without incurring additional costs. In order to become familiar with the format of the tasks in the final test, the participants have access to a sample test for each of the three phases of the course, allowing them to attempt and practice solving the test tasks; however, they do not receive descriptive formative assessment. The minimum estimated time needed to complete the course is nine months. In order to best meet the different circumstances and needs of the students, there is a possibility of extending the course by up to three months free of charge, and up to a maximum of another three months – by means of a paid extension. The course is individual in nature, so the forms of communication with other participants are limited to two moderated forums: a general forum and a thematic forum dedicated to discussing issues related to exam preparation.

The pilot implementation phase of the course, conducted in accordance with the so-called rapid prototyping approach of Tripp and Bichelmeyer (Tripp & Bichelmeyer 1990), began in May 2014. The tutors - totalling almost 200 people - participated in all modules of the course. Thanks to this they became thoroughly acquainted with the content, types of tasks and forms of evaluation from the point of view of the participant. This allowed for a thorough and in-depth understanding of the content and tasks of the course as well as the testing of instructional effectiveness along with the usefulness of applied concepts and planned processes such as interactive activities and navigation frameworks. After completing the evaluation and during a series of teleconferences, the participants, as future tutors, provided to the authors and developers of the course their observations and remarks; consequently, their feedback was considered in the course of the modification of the content and communication tools.

Immediately following the completion of the course, there was another distance training session, this time in the field of tutoring skills, which covered the following topics:

- specificity of distance-based and low-contact learning;
- specificity of learning by adults and the elderly;
- working with asynchronous and synchronous communication tools;
- constructing effective feedback;
- creating social relationships with course participants;
- supporting participants in the process of self-organised learning;
- motivating, supporting and advising participants.

The demonstration version of that course is available online at website http://lernplattform.goethe.de/course/view.php?id=53. Future DLL course tutors had been recruited, for the most part, from those who for many years had collaborated with the Goethe-Institut on international educational projects. Since they did not have any experience or formal preparation in performing tutorial duties, this training was crucial, mainly for defining common and homogeneous tutoring standards. Based on the materials available to the author from the head office of the Goethe-Institut in Munich, as of June 2018, there are more than 140 DLL course cycles running in various detailed configurations, in which a total of over 2900 international participants are taking part.

2. TARGET GROUP AND CONTEXT OF THE COURSE

The *DLL Methodik und Didaktik* qualification course which has been offered by the Goethe-Institut since 2015 is directed at German teachers who teach foreign language lessons, conducting classes at all levels of school education, including adult classes. Teachers who have at least a few years of teaching experience or have had appropriate pedagogical or German-speaking lessons as a foreigner are the main target participants. In addition, applicants who are not native speakers of the language need to produce proof of proficiency in the German language at least at a proficiency level B2 of the Common European Framework.

Due to the fact that the content of all course units is available both electronically, on the Moodle platform, and also in book form, participants can define their preferred learning style: exclusively online, by reading the content available on the platform, mainly using printed content or by only posting the solved tasks on the platform. According to the author's observation, learners older than 35, despite their keen interest in new technologies and modern forms of education are definitely more likely to prefer traditional forms and choose the paper version of the DLL, which is in contrast to the younger participants.

One of the critical factors influencing the effectiveness of e-learning is undoubtedly a strong and stable motivation. A participant who utilises the distant mode of learning, in addition to a cultivated sense of self-reliance, also needs good time management skills along with a mastery of self-regulation strategies in confronting unfamiliar and complex teaching situations. Empirical studies in this field have shown clearly a positive correlation between internal motivation, arousing thematic interest as well as teaching effectiveness (Schiefele 1996; Schiefele, Pekrun, 1996). Apart from motivation, the learner's personality traits are also very significant. As pointed out by Baumert and Köller (1996) and Niegemann et al. (2004), those who achieve positive results in remote teaching are flexible, reflective in their approach, exhibit analytical skills, show responsibility and awareness of goals, exhibit perseverance, curiosity and openness and have a positive self-image. The present author's observations seem to confirm that: it is significant that internally motivated learners rarely need additional incentives to learn, they take the initiative and responsibility for learning effectiveness, they try to maximise the benefits of taking part in the course through forum participation, networking with other participants, they also ask/formulate additional and substantive questions, correct the submitted tasks and are not satisfied with lower ratings.

The current political and social situation in Germany has significantly influenced the context of how the course is conducted. The migration crisis has prompted the need to prepare a large number of teachers in a short period of time for language courses catering to the refugees, the so-called integration courses (*Integrationskurs*). These courses include 600 hours of language study along with an additional 60 hours, during which participants learn about the history, society and the main aspects of German culture. From the very beginning, the implementation of integration courses and the verification of teacher qualifications have been coordinated by the *Federal Office for Migration and Refugees* (German: *BAMF*). Among the nearly 7000 licensed public and private entities authorised to conduct BAMF integration courses, there are higher vocational schools as well as branches of the Goethe-Institut. The above-mentioned situation caused a surge of interest in the DLL course and a staggering increase in the number of students at the turn of 2015 and 2016. To each tutor this specifically meant a manifold increase in the number of students from an average of 20-25 to 80-90. The situation was further complicated by the fact that most of the new entrants received the funding for attending the course from BAMF, however they were obliged to complete it within a nine-month period, which left them under pressure.

3. CONSTRUCTION AND SELECTION OF CONTENT

Each of the six DLL (DLL3-DLL2, DLL6-DLL4 and DLL5-DLL1) units is built according to a clear and uniform layout of the content, providing a good intuitive orientation. An example of the DLL demonstration course is available online at http://lernplattform.goethe.de/course/view.php?id=16.

The DLL3 module is dedicated to the specificity of the target language and explains the characteristics of German as a foreign language, in terms of its lexical, grammatical, phonetic and pragmatic aspects. The main purpose of the course is to develop the participant's linguistic competence. In turn, the DLL2 module focuses on the question of how to effectively learn a foreign language. The focus is on the student who is the subject of the didactic process and whose personal variables determine the effectiveness of learning.

The second phase starts from the DLL6 module. This unit discusses planning requirements for the whole cycle of education as well as the individual lessons. Course participants will learn/explore the content of the framework guidelines and the didactic principles of teaching. This module indicates important landmarks for the day-to-day work of the teacher and informs about the innovations in lesson planning, such as different types and models of lessons. In DLL4, the authors focus on tasks, exercises, and interactions as being the central elements of each lesson. The last phase, referred to in the DLL5 module, concerns educational and media materials, including the ability to effectively adapt and create their own glottodidactic materials. DLL1, the final course module, tries to answer the following questions: How can one professionally develop themselves as a teacher? What are the specific challenges that accompany teaching? How to create a motivational and inspirational atmosphere that is devoid of fear? How to control the effectiveness of the didactic process and measure school achievement? As can be seen from the above characteristics, the selection and ordering of the course modules is characterised by the logical progression of the content from the fundamental issues focused around psychological, physiological and linguistic conditioning of effective teaching to the specialised issues directly related to the planning and conducting of the didactic process. Each unit includes a detailed list of learning objectives in its introduction and ends with a self-evaluation; each provides a glossary of basic terms, an answer key for selected tasks as well as a wide range of examples from current textbooks for learning German.

The above-mentioned evaluation sheet consists of 16 questions (cf. Table 1.), from which nine are multiple-choice questions and seven are open and give the participants space to freely express the opinions regarding the course.

Table 1.

Evaluation sheet for participants in every module of the course

Introduction: "Help us to further improve the quality of the course - your opinion is very important to us! Please fill out this questionnaire. The survey is of course anonymous, all data is used confidentially."

Number	Question	Options
No. 1	Did you complete the course unit extra-occupationally?	Yes No Partially
No. 2	How many hours did you spend on this lesson about every week?	4-5 Less than 4 More than 5
No. 3	Did you have access to the lesson while completing the course unit?	Yes No Partially
No. 4	Did you find all the information you needed to complete the course unit in the course programme?	Yes No
No. 5	If no, what was missing in the course programme, what was unclear, ambiguous?	*Open question*
No. 6	Which content was particularly valuable to you?	*Open question*
No. 7	What content did you miss?	*Open question*
No. 8	Were the tasks helpful?	Yes No Partially
No. 9	Did you have any difficulty understanding the tasks?	Yes No/ If so, please answer the next question
No. 10	Where and what kind of difficulties were there?	*Open question*
No. 11	Were there any technical issues with the online connection that caused you to miss certain offers of the course?	Yes No/ If so, please answer the next question
No.12	What technical problems occurred?	*Open question*
No.13	Was communication with the tutor easily possible?	Yes No Partially
No.14	Did the tutor adequately respond to your requests?	Yes No Partially
No.15	What did you like?	*Open question*
No.16	What bothered you during the course?	*Open question*

Source: own work

An important and attractive feature for the participants of each course is the actual recording of language classes, conducted at branches of the Goethe-Institut across three continents thereby in different and often very specific conditions. Each module uses the portfolios method, which supports autonomous and reflective learning. As a kind of individual dossier, the portfolio contains 10 to 20 tasks and on one hand serves as a self-documentation of achievements, while on the other hand a way to formulate questions for further self-study. 70% of all tasks are mandatory, the rest are marked as optional. Each task is given a form of feedback ("answer key", "tutor response", "automatic feedback" – in the case of tests), as well as estimated time needed for its execution. For example, the DLL1 module includes a total of 73 tasks, 23 of which are tasks containing individual feedback and an assessment from the tutor. Correct execution of other mandatory tasks is confirmed by sending an automatic notification. Proportions have been preserved between the receptive activities which check the understanding of content and the activity characteristic of open tasks or mini-projects.

Another valuable and important component of a course that favours empowerment is an action-research-type task, known as *Praxiserkundungsprojekt* (*PEP*). Because of the high dynamics of changes occurring during school routine and thus the high unpredictability of everyday situations of teachers and educators, an approach that promotes the development of reflective and lifelong learning (Kwiatkowska 2008) is becoming increasingly important and justified. One of the methods serving this purpose is action research which is a kind of pedagogical design study and implementation, undertaken by a teacher which aims at improving the practice of pedagogy (Boeckmann 2010; Huber 2009). As part of the study, the teacher (being either a student or a course participant) formulates his or her own research question, carries it into a student group of their choice and then documents and analyses the results.

Action research is a multi-phase process; which in particular, consists of the following stages (Surdyk 2006: 912): basic diagnosis and analysis of the status, in regards to teaching and learning; formulation on the basis of an analysis of the initial state of questions and hypotheses, concerned with improving teaching and learning; defining the context of data collection, timing and methods, i.e. the planning of a research project along with the systematic collection of data in as many different forms as possible for the purposes of triangulation; the empirical verification of questions and hypotheses by analysing and interpreting the collected data in the search for solutions to problems and changes in past behaviours or practices; the implementation of changes as well as the formulation of further questions.

Research questions formulated within the framework of the course should be closely related to the content of the course units concerned (e.g. DLL2, DLL3). This allows the course to gain a stronger connection and reference to the practice and schooling experience of the course participant and the educational theory becomes secondary to the practice and is contained in the activity from which it is extracted and brought up to the level of consciousness. Working on the PEP project also gives participants the opportunity to become aware of and possibly verify the so called internal pedagogical theories (Michońska-Stadnik 2013). As deep-seated views and private opinions of professional theories held by individual teachers' internal pedagogical theories are significantly conditioned by their practical actions and behaviour, they relate on the one hand, to the language itself along with the processes of its teaching and learning, while on the other to the variety of conditions for success as well as the essence of motivation.

4. ROLE AND SPECIFIC TASKS OF THE TUTOR

In the context of successful teaching, the tutor fulfils specific tasks, becoming a consultant who accompanies and supports the learning process. Tutoring does not require the delivery of substantive information, as it is already provided in the form of materials such as text, sound files, films, drawings, simulations etc., on the platform, but rather by being an active guide and advisor to the learner (Erpenbeck et al. 2015: 21). The tutor should thoroughly understand the specifics and nature of tutoring in order for the scope of his intervention not to overly and unnecessarily interfere with the learner's own and individually organised learning process. The scope of tasks for both the tutor and the learner is determined in a precise manner within the curriculum, relating to a form of schooling practice known as the *class contract* (German: Klassenvertrag). The responsibilities and tasks of the tutor in the DLL course relate to four key areas also mentioned in the subject literature (Häfele & Maier-Häfele 2008; Klimsa & Issing 2011). They are didactic, socio-communicative, technical and organisational tasks.

4.1 Didactic tasks

Didactic tasks boil down to the systematic provision of feedback information of the sent tasks. Occasionally, course participants also direct queries to the tutor requesting the clarification of terminology related to the course material. This is most often the case in the first module (DLL3) as well as the DLL5 module which is related to the use of information and communication technology in teaching. For most of the inquiries, one only needs to refer to the available course material without the need for additional resources. For interested students who wish to explore the issue themselves, the authors prepared in every module a list of additional literature, consisting of 40-50 bibliographic items.

4.2 Socio-communicative and technical tasks

Socio-communicative tasks relate to establishing contact with the participants, the systematic indication of one's presence on the platform, and the willingness to provide help and support in order to motivate learning. This requires the tutor to understand individual style of learning, respecting various work routines while also accepting individual views on the essence of teaching as well as to understanding the different role of a teacher. Since the beginning of the course, the DLL group of participants has been very heterogeneous as they have been recruited from all continents and have very different levels of initial knowledge, putting some high demands on the intercultural competence of the tutors.

As far as technical tasks are concerned, the tutor is responsible for providing information on the operation of the platform and its tools, taking care of the smooth operation of the technology, and reporting technical difficulties to the support team. A significantly higher amount of questions related to technical aspects appear in the two first modules of the course (DLL3 and DLL2). Although an extensive and highly detailed technical guide for each type of task and activity is available on the platform, the tutor must take into account additional time constraints resulting from the need to answer not only substantive questions, but also by providing technical support in order to solve problems. Unfortunately, from their point of view, the participants perceive this procedure as not being optimal, or even unfavourable, and would like to interact directly with IT professionals so as to reduce the response time to a minimum.

4.3 Organisational tasks

Organisational tasks include informing the learner about their progress in completing the mandatory task pool, sending the enrolment key for the next module, and finally informing the learners of their completion of a single module or the entire course. Equally important as in traditional learning is the ability to diagnose educational needs and to objectively evaluate participants on the basis of clear and well-known criteria as well as evaluating own achievements.

A major obstacle to the above-mentioned tasks and responsibilities is the large diversity of the group, and the very vague information regarding the participants which is being supplied to the tutor. It is only during the course that the tutor can obtain further information which is relevant. An improvement in this matter would be to include important data relating to learners (for example, the form and extent of past professional experience, occupational interest, type of school in which the participant is either employed or intends to work at) in their user profile. With a relatively small number of participants (between 20 and 30) it is possible to provide feedback within 24 hours, which is consistent with expectations and recognised in the evaluation as one of the major advantages of the DLL course. However, with a number of 80-90 participants, this is not physically possible. The organisers did not foresee any form and possibility of the temporary support of a tutor who is too busy due to a large number of active students. Another important issue is that only 5% of participants report that they are planning longer breaks on the platform, which greatly reduces the predictability of the time load along with the planning of the tutor's activities. It would be helpful to create a tool to easily record planned breaks.

CONCLUSION

The DLL course concept has been developed for the daily activities and challenges facing the teacher in the classroom. The authors have been able to skilfully integrate discussions related to traditional issues such as teaching language skills, developing grammar, lexical and phonetic skills with more general aspects such as individualisation, the learning of autonomy or strategy training. The lesson examples provided are very numerous and varied enough to not prefer one narrowly defined didactic model and teacher's teaching pattern; and through open tasks tend to encourage participants to actively seek their own individual career path. In terms of content selection, the course consciously and deliberately does not favour any of the familiar methods and techniques of teaching foreign languages, presenting participants with broad and varied spectrum of issues, taking into account all the previously developed and recommended principles of scientifically proven effectiveness such as, among others, language proficiency, intercultural orientation, self-reliance, reflectivity and learner autonomy, competency of autonomous education, task orientation and the use of activation methods. The results of the evaluation questionnaires confirm that the participants particularly appreciate the platform itself along with all its tools, the high availability of tutors, the professional support in both substantive and technical matters, as well as the speed of feedback. Among the positives is the fact that the teaching objectives are very clear and achievable within the allowed time frame. Participants also emphasise that the course material is prepared by keeping all key methodological principles and allowing for comfortable self-reliant workflows. In conclusion, it can be stated that the temporary and substantive framework of the *DLL Methodik und Didaktik* course, as well as its technical conditions, as specified by the authors, seem to be fully adequate at being implemented and completed within the allowed time frame.

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ON THE EXPERIENCE OF AN EXPERT IN AN OPEN ONLINE COURSE CONTEST

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Abstract: *The article is devoted to the illustration of experience gained while conducting assessment of open online educational courses as a member of the Expert Council of EdCrunch Award Contest, the only contest of this kind within the framework of the EdCrunch events in the world. Criteria for course assessment for both experts and consumers, the requirements for applicants are presented. The article also presents summarized results of experts' feedback as a conclusion.*

Keywords: digital educational environment, open online course, assessment criteria, rubrics.

INTRODUCTION

Understanding the need for the expansion of e-learning as one of the most important ways to overcome the global challenges faced by the education system was reflected in a few international strategic planning documents. In particular, the Incheon Declaration, which was adopted at the World Education Forum in May 2015, outlined the development priorities for the education systems of the member countries of UNESCO (Incheon Declaration and Framework for Action for the implementation of Sustainable Development, 2015). Nowadays in the Russian Federation a number of initiatives aimed at creating necessary conditions for the formation of a more advanced digital economy are being implemented. Enhancement of the digital economy is considered to increase the quality of citizens' life, ensure economic growth and national sovereignty and as a result should lead to a rise in Russia's competitiveness. Most of the initiatives, for example, "Strategy for the Development of the Information Society in the Russian Federation for 2017-2030" and "the Digital economy of the Russian Federation Program", are quite complex and thus require competent staff in the implementation process. It is therefore necessary to properly modernize the system of education and vocational training to bring educational programmes in line with the needs of digital economy. Hence, education requires introduction of digital tools for learning activities with their further integration in existing information environment. Moreover, the current state and speed of economic development require availability of a learning tools, which can be accessed on an individual basis at any time of an individual's life and in any place. In order to meet the needs described above, a state priority project "Modern digital educational environment in the Russian Federation" was launched. One of the objectives of the project is to expand opportunities for continuing education for all categories of citizens while fostering its systematic quality improvement. The tools, with which the goal is planned to be achieved, include a widespread introduction of open online courses (via the Internet), allowing interactive participation. The chosen strategy requires involvement of specialists from different areas to create not just a universal educational platform, but also modern high-quality teaching materials. Moreover, the project requires creation and implementation of new approaches to the formation of a learning environment and the evaluation of students' learning outcomes.

1. THE CONTEST EDCRUNCH AWARD

The Open Online Courses (OOC) annual Contest EdCrunchAward is one of the educational events which promote the fulfilment of the goals set by the government. The contest is held by the organizers of the International Conference on New Educational Technologies EdCrunch-Moscow (Conference). The founders and organizers of the conference and contest are: National University of Science and Technology MISIS and Charitable Foundation "Rybakov Fund" with the support of the Federal Research Center "Computer Science and Control" of the Russian Academy of Sciences.

Government and non-government non-profit educational organizations, commercial institutions and teachers of various education levels were invited to participate in the contest by submitting materials through the official contest website.

The mission of the contest (as it has been announced by the organisers) is to make substantial improvements to the education system by introducing best practices in e-learning. The courses submitted to the contest should belong to either secondary, higher or non-formal level of education and should be related to the following disciplines:

- social, human sciences and liberal arts (Russian language and literature, foreign languages, history, social studies, world art culture, music, fine arts);
- physics and mathematics, natural and technical sciences (STEM);
- non-formal education can be from any field of knowledge.

To be more specific, the contest objectives are to:

- detect best practices for creating open online courses and introducing them to the educational process while implementing educational (training) programmes;
- highlight best courses from the consumers' and experts' points of view;
- improve tools and methods of online learning in Russian and in the international education context;
- disseminate modern innovative educational technologies;
- identify and provide support to creative administrators, teachers, tutors and entrepreneurs;
- provide an opportunity to enhance knowledge and skills for all stakeholders (methodologists, producers, designers, etc.).

The contest organizers fulfill the following functions: formation of the contest Expert Council; provision of information support; reception and processing of the materials; presentation of the contest applications to the Expert Council for consideration; running award process for the contest winners. Moreover, the organizers of the contest are responsible for providing publicity for it, maintaining equal conditions for all the participants and preventing any information disclosure about the results before the date of their official announcement.

The submitted courses can be of any type (according to generally used OOC classification described below) except cMOOC (connectivist massive open online course). This type of course is excluded from the contest, because there is no transparent, formal and widely used methodology to evaluate the quality of such courses, as the course is focused less on lectures and tests, but more on an exchange of experience, communication of the participants. Below are listed the course types which can participate in the contest:

- xMOOC (massive open online course which is usually commercial and based based on traditional approaches to online course developing);
- BOOC (a big open online course);
- DOCC (distributed open collaborative course);
- LOOC (little open online course);
- MOOR (massive open online research);
- SPOC (small private online courses);
- SMOC (synchronous massive open online courses);
- mOOC (micro Open Online Course);
- SOOC (selective Open Online Course);

- ROOC (regional Open Online Course);
- GROOC (group open online course);
- MOOC 4.0 (many-to-one – co-education with deep impact on each student).

2. THE CONTEST EXPERT COUNCIL

The Expert Council must include individuals from following categories:

- course designers (they might be designers and teachers at the same time, like S. Thrun, who is known as "Godfather Of Free Online Education", and founder of Udacity company, offering massive open online courses);
- web and graphic designers;
- teachers;
- tutors;
- administrators-in-training;
- students-learners;
- marketing specialists and other managers in education and educational business;
- media specialists (Paton, Fluck, & Scanlan, 2018).

In practice, the majority of the Council members are teachers (usually around 95% from 80 people) with the rest of the Council composed of designers, administrators, analysts and media specialists. Council members represented various regions of Russia from St. Petersburg to Ekaterinburg and Novosibirsk as well as many educational institutions. The overall size and composition of Council members demonstrate the timeliness and importance of holding such an event.

3. ASSESSMENT CRITERIA

Course assessment is very important because it has a strong impact on learning and is an indicator of the quality of learning. In the online environment, methods and criteria of assessment can be very different. Let us consider some of the USA institutions involved with course assessment and examples of criteria used.

Quality Matters (QM)

It is a quality assurance leader in online education. Its impact and influence is seen broadly across the US and expanding internationally. It has 800 subscribers and is used for secondary, higher education and is also used in professional development. It has eight standards:

- course overview and introduction;
- learning objectives;
- assessment and measurement;
- resources and materials;
- course activities and learner interaction;
- course technology and learner support;
- accessibility and usability.

Within the eight general standards the higher education rubric has 43 specific standards. Reviewers follow a specific course assessing algorithm.

Association iNACOL (International Association for K-12 Online Learning)

It specializes in secondary education (with special attention to Advanced placement programmes). Evaluation criteria include:

- mastery;
- personal achievements of the student;
- graduation result;
- readiness for college and career;
- availability of additional opportunities for students from economically disadvantaged families.

Universities

The next group of organizations involved in evaluating online courses are universities. They produce internal self-evaluation by their own criteria and provide external services. Online courses are evaluated in nine categories, ranging from 3 to 8 criteria. The rating categories are shown below:

- introduction and course overview;
- evaluation of the course and assessment of students' knowledge;
- training materials and resources used;
- student engagement and community;
- pedagogical design and supply of the course;
- technology for teaching and learning;
- support and resources;
- accessibility and versatile design;

- conclusion and summing up.

From what has been said, it is obvious that the evaluation of online courses is a topical and popular subject, and the criteria themselves are not fossils developed decades ago, but dynamically respond to changes (Lederman & Jaschik, 2014).

Talking about the contest, the set of rubrics for assessment had initially been chosen by the organisers and extended during mutual following online discussions between experts and organizers. The set of rubrics was based on a system of criteria and assessment mechanisms proposed by a number of international organisations such as QM, Open ECB Check-Quality and some others (Murphy & Stuwart, 2017). The assessment of course quality includes evaluation of various course aspects, with the core being quality of:

- course and overall learning objectives, competences received or expanded by the participants;
- overview and introductory part of the course;
- course assessment tools and measurement of the results achieved by the participants;
- content and provided training materials;
- learning activities on the course and ways of interaction with students;
- technologies used in the course;
- student support and administration;
- accessibility, usability and design;
- course marketing;
- feedback on the course provided by the participants.

A team of experts (for each subject) approved by the contest organizers evaluates competing courses. As soon as the first application has been received, the experts start the evaluation process. Courses are compared on the basis of scores which they receive during the evaluation: each expert assigns his score for each evaluation criterion, the scores for each criterion are then averaged by a number of experts participating in the course evaluation, and finally the average scores are summed. The contest organizers determine the minimum acceptable number of experts assessing a single course.

The contest had a few nominations, where "The best course from the experts' point of view" was one of them. In 2017 students' evaluation was for the first time included in assessment and nominations.

4. STUDENTS' EVALUATION

Several Russian organizations, for example Internet + Education Competence Center and an autonomous non-commercial organization Institute for Internet Development declare that along with the expert review, there should exist mechanisms allowing for evaluation of quality of e-learning and the MOOC by end consumers. Therefore, organizations named above, proposed a project in order to distinguish and consolidate the interest of consumers of e-learning services and as a result, the procedure of OOC assessment was proposed (Nikanorov & Shvindt, 2017; Nikanorov & Shvindt, 2018). The assessment blocks are divided into three sections:

- Quality assessment. This section contains indicators and criteria measuring the quality of the materials presented in the course. In this category the fulfilment of consumer’s main requirements towards the content of the course are evaluated;
- Evaluation of e-learning results and course acknowledgement. This section contains indicators and criteria measuring how well according to the consumers the course measures their course progress and achievements. Additionally, this is where procedures for verification and recognitions of the course results by higher education institutions or employers are evaluated;
- Architecture assessment. This section contains requirements for course design (including interfaces allowing participants to interact with the course and with each other) and technologies used in information transfer. Core criteria of this section are: availability and accessibility of needed materials, user friendliness of the interface, availability and results of self-evaluation of learning outcomes.

Student evaluation process and the criteria used in it neither duplicate nor substitute professional and expert evaluation but rather supplement it. Inclusion of student evaluation provides opportunity to characterize the needs of consumers, allowing to adjust the course to better meet the needs and interests of consumers.

5. INTEGRATED NOMINATION

In November 2017, an additional contest nomination was announced. The new nomination used the results from integration of experts’ and students’ assessments. Additional winners of the contest were announced by the end of the year. It is worth mentioning that all the winners, applicants and Expert Council members received certificates, which were produced with the use of blockchain technologies to encrypt personal data, which protect certificates from being falsified (Bogdanova, 2017).

Overall number of applications submitted to the Contest was ~80, which is very close to the maximum capacity of the Expert Council in its current composition, showing a growing interest in the Contest.

6. EXPERTS' FEEDBACK

After the Contest had finished, the contest organizers distributed a questionnaire among the experts to collect feedback. Overall feedback was quite positive, experts particularly noted the wide geography of contest participants, the presence of courses developed by regional higher education institutions. It can be stated that the authors succeeded in presenting course content interestingly and consistently.

As for other positive sides of the Contest it should be noted that all courses contained detailed introductory materials and various types of progress assessment. Experts' feedback summary showed that most of the courses ensured compliance with the entire set of evaluation criteria at a proper level, no matter of the subject chosen by course authors. All subjects presented were interesting and relevant, the quality of the teaching materials was at a good level. It is worth mentioning that the overall impression of some courses even arose a desire among the experts to enroll in them. Most authors managed to adapt the content of their course, which was initially offline, to online learning while being able to adjust the form and depth of presentation in accordance with the target audience of the course. Many courses were well enabled with sufficient tools and techniques, including educational materials and an organized system of counselling (one-to-one or one-to-many), to help participants to achieve learning objectives stated in the course.

However, courses of inferior quality were also submitted. Apparently, authors of such courses were either not completely familiar with the main evaluation criteria or were not self-critical enough. For example, some courses did not provide an opportunity to browse the whole timeline and content of each section of the course. In high quality successful courses a student has the right and possibility to know what will be taught in the future, and having looked at several paragraphs ahead, to get an understanding of the entire course with tests and assignments. In spite of the fact, that overall design and user-friendliness were well thought out in most courses, some of them did not have a convenient navigation system.

As for the platforms used to run the courses, the most convenient courses were usually located on well-known platforms such as Coursera or Lectorium, which have high technical capabilities. It should be noted that those platforms provided equal, high-profile opportunities for creating courses of both science and arts courses types. Taking local preferences into account, usage of domestic platforms such as Lectorium or Open Education might be preferred, as it creates a psychologically comfortable learning environment for users. While working as an expert, one can get an opportunity to get acquainted with technical capabilities of different platforms. An observation worth noting is that courses running on the same platform look similar. For example, Stepik platform courses, which initially seemed fascinating, later lost their attractiveness because most of them followed a similar learning process and had a quite limited set of technical means. While choosing a platform for the course attention should be paid to its technical capabilities in order to provide diverse and entertaining learning, which does not lack any steps of course life cycle, such as pre-start marketing, student enrolment, distribution of materials, assessments.

A special comment should be made on course metadata cards, which is another name for course passports. Quite often the cards were not carefully filled out, making it feel like the course purveyors thought that the card is not an important structural part of the course. Whereas the card should contain all necessary information, that will allow a potential consumer to decide on whether to enrol in the course or not. For example, if the card stated that the course can be taken by people with disabilities, it should be also noted how the course grants this opportunity for the consumer to make sure that he will be able to finish the course.

Overall, the contest facilitates introduction and expansion of technologies of distant learning in the educational process, stimulating the development of online-learning and supporting its self-improvement.

CONCLUSION

Given the fact that the contest is rather new and is evolving, it can be stated that it makes substantial contribution to arriving at solutions to the challenges the Russian education is currently facing. The contest forms a professional community, contributes to the creation of a system for assessing the quality of online courses and online resources for general education, it allows combining expert and peer reviews, which facilitates development of more complex rating systems.

In the nearest future with a large number of participants and experts, such contests will provide an opportunity to perform a statistical analysis of the results with a view to obtaining reliable data which will allow making informed judgments on the status and trends in online education in Russia.

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COOPERATION OF EDUCATIONAL INSTITUTIONS WITH PUBLIC LIBRARIES IN THE CONTEXT OF ICT-SUPPORTED MEDIA AND READING EDUCATION

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Abstract: *This article attempts to illustrate effective cooperation between two institutions that are very important for the education of young people: the school and the library. One of the aspects - development of media and ICT competencies in students is analysed in the context of public libraries' active participation in this important process and determinants of success of such a process, including innovative projects utilizing new technologies.*

Keywords: school institutions, public libraries, media and ICT competencies, information literacy, media education

INTRODUCTION

This article is a specific theoretical part of a study, as a separate part of the study is a report on the first stage of a pedagogical experiment carried out among primary school pupils, largely based, first, on regular / mandatory library lessons and secondly, on the opportunities afforded by essential new technologies. Both parts - articles are complementary to each other and make up a whole: the theoretical issues and the study report constitute a comprehensive picture of practices designed to verify the main hypothesis put forward by the researcher: does systematic and planned cooperation between public libraries and education establishments in the context of education supported by new technologies determine the quality of readership and ICT competencies of school age children? The above obviously requires some introductory outline of the subject matter. That is why the first problem to discuss by way of an analysis of source documents is the state of child readership as reported on a yearly basis by the National Library and projections put forward by the Ministry of National Education. Next, the authors discuss the broadly understood problem of the relationship between the young generation's level of ICT competencies and the digital environment in which they have been growing up. An attempt is also made to describe the very important phenomenon of Information Literacy and the subjectivity of public libraries in teaching competencies; legal framework of library operation is discussed as well as their equipment, including new technologies and the essence of the children's librarian's predispositions. The theoretical part is summarised in the context of education digitization, starting from the targets of the Ministry of National Education, through school information centres, competencies of teaching staff and ending up with a general outline of legal opportunities for cooperation between the school and the library. The most important institutions whose source materials are referred to in the text include: the Ministry of National Education - the Polish government department responsible for the education system in Poland; the National Library - one of the oldest cultural institutions in Poland, the most important scientific library, main archive and research and methodological centre for Polish literature and readership; the Book Institute – a Polish cultural institution that promotes reading, books and Polish literature both at home and abroad; the National Readership Development Program - a government program for the years 2016-2020, being implemented to improve readership and strengthen the role of libraries in education in Poland.

1. BACKGROUND AND CONTEXT

Currently, the main directions of research in the field of media education are already generally defined. The methodology for the organization of this process in school and training institutions is preliminary developed. The formation of media competence of future teachers has become the subject of individual and collective research (Hazanov, 2018). The author conducted the study "Tools of media education in my profession" among students and analyzed the results. The article indicated the perspectives of studies of formation of media competence of future teachers in the process of learning pedagogy (Hazanov, 2018).

Other researchers have studied the process of formation of media literacy among young people, e.g. the problems of formation of media literacy of young people in the competence approach (Kiuru, Popova 2016).

Parola, M. Ranieri, (2010) and later M. Ranieri, I. Bruni (2018) present the “results of e-MEL, a European project aiming at promoting the development, implementation and testing of training scenarios for pre- and in-service teachers' training in the field of digital and *media literacy education.* The analysis of the results led the research team to identify the critical and successful aspects of the testing, and to draw some recommendations for the future implementation of teacher training interventions." The authors reflected "on sustainable models of media and digital skills training both in terms of teacher education and teachers' professional development".

Another researcher V. Kacinova (2018) in her own study set out "to demonstrate the cross-curricular character of media competence developed in the process of media education that is integrated into the content of school education in accordance with the prevailing current international curriculum trends and with emphasis on the Slovak curriculum." "In terms of comparing the conditions during the period of incorporation of media education as a compulsory part of the content of Slovak education system with the contemporary innovated form of the curriculum, the study mainly presents which school subjects are instrumental in developing the dimensions of media competence of students, especially within complete secondary general education, and how they participate in the development." The author describes the model, which includes the current key framework activity categories stimulating the required development of media competence or literacy in the context of Slovak educational policy.

A study by (Rojo, Goni, Urbina, 2018) was aimed at assessing the media and information competence of a sample of 150 adolescent students from Esmeraldas (Ecuador), and to analyze differences related to sex, educational level and type of school attended. The data were gathered using a "Media and information competence in adolescents" (CMI) questionnaire. The questionnaire was completed on-line by the participants. The authors stressed, that "the analysis of the results revealed very low levels of media and information competence, with no significant differences related to either sex or educational level, although significant differences were found in global media and information competence in accordance with the type of school attended. These results are consistent with the findings reported by other studies in other contexts, such as Spain, and highlight the need to improve media literacy and media education both in the formal school curriculum and in nonformal education aimed at the general population". (Rojo, Goni, Urbina, 2018).

The authors (Mavropulo, Muryukina, 2018) have studied the essence of the concept of media competence, the indicators of the development of the audience media competence from the point of view of *psychology*. The indicators were as follows (in ascending order): 1) contact; 2) motivational; 3) conceptual; 4) evaluative; 5) creative. According to the researchers, "there are several important conditions regarding this arrangement: absolute mobility of media education indicators; "work" of lower levels even while moving to higher levels of development".

The other categories of research areas include transformation of contemporary libraries, ICT tools for support in context of cooperation and functional libraries and school.

As stressed by other researchers (Amalia, Menanti, Sinaga, Rajagukguk 2017) “the library as a learning resource and, all at once, as information sources for students related to reading activity, begins at primary school level. Media are really needed to facilitate students’ reading in the school library, from the moment they start school until they graduate. The library media service, by means of software, has been introduced to students in relation to stages called AMALIA model (Attention, Memorizing, Accelerating, Literal, Improving and Asset). Based on the research result it is recommended that the school management can implement the library card and ICT-based library service system in managing their school library. (Amalia, Menanti, Sinaga, Rajagukguk 2017).

V. Kadam (2017) in his own research analysed, as a case study, the Application of SWOT, Principal Component and Cross-case analysis for Implementing and Recommending an ICT Technology in Library.

“School libraries should be a means to access knowledge, and Information and Communications Technology can facilitate adolescent students’ starting to use these technologies to develop their capabilities and skills in finding information” stressed Chornet (2015). The author of the study analyzed a various innovative proposals that have been implemented in various school libraries in the world and concludes that it is important for pre-university students to understand and master these tools before entering the world of work or college.

2. CHILD AND YOUTH READERSHIP – WHAT STUDIES HAVE SHOWN

A statement by one of the leading 21th century children's writers aptly reflects the state of mind of today's young people. Children who read understand more, can see more, are more flexible, creative, open and in more cases consider themselves happy. Pupils who have not developed a reading habit find education and growing up a dark abyss in an incomprehensible world. New technologies make available to them new, alternative opportunities of reading and media education. In an era of 21th century digitization, illiteracy continues to exist. Illiteracy, often associated with third world countries where children's access to education is difficult, *does* exist in technologically advanced countries, where the reading skill, in the technical sense of the word, has been acquired by nearly everybody. However, if we were to consider the definition of the reading process as „one of the forms of linguistic communication, understood as the ability to convey (create) and comprehend (receive) information in accordance with the rules of a particular language, in which the essence and purpose of reading is understanding the information conveyed“ (Sochacka, 2014: 17), a question about passive illiteracy arises: does technological progress develop the reading skill in young people or lead to the decline of the skill? Is the ability to read still an essential need and form of obtaining information? The educational objectives of the core curriculum assume preparation of students for using various sources of information, for developing their skills of selection, critical reception and use of information, for activating their core self-study skills and using new technology tools for the purposes of intellectual activity, including broadening of their interests and, what is quite interesting, stimulating their reading needs (Choroś, 2010: 60). For the need to read, until recently, was a natural need.

The National Library's annual readership report is an important source document from the perspective of the bookselling, publishing and commercial sectors as well as, last but not least, children's education. And, despite the fact that report respondents include people over the age of 15, the report comprises the themes of child readership as well as reading to children. Considering books and reading culture as essential sources of information (necessary for developing ICT competencies) in the current decade, and opposed to digital resources, it is worth making a comparison between the two most recent reports - for the years 2016 and 2017. The information below is a presentation that is placed, in terms of subject matter, into the scope of the study and therefore is not a comprehensive interpretation of the document (Figure 1 - Figure 4).

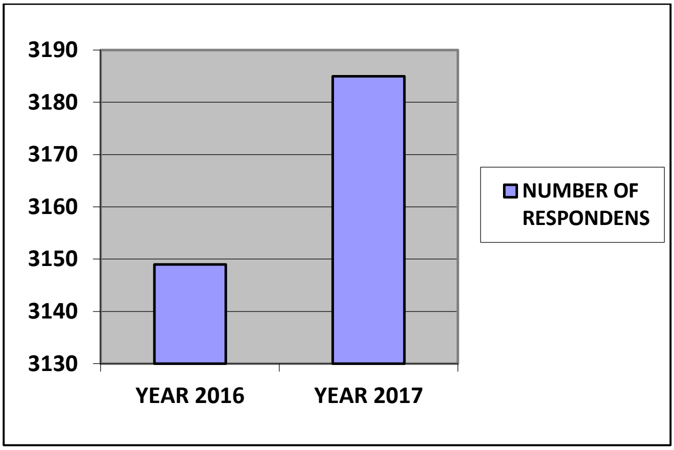

Figure 1. Number of respondents in the representative sample in the years specified

Source: Own work based on http://bn.org.pl/download/document/1493378303.pdf - National Library's report on readership in Poland in 2016; http://instytutksiazki.pl/files/upload/files/Stan%20czytelnictwa%202017.pdf - National Library's report on readership in Poland in 2017.

Readership studies are carried out on an annual basis by the National Library jointly with the Book Institute. These studies take the form of a computer-aided structured interview (CAPI method) conducted in respondents' homes selected using the random route method. In each edition the form contains the same questions in a precisely determined sequence. According to the researchers, this deliberate ordering allows for high probability of comparative reliability of the results from subsequent years.

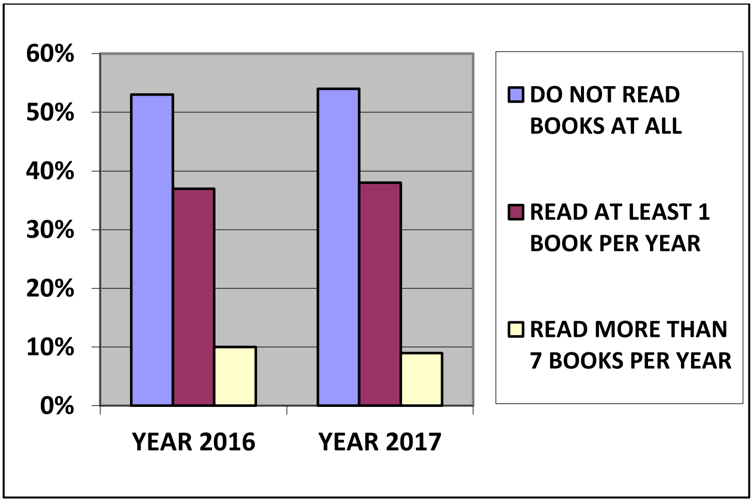

Figure 2. Reader segments

Source: Own work based on http://bn.org.pl/download/document/1493378303.pdf - National Library' report on readership in Poland in 2016. http://instytutksiazki.pl/files/upload/files/Stan%20czytelnictwa%202017.pdf - National Library's report on readership in Poland in 2017.

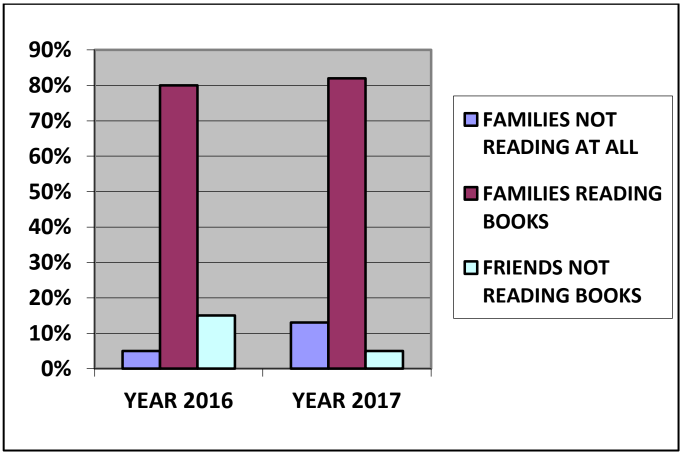

Figure 3. Reading models in the child's environment

Source: Own work based on http://bn.org.pl/download/document/1493378303.pdf - National Library's report on readership in Poland in 2016. http://instytutksiazki.pl/files/upload/files/Stan%20czytelnictwa%202017.pdf - National Library's report on readership in Poland in 2017.

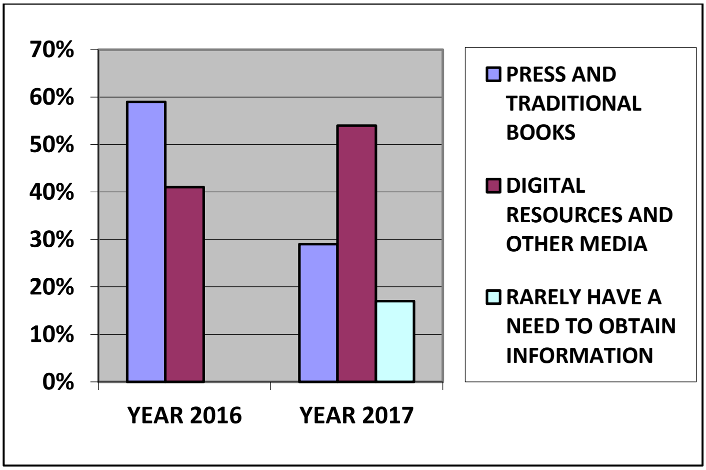

Figure 4. Sources of information

Source: Own work based on http://bn.org.pl/download/document/1493378303.pdf - National Library's report on readership in Poland in 2016. http://instytutksiazki.pl/files/upload/files/Stan%20czytelnictwa%202017.pdf - National Library's report on readership in Poland in 2017.

The 2017 report includes additional information on teacher readership and the sources of information from which they obtain information. As it was assumed that teachers were a group that particularly intensively activates readership and as a result, the development of ICT skills, responses were obtained relating both to traditional literature and literature associated with new technologies. It turned out that 99 % of the teachers had a collection of hard copy books at home, and as many as 72% said they had more than 100 books. 85% of the respondents from this professional group declare that they read literature in a new form, that is e-books, audio-books. On the other hand, 76% said they read other texts and digital resources using devices connected to the Internet. Unfortunately, not even half of the respondents, just only 42% of the teachers were readers or users of public library services. At this point it is worth considering to what extent, on one hand, the teacher's declared high readership culture and, on the other hand, their passive attitude towards libraries as information centres, translate into the level of education and competencies of the youth.

The first priority of the Ministry of National Education for the years 2016/2017, within the framework of the main directions of the state's educational policy in the 2016/2017 school year, was to promote readership and develop reading competencies of children and youth. The document provides, among other things, that schools have to establish their libraries and employ full time librarians. Furthermore, schools are expected to organise activities intended to promote reading among children. In addition, there is also the requirement to participate in the National Programme for the Development of Readership. The organisation of school libraries is governed by the Act of 14 December 2016 - Educational Law.

Article 98 provides that a school should establish a library on its premises and that each pupil and member of teaching staff should be provided with free access to the library. This makes it mandatory for educational establishments to specify in their statutes the scope of the teaching staff's responsibilities, including those of a teacher librarian, in item 23 (Act of 14 December 2016 – Educational Law).

The organisation of the school library as well as the conditions and scope of cooperation between the school library and pupils, teachers and parents as well as other libraries is provided for under Article 103. The article requires the school, as part of its statutory objectives, to provide pupils with access to the library (item 2). (Ibid). Article 104 lays down supplementary details, that is, sets out the responsibilities of the school library, extending far beyond the basic, “old” duties of collecting, cataloguing and making available textbooks and other educational and library materials. In the context of the problem addressed in the study, item 2 seems to be the most important, i.e. creating conditions for effective use of ICT technologies (Ibid). If, as part of interpretation of the regulations, we were to combine the requirements under Article 98, item 23 with Article 104, item 2, and to take into account the real situation regarding libraries' equipment and technical / organizational capabilities, it is advisable and necessary for educational establishments and public libraries to work together in the context of ICT-supported readership education.

The National Programme for the Development of Readership is a project undertaken under the auspices of the Ministry of National Education. The key priority of the programme is to implement measures aimed at promoting reading and developing ICT competencies in school pupils. The programme, in its Article 3, item 2b, requires school libraries to cooperate with public libraries, to promote readership, purchase books and initiate reading events. The Ordinance of the Council of Ministers of 6 October 2015 is a large document that provides in detail for generous funding and other forms of support for schools in dealing with specific problems. Unfortunately, the National Programme for the Development of Readership is a typical example of a theoretical programme that the interested parties fail to deliver in practice.

It is worth analysing discourses regarding this subject matter so that conclusions can be drawn and suitable projects can be undertaken. The functioning of school libraries is also governed by the Ordinance of the Minister of National Education of 14 February 2017 which provides that “the primary school's responsibility is to introduce pupils into the world of literature, to strengthen their reading interests and to equip them with reading competencies necessary for critical reception of literary works and other cultural texts“ (Ordinance of the Minister of National Education of 14 February 2017 – the Core Curriculum). Besides, there are many other statutory documents governing the operation of school libraries. It is interesting to note that none of the documents places real emphasis on developing ICT competencies in the educational community.

3. ICT COMPETENCIES AS AN IMPORTANT CATEGORY OF INFORMATION LITERACY OF CHILDREN IN EDUCATION

In English language literature the term "information literacy" (IL) is used to refer to the ability to effectively use information in the performance of one's tasks and delivery of goals. As Christine Bruce says, although the idea of information literacy dates back to the 1970s, it is only in the XXIst century that it has gained ground as a key competency. Despite the fact that numerous organizations, researchers and scientists have tried describing information literacy, there is no single agreed-upon definition of this term. Definitions found in literature, in most cases, refer to the term as a set of skills connected with obtaining information, starting from identifying information needs and ending up with effective use of information (Borawska-Kalbarczyk, 2015: 131). The term information literacy was first used in 1974 by the American educator Paul Zurkowski, the then President of US Information Industry Association, in a report "The Information Service Environment, Relationships and Priorities". The concept became popular in education in the 1980s, when educational programs focussing on IL were developed. As a result, information literacy models and standards were promoted by such organisations as the American Library Association, Association of College and Research Libraries, American Association of School Librarians, Chartered Institute of Library and Information Professionals, Society of College, National and University Libraries.

In her research, an author (Torlińska, 2005: 369) analyses and provides examples of definitions of information literacy. Currently, one of the most often cited definitions is the one put forward by the American Library Association – ALA) in 1989: information literacy is the ability to recognize when information is needed and to locate, evaluate, and use effectively the needed information.

People who effectively use information are those who have learnt how to learn. They know how to learn because they are aware of the organisation of knowledge, they can find and use information in such a way that others can use it too. They are prepared for life-long learning because they know how to find information necessary for resolving a problem or for taking a decision (American Library Association, 1989). As stressed by B. Torlińska in her paper (2005: 369), some "other definitions of the term Information Literacy address the problem in a similar way, only changing slightly the scope of the skills included''.

Thus, for example, Doyle defines a person skilfully using information as an individual who recognises when information is needed, is aware that accurate and complete information is a basis for intelligent decision-making, identifies potential sources of information, uses effective search strategies, uses sources of information including computer-based and other technologies, evaluates information, organizes information for practical applications, integrates new information into an existing body of knowledge and uses information in critical thinking and problem solving (cf. Doyle, 1992).

In Polish literature on the subject, information literacy is usually translated as, among other things, information skills, information efficiency, information proficiency, information awareness, information literacy or information competencies. English synonyms and related terms include: information skills, information literacy skills, information literacy competencies, information competence, information competence skills, information problem solving, information fluency, information handling, information empowerment, information technology (IT) skills, information and communication technology (ICT skills).

What guarantees the contemporary teacher's IT competencies is their focused development at various stages of continuous professional preparation of teachers, including:

• Selection of students with proven talents and predispositions for teaching, in forms with extended pedagogical curriculum and in secondary level educational institutions.

• Preparation for entry into pedagogical institutions of higher education, of students with appropriate abilities, considering teaching as a vocation.

• Future teachers' attendance of pedagogical courses at pedagogical institutions of higher education (Zlotnikova, 2004).

• Improving teachers' skills, training teachers on post-graduate courses throughout their teaching career, including the use of distant teaching modes.

• Continuous teaching methodology support for teachers and their self-study. (Smyrnova-Trybulska 2018)

In her book *Seven faces of information literacy* (1997) Christine Bruce identifies seven categories of IL as experienced by Australian educators in two universities:

1. Information technology conception – using information technology for information retrieval and communication
2. Information sources conception – finding information
3. Information process conception – executing a process
4. Information control conception – controlling information
5. Knowledge construction conception – building up a personal knowledge base in a new area of interest
6. Knowledge extension conception – working with knowledge and personal perspectives adopted in such a way that novel insights are gained
7. Wisdom conception – using information wisely for the benefit of others. (Bruce 1997)

Information literacy (is not)... teaching a set of skills but rather a process that should transform both learning and the culture of communities for the better (Breivik, 2000)

It is necessary to provide separate definitions of ICT competencies and of media competencies. The issue is that "media and information education has been the subject of academic debate for years and one of the government's priorities, as set forth in such documents as Development Strategy for Social Capital or Poland 2030, but no answer has been provided yet to the fundamental questions "What is media and information education?," "What is their substantive scope?" and "What specific competencies should be developed?" (Dąbrowska, 2016: p. 6).

According to W Strykowski, media education is [...] education in the field of media designed to allow students to understand the nature and impact of media, and to use them rationally and effectively in didactic contexts and in situations of upbringing, formative nature (Strykowski 2003: 18). Izdebska defines media education as [...] media inculturation, as creating conditions for acquiring competencies allowing for using media, for understanding media messages (Izdebska 2004: 384).

W. Smyl (2007) looks at various aspects of media education, including children as media recipients, concepts and goals of media education, school media education in Western countries, the history of media education in Poland, media education in the Polish school education system.

Attempts at formulating the subject matter have been made by numerous domestic research centres with commercial and educational goals in mind. When preparing the tables presented below, account was taken of "Media and Information Competencies Catalogue" developed by the Modern Poland Foundation and a competencies catalogue comprised in the "Children on the Web" publication by P. Siuda, referred to as "IT Competencies vs Information Competencies – Pupils and Teachers" (2015). They refer to media competencies relating to specific subject matter areas, including use of information, relations and language in media environments, creative use of media as well as ethical, economic, legal aspects and issues related to security on the Internet. The tables below set forth some of the requirements that pupils are expected to meet at particular levels of primary school education (Table 1 – Table 3):

Table 1.

Use of information competencies

ASPECT	**PRIMARY SCHOOL, FORMS I-III. THE PUPIL WILL DEMONSTRATE:**	**PRIMARY SCHOOL, FORMS IV-VI. THE PUPIL WILL DEMONSTRATE:**
SOURCES OF INFORMATION	Familiarity with essential information sources;	Critical approach to information sources;

	the ability to use the school library;	the ability to select information sources;
	awareness of a variety of information sources;	the ability to select information quality;
	the ability to distinguish between an advertising message and information message;	
SEARCHING FOR INFORMATION	The ability to use essential searching methods, in traditional and electronic information sources;	Familiarity with differences between the structure of words in natural languages and in IT system languages;
	the ability to use simple phrases and queries in search engines and encyclopaedias	awareness of peers' various media behaviours;
		the ability to find information in electronic and traditional information sources;
		the ability to accurately phrase a query;
CRITICAL APPROACH TO INFORMATION	Awareness of information being false, incomplete, imprecise;	Awareness of differences in information depending on the sender's intentions;
	awareness of lack of clarity the intentions of information provider;	the ability to challenge information
	the ability to intuitively tell the difference between true and untrue information;	the ability to verify information;
		knowledge about information manipulation and differences between information and gossip;
USE OF INFORMATION	Awareness of the necessity to sort out Internet resources;	The ability to edit and disseminate the results of his/her work;
	the ability to create, retain and process results of his/her work;	the ability to create patterns, to organise and classify materials;

Source: own work based on: A. J. Dąbrowska (2016: 23-79), P. Siuda (2015: 2-6)

Table 2.

Competencies regarding relations in media environment

ASPECT	PRIMARY SCHOOL, FORMS I-III. THE PUPIL WILL DEMONSTRATE:	PRIMARY SCHOOL, FORMS IV-VI. THE PUPIL WILL DEMONSTRATE:
PERSONAL IMAGE	awareness of the importance of personal data protection;	knowledge on how to build one's image in the virtual reality (distortions);
	the ability to distinguish between her/his personal traits in the real and in the virtual world;	awareness of negative consequences of media activity (fake news, stalking etc.);
		the ability to create one's image in virtual space with security taken into account
COMMUNICATION	The ability to use messages of various nature (formal, informal);	The ability to adjust the form of a message to the context (blog, a post in a forum, a memo, official correspondence);
	the ability to operate essential means of communication (telephone email) and awareness of their features and uses;	the ability to find on the web people with similar interests and to communicate with them;
		the ability to select a technology suitable for communication needs and level at a given moment;
		the ability to distinguish between the characteristics of direct and indirect communication;
		sense of responsibility for information disseminated
		familiarity with essential elements of information and effective analysis;
		the ability to formulate

		messages and express opinions on messages received.
ENVIRONMENT	The ability to distinguish between the world as shown in media and the real world; familiarity with security and hygiene rules applicable to the use of media; awareness of global flows of information and media resources thanks to which he/she can learn about remote places; the ability to use various sources, channels and forms of information flow.	Awareness of dangers associated with activity in the virtual world (making friends, addiction); the ability to actively use new media in communication (discussion groups, social media sites); the ability to use various sources, channels and forms of information flow; familiarity with essentials of security in the web and respecting copyright (downloading, viewing, information from dubious sources).
LINGUISTIC NATURE OF MEDIA	Awareness of the differences between real and media messages the ability to use and distinguish between the language of media and natural languages; familiarity with various forms of media and audiovisual transmission (differences between textual messages, audio and video); the pupil can identify benefits and limitations when receiving such communication).	The ability to identify differences between digital and analog technologies and indicate examples of such devices; the ability to name characteristics of language of movies the ability to explain such terms as frame, movie, binary system etc.; the ability to explain the term multimedia as a technology integrating various methods of transmission.
MEDIA COMMUNICATION CULTURE	The ability to evaluate a particular media message in aesthetic categories; the ability to use emoticons and other additions when communicating via sms or email; familiarity with offensive	Awareness of the vulgarization of media culture; The ability to evaluate and select messages that counter vulgarization; the ability to use emoticons and other additions when

	gestures.	communicating via sms or email; familiarity with offensive gestures is able to explain them verbally and accurately.

Source: own work based on: A. J. Dąbrowska (2016: 23-79), P. Siuda (2015: 2-6)

Table 3.

Competencies in creative use of media

ASPECT	**PRIMARY SCHOOL, FORMS I-III. THE PUPIL IS ABLE TO:**	**PRIMARY SCHOOL, FORMS IV-VI. THE PUPIL IS ABLE TO:**
CREATION	take pictures, record one's voice or sounds from the environment, record a short video movie, draw a simple picture using appropriate software and essential tools; write a short text using a word processor; jointly with other pupils, can create a simple story using media messages.	carry out simple operations of recording movies and pictures in digital format; record and prepare for playback a short movie, simple graphics, modified text using a word processor; make one's own intellectual contribution to collective creation of a media story (digital storytelling).
PROCESSING	carry out simple operations of editing and modifying movies and pictures in digital format using simple software for content manipulation; indicate that analog content can be converted into digital content, played back using digital devices.	carry out more complex operations of editing and modifying movies and pictures in digital format using simple software for content manipulation combine modified content, make additions, build a plot, operate essential office equipment (a scanner, printer, computer programs).
PRESENTATION	Make a presentation of the content he/she has prepared himself/herself,	Operate a projector, computer and other media available in the

	using multimedia equipment (computers, projectors etc.)	classroom (projecting a picture, a message, a presentation); name Internet websites, blogs, on-line / off-line tools to create content.

Source: own work based on: A. J. Dąbrowska (2016: 23-79), P. Siuda (2015: 2-6)

The above requirements constitute theoretical assumptions for children's abilities. However, it needs to be remembered that for the process to be effective, "during teaching students should be allowed to construct knowledge based on their own experience. Teaching should not be limited to the teacher's verbally transmitting knowledge. That is why the teacher should not focus on developing specific skills, but emphasise learning in a context with multiple meanings" (Smyrnova-Trybulska, 2018: 234). That is why, from the perspective of pedagogy and media education, the following aspects are important:

1. Mechanisms of obtaining and internalizing information by children by means of new technologies.
2. Studying the quality and type of media impact on the selection of information sources and communication and, hence, on the world view, pros-social attitudes and values that guide millennials.
3. Level of reading and media competence as a factor determining children's general development.
4. Moulding the social and educational behaviour of school age children, as determined by indirect communication using new technologies.
5. Methodology and didactics of the educational process with the use of technologies. (Kruszewska, 2013: 178).

6. PUBLIC LIBRARY AND PRIMARY SCHOOL – JOINT MEDIA EDUCATION

„For the past few years new, interactive technologies have been the basis of communication and cooperation between librarians and readers. Nowadays it is hard to imagine the functioning of an information institution without using network tools and services which effectively help present the institution's offering" (Chruścińska, 2014: 2-10). In 2008, upon the initiative of the Foundation for the Development of Information Society, work started on a programme for the development of libraries. The priority of the project was to upgrade the status of public libraries, from dusty old libraries to information and communication centres for the local community. Therefore efforts focused directly on projects intended to increase the quality of users' information and media competencies. Over the 6-year duration of the first edition (2009-2015) libraries were equipped with computer hardware (12 thousand units), training courses were held for 11200 librarians and library workers, refurbishment projects were started funded by the communes, public institutions and private companies started participating in the activities of libraries (http://frsi.org.pl/projekt/program-rozwoju-bibliotek/ - Programme for the Development of Libraries). The main benefit for the libraries was an impulse encouraging libraries to open up to readers and their real needs (workshops, training courses, meet-the-author sessions). The librarians were provided with opportunities for training and improving their qualifications. Local governments showed flexibility in funding the libraries.

The local communities were provided with venues where to meet, hold discussions and relax. No doubt, the Programme for the Development of Libraries helped improve library services. Furthermore, more opportunities were provided to properly develop children's media and information competencies. For library users computers are sources of information, allow user to communicate, pay bills over the Internet, look through job advertisements, send their CVs and covering letters (https://www.bibliotekawszkole.pl/archiwum/2009/11/Program_rozwoju_bibliotek_opis.pdf). Computers also allow for developing one's interests and acquiring new skills – i.e. by e-learning (as statistics provided by the Central Statistical Office show, in 2012 e-learning classes were offered at 11% of libraries in Poland and 15% of libraries covered by the Programme for the Development of Libraries, and the percentage continued to rise thereafter).

Changes in libraries are the result of not only capital investments but also the librarians' new skills. In the years 2010-2012 the number of librarians attending training increased annually by 131%. That was the result, among other things, of workshops and training courses offered to librarians under the Programme for the Development of Libraries. Librarians are increasingly using new technologies in their work. In 2012, 37% of Polish libraries had an on-line catalogue, 18% had a profile on a social networking site (Ibid). The librarians' competencies referred to in the statistical data are a key factor determining the successful operation of a library. On the other hand, what has not changed for a long time is the librarian's reliable service for the community hungry for information. At this point it should be emphasised that there are no special criteria for selection of librarians for service in the children's departments of public libraries. The reason is that there are no regulations clearly specifying predispositions or additional education (e.g. pedagogic) required of children's librarians.

Standards for child libraries are governed by, among other things, IFLA's section of libraries for children and youth in the document "Guidelines on services in libraries for children" where, in part II, it says that there is a requirement for local institutions to cooperate for the benefit of children to ensure their information, media and educational needs are met. There are also guidelines regarding the necessity for librarians to have predispositions for working with children, e.g.

familiarity with child psychology and development, possessing such qualities as empathy, flexibility and open mind, theoretical and practical knowledge on information and media communication etc. (https://www.ifla.org/files/assets/libraries-for-children-and-ya/publications/guidelines-for-childrens-libraries-services-pl.pdf - IFLA standards for libraries for children). However, in real life it often turns out that librarians employed at children's departments do not have pedagogical credentials, predispositions for working with children, fail to meet applicable standards, if only IFLA ones, perform their jobs as if they were office clerks and not educators, initiators or specialists in children's literature. This in turn results in children receiving insufficient information and communication education and, probably, lack of willingness to cooperate with schools.

New technologies have also created opportunities for teachers to deliver instruction at 21st century technology level, using educational equipment such as computers, multimedia in the broad sense of the term, interactive devices and others.

Both teachers and students have access to e-resources which can assist in self-learning:

• Digital libraries - there are ca. 120 digital libraries in Poland with a wide range of subject matter (http://www.ebib.pl/serwisy/biblioteki-cyfrowe-w-polsce/; http://lustrobiblioteki.pl/biblioteki-cyfrowe-poland)

• Reading portals and open source portals – a database and archive of lesson plans, methodological inspirations and many others: open resources.pl

• Teaching material resources - digital teachers.pl, edukator.pl, Wsipnet.pl, and others

• E-textbooks – currently, leading publishers of school textbooks offer teaching materials in the form of e-textbooks, with the same content as paper versions: School and Pedagogical Publishers, Greg Publishing.

• Supplementary e-learning courses: e-kursy.ore.edu.pl,

• Teacher community portals and thematic blogs.

In Poland, an Open Catalogue of Educational Resources operates which explicitly regulates the copyright for a specific work and assigns works to the following categories:

• Public domain, Free license (so-called Creative Commons) - available in full version free of charge; under copyright law allowing for any use including free interpretation, deleting fragments, translation, etc.

• CC license – a publication fully or partially available but only for private non-commercial use.

• Open Access with all rights reserved – a publication available in full or partial version but with full copyright reservation.

• All rights reserved with access conditions such as registration, payment, and time limit of access; publications with security features, completely closed. (Grodecka, 2016: 6).

In order to provide a glimpse into teachers' activity in terms of digital reading, it is worth taking a look here at the results of the research mentioned in the preliminary report (Figure 5 – Figure 6).

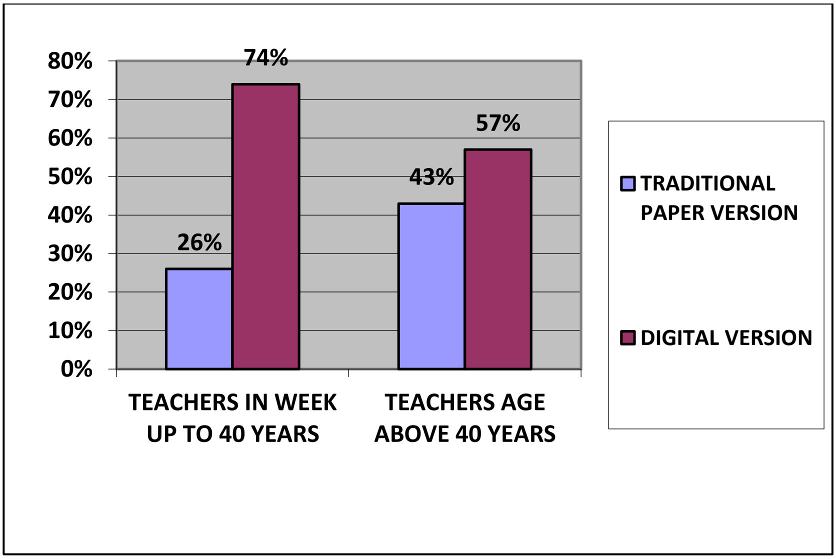

Figure 5. What are the forms of scholarly journals, books, school textbooks and other materials necessary for self-improvement and professional work that you use most often?

Sources: Own work

All of the above sample resource undoubtedly contributes to the teacher's quality of knowledge and the level of competence. In addition, teachers can use reading resource platforms access to which is provided free of charge by public libraries, such as Academica or IbukLibra.

The Ministry of National Education has set priorities for the years 2017-2020. In the 2017/2018 school year, main objectives of the government's education policy include, as set out in item 2, improvement in the quality of IT education and, in item 3, Internet security education and responsible use of social networking sites by children.

The currently valid Ordinance of the Minister of National Education of 14 February 2017 – the Core Curriculum clearly specifies the essence of developing ICT competencies as early as the first stage of education - early school education, requiring schools "to create adequate conditions for pupils to acquire knowledge and skills necessary for problem solving using IT methods and techniques, including logical and algorithmic thinking, programming, using computer applications, searching for and using information from various sources, operating computers and essential digital devices and using these skills in class" (Ordinance of the Minister of National Education of 14 February 2017 – the Core Curriculum). Children should be taught to adopt a critical approach towards the quality and quantity of information, information sources, Internet resources and digital security.

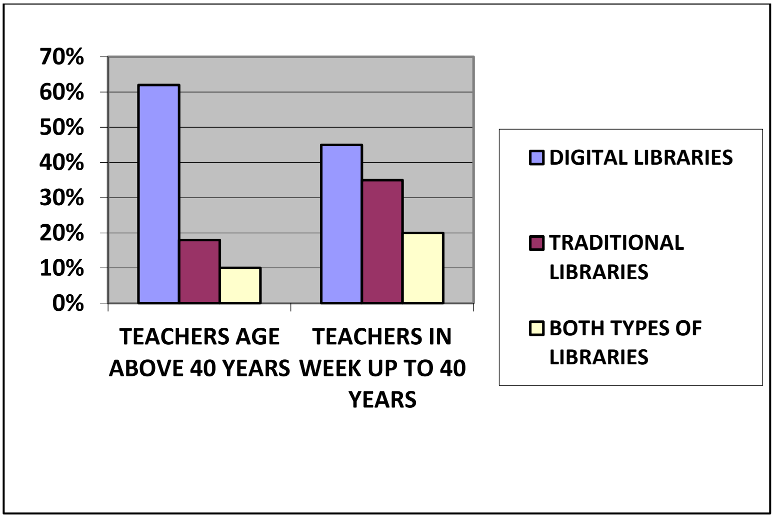

Figure 6. What kind of library do you use?

Sources: Own work

The guidelines recommend adjusting media and IT education to children's age, so these are of preliminary nature. Guidelines regarding IT education at the second educational stage - in forms IV-VI - require that children's ICT competencies should be developed in such a way as to enable them to use such competencies practically in various areas of their lives, when carrying out their responsibilities or developing their interests. What is also significant is that the guidelines point to the necessity to use new technologies in teaching all school subjects, which „allow for better understanding the current capabilities of new technologies, of computers and applications thereof" (Ibid).

The ordinance emphasises global solutions that children can use thanks to high ICT, communication, media competencies as well as competencies involved in technical operation of technologies. Detailed requirements are set out in item VII. IT education provides for quite high standards that pupils are expected to meet after they finish school. Given the small number of computer class periods in a week (2 classes per week), it seems necessary to provide support for schools through cooperation with public libraries.

7. DISCUSSION

Abolishing the above barriers was one of the priorities of the Programme for the Development of Libraries. That is why a model of cooperation between school and public libraries was developed, based on the following conditions:

1. School libraries should be able to use all of their strengths in the process of teaching educational competencies.
2. Pupils should be provided with opportunities to use all knowledge resources available locally irrespective of their location.
3. All local institutions engaged in collecting knowledge and information resources should work together with each other in the context of information and media education.
4. School librarians and subject librarians should be provided with access to training opportunities and other forms of further education (Cooperation between public and school libraries in rural areas - an overview of issues https://www.bibliotekawszkole.pl/archiwum/2009/11/Program_rozwoju_biblioteк_opis.pdf)

CONCLUSIONS

Cooperation between public libraries and educational establishments appears to be limited by actual technical, organizational and legal capabilities:

1. Libraries operate within two different organizational systems:

- public libraries report to the Ministry of Culture,
- school libraries report to the Ministry of Education.

2. Therefore hardly any projects are undertaken that entail cooperation between the two types of libraries.

3. The core curriculum does not provide for class time to be used as library lessons; it merely provides for a visit to a public library (and time spent in such a library is deducted from the school curriculum schedule).

4. In light of the above, before a form of pupils visits a public library, the parents' written approval has to be obtained and a group of teachers need to be instructed to go with the pupils.

5. Making records of library activities requires consent to disclose children's sensitive data (e.g. children's faces on photographs).

6. There is no regular communication between subject and school librarians (unnecessary rivalry).

7. Subject librarians working in children's departments often have no predispositions to work with children, have no adequate credentials or opportunities for further improving their skills.

8. Public libraries have insufficient accommodation resources to be able to run activities.

9. There is insufficient awareness on the part of managers of the necessity of cooperation between public libraries and primary schools.

10. Digital technologies and collections available in public libraries require expensive consents and licences (e.g. a licensing umbrella for screening movies) because they are not covered by Section III, chapter 3 of the Act on Copyright and Related Rights. Fair use of protected works - see (Ustawa o prawie autorskim i prawach pokrewnych [Act on Copyright and Related Rights] 1994).

This article only discusses a part of the studies carried out. In subsequent publications the authors will discuss and analyse the results of empirical research and put forward their proposed solutions to the problems and challenges described above.

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EDUCATIONAL ONLINE RESOURCES IN TEACHING SOCIOLOGY: UKRAINIAN EXPERIENCE

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***Abstract**: The article is analysing existing and potential opportunities of the use of educational online resources in teaching socio-humanitarian courses. The article defines educational web-resources and educational websites, reveals their functions in the teaching process of higher educational institutions and presents their main varieties. Analysis of sociological research results permitted to uncover the purposes of using the Internet by Ukrainian students, the most popular types of resources with them to prepare for classes, as well as the importance of information on the university's website. The research presents the potential of official university websites, electronic repositories, information portals, professors' personal pages, websites of leading sociological centres, the role of educational literature and periodicals in teaching sociology and activating cognitive capabilities of university students of all courses.*

***Keywords**: sociology, information portal, university website, electronic educational resources*

INTRODUCTION

In the modern world, information and communication technologies (ICTs) have integrated with any field: they are used in economy, industry, culture, and in social services for people as well. Evidently given this rapid change, the system of higher education cannot stand aside from these transformations, because it is responsible for the quality and efficiency of training specialists shaping the future of the country. Most professors have long realized that the use of ICTs in the educational process significantly enhances its efficiency and makes it easy to find common ground with applicants of higher education, since for them it has become a much more attractive instrument of accessing educational information compared to visiting libraries and reading paper versions of scientific journals. This is especially true of sociological disciplines, since the study of specific traits of ever changing modern society, social communities and individuals can only be based on the analysis of latest sociological research, provided by the Internet. This fact defines the urgent nature of defining the role of online resources in teaching socio-humanitarian courses, namely sociology.

1. DEGREE OF SCIENTIFIC ELABORATION

1.1 Recent research into the use of ICTs in teaching sociology

The issue of the introduction and use of ICTs in the educational process is gaining importance recently. This, in turn, intensifies scientific research in this area. Due to the rapid development of the Internet, scientific community has been publishing more and more research into the existing experience and ways to enhance the use of Internet's elements in the learning process. The peculiarities of creating, maintaining and introducing educational websites are analysed in the works of a number of modern scholars. Smyrnova-Trybulska, Morze and Makhachashvili research into various ICT Tools implemented in teaching (Smyrnova-Trybulska, Morze, Makhachashvili 2016). I. Nikolaescu and O. Griban have studied modern educational websites as a means of vocational and pedagogical self-realization of the teacher in the system of postgraduate education; G. Stetsenko developed a methodology for using educational Web resources in the process of preparing future teachers of informatics; O. Radchuk highlighted the possibility of using an educational website in students' academic and scientific work; T. Vinardchuk emphasized the role of educational Web resources in providing continuing education; V. Osadchy has established the prerequisites and technologies to create educational Internet resources.

Various aspects of the use of a university official website as a type of educational web resources are explored in the research of such scholars as N. Kononets (potential of a website for the provision of quality education), O. Konevshchytska (a university website as a means of information and communication interaction between subjects of education), O. Buryak (the significance of websites of educational institutions for the construction of a uniform information educational space), L. Filipova (general principles and methods of informational content modelling of the university website), etc. A thorough study of the contents of university website is available in the works of A. Shelestova, who analyses the purpose, characteristics, features and advantages of e-learning documentation as a content component of a university's website; requirements for filling the websites of universities. At the same time, Morze stresses that participation in a university's information and educational environment prompts the improvement of teachers' ICT competence (Morze 2013), so the activity in this field is mutually beneficial.

Various cases of creation and use of electronic depositaries of university libraries and information portals of universities of different levels are studied in papers of a number of Ukrainian scholars: G. Gordiychuk, O. Ivankevich, V. Vakhnovan, S. Mislovska, L. Panchenko, O. Shumeyko. In particular, O. Ivankevich and V. Vakhnovan investigated the specifics of creation and implementation of electronic archives of university scientific products, and identified the benefits of institutional repositories. S. Mislovska proposed a conceptual approach to the application of information and communication technologies in the management of educational process in higher educational institutions of Ukraine, exemplified by the use of information and educational portal. L. Panchenko carried out a thorough study via content analysis of the principles of designing the portals of Ukrainian and Russian universities, compared information, communication, linguistic, navigation and personification services, as well as analysis of the indicators characterizing the content, design and features behind technical exploitation of the websites of pedagogical universities of Ukraine.

Nevertheless, as to the approaches to the use of ICTs in constructing e-learning environment, a collaborative group of Ukrainian, Russian and Slovak researchers argue: “Teachers of the information age have to master a virtual learning environment as a new area of their career, as a "new stage" of the educational conditions. Therefore, they must be in possession of a new pedagogical methodology, innovative approaches to educational interactions. They have to comprehend the specific psychological and pedagogical background of activities in this environment, from mass, in-line training to personal-oriented processes based on modern information and communication behaviour of young people” (Morze, Noskova, Pavlova, Yakovleva and Drlik 2014).

Direct analysis of the use of information technologies and the Internet in teaching sociological disciplines is presented in the research of A. Vorontsov and V. Lukianov, L. Ditkovska, N. Malikova, A. Slobodyanyuk, S. Scheglova and others. Thus, A. Vorontsov and V. Lukyanov disclose the possibilities of transforming usual lecture courses on sociology into multimedia mode, the use of electronic compilation textbooks as a way of managing students' independent work (Vorontsov, Lukianov 2011). In her turn, L. Ditkovska claims that in order to improve the teaching efficiency it is wise to develop tasks in electronic form for classroom laboratory work and independent work of students, to prepare electronic tests for thematic and modular knowledge control and to publish them, in Moodle system in particular (Didkovska 2013). Investigating innovative approaches to teaching sociology, N. Malikova found that in modern conditions it is efficient to teach sociology given there is a chance to collect social information in virtual networks of Internet communities, where we can observe live interaction of respondents, experts, representatives of various modal and reference social groups (Malikova 2011). A. Slobodyanyuk argues that awareness of a wide range of institutionalized and non-institutionalized forms of scientific knowledge presented in the network broadens students' perceptions of the Ukrainian and world scientific community, contributes to the development of their cognitive culture (Slobodyanyuk 2007). The directions of using Internet technologies in the teaching of sociological disciplines are studied by S. Scheglova, who notes that today the Internet boasts a plethora of websites containing a rich variety of materials for secondary analysis, which improves students' cognitive culture, intensifies their interest in conducting their own research and presentations of their materials (Shchiehlova 2002).

1.2 The goal of the paper

However, despite relatively high interest in the role of ICTs in modern education, researchers tend to focus on the advantages and disadvantages of using ICTs in the student's learning process. At the same time, the study of possibilities of using Internet resources in teaching sociological disciplines has not been the focus of wide research and we can state the fact that modern researchers lack attention to this topic. All this suggests that studying the existing and potential advantages of educational web-resources in teaching sociology provides an opportunity to discover new perspectives in improving the quality of higher education and integrating Ukraine into the world of scientific and educational environment.

Today, most Ukrainian universities have faced the problem of insufficient amount of funds for providing the libraries with educational literature to support a high-quality educational process. This is due to limited publishing volume, its high cost, on the one hand, and, on the other hand, the lack of funds to purchase the amount required for each student (especially for human sciences – sociology, political science, psychology, which are studied by all higher education students of a specific year). Besides, with the rapid information flow, textbooks and tutorials quickly become obsolete, and teachers should seek new ways of obtaining reliable contemporary data and recommend their students to rely on specific parts of textbooks, but also access the Internet and educational websites. The latter contain modern authentic material on any subject, educational and methodological materials. With the help of such electronic educational resources, many didactic tasks can be solved: to form in students the skills to understand scientific texts, enrich their own categorical and conceptual apparatus for sociology, deepen their knowledge, develop the ability to navigate the modern world and identify the causes and consequences of certain social events, promote the increase of motivation to the study of human sciences, expand the horizons, develop professional competence in students and teachers.

Today the Internet is abound with web resources containing a plethora of diverse materials to study sociology. As of July 2018, the search in Google for the term "sociology" in the Ukrainian language allows you to view almost 2 million webpages, and the tag "socio-humanitarian sciences" from more than 17 million web sites that contain information about various aspects of studying this field of knowledge. More opportunities are provided by the Internet in the English-language interface, where 124 million web sites, portals, and pages are devoted to topic "sociology".

Normally, "**the educational Internet resource** is a collection of integrated hardware and software as well as educational content intended for publishing online in order to advance, popularize or discuss it" (Osadchy 2009).

"Educational web resources are electronic educational resources located in the web environment of a local or global network presented in different formats (text, graphic, audio and video formats etc.). Educational web resources can be classified according to different criteria, in particular, for functional purposes (educational, methodical, reference, normative, scientific, pedagogical software), for the intended purpose (official, scientific, popular scientific, advertising), for a group of users, receiving educational web-resources (professor, teacher, schoolchildren, students etc.), depending on the nature of core data (text, graphic, audio, multimedia data), depending on the mode of user's activity (focused, of wide interest), by the access method (local, global), depending on the form of ownership (open, closed, combined)" (Stetsenko 2010). Speaking about the functions of electronic educational resources, we note that in the educational process, on the part of the professor they perform methodological, organizational, managerial and presentation functions, and on the part of students – theoretical-cognitive, activational and applied ones.

An educational website is usually described as a "system of electronic documents hosted on a computer network with a common address, promoting purposeful learning process" (Gryban 2015). On the other hand, an educational website is considered as "a set of interrelated web pages that are united by common themes, located in the web environment of a local or global network and designed to provide education, training and functioning of an educational institution" (Vinarchuk 2011).

"An educational website is a collection of web pages with similar design that provide a focused process of learning, education and upbringing in the interests of the individual, society, the country, united by content, navigationally and physically located on the same server, it can be used for attestation of those who study, or the assessment of educational achievement" (Yashina 2016).

In view of intensified use of ICTs by educational institutions of various levels, more and more new websites appear on the Internet where one can find articles, textbooks and educational aids. Presently, according to the Google system, there are almost 25 million links for keywords "educational site" in Ukrainian Internet. Typically, among educational sites there are groups such as: "websites providing access to existing educational products; sites stimulating process of creating innovative educational products; sites promoting the introduction of new forms of managing educational process; sites for educational and methodological support of the educational process" (Shaxina, Medvedyev 2016).

Almost every publication on educational websites is presenting an attempt to classify them according to different criteria. The most detailed classifications are available in articles by G. Stetsenko, I. Nikolaescu, O. Griban (Nikolaesku 2016; Griban 2015; Stetsenko 2010). After analyzing and organizing them we propose to identify the following educational websites:

1. Official websites. These are websites of government agencies that host such educational web resources as government documents, regulations and laws.

2. Web sites of educational institutions. Such websites allow, on one hand, to find information about the practices of an educational institution, on the other hand, it is a platform where professors can advertise their achievements. These are the Internet resources of institutions of general secondary education, which help organize distance parents' meeting, hold contests, provide information support, communication with the environment outside school; websites of institutions of vocational education (colleges, technical and training schools); websites of university faculties and departments; websites of Higher Educational Institutions.

3. Student distance learning websites and websites for full time students are websites similar to a guidance manual, an electronic lecture textbook, a laboratory course, an electronic math task book, an electronic tutorial, websites for testing or assessing knowledge, websites of distance education centres and testing centres (for example, websites: electronic lecture textbook, laboratory course, electronic textbook, website for testing, assessment, etc.). Such websites are web projects that facilitate educational process through telecommunication networks.

4. Educational web services, educational portals are sites that allow you to create and store educational products (such as presentations) in real time.

5. Web sites for the dissemination of educational and cultural information: (virtual libraries, reference web libraries, virtual journals and newspapers of educational character, web sites of educational newspapers and magazines, virtual museums, web sites of museums, virtual clubs, collections of scientific works. These web sites promote easy access to modern scientific and methodological literature without leaving home, which is of great importance for a modern professor in conditions of constant shortage of free time. These kinds of websites include web sites of professional journals The majority of teachers and students are now eager to study in electronic libraries, since the benefits of such training are the chance to work in a library at a convenient time in a convenient place, as well as optimization of professional activity due to saved time and labour resources, the ability to be virtually in a library of another city or a country.

6. Educational press - electronic editions and sites of traditional newspapers, magazines and other publications with free access

7. Topic Sites - Sites on a specific topic or field of knowledge.

8. Web sites for scientific research. These are resources that feature research work of schoolchildren, students, teachers, professors and research staff; virtual scientific laboratories; so-called "creative workshops"; web sites of research and training centres. These resources enable teachers to organize and supervise joint research activity of schoolchildren not only on interschool level but also in international mode.

9. Information and reference websites. This group includes various electronic encyclopaedias; online dictionaries; online catalogues; databases; catalogues; websites that contain information on conferences, contests, scientific and educational seminars, grants.

10. Internet websites for competitions and informational Internet projects. Sites to connect students and professors, schoolchildren and teachers, schoolchildren and parents; Olympiad and quiz sites; websites of informational and entertaining projects in education; resources for conducting educational competitions. As a rule, such sites provide an opportunity for obtaining certificates and diplomas for participation in competitions, which enriches the portfolio of teachers.

11. Web-sites similar to virtual teaching and learning associations – are websites of methodological associations of teachers of school subjects, sites for thematic conferences and online chat rooms on education issues, websites for creative interaction of teachers, network instructors, advanced training sites for teaching staff.

12. Educational communities in social networks and other channels of communication – communities in social networks, thematic associations of professors sharing similar professional interests, teleconferences, chats, forums. Such communities provide a wide range of opportunities to communicate with colleagues, share experiences and information, present themselves and collaborate with colleagues in other regions.

13. Consulting websites – advisory websites for teachers and students, students and professors, websites for advisory assistance to scientific and methodological centres.

14. Personal Sites - websites of Scientists, professors and other academic staff, educational blogs.

The versatility and extraordinary potential of the use of web-technologies in educational and scientific activities allows to distinguish the main functions of the appropriate use of educational web-sites: “informing and presenting, advisory, informational and methodical, educational, educational support for interaction of participants. They permit to open new possibilities of interaction with the public and allow:

- to communicate interactively to the audience regardless of its territorial location;

- promptly summarize the activities of the web resource by publishing news, reviews, catalogues of publications, as well as scientific, methodological and practical materials;

- use modern communication tools such as e-mail, interactive conferences and forum – and effectively organize portal support services;

- increase participation of academic staff and students in Internet Olympiads, competitions, conferences" (Bulejko, Karlova).

The use of educational websites in learning must be systemic and consistent, support students' individualization and differentiation, interactivity and reflectivity, must be optimal and relevant. IT is required of educational websites to be comprehensible in scientific terms, contain some sort of problem to be solved, be visible, adaptable. Educational websites must be fundamental, correct and objective as to the contents of educational material. Materials should be free of excessive complexity and must not contain unnecessary details for students. The materials are to highlight topical educational issues that must be addressed. Websites must be visible and suggest using perceptual objects. And besides, a website must be adaptable for the individual characteristics and needs of the student (Parnenko 2012).

1.3 Methodology of research

Thus, educational web resources provide endless possibilities of studying sociology and deepening the knowledge of social issues. These are open access resources of the Internet, educational portals, educational literature, publications in mass media, websites of leading sociological centres, etc. In order to analyse the motivation for use of educational websites in the educational process the department of Sociology of Dnipro State Technical University conducted an author's sociological study in May-June 2018, which allowed to establish the scope of use of information and communication technologies by student youth in the process of studying. Respondents were asked to answer a number of questions that included identifying the attitude of students towards the use of electronic information resources during training, the purpose of the use of the Internet, the usefulness of electronic information resources for educational purposes. The collection of initial sociological information was carried out at the leading universities of central Ukraine, in particular, bachelor and master students from Dnipro State Technical University (DSTU) in Kamyanske, the O. Gonchar Dnipro National University (DNU) in Dnipro and Kryvy Rih State Pedagogical University (KRSPU) in Kryvyi Rih. These universities are leaders in the educational network of the region, and therefore the answers of the interviewed students can be extrapolated to all students in the central region of Ukraine. The sociological survey was conducted by an anonymous questionnaire with a specially designed toolkit. The common sample amounted to 28.1 thousand people (20 thousand students from DNU, 3.6 thousand from KRSPU, 4,5 thousand from DSTU according to website www.education.ua). The purposive sample was 379 people, which, with 95% probability and 5% error confirms the reliability of results. We used random sampling via the method of simple probability selection. The sample is representative by sex and year of study. The sample included 180 students of DSTU, which comprised 56.4% of the total number of respondents, 65 students of DNU (20.4% of respondents) and 74 students of the KRSPU (23.2% of respondents) aged 17 to 35 attending various presence courses. The empirical background of the study makes it possible to draw some conclusions about the peculiarities of the use of websites in the educational process.

In order to present the web resources used by professors of sociology we provide a review and list a few suggestions.

2. RESEARCH RESULTS

First of all, it was determined that the majority of modern Ukrainian students surveyed use the Internet to communicate with their friends through social media and e-mail (54.2%), as well as to find materials for classes and deepen their knowledge (47.7%) (Figure 1)

Unfortunately, participating in distance courses was the last position in the chart on the Internet (5.9%), however, we tend to believe that considering the fact that there is a need to constantly improve one’s knowledge independently and the number of hours for students’ independent work is increasing in the curricula, namely for mastering sociological disciplines and to implement the idea of lifelong learning, the number of people who will take part in distance education will increase significantly. Let us emphasize that unfortunately, presently there are practically no distance courses in sociology in Ukraine, but there is a possibility of

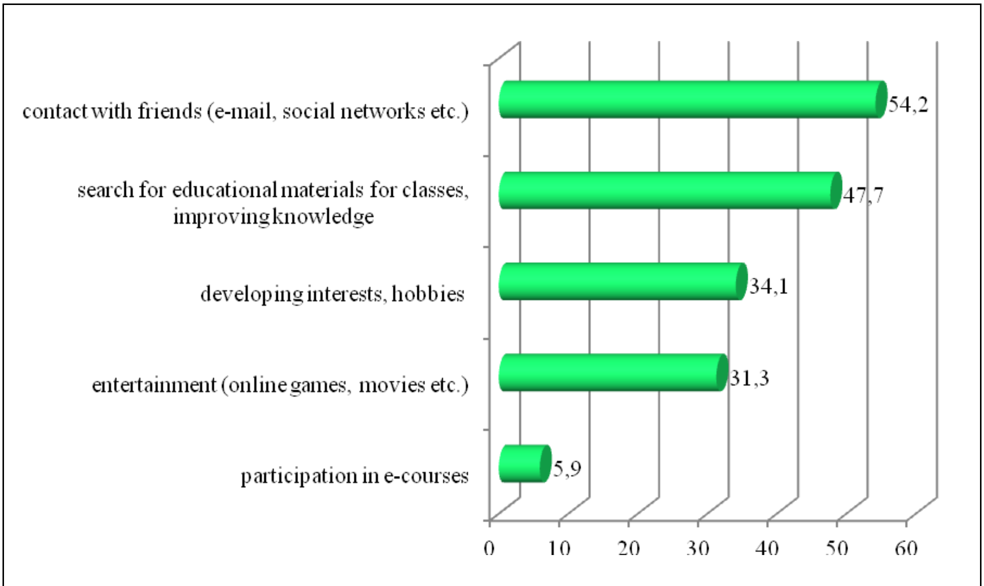

Figure 1. The goal of using Internet by students (in %)
Source: Own work

studying sociology in higher educational institutions of Ukraine in distance mode.

In our experience of teaching sociology for the improvement of knowledge, we recommend that students take part in massive open online courses of the

Prometheus project. All courses offer free online access for all people in Ukraine regardless of place of residence, age, wealth and health. Massive open online courses (MOOCs) consist of video lectures (at least 4-5 hours), interactive tasks that help consolidate the knowledge gained, as well as a forum where students can ask a teacher and communicate with each other. This platform provides a series of courses that will help students studying the course "Sociology" and students of non-sociological specialties to deepen their knowledge in the course and develop skills in analysing social processes. In particular, the courses "Sociology and Social Research: What, Why, Why?", "Data Analysis", "Research on Corruption: How Does It Work?", "Social Work for People Chronic Illness", "Women and Men: Gender for All", "Information Wars", "Science of everyday thinking", "How to effectively plan and hold dialogue", "Urbanism: a modern city".

At the same time, as to the use of specific Internet resources the results of the study (Figure 2) are the following: to prepare for classes the highest proportion of university students uses Internet resources in open access (81.8%), materials received directly from the professor (66%) and educational internet portals (54.6%). In addition, every third student uses electronic resources of university libraries, and one in four – educational materials on the Internet available at an additional cost. All this proves that traditional libraries are completely losing their readers, and the internet and its websites and portals are increasingly becoming a means of mastering university subjects.

According to the results of content analysis of the first fifty links in Google for the keyword "sociology" in the Ukrainian version, we observed that almost half of them (46%) come from Ukrainian universities (22 links) and their repositories (3 links). At the same time, 16% refer to free e-libraries, 10% to media websites, 8% to educational portals (osvita.ua, education.ua), 6% to websites in the wiki group. Unfortunately, only two of the analysed websites belong to the leading sociological centres (Institute of Sociology of the National Academy of Sciences of Ukraine and the Razumkov Centre), although all of them are among the first twenty links; and two – from the massive open online courses (the 10th link) and the Google Academy (only 47th link). Three more links come from the website of a magazine and a few organizations that are not experts in sociology.

“The official website of the University as an informational and educational resource in the educational process provides considerable potential for implementing e-learning, distance learning and familiarizing students with electronic teaching materials. The website of an educational institution is defined as a collection of electronic documents that provide reliable information about the normative principles and the main areas of activity of higher education institutions united by one e-mail address, a domain name or IP address (domain name or IP address) and its Internet representation in World Wide Web” (Kononets 2012).

Being a corporate information portal, the university's website, among other things, allows you to get information about universities, its structural units,

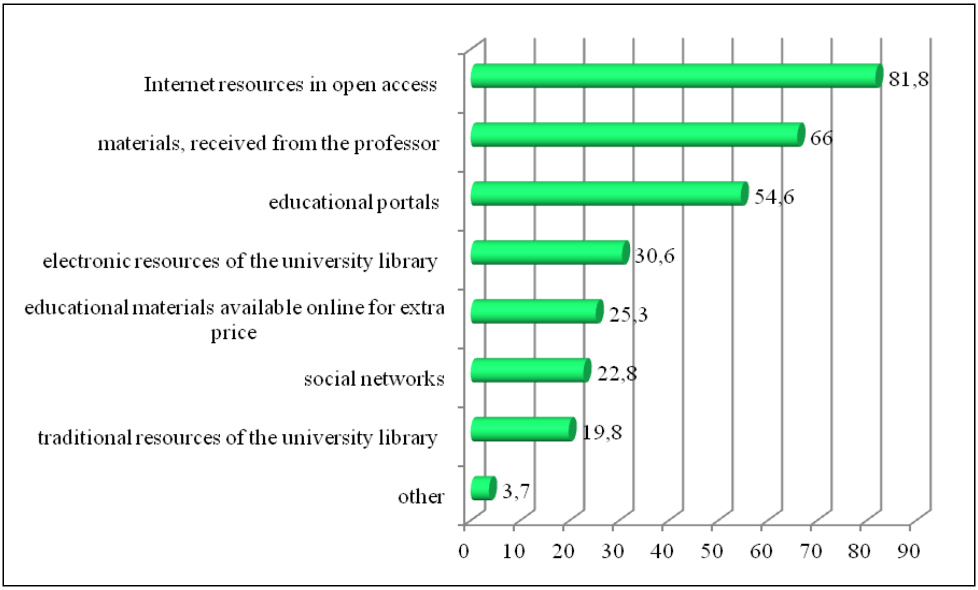

Figure 2. The most popular students' digital resources to prepare for classes, in %

Source: Own work

specialization areas and courses (representative function); everyday life of the institution – a schedule of classes, events, contests (informative function); to organize the educational process enhanced by the Internet, to implement distance learning, to introduce and use electronic learning resources by students of all forms of education, to find information for studying various disciplines (educational function); fix and represent interconnected content addressed to different participants (coordinating function), provide information and communication interaction between the subjects of the educational process, as well as with the "external" information space (communicative function), etc.

It is the information content that gives an institution's website the right to be regarded as an informational and educational resource. Information resources of the Internet allow professors effectively facilitate students' cognitive activity, quickly access their learning outcomes, readjust their teaching to improve the level and quality of knowledge, improve pedagogical skills, be aware of sources of educational, methodical and organizational information (Gorbatyuk 2015).

University websites are elements of institutional information and communication environment, and as such they can be characterized by the following: they provide interactive communication; a multifunctional communication mode of "many to many" which includes the mode "one to many" and "one to one", which allows to implement various types of interaction based on the needs of users and the tools they use. Users, supported by control over the search and receipt of information are empowered to take an active part in the communication process (Shelestova 2015).

Returning to the analysis of study results, we note that students in the central region of Ukraine were asked to evaluate what information is most important for them on the university's website and to establish a rank from 1 to 5, where 5 refers to the most important one (Table 1).

Table 1.

The importance of information on the university's website (from 1 to 5, where 5 – the most important information)

Position	Timetable of classes and consultations (in %)	Study materials, literature (in %)	Resources for distance learning (in %)	Information about various events of various topics in the university (in %)	Information about employers and chances of employment (in %)
1	14,7	13,7	25,3	43,2	32,8
2	8,9	8,9	20,8	22,3	18,8
3	19,5	13,3	23,2	17,1	13,9
4	24,2	27	22,1	9,4	19,2
5	32,8	37,2	8,7	8	15,3

Source: Own work

As a result, it was found that the ranked distribution of the most important data on the university website are the methodological materials and literature, as well as the schedule of classes and consultations, since most students rated these types of information the highest – 37.2% and 32.8% respectively. At the same time, the most insignificant and unimportant was considered the information on various events in the university, information about employers and employment prospects, because these resources were chosen by 43.2% and 32.8% respectively. At the same time, the average position ("3") was chosen for the most valued resources for distance learning – 23.2%. In our opinion, this is explained by the initial stage of distance education, and full-time students are more accustomed to direct communication with professors in classroom times, where they receive all the necessary information on sociology and specific recommendations for the literature, which is necessary for mastering the course. This is also confirmed by the fact that as many as 66% of the interviewed students often use materials received from the teacher to prepare for classes.

Thus, from the table it follows clearly that modern students no longer imagine their studies without the opportunity to use the methodological materials and literature, which should be contained on the website of the university. In this context, the details of the functioning of electronic repositories of literature and information portals of universities should be discussed in more detail. Repository can be refined as open access network services for storing, systematizing and managing digital collections of intellectual products from one or more university communities and disseminating digital material created by the institution or its employees (Ivankevy`ch, Vahnovan 2013). “A portal is a Web site designed for a specific audience, which provides: the aggregation of information content and delivery to an important audience for information; joint work and collective services; access to services and applications for the selected audience, provided on the basis of strict personalization” (Uspensky`j 2001).

The use of the information portal in the teaching of sociology corresponds to the strategy of building a unified European educational space and contributes to increasing the efficiency of independent work of students, developing self-education and self-improvement skills, constant professional growth, social and professional mobility, as well as forming the ability of critical thinking and assessment of social facts.

My`slovs`ka argues that ICT-enhanced information and education portal fulfils the following functions for learning: “accessibility – the principle of "learning always and everywhere" through the services of knowledge and resource delivery, outcomes assessment; functionality – e-learning doesn’t reduce the role of traditional forms of learning, but complements them; universality – today's most popular electronic education systems are in the form of information and education portals; independence – due to mechanisms for automatic submission and checking assignments, the subjectivity of assessment and teacher’s influence on students is reduced” (My`slovs`ka 2014). Overall, university web-portals provide students with flexibility as to their learning strategy.

The information portal of Dniprovsk State Technical University is successfully operating, where one can find all faculties and departments. The purpose of its creation is to provide students of various specialties and forms of study with methodological and educational materials for any course. Students of all the specialties of the university take the course Sociology and the webportal gives them an opportunity to get acquainted with the curriculum, lecture courses, methodical materials to prepare for seminars and independent work. Through free access to the portal at any time convenient students can deepen their knowledge in a particular topic of sociology, prepare for practical classes, formative and summative assessment. In our opinion, it is important that the material is available both for download and for free reading on the device screen. The methodological files developed by university professors are not in public access and can only be downloaded / retrieved after authorization. Authorization access is provided by the first name as a login and password, students log in via the number of their students' card, and the staff – by their employee number.

At the same time, similar information portals of higher educational institutions is a professional teacher's card, as the teaching community presents their scientific developments and creates educational and methodological products in the form of special courses, lectures, mini-workshops, etc. Today, as argued by Savenkova, “the weight of a scientist in the professional community, their influence on the events taking place in the chosen field of knowledge, is largely determined today by the extent to which the results of their research are comprehensibly, structurally and naturally presented in the network”. The researcher continues as to the educational role of personal websites and pages, “as they can become an information base for students and post-graduate students, through which they can provide online information on courses and topics taught at an educational institution” (Savenkova 2014). Through their own blog / website, teachers promote and present their work, as well as opportunities for university and other participants in the educational process to study the theoretical material and practical experience in research, posted on the Internet. The personal site itself is gradually becoming a key element of the Internet science infrastructure and the more diverse the activities of the scientist will be on the pages of the site, the more aspects will be covered, the more mobile the information update, the more likely that the pages will find their users, the more useful and interesting they will be for the online audience.

In practical training of sociologists we advise recent information technologies: Microsoft Excel as well as expert software SPSS for Windows, OSA for Windows and SOCIOLOG. OSA package is widely used to enter results of opinion polls and do statistical analysis, empowering users with the tools to perform all kinds of processing sociological information. The package SPSS Statistics is designed for broader purposes. It was developed for analysts and scientists, enabling them to solve business problems and research tasks during the whole analytical process. A key element of the package SPSS Statistics is SPSS Statistics Base, where access to data, data management and reporting are similar to OSA. Mastering these tools gives students a practical toolkit for their future professional life (Sorokina, Karimov, Karimov, Zayarna 2015).

There is a significant potential in personal scholars’ pages to study sociology. In particular, most sociologists now have personal profiles in Google Scholar and ResearcherID, which feature topical results from research and practical sociological questionnaires. Currently, Google Scholar portal has more than 3,780,000 articles and publications for the keyword “sociology” and 3,610,000 links for the keywords “sociology research” which allows current students to keep abreast of developments in the field of sociology around the world. There is a rich collection of Ukrainian sociological publications on this portal, with more than 84 thousand positions and 17 thousand added annually. When studying sociology, personal pages of the Institute of Sociology of the National Academy of Sciences of Ukraine will also be useful, where you will find biographical information, scientific interests and a list of publications that, thanks to free access, can be saved when preparing for training sessions and discussions during university seminars. Information on the rank of leading sociologists of Ukraine and their scientific achievements is also available on the website of the V.I. Vernadsky National Library of Ukraine.

When teaching sociological courses, we encourage students to get acquainted not only with theoretical scientific developments, which are discussed in textbooks and monographs, but also to follow the practical research of sociologists. The websites of the leading sociological centres of Ukraine (Socis) (http://socis.kiev.ua), Kyiv International Institute of Sociology (https://www.kiis.com.ua), Sociology Group "Rating" (http://ratinggroup.ua), the Razumkov Centre (http://razumkov.org.ua), Ilko Kucheriv’s Foundation for Democratic Initiatives (https://dif.org.ua), Gfk Ukraine (https: // www. gfk.com/uk-ua/), Kantar TNS (https://tns-ua.com), the O.Yaremenko Ukrainian Institute of Social Studies (http://www.uisr.org.ua), Institute of Sociology of the National Academy of Sciences of Ukraine (http://i-soc.com.ua), the Institute of Gorshenin (http://gorshenin.ua/topics/sotsiologiya/) et al.. Students can get acquainted with the results of quantitative and qualitative social and marketing studies on the socio-political, socio-economic and cultural situation in Ukraine, migration, education, political, medical, patriotic, religious issues in general in Ukraine and in the regional context, attitudes towards reforms, European integration, people's trust in public institutions, etc. Here you can see both analytical materials regarding research, publications of leading employees and banks of quantitative survey data. In addition, these websites provide an opportunity to follow not only the research but also the speech and presentation activities of sociologists, thus learning from the best examples and building up the ability to present results of their own research.

Another important source of socio-humanitarian knowledge is the publications of scientists in the expert journals on sociology, published on websites of universities and research institutions in electronic format. In particular, from our teaching experience we recommend university students to read and then discuss at seminars and practical classes updates from such journals as:

- Sociology: Theory, Methods, Marketing (http://www.irbis-nbuv.gov.ua/cgi-bin/irbis_nbuv/cgiirbis_64.exe),
- Bulletin of T. Shevchenko Kiev National University. Sociology (http://visnyk.soc.univ.kiev.ua/index.php/soc),
- Grani (https://grani.org.ua/index.php/journal/issue/archive),
- Herald of V. Karazin Kharkiv National University. Series: Sociological Studies of contemporary society: methodology, theory, methods (http://www.sociology.kharkov.ua/index.php/ua/visnik-khnu-seriya-sotsiologiya),
- Ukrainian society (http://www.ukr-socium.org.ua),
- Bulletin of the National Technical University of Ukraine "Kyiv Polytechnic Institute". Politology. Sociology. Law (http://visnyk-psp.kpi.ua),

- Scholarly Papers of NaUKMA. Sociological Sciences (http://nz.ukma.edu.ua/index.php?option=com_content&task=category&sectionid=10&id=62&Itemid=47),

- Bulletin of Odessa I.I. Mechnikov National University. Sociology and political sciences (http://lib.onu.edu.ua/en/sotsyologyya-y-polytycheskye-nauky), and others.

Involving electronic versions of professional sociological journals in the educational process promotes individualization of learning, as each student can get familiar with them at the right time, at the appropriate pace, copy the received materials to a medium or hard drive, print them and work with them when it is convenient, and also quickly go to links to other publications. Besides, when reading articles by scholars, university students can choose pressing topics and extra materials for their own research, since professional journal websites provide access to various sources of study materials, to remote databases, knowledge, numerous conferences around the world, they can work with this information. That is why the use of electronic versions of professional sociological journals in teaching sociology makes students' learning much more comprehensive and prompt.

CONCLUSION

The use of online resources is currently a basic instrument in teaching socio-humanitarian courses. On the one hand, they improve the quality, promptness and efficiency of learning and on the other – they reduce the time of presenting and studying certain study materials. In our opinion, educational websites, contribute to more active involvement of students in the learning process, better understanding and memorization of material, keeping constant interest in human sciences. In addition, with the changing role of professors from a unique source of knowledge in the field and a lecturer to an instructor and tutor who assists students in selecting proper teaching materials, educational websites provide virtually unlimited possibilities of search, selection, synthesis, structuring and demonstration of the material. At the same time, the use of the Internet in classes and in students' independent work allows to make both teaching and learning process more flexible, strongly differentiated and individual, as well as promote self-realization and self-development of the professor's and student's personality.

Educational e-resources are an urgent need for the present and it is impossible to modernize the educational process without their introduction. They facilitate access to the latest sociological literature, all lectures, methodological developments, thematic plans, enabling modern students to save their time, if they do not want to stay in the library, but want to do it quickly and in a comfortable environment and at a convenient time. Educational web portals, electronic libraries, official university websites and their information portals, websites of leading sociological centres, personal websites of sociologists provide a wealth of materials to prepare for seminars, discussions, and independent students' work. This contributes to greater awareness of students and the ability to learn and discuss different points of view about a particular social fact, because each student can choose which source to use to obtain this or another piece of information. Through websites of periodicals students have access to the latest publications on pressing topics in sociological journals. Therefore, the use of educational e-resources in teaching sociology makes the learning process more diverse, attractive, and dynamic; it stimulates students' creative activity and contributes to the comprehensive training of professionals.

When teaching human sciences in technical universities, the main task of the professor is to convert learning from passive mechanical mode to active, constructive and creative one. One of the ways to do it is to support classes with electronic educational books and thematic websites, recommend as main and additional sources of information specific digital multimedia educational cases from open collections, special software, resources of scientific databases. Teaching talent, supported by these resources in teaching sociology improves cognitive activity of students, develops research, creative skills, contributes to more effective formation of general and special competences, gives students the experience of a variety of resources for human sciences, actually implemented by their employed colleagues, which gives students real-world experience and improves the quality of future sociologists.

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INFORMATION TECHNOLOGY IN THE CONTEXT OF PEDAGOGICAL INNOVATION FOR SUSTAINABLE DEVELOPMENT. EXAMPLES OF ACTIVITIES IN POLAND AND AUSTRIA

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Abstract: *The main issue raised in the text is the issue of using information technology in education, in a multilayered manner, which compels intellectual and ethical considerations. Attention was paid to the problems of the Internet in the era of globalization, the common home of all people, which is the object of human concern for sustainable development. There is also an important issue of the TECHNOLOGY of integrated EDUCATION - humanity and everything that surrounds it is a unity, and nature is not something separate.*

The role of education in shaping an awareness of possible international dialogue in the issue of re-established ecology is also underlined. Modern technology in education is not an action aimed at completely stopping human interference in nature and preserving it in an absolutely intact state, but a harmonious coexistence and joint development of a man together with the world around him. It is primarily a new lifestyle, a positive use of information technology for solidarity between people and the resulting new attitude to nature.

The competences belonging to the imagination of information technology undoubtedly include skills such as: anticipating the technological and Internet effects of the actions undertaken, the ability to see and integrate human connections, school education and IT processes and design activities with the requirements of technological knowledge. It is nowadays that it is a call to the proper attitude of man towards the world around him.

Keywords: Information technology, globalization, computerization, sustainable development, educational innovation, ecology

1. INFORMATION TECHNOLOGY AND SUSTAINABILITY IN EDUCATION

The problem of nature protection has a social dimension. Natural resources should serve primarily to satisfy basic human needs. Both the benefits and costs of civilization and technical development should be equally distributed to all citizens. It is above all a new lifestyle, solidarity between people and the resulting new attitude to nature (Peacocke 1991: 147-149). Work on these issues may result in developing new attitudes towards ecology, ecological values and, consequently, love for the Creator of the world and people in society. Sustainable development - is such a socio-economic development in which the process of integrating political, economic and social activities takes place, preserving the natural balance and durability of basic natural processes, in order to guarantee the possibility of satisfying the basic needs of individual individuals of present and future generation (Prawo ochrony środowiska, Dz.U. (DZIENNIK USTAW)2001.62.627, Art. 3 ust. (USTĘP) 50 (Environmental Protection Law, Journal of Laws, Journal of Laws 2001.62.627, Article 3 paragraph (USP) 50;); cf. Sztumski 2006, p. 73-76).

It is known from experience that knowledge about sustainable development is not enough - this one is disseminated, and for many years has found a place in the core curriculum of a modern school. Sustainable development would have to become the value that people will manage and feel responsible for strengthening it. And this already requires systematic, consistent and careful educational activities, involving the development of morality and responsibility for their actions and others. Therefore, formal and informal education should raise and expand the awareness of complex environmental, social and other connections, in which every educational institution always participates (Brożek, Gawlik 2011, p. 10-33).

The shaping of the pro-environmental attitude was reflected in the International Strategy on Environmental Education, where the following statement is stated: “Environmental education cannot be one more item added to the existing grid of hours. It should be included in the programmes of all subjects regardless of the age of the learners (...). Its content should penetrate into the components of school education programs” (Kowalak, 2009: 313-314).

The main task of the school is to implement an educational programme that promotes sustainable development, to combine ecological education of students with moral education. The school is an institution that supports both individual and social development. Support for individual development is accomplished through help in shaping personality, deepening self-awareness, searching for new forms of self-realization, which is indispensable for the student to experience personal happiness. This is what the social development imposes - growing in culture, getting to know and taking over patterns of functioning, finding in the world and contributing to it, conditioned by personal development. In this development, a teacher plays an important role, modelling the behaviour of students, and gives an example to follow.

International cooperation of schools requires such meetings, which will be of help and inspiration to undertake effective implementation of education for sustainable development in schools. During the meetings, it will be possible to exchange their views to reinterpret the content and to evaluate the methodological workshop in the work of teachers. Different ways of understanding eco-development, as the implementation of the global concept of activities, for sustainable development, are improving education, and teaching and teaching.

The PARTNERSHIP which is characterized by interaction and communication is important in this process. The educational community is a huge communication space THROUGH THE INTERNET, through which teachers, parents and children send messages through infinitely many channels. Thanks to this, a convenient source of inspiration and development, interaction, and meeting with man and man is created.

Educational activities aimed at the experience and understanding of reality, "use-tested experiencing", making social changes and constant attempts to understand oneself and others create conditions for thoughtful and conscious actions, using the strength and power of authorities and values creating culture.

Strong emotions accompanying the information contained in audiovisual communications are coded in the children's consciousness. Upbringing to the media means shaping appropriate attitudes towards the mass media. The attitude itself means a relatively permanent attitude of a person (negative or positive) to a specific object. Negative attitude shows addiction to the media leading to the creation of a specific mentality, in other words a distorted worldview (in a broader perspective). Positive attitudes require some effort on the part of the "receiving" media message. They are based on his critical thinking, preserving them and allowing them to preserve their own opinions in specific creative activities. We share positive attitudes with attitudes: critical - healthy objectivity; selective reception; creative activity - insufficient media coverage to satisfy the field of creativity and for personal intellectual pursuit; wide horizons - built on a proper hierarchy of values, dialogue - when the ability to communicate participatively or interactively is undertaken; tolerance - opening up to the phenomenon of diversity. Upbringing for information is an education for the information society.

Thanks to the analogy between what happened before and sometimes the newest, young people can develop specific intellectual predispositions useful in their lives, such as: criticism, the ability to think logically, analysis of political and social phenomena, selection and evaluation of information provided by the mass media, a sober assessment of the situation, attitudes and statements of politicians also in ethical terms.

The Internet is a dynamically developing tool and the space of knowledge. It is difficult to imagine contemporary science and education without this source. On the other hand, we observe that young recipients are not prepared to use this source. For example, a mass phenomenon is the copying of all kinds of content or uncontrolled use of sources of knowledge that are not verified from the scientific point of view. The existence of threats of unperturbed use of the Internet and the lack of strategies for schools to prove their children's ability to properly use Internet sources has been proven (Smyrnova-Trybulska 2017, p. 130-139).

The Internet is entering more and more new areas of our lives: e-learning, electronic libraries, virtual laboratories, medicine, services (banking, tourism). The basic element of these and similar websites are websites that make up more complex websites, portals and internet platforms.

1.1. Information technology (IT)

It occurs as a new field of cognition as a source of help in teaching other fields. **A multimedia computer** with **software, multimedia** and **the Internet** are its main components. An electronic book (*e-book*) is defined as content stored in electronic form, readable using special computer software. The manual in a digital form enriched with multimedia links (files) and simple hypertext structures becomes a multimedia textbook. In turn, the term *hyper-book* is referred to an electronic book with the characteristics of hypertext with all its consequences - the richness and diversity of navigational and thematic links. The basic didactic functions of the modern textbook are: information and cognitive function, research, practical and self-education. Multimedia materials, published *online*, allow to implement didactic postulates, such as: multilateral cognition, adjusting the pace of information transfer to individual features, viewpoint, etc. For the multimedia model of the script, didactic functions were defined as follows:

- presentation of educational content (included in the curriculum and outside the curriculum),
- visualization of the teaching material and illustration of practical implications,
- supporting the process of independent performance of tasks (especially in the case of those students who are not able to "grasp"),
- individualization of teaching content and adjustment of the rate of information transfer to individual features,
- individualization of the learning process,
- enabling self-control of learning outcomes (Okoń 1996, p. 71).

At present, it is not enough to consider computer technology only from the perspective of education technology, but it should be taken into account that it has become an integral part of every field of human activity, so it should appear in almost every field of education as an element of this field. For nearly 20 years, IT education (or education related to computers) has been the subject of constant interest of quite a large group of specialists. This was appreciated by the management of the Ministry of National Education and Sport, establishing the IT and Media Education Council. The success of this body and people cooperating with it can include the study "Standards of teacher preparation in the field of information technology and IT", which was used, among others, in the ministerial standards of teacher training. The team cooperating with the Council has also developed a new proposal for the informatics core curriculum for secondary schools and related maturity requirements (Sysło 2004: 37).

2.INFORMATION TECHNOLOGY - EXAMPLES OF ACTIONS

Living with "big screens" - TV, computer, Internet and mobile phone - may soon become the dominant form of socialization of a young man. Virtual reality, which however does not always correspond to what is real, affects human beings. The contemporary virtual world is effective and has great power, it is a MASS means of data transfer, and thus has a profound impact on people, interpersonal relations, development of science and the entire world economy. The world of cyberspace has created its own tools (instant messengers, blogs, email), brands (Google, Yahoo!, Facebook), or contact methods (webcam, social networks).

This results in visible socialization and interpersonal changes, which include:

- handling several multimedia at once;

- learning with active (active) multimedia devices;

- mass usage of the world of cyberspace in science and with homework (the latter has more and more often the form of unreflective copying;

- social interaction with parallel active use of multimedia (conversation on a Gadu-Gadu, talking with a peer and parallel communication by a mobile phone);

- devoting more and more time to multimedia;

- slower sleep time (visible already from older primary school classes);

- night fatigue (the result of the so-called lack of sleep and lack of temporal access between sleep and discontinuation of multimedia.

Multimedia devices are increasingly taking on the “subjectivity” of a human being, and we are becoming more and more dependent on multimedia (Andrzejewska, Bednarek, Sarzała 2007, p. 79-83).

The comparison of actions in Austria indicates that teachers in Poland represent a rather passive attitude of the Internet user and prefer using content created by others over their own activities and activities for the co-creation of the modern network (*Applications based on own observation and research workers from Kirchliche Pädagogische Hochschule Wien / Krems*). We mainly browse websites and contact via the network. Thus, teachers generally attach great importance to the use of tools to operate information, but it is more important to them to participate in the process of seeking information (acquiring from others) than participation in the process of creating content (creation for others).

Nowadays, schools are looking for innovative teaching methods. New technologies perfectly fitting this trend. We can include 3D printing and 3D CAD design. These two areas have not been included in curricula in other countries since today. The development of creativity, spatial imagination, new technologies thanks to 3D engineering changes the current approach to science.

In order to prepare the next generations for the professional future as much as possible, educational institutions are happy to buy 3D printers. In Austria, the use of 3D printers in education is not a technological novelty, it seems a natural choice of devices for building three-dimensional reality. Austrian teachers use them in virtually every school subject - from mathematics (creating and printing solids), plastics (creating sculptures, decorations), biology (printing cell models) and above all in technical classes and information technology (3D object design, projection and technical drawing). As stated at the educational fair: everything can be printed, only the imagination limits us, because 3 D printers cannot only develop, but also complement the didactic base with everything we come up with, it is also possible to print projects that will be created by students. The most popular application of 3D printing is rapid prototyping, which accelerates the testing of new solutions, increases the efficiency of school activities. Using a printer equipped with two heads, the students, preparing for a given profession, can create geometrically complex objects with high precision, they can quickly make further corrections to the project and verify them in a 1: 1 scale.

The use of a 3D printer enriches the learning environment and makes it easier for students to acquire and remember the material. 3D printing can also have a big impact when choosing a profession by students. It allows them to experience the successes and pleasures associated with a scientific or engineering career. It opens up new opportunities in areas that students may have previously considered boring or exceeding their abilities. It can also arouse the desire to consciously change the world (Malara, Ryńca 2017: 9-26).

The implementation of 3D printing technology in the Polish school is already happening, but its widespread use is only a matter of time. There are more and more 3D printers available on the market at affordable prices, which are designed and used specifically for institutions that want to provide students with the option of using their devices in person, and not just watching the next teacher's activities with this modern form of printing (from looking at no one has learned anything yet). The set also includes a specialized 3D scanner, including 3D pen 1.0, which includes, among others, templates for creating objects, additional accessories and instructional videos, which works well in schools in Austria.

Companies provide telephone support for people, i.e. teachers and lecturers who support 3D printers in educational institutions. Teachers in Poland are directed at a curriculum that is helpful in preparing lessons on 3D printing devices. The whole is complemented by the XYZmaker program, thanks to which students will be able to develop their modelling skills from an early age. Printers coming out from under the XYZprinting wings (which distributor is AEMCA) are equipment designed for those who not only want to learn the basic techniques of 3D printing, but also to explore its secrets and develop their skills. What is also worth mentioning is the Polish printer Zortrax, which has gained recognition around the world. A 3D printer is just a tool. How it will be used in education - depends on the creativity and competence of the teacher. Contemporary education requires reforms, looking at Western trends, we learn that learning is provided through experience, *much better to see and touch*, using 3D printing in class activities (Kwapuliński, 2008, p. 31-57).

Let's not forget that the creation of the printout must precede the computer modelling process. The opportunity to prepare your own, completely original project from scratch and get tangible results is a source of enormous satisfaction for the student. Satisfaction with the effects of own work encourages further involvement in learning new technologies, stimulates creativity in the child and the need to acquire new skills. Looking at Western trends, we are slowly learning that learning is provided through experience, which is why methodologists emphasize the role of activating teaching methods. Instead of learning by heart how different objects are built, it's much better to see and touch them.

This is the first, most important advantage of using 3D printing in class. With the use of spatial printers, you can create mock-ups of geographical lands or settlements, but also implement completely abstract ideas of students.

Young people in Poland and Austria, however, have common computer interests related to communication. Almost every Internet user uses instant messengers that allow you to communicate with other people in real time (that is, send and receive messages in a short time, as during a conversation).

The most popular communicators used in Poland and around the world include: ICQ (the most popular in the world), Gadu-Gadu (the most popular in Poland), Skype (the largest and most popular voice communicator in the world based on P2P technology), Tlen.pl (the second one relative to the popularity of communicator in Poland). It is worth noting that there are also multicommunicators that allow communication with users using other types of communicators through the appropriate set of plugins (e.g., Oxygen, Konnekt, Miranda IM, AQQ, Pidgin, Kopete or Trillian).

An example of the use of 3D printing can be an EU project managed by the Polish Universities: "*Learning by Making* as Motivation Trigger. 3D Printing etc.". The aim of this project is primarily:

- Design and model an active, learner-centred teaching approach for engaging underachievers into STEAM related projects through real product design and making practices
- Help underachievers in STEM related subjects to improve their performance and develop 21st century skills through their engagement in interdisciplinary projects in three dimensional object design
- Plan and enact activities and workshops that promote teacher professional learning and pedagogical change
- Create Open Educational Resources (OER) that will support school community members (within and beyond the partnership) to apply the MAKEITREAL learning intervention
- Open STEM education though the infusion of arts and the support of product design and making practices moving beyond clichés according to which only STEM-talented students can make it.
- Establish synergies among schools, academia and the industry towards creative and meaningful engagement in STEAM education (https://makeitreal.info/).

2.1. Educational programs

An educational program is a computer program supporting the teaching process. Educational programs are: electronic textbooks, programs supporting repetition and memorizing and checking the level of knowledge. Games and educational programs are a great complement to didactic materials. They can support the learning process or introduce the user into the world of science, so they should be included in the collections of each library. Education through play facilitates the learning process, which is why libraries should promote the use of educational games. By giving students tools to access information, we allow them to indicate what needs to be done so that learning at school can be effective and useful in real life. If in education we do not use the possibility of electronic communication, it will be tantamount to the fact that our ancestors did not use the alphabet and books (Blömeke 2010, p. 43n).

Computer game is not a simple successor of board games known to us for centuries. This is a completely new technical and social phenomenon. Researchers dealing with cyber-bullying indicate that it is not enough to mention gaming characteristics (psychological, technological, cultural, sociological), but it is necessary to show their extremely strong impact on players' behaviour, especially the potential of "absorbing into the NETWORK". However, we would like to explicitly say that we do not belong to supporters of the liquidation of these games or forbidding the use of them by young people and children. Already at the outset, we note that the essence of the problem lies in understanding when and under what conditions and which games the child can use (Boroń-Zyss 1995/1996: 31n).

Nowadays, information technologies are closely connected with the concept of multimedia education. They are identified with methods and techniques of communication in the area of creating, storing, selecting, transmitting and sharing information. They determine the pace and level of development and have a significant impact on structural and social changes, which is largely determined by the speed of sending, searching and processing information. They influence the individual's activity and way of thinking by improving the techniques of collecting, processing and generating information - they change the social structure and create the information society (por. Monet 1999, p. 8; Bednarek 2006: 46).

2.2. ADAPTER portal

This is the first cinema on the web created especially for people who cannot see or hear. In Austria as well as in Poland, ADAPTER IN SCHOOL is a response to the needs of schoolchildren. It is part of the ADAPTER portal, which was prepared for children and youth. It has been noticed that children with hearing and sight dysfunctions cannot use widely available film education or adaptation of film school readings. In addition to the films, additional educational materials with sign language are made available to students. The ADAPTER portal is available at the address *www.adapter.pl.* ADAPTER gives everybody a chance for a home movie screening. All you need is internet access, a computer, telephone or tablet. The portal is very easy to use and available according to WCAG 2.0 standards. This means that a blind person can easily navigate through the keyboard and screen readers. ADAPTER has also been designed in black and yellow and white. It was not about a clear look, but above all about making the site readable by the visually impaired. The portal is based on an available player created by *Vimeo*, which allows the video to be paused, undone and moved forward using cursors. The simplest and most effective solution - the Internet! (Baron, Ford, Kay 2007: 113).

Innovative actions have also been taken in Poland. In addition to standard subtitles, movies with simplified subtitles are also available. That's why two types of subtitles are provided for the films posted on the ADAPTER IN THE SCHOOL: standard - for the hearing-impaired youth and subtitles for the deaf youth. This solution is mainly for young deaf people who use sign language and only in later years learn to read and write fluently. For this group, the mother tongue is a foreign language. That is why simplified subtitles are also a great form of learning the Polish language (Szczygielska 2016, p. 79-83).

From everywhere we are bombarded with slogans of innovation and creativity. The skills and knowledge requirements change all the time. How should we look after our internal sustainable development. We should not yield to the dictates of the organization. Sustainable development is the perception of man and his spirituality. Noticing the family, society in the process of constant change. It is an attempt of an evolutionary search for the growth of knowledge and skills. Searching for productivity at no cost. It's building an organization with responsibility. We have shaped this sustainable development from an early age. In a school that expands knowledge of technological novelties, there cannot be any subjective treatment of a student who needs to develop integrally, holistically in his / her environment.

The aforementioned qualities of education enriched with new technology contribute to the sustainable development of the human person, in which the school can help by:

- definition of teaching objectives;
- improving teacher-student interaction;
- creating and sharing knowledge sources;
- improvement of the reception standards of audiovisual information;
- enriching the control and evaluation of the learning process;
- perfecting individualization.

Multimedia performs a variety of functions: support activities undertaken by the teacher and student activities, make classes more attractive, shape and develop independence. They are a source of information and inspire you to undertake comprehensive self-activity. They constantly maximize the improvement of skills related to searching and selecting information in accordance with the needs and objectives of education. They support the creation of conditions for learning and practising various skills: from simple sensory and motor skills, to more complex ones - connected with making decisions and solving problems (Błeszyński 2008, p. 446).

2.3. Application of information technology and multimedia resources on the example of WU (Vienna University of Economics and Business)

WU (Vienna University of Economics and Business) is one of the first schools in Austria to introduce compulsory use of Notebooks as a working tool for all students. In the 1990s, this school, as well as many other Austrian schools, had professionally equipped computer rooms, used for such subjects as, for example, computer formatting of texts and for foreign language learning. In 2000, a new working tool was introduced, namely the Notebook. Students deciding to attend this elite, private economic school, under the supervision of the Vienna Traders Fund (Fonds der Wiener Kaufmannschaft), undertake to fully use notebooks from the second grade in this five-year school of economics, ending with the final exam.

Notebooks are used in all teaching subjects except physical education. The decision that the use of this modern work tool starts only from the second year of teaching at school is dictated by pedagogical and practical considerations. Students have one year of proficient knowledge of typing on a computer keyboard with ten fingers, while the number of errors per minute should be minimal and evaluated in the form of practical tests. During the first year of teaching, students get personal access to the school's electronic network (account) and are gradually introduced to the use of various possibilities of electronic search and data processing, i.e. acquiring knowledge available on the World Wide Web.

Starting from the second grade, the full use of the notebook as a student's work tool begins. It is used firstly as an electronic notebook, for the student's various work in a given subject. Many years of experience show that pupils using the notebook write down the content given by the teacher faster than students who write in a traditional way. Students' notes can be immediately sent electronically to students to work in groups or to the teacher for control. It is also possible to use students' problems developed during the classes. In a similar way, saving and sending homework takes place, which is electronically checked by the teacher. In the same way, homework adjusted by the teacher is obtained. Preparing their electronic notes and documents, students get to know not only the basic formatting of texts in Word, but learn to prepare documents in accordance with the required European standards. Creativity of work develops when choosing the graphic introduced to your own text, so that it emphasizes or reflects the described content. In the information and communication technologies (Informations- und Kommunikationstechnologie) classes, students learn to use professional programs, create websites, create their own advertising films, and posters using programs such as Adobe or Corel Draw. An interesting and important issue is the issue of “copyright”, that is, honest dealing with someone else's text or graphics. The students with whom this topic is taken up are interested in this issue, they discuss selected examples and learn about binding rules and regulations. In this way, ethical attitudes to the responsible use of multimedia are shaped at WU (Vienna University of Economics and Business).

The notebook is used not only as an electronic notebook storing notes, tasks and exercises from all years of teaching, but also serves as a textbook. Students have two options to use the electronic textbook: the first is the purchase of a printed copy, to which on the relevant website the student receives reserved electronic access and can use the exercises there, or extensive information extending the subject discussed in the lesson. It can also perform tests that check their knowledge on a given topic, or to memorize completed exercises. The second option is full electronic multimedia textbooks, available on the network or entered into the student's computer memory.

A notebook is also a tool by means of which knowledge of students is tested in the form of various tests, which are enriched graphically constitute an interesting alternative to written tests or cards. Class works in the mother tongue and foreign languages are also written in notebooks and sent for check electronically. Students have the opportunity to use an electronic dictionary or automatic spell check functions in Word. They must demonstrate grammatical knowledge in their native language, because automatic suggestions for amendments do not always agree with the forms required in a particular text.

The written exam in German language, economic subjects, foreign languages and mathematics requires the use of a notebook. Students receive their matriculation tasks in both electronic and printed form. Completed graduation work is also given in both forms: electronic record in the previously specified file of completed secondary school certificate and in the form of a printout of previously completed tasks. A notebook in combination with a projector (beamer) is often and willingly used as a tool during presentations as part of the matriculation exams.

At WU (Vienna University of Economics and Business) the electronic Feedback method is used more and more, i.e. the assessment of students' work by the pedagogue, as well as the assessment of individual lessons by students and the work of the teacher. To this end, student's favourite applications such as Kahoot and Mentimeter are used.

2.4. Sustainable development and information technology at WU (Vienna University of Economics and Business)

Since 2003, WU (Vienna University of Economics and Business) has been carrying out projects devoted to sustainable development and spirituality. The inspiration for this is the subject of the Catholic religion, which organizes about 12 to 15 pro-ecological or pro-social projects every year, inviting various teaching subjects to common activities as well as other religions and religions. The method of work is based on the economic project management, which is provided for on the third level of the curriculum. Over the course of 15 years, the school has gained a number of experience in this area by carrying out approx. 200 projects in the field of sustainable development, in which approx. 2,000 students participated, engaging in Austria and abroad. All activities were focused on the common platform Amicus Award, which as a prize is given to three of the best projects made in a given year. Amicus Award is organized annually by one of the oldest classes, using its own programmed website, school Internet, as well as many IT functions such as PPT presentations, contact with project partner organizations by e-mail, electronic project descriptions and photographic documentation. The whole is described by the students in the form of articles and photographic and electronic documentation and sent to the media through the agency of the PR Office of the Vienna Traders Fund.

An example of a combination of sustainable development and information technology can be an international project called S.Ec.Mo. (Social-Ecological Movies). In this project, students of the second class decided to make short films about the subject of sustainable development in the school environment by means of a time-lapse method, inviting pupils from Poland to work together and creating international film groups. After learning about the technique of making films by frame-by-frame, each group looked for the right theme, wrote a script and shot individual scenes, which were later submitted by groups of students to a program enabling the creation of films from thousands of individual photographs. After finishing the work, a festival of student films was organized and a special pedagogical board awarded prizes to the best film groups.

Many years of running projects in the spirit of sustainable development and spirituality, as well as using modern means of information technology, cause a lot of interest among students and teachers of WU (Vienna University of Economics and Business) in joint engagement in the modern world.

Media education provides teachers with greater freedom in teaching methods. Currently, there is a great emphasis on modern teaching methods based on the use of technical means as well as various multimedia programs.

It should be remembered that the technical message can never fully involve the teacher. The best results are usually achieved by combining technical means of communication with a "living" impact on the recipient. There are various views and positions on the role and place of the process of computerization of Polish education.

CONCLUSIONS

Man is moving through his actions to the existing balanced interaction between organisms and the environment, the whole ecology of the earth, thoroughly change, and yet man is completely dependent on nature, therefore man's mission to the world can be described by three verbs: transform, serve and protect; nature is not a self-renewing magazine, therefore man cannot take a gladiatorial attitude towards her; we are not the only or last generation, hence we cannot leave the wastes in decline. Today, ecology is a call to the proper attitude of man towards the world around him (Krawczyk 1986, p. 13-23).

The problem begins to appear when “technical culture” overcomes man: when things instead of serving man, subordinate man to themselves. There is a “dehumanization” of culture, contamination of the base human environment in which man lives. As Fr. Józef Dołęga: “If specific actions are taken to protect the environment, they are usually limited to removing the disastrous effects of human activity, not the causes of the threats. The main cause of all environmental hazards is the man himself” (Dołęga 1993: 159, after Langiewicz 2002: 517).

At the time of the information society, tasks in the field of media and information education become one of the most important challenges facing education. Recently, state institutions have taken a number of initiatives aimed at fundamental modernization of Polish schools and raising the digital competences of Polish society. Among these initiatives, the “Digital School” project has a special place, the aim of which is the comprehensive implementation of the use of information technology and improving access to digital technologies.

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III. ALTERNATIVE METHODS, FORMS AND TECHNIQUES IN DISTANCE LEARNING

USE OF ARTIFICIAL NEURAL NETWORKS IN THE SELECTION OF EDUCATIONAL CONTENT ON AN E-LEARNING PORTAL

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Abstract: *An individualized learning path is a new solution that has been introduced in didactic materials made available to students on the educational portals of our universities. This approach stems from the fact that students participating in the educational process, on the one hand, have different needs and expectations, and on the other hand, different possibilities and limitations in acquiring knowledge. The conducted research allowed recognition of the differences and the selection of the most appropriate of the three learning paths offered. Indication of the learning path is made by means of a classification system, for the construction of which artificial neural networks were used. On the basis of the tests carried out, it was shown that when selecting the learning path, the best results are provided by a multi-layer network, with one hidden layer that contains 9 neurons. The network was taught in 50 epochs, the activation functions of the hidden and output layer neurons were hyperbolic tangent and linear function respectively. Over 98 percent correctness was achieved in the classification of new students starting the education process. The innovation of the proposed solution is to demonstrate in practice the possibilities of individualizing the student education process and thus its adaptation to the educational needs and competency gaps of participants in this process.*

Keywords: educational portal, learning path, neural networks, classification of students

INTRODUCTION

Personalisation of internet portals has become an everyday reality. Internet users receive personalized advertisements, content in online publications, etc. An important factor in the current era of computerization, universal access to the Internet, and Lifelong Learning is the personalization of learning paths using multimedia intelligent education systems. A significant problem of such systems is the faithful reproduction of both the teacher's and student's activities in it, and the implementation of such software that would provide an adaptive teaching process. Education at a technical university places particular emphasis on practical application of knowledge, and the most commonly used method of education using an educational portal is blended learning. The goal of blended learning is to combine two modes of learning: face-to-face and on-line materials (e-learning). Time spent with the teacher is used primarily to engage students and allow them to gain interactive experiences. At the same time, participants can use the network rich in materials at any time of the day, from any place. This gives the learners with a plethora of other duties the flexibility they need in organizing their own learning process. Introduction of modern didactic means to the learning process and multi-sensory transmission of program content consolidates the knowledge acquired by students and makes them aware of the possibilities of using this form of education in the future (Baylari, Montazer, 2009; Anand, Mobasher, 2005).

The issue of selecting the learning content for the group of students discussed in this work concerns primarily the didactic materials made available on educational websites of universities. In this case, it is necessary to use methods that, in addition to knowledge acquired about the students, can take into account the different and often changing levels of knowledge they possess about particular topics, as well as the variable degree of its further acquisition. Systems designed to solve the problems of classification, in addition to being able to learn from examples, should also improve their performance as new experiences are accumulated, i.e. during the expansion of the student knowledge base that was built prior to the launch of the classification process. Therefore, it seems that the most effective classification algorithm that meets these requirements can be built using advanced data mining methods, including Artificial Neural Networks (ANN). Networks quickly learn to recognize user preferences in different data sets. ANN are characterized by the fact that they have the ability to map even the most complex functions. For this reason, non-linear models can be created easily and rather simply, without the need for the user to formulate hypotheses. This non-linear nature of the network increases the possibilities of its applications, which is especially important in the case of the need to select the right paths for new groups of students, which change with the following year's recruitment to the university. The article describes the operation of such an example of an experimental system that ensures the creation of personalized e-learning courses, allowing the selection of optimal learning paths.

1. NEURAL NETWORK

Neural networks allow control of the problem of multidimensional data, which in other methods of artificial intelligence makes it difficult to model nonlinear functions that have a large number of independent variables. In practice, neural networks themselves create the necessary models by automatically learning from representative data in which the dependency that is interesting to the user is hidden. Based on this data, the necessary structure of connections between data is automatically created in the network's memory, which takes the form of so-called weighting factors. On the basis of the thus created structure, the network performs all functions related to class forecasting, i.e. the use of the created model (Tadeusiewicz, 1999, Tadeusiewicz et al. 2007). Another important feature of artificial neural networks is resistance to errors and damage. This is manifested by the ability to act in spite of the existence of certain damage to the network and when the data analysed is disrupted, uncertain or incomplete. However, the most important feature that characterizes neural networks is the ability to learn (Duch, 2000; Kurzyński, 2008; Markowska-Kaczmar, Kwaśnicka, 2005).

In network learning, one of the most commonly used methods can be used:

- supervised learning (with a teacher) – consisting of networks providing examples of inputs and corresponding outputs,
- unsupervised learning (without a teacher) – characterized by the fact that the system itself has to discover the features that appear in the input data; in the learning process mechanisms are used to discover similarities between patterns and cluster identification,
- reinforced learning (with a critic) – the output patterns are not provided; however, there is an external observer who assesses the results of the network processing and uses them in the process of selecting weights.

The specificity of applying each of the mentioned methods lies in the fact that the result of the learning algorithm is used for changes (so-called tuning) of network parameters to improve its performance (Duch, 2000; Kurzyński, 2008; Markowska-Kaczmar, Kwaśnicka, 2005).

The most common method is supervised learning, which is implemented through the use of the information contained in the training set. Network learning is incremental (iterative). Learning rules refer to specific network parameters that are equivalent to the weights of synaptic connections in biological neurons. In a single step of network learning, the vector of traits *x* of the next teaching object is given to its input, the responses of the network *y* are observed, and after comparing it with the given value *d*, the appropriate correction of the network parameters takes place. These parameters are called weights. In the first step, their values are chosen randomly and then changed in such a way as to minimize the error between the response of the network *y* and the expected value *d*. Such a single step is called an epoch or a learning cycle. These epochs are repeated many times until the condition of stopping the algorithm is met. This condition may be the execution of a set number of epochs or the obtaining of the required quality of network operation by achieving a certain error threshold defined at the beginning.

The quality of network operation is most often measured by the mean square error. The network learns until such a time as the error value falls below a certain set value. It is also possible that both conditions must be met in order to stop the algorithm. After completing the learning, the values of the weights are remembered, and the network can be tested and also used to predict the class of new objects.

One of the tasks for which neural networks are used is classification, both non-reference and reference. Non-reference classification serves to analyse the structure of the surveyed collectives. Reference classification, on the other hand, consists in assigning each examined case to one of the classes. The number of these classes and their characteristics are known before the classification process begins. A network that has the task of classifying objects should receive on the input the values of the variables that describe them, and on the output the expected class identifier (e.g. number, label). The method of their interpretation depends on the type of classification problem and the way the output variable is represented (Lula, 1999; Lula, 2006; Kurzyński, 2008; Tadeusiewicz, 1993, Tadeusiewicz, 2007).

To solve the problem classifying of students for individual learning paths, one-way multi-layered networks were used, taught using the supervised method. Multi-Layer Perceptron (MLP) networks consist of a layer of input and output neurons. Between them there is at least one layer of hidden neurons that mediate the transmission of signals between the input nodes and the output layer. This layer is a collection of neurons that are not interconnected. Connections only occur between neurons in different layers (Markowska-Kaczmar, Kwaśnicka, 2005; Galushkin, 2007; Kurzyński, 2008).

A characteristic feature of an MLP network is the flow of information in one direction: from neurons located in the input layer, through hidden layers, to the neurons of the output layer. Neuron connections between individual layers are full, connected on an all-with-all basis. However, there may be a case when some connections do not occur (so-called partial connections). The advantage of a one-way network is that it always has stable behaviour (Tadeusiewicz, 1993; Wilde, 1997; Duch, 2000).

Teaching the neural network is based on the automatic search for such weighting factors in all neurons throughout the network, which guarantee the smallest value of the total error of forecasting committed by the network. During the learning process, this error is systematically reduced, resulting in a gradual improvement in the network's performance.

To create a neural network that aims to classify students who study on the e-Student portal (the virtual education portal of the Stanisław Pigoń State Higher Vocational School in Krosno, shared on the Moodle platform) and attend the course *Algorithms and data structures* (Dębska, Kubacka, 2014), the *STATISTICA Neural Networks* software was used. Its undoubted advantage is the built-in Automatic Network Designer module, which in most cases can effectively conduct the process of searching for the appropriate network model. All that needs to be done is selection of the type of network, the number of networks to be taught and the number of networks to be remembered, the activation function for the hidden and the output layer, and the range of weight reduction factors. The designer generates a set number of networks with various functions of neuron activation. The statistics of these networks can be analysed, then the best network can be selected and used for further research (it is possible to write the structure of the taught network in C/C++). The discussed module of the STATISTICA system was used in the described studies (Bishop, 1995; Welstead, 1996; Lula, 1999, Lula 2006).

2. DATA AND METHODS

The study whose results are discussed in this article~~,~~ was conducted on didactic materials prepared to assist in teaching the course *Algorithms and data structures*. The teaching was conducted using the blended learning method during the second semester of the first year of a *Computer Science* course. The choice was not accidental, because this is the first subject for which e-learning materials were developed and the students had already benefited from blended learning since 2010. The subject was divided into 5 thematic modules. Each module was in turn divided into lessons. Their number in the module depends on the complexity of the problem and the amount of material discussed during each unit. One lesson unit may include one or more topics. Each module ends with a test checking the student's knowledge, followed by classification, and a positive result provides the student with access to didactic materials from the next module. The content of didactic materials placed in the lessons corresponded, as to the degree of difficulty, to the requirements set in the sheet for the subject *Algorithms and data structures*, which documented what knowledge and skills should be obtained by a student who has achieved results at the assessment level of 3.0 (satisfactory), 4.0 (good) and 5.0 (very good). Selection of the subject of the lessons for subsequent learning paths was directed not only towards optimal adjustment to educational needs, but also the need to adapt the didactic materials to the competency gaps of the learning participants observed during classes conducted using the traditional method. In the conducted research on the personalized educational system, it was assumed that the selection of individual learning paths would take place in two stages. In the first stage initial selection of learning paths is carried out. The student's classification takes place on the basis of historical data, i.e. grades from subjects whose knowledge is necessary to study the current subject matter and the results of the placement test. Prior to the pre-classification process, these data were normalized using the *minimax* function. After initial acceptance, the student may proceed to independent study of the subject on the optimal learning path selected for him. As a result of the initial classification, 111 students were qualified to study on the first learning path, on the second path there were 57 students, while 29 students were assigned to the third path. Debska and Kubacka (2016) described the initial classification as well as the second and subsequent stages, which in this case were implemented using the cluster analysis method, with the Matlab system used for calculations. The conducted cluster analysis using the unsupervised method showed that three groups of people can be distinguished in the surveyed group of students, representing three well-separated learning paths. These results became the basis of the present study, whose aim was to develop a classification model using artificial neural networks, which can be used for classification of new students.

Data for classification using ANN were downloaded from the Moodle platform databases. These are the results obtained by students after the completion of the first part of the subject *Algorithms and data structures*, which discusses the subject of the time and computational complexity of algorithms. The objective of the classification algorithm was to assign each student to the appropriate class, on the basis of which training materials from the next section (RAM Machine) were to be made available to them. The contents contained therein are intended to meet their individual needs.

The input vector of the neural network consisted of 197 cases, each of them containing the following attributes:

- the mark obtained in the test,
- test solution time,
- number of approaches to solving the test,
- the number of the learning path which the student is currently on.

The output variable in the training set was the identifier of the class to which the student was assigned by a teacher based on the results that the students obtained during classes conducted using the traditional method. In this set of observations, 27 cases belonged to third class, 91 to second and 79 to first. The correct selection of the class was also confirmed by an unsupervised method of cluster analysis. In order to reduce the subjectivity of the assessment, the personal data of students was replaced with consecutive case numbers.

The initial parameters that were set during network design were as follows:

- minimum number of hidden neurons,
- maximum number of hidden neurons,
- error function,
- activation function of the hidden layer neurons,
- activation function of the output layer neurons.

Using these parameters, various models of artificial neural networks were created. Each of these networks was taught and tested on the same cases.

The training set was divided into three subsets: learner, testing and validation (in the ratio of 70:15:15). The first one is used to teach the network, the second for the final evaluation of the prognostic quality and selection of the best network (testing), and the third to verify the network learning process, which consists in controlling the effects of the learning algorithm over its duration (validation). Such a division of the training set, with an artificial subset allocation, which will not be used to teach the network, is a way to protect the network against over-matching. This subset is used to check whether the network has properly conducted the process of generalization of knowledge "received" from the training data (Statistica, 2009).

3. RESULTS OF THE NEURAL NETWORK LEARNING PROCESS

As a result of the operation of the generator, more than a dozen neural networks with different parameters were obtained. The best was achieved by a network containing 9 neurons in the hidden layer. The learning quality for this network is 99.28, testing quality 96.55 and the quality of validation is 100.00. The network was taught in 50 epochs, the activation function of the hidden layer of neurons has a hyperbolic tangent and the output layer is linear. Figure 1 presents a chart of the learning process for this network. On the x-axis, subsequent learning cycles are marked, and on the y-axis the participation of incorrect classifications. The learning and test sample chart shows that the lowest error value was achieved in the 50th cycle of this network’s learning.

The second network, with only slightly worse parameters, is a network that also contains 9 neurons in the hidden layer. It differs from the previous network in the activation function. In this case, both functions are a hyperbolic tangent. The learning quality for this network is 98.56, while testing and validation are 96.55 and 100.00 respectively. Figure 2 shows a graph of the learning process of the network. It can be seen that the network needed 53 epochs to learn.

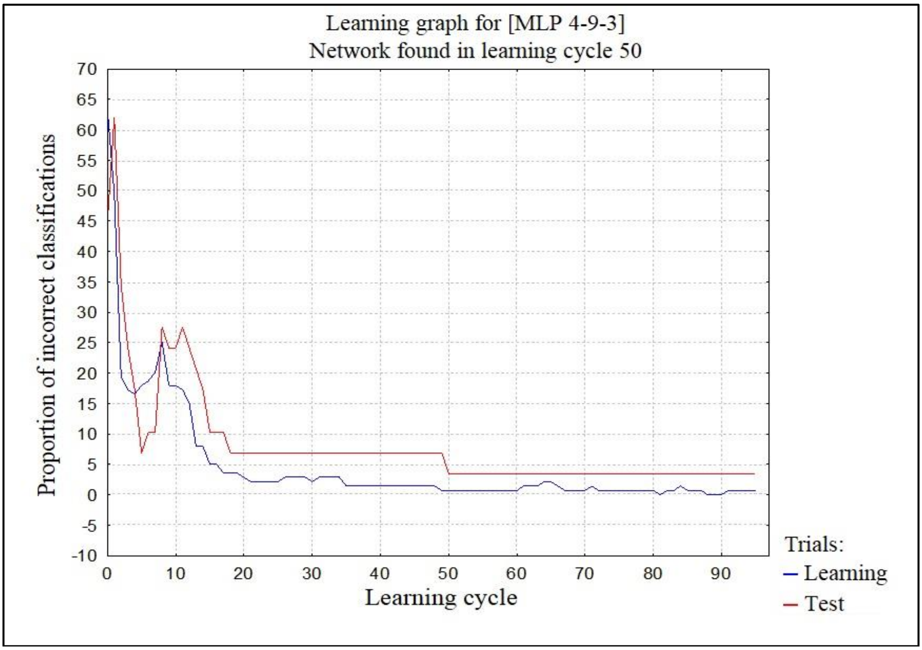

Figure 1. Learning graph for the best-performing network

Source: Own work

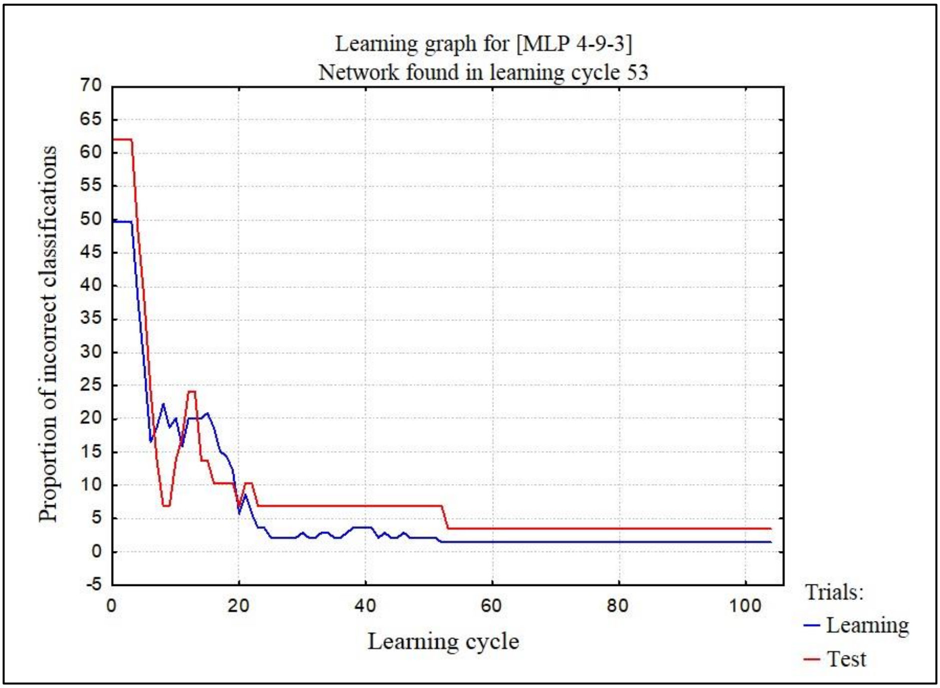

Figure 2. Learning graph for the second network.
Source: Own work

The next, third network, contained 8 neurons in the hidden layer, which are activated by the hyperbolic tangent function. The output layer neurons are activated by a linear function. The quality of learning, testing and validation for this network was analogous to network number 2. From the graph presented in Figure 3, it can be seen that the network needed 31 epochs to complete learning.

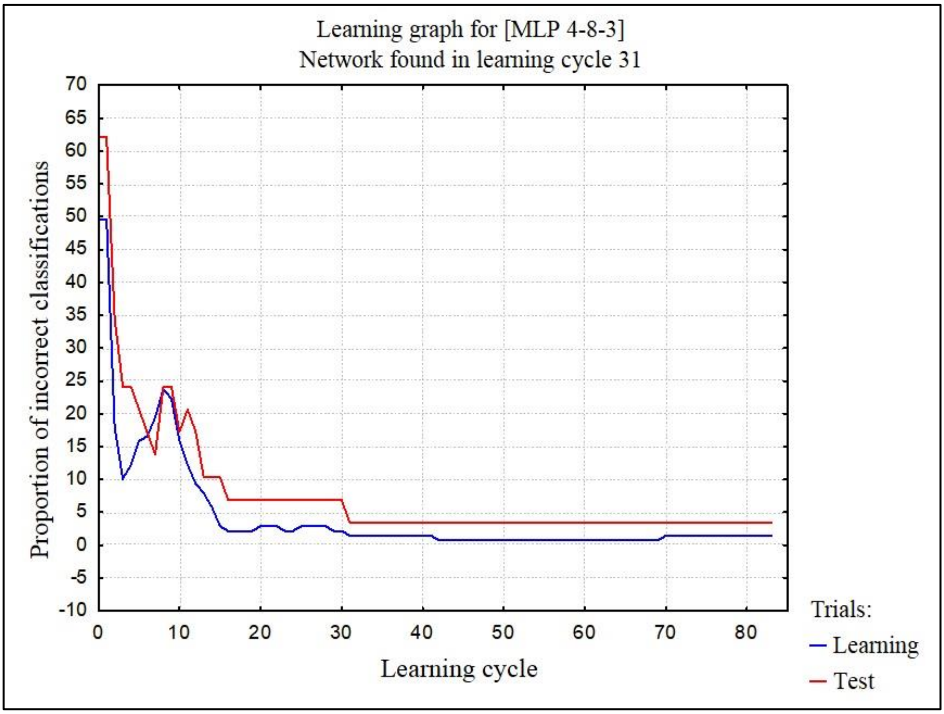

Figure 3. Learning graph for the third network

Source: Own work

The last of the analysed networks is characterized by the same quality parameters of testing and validation as in the previously described networks. However, it is characterized by the lowest value (slightly lower than the others) of the learning quality parameter among the discussed networks. It is 97.84. The network needed 26 learning cycles to learn (Figure 4).

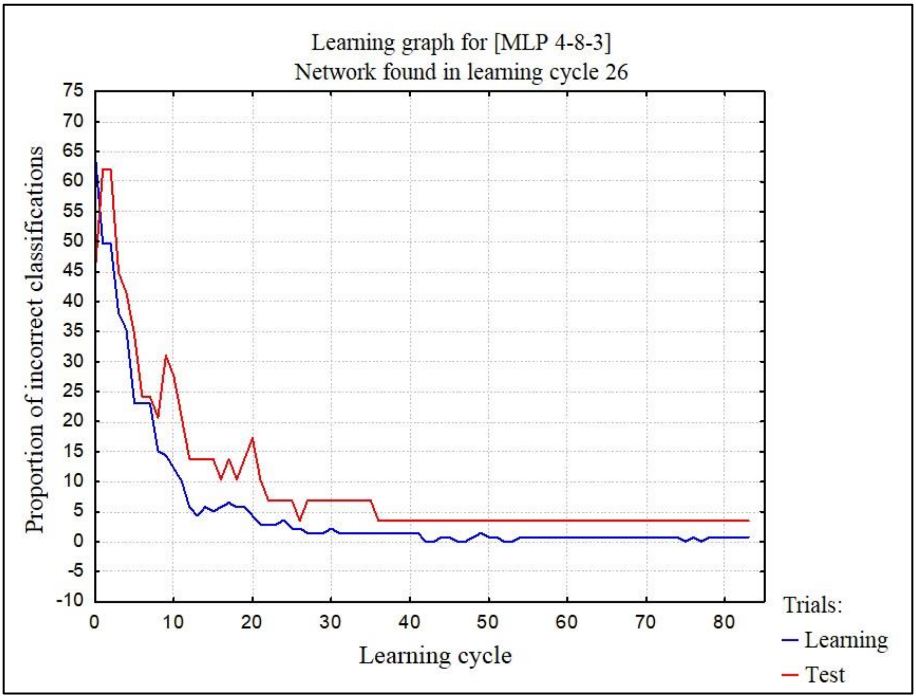

Figure 4. Learning graph for the fourth network

Source: Own work

4. NETWORK TESTING

In fact, the network's ability to generalize results is demonstrated by the correct result of its operation for new data. This is a confirmation of the legitimacy of implementing a given network. Therefore, external testing was used to check the performance of the discussed networks. All four networks discussed above were qualified for testing.

The data source used for the tests were also Moodle database tables. The data stored in them are the results obtained by students of three subsequent years, after completing four consecutive modules of the subject *Algorithms and data structures*:

- *Time and computational complexity of algorithms,*
- *RAM machine,*
- *Dynamic structures,*
- *Sorting algorithms.*

After the completion of each section, the students were again classified into one of three learning paths. The data sets in each test contain 197 cases for the first cycle of learning (the collection includes two student recruitments for 2015/2016 and 2016/2017) and 57 cases for the second cycle (academic year 2017/2018). The students in the second group constitute the so-called control set, i.e. they are completely new cases that were not taken into account when building the classification model.

Table 1 presents a summary of the classification results performed by individual networks for the first and second learning cycles. Their placement in the table corresponds to the order in which they are discussed, and to facilitate identification of the network, the column "*learning cycle number*", which was different for each of the networks in question, was placed in the table. The Section 1 test 1 column is empty because it was data used to teach the network.

The results obtained during the first and second learning cycles are similar. The results obtained during the tests confirm that the best of the generated networks is a network with 9 neurons in the hidden layer activated by the hyperbolic tangent function and with output neurons with a linear activation function. For students of the last year, the correctness of the classification based on the model of the first network is greater than 98.5%. Thus, the created model is predictive and can be successfully used to generate learning paths on the e-Student portal.

Table 1.

Summary of classification results for two consecutive learning cycles

1Net-work No.	Number of network neurons	Number of learning cycles	Section 1 test 1		Section 1 test 2	
			Cases classified correctly	Cases classified incorrectly	Cases classified correctly	Cases classified incorrectly
1	MLP 4-9-3	50	-	-	98.53%	1.47%
2	MLP 4-9-3	53	-	-	96.21%	3.79%
3	MLP 4-8-3	31	-	-	96.47%	3.53%
4	MLP 4-8-3	26	-	-	91.21%	8.79%
Net-work No.	Number of network neurons	Number of learning cycles	Section 2 test 1		Section 2 test 2	
			Cases classified correctly	Cases classified incorrectly	Cases classified correctly	Cases classified incorrectly

1	MLP 4-9-3	50	97.46%	2.54%	99.03%	0.97%
2	MLP 4-9-3	53	95.43%	4.57%	96.01%	3.99%
3	MLP 4-8-3	31	95.43%	4.57%	96.47%	3.53%
4	MLP 4-8-3	26	93.4%	6.6%	88.97%	11.03%
Net-work No.	Number of network neurons	Number of learning cycles	Section 3 test 1		Section 3 test 2	
			Cases classified correctly	Cases classified incorrectly	Cases classified correctly	Cases classified incorrectly
1	MLP 4-9-3	50	96.95%	3.05%	98.97%	1.03%
2	MLP 4-9-3	53	95.43%	4.57%	95.53%	4.47%
3	MLP 4-8-3	31	95.43%	4.57%	95.63%	4.37%
4	MLP 4-8-3	26	94.42%	5.58%	91.28%	8.72%
Net-work No.	Number of network neurons	Number of learning cycles	Section 4 test 1		Section 4 test 2	
			Cases classified correctly	Cases classified incorrectly	Cases classified correctly	Cases classified incorrectly
1	MLP 4-9-3	50	97.97%	2.03%	99.1%	0.9%
2	MLP 4-9-3	53	97.46%	2.54%	96.03%	3.97%
3	MLP 4-8-3	31	96.95%	3.05%	96.03%	3.97%
4	MLP 4-8-3	26	90.86%	9.14%	90.23%	9.77%

Source: Own work

As a result of classification using neural networks, each student was assigned to their individual learning path. Paths are selected individually for each person, after they pass the test for a given section. Table 2 summarizes the number of students using teaching materials available in modules 2-5, after completing modules 1-4 and qualifying for one of the three learning paths. In both learning cycles one can notice a decrease in the number of people on the first learning path. In each module, the smallest number of people were taught on the third path.

Table 2.

Numbers of students assigned to individual learning paths in the first and second learning cycles

Learning module passed	path 1		path 2		path 3	
	Cycle 1	Cycle 2	Cycle 1	Cycle 2	Cycle 1	Cycle 2
1	79	20	91	25	27	12
2	89	18	76	26	32	13
3	91	19	70	26	36	12
4	83	16	68	27	46	14

Source: Own work

CONCLUSION

The four neural networks described in this paper have been tested on new, previously unknown data. The high results obtained during the tests show that these networks have the ability to generalize.

Based on the analysis of the results of the conducted research, it can be concluded that neural networks are a very good tool for indicating the learning path on which students will find the teaching materials best suited to their particular abilities and potential limitations in acquiring knowledge but enabling them to acquire professional competences. The students' knowledge was tested in an examination in the subject *Algorithms and Data Structures*. The multi-layer network with one hidden layer proved to be the best. In the input layer there are 4 neurons, in the hidden layer 9, and in the output layer 3. The functions of neuron activation in individual layers were: hyperbolic tangent, for the hidden layer and the linear function for the output one. The number of neurons in the output layer was determined by the specificity of the tool used to create it (*Statistica Neural Networks package*) and is equal to the number of classes to which cases are assigned.

The assumption regarding the number of neurons in the hidden layer calculated on the basis of Kolmogorov's theorem has been confirmed. Based on this theorem, it was calculated that a sufficient number of neurons in the hidden layer is 9. The best parameters for the quality of learning, testing and validation were obtained for the network designed in just this way. Tests carried out for external data (new groups of students) confirmed that this network achieves the best results in the classification of new cases. Confirmation of the thesis of the correct assignment of the students to the learning paths was provided by the answers they gave during a discussion on the structure of the didactic materials made available to them.

As a result of the conducted research, it has been shown that a neural network with one hidden layer has a sufficient structure to solve the problem of assigning students to individual learning paths. This does not mean that a network with more layers would not cope better with the discussed problem, but the very good results of the testing phase achieved by the discovered network meant that further expansion of the network, with subsequent hidden layers, was discontinued. The test results confirmed a paradigm with which many researchers of neural networks agree, which states that networks with one hidden layer are sufficient to solve most classification problems (Markowska-Kaczmar, Kwaśnicka, 2005; Kurzyński 2008; Osowski, 2000).

Analysing the above facts, it can be concluded that it is reasonable to implement a neural network with the best parameters obtained during tests to generate individual, evaluating learning paths.

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ICT AND INFOGRAPHICS OF ORGANIC CHEMISTRY TOPICS ON THE ELEMENTARY SCHOOL LEVEL, AS A METHOD OF INCREASING TEACHING EFFECTIVITY

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Abstract: *the work is an analysis of contemporary problems related to chemistry teaching in a primary school. Problems, which result from the collision of dynamically developing digital and multimedia culture with the teaching trends that still prevail at schools. The dissertation presents three pillars on which modern education in the field of natural science can be based: scientific theory, experimental practice and graphic illustration of chemistry – a school subject, widely regarded as difficult and uninteresting. In order to support the efficient and effective implementation of the lesson topics the problem-based learning method using the traditional school textbook and the problem-based learning method supported by infographics and ICT was proposed. Both methods were aimed at students who have learning problems and also those who are gifted. The effectiveness of selected methods has been checked during chemistry lessons, and the conducted surveys have allowed to assess the level of understanding of knowledge and acquired skills.*

Keywords: teaching, problem-based method, infographics, ICT, work in the cloud

INTRODUCTION

The ICT (Information and Communication Technology) era presents contemporary teachers with different and new requirements profiled for continuous shaping and development of specific areas of information competence, outlining the directions of professional changes, including in the sphere of applying new technological trends to educational practice (Baron-Polańczyk, 2015). Teaching chemistry and other subjects in the field of science is a real challenge for modern teachers. These areas undergo a constant development. Modern researchers are constantly improving the laws learned many years ago, which translates into frequent updates of the content taught at school. To pass this knowledge to the young people, who come into contact with purely chemical issues for the first time, is often difficult and meets with resistance resulting from the abstractness and intangibility of the discussed content. There is a stereotypical belief among students and even our society that chemistry is a difficult and incomprehensible science, and chemistry teachers are often associated with the worst memories from a school bench. This work aims to show the attractive aspects of chemistry – the school subject which is disliked by students, and to propose a key for understanding modern chemistry by a modern student.

1. PROBLEM-BASED TEACHING/ LEARNING

When talking about effective methods used in education, some theories developed by broadly understood pedagogy should be mentioned (Okoń, 2003). Analyzing the course of chemical education through this prism, we come to the conclusion that this subject is not much different from others. Why, then, learning science is so often disliked by students?

Chemistry is a science about the nature of matter, so it is a field describing everything that surrounds us. Apart from laws such as the law of definite proportion or Avogadro's law, it primarily helps the students to understand the regularity of the surrounding world. At the beginning of chemical education, students do not fully comprehend the surrounding environment, but are able to describe it thanks to their own observations, early school education, or responses to the surprising and often exhausting questions that parents are asked when kids are about 3-5 years old.

The 21st century offers new information channels such as the Internet. It can be described by concepts such as: mass-accessibility, multiplicity, quantity, speed, quality "(...) disturbing concepts introducing confusion to a world in which those mentioned above needs have so far been achieved in a much slower, calmer and less global manner. The technical possibilities and their easy availability give the impression that everything is extremely easy and simple. There is a belief that creating an information website or your own website on the Internet does not require a great knowledge. It is enough to know the basics of html or learn how to use platforms that support web development (joomla, wiki). Sometimes, to express your own thoughts, promote your work, one does not need to know anything, it is enough to sign up for discussion forums, create a blog, enter the Science Wiki, send a movie productions to YouTube, paste a presentation to SlideShare and become a full citizen of the world of information.

The Internet is full of service websites and new ones are being constantly created. All of them responding to already articulated needs, or even being ahead of them. As a result of this mass production, searching the Internet is getting more and more difficult. The specialists in electronic information advise us: before you sit down to look for something on the Internet, train your eyes and fingers to use many techniques that will help you and train your intellect to have a critical approach to what you come across, because you will have to ask a lot of questions before you find trustworthy information and use it. Search wisely! (Barker, 2007). “Due to the nature of the Internet, publishing is becoming simpler and no one controls this process“ (Bednarek-Michalska, 2007: 10). Therefore, unverified information should be approached with a great deal of caution.

Nevertheless, every child and every young person has the potential to become a scientist and on their own and formulate laws governing nature with just a little support. Such thinking has become the basis for the concept of problem-based learning at school (Okoń, 1975). Problem-based learning somehow reverses the order of the traditional system of passing the knowledge. The method is based on own attempts to come to a given solution, then checking whether things are the way you think they are, so in the first place – stating the thesis, and then approaching the essence of the problem, i.e. chemical law.

Let's ask ourselves once again – *Why is chemistry not liked by students*? And let us answer the question *because often the teaching method that favours students' memory does not work in this case.* A modern student who knows very well how to format a computer and set up a Smartphone, does not like to hear the phrase *because that is the way it is and that’s all*. The theoretical teaching of the subject arouses aversion, destroys the natural need for searching and the youthful curiosity of the world. In contrast, problem-based learning focuses on creative and independent thinking and acting independently. It provides not only expert knowledge, but also shows the path to reach this content, helps to penetrate into the laws of nature and creatively interfere in the natural and social world. It often happens that the young people entering their adult lives feel embarrassed because of the abstract nature of the knowledge they acquired at school and lack of skills to apply it in everyday life. Modern education system, and chemistry teaching, should therefore put the students in a centre, so that even if they have no interest in the subject, which due to social diversity is completely normal, they know at least the method of reaching conclusions based on careful analysis and their own critical observation. The problem-based learning method is also open to those students who are particularly interested in the subject, supports them through creative action, and maximizes their potential.

It would seem that when applying the problem-based teaching method the teacher is not really needed, because the student's work consists in generating ideas, independent search for information, observation, self-reflection and, as a result, reaching conclusions. There could be nothing more wrong. In every educational method, the teacher is a team leader. The teacher is present when the work begins, when the thesis is formulated, he or she supervises students' work, stimulates the discovery of new sources of information, provokes further analytical questions, and above all, makes sure that at the end of the work, the student formulates the correct conclusions, because despite the scientific nature of the work, at the end of the day, during school lessons the student must get to know the truth. Whatever method he or she intends to use to discover the law of mass conservation, it must at the end be properly and truly presented.

2. CHEMICAL EXPERIMENT VS THEORY

Two basic interrelated cognitive pillars are essential in the implementation of the problem-based teaching, or any method of supporting the transfer of knowledge in the field of natural sciences: these are theory and experiment. During the traditional learning process, the experiment is like an empirical support for strict rules, theories and laws characteristic of the branch of science; using problem-based teaching, we very often stress the experimental area because of the need to build a creative and practical approach to the task and to discover new contents. Neither theory nor experiment can act alone because "theoretical assumptions are used to discover a certain part of the world as interesting cognitively. They also set out measurement procedures and interpretation methods. However, the theoretical assumptions remain in close conjunction with experimental assumptions defining the practical and empirical meaning and applicability of some apparatus, and the principles of their combination and transformation (Sobczyńska, 1993). Teaching through an experiment is not only a way to illustrate difficult scientific issues in an attractive way, for a chemist teacher, it is a real remedy. In fact, the chemistry teacher is very lucky, because even with the most clumsy group of students, he or she is at least able to interest them. The experiment is primarily a substitute for scientific work, which is why it is strongly encouraged that the experimental methods are implemented as tasks that are not just a teacher's show, but which each student can do on their own. It is a kind of confrontation with the technique of performing experiments.

In February 2018, students of the Faculty of Chemistry at Adam Mickiewicz University, were observing a chemistry lesson taking place in the so-called "district class" in one of the Poznań peripheral primary schools. In the teaching environment there is such a term for a group of students from nearby families, often struggling with various educational problems, which unfortunately affect the quality of both learning and teaching. The topic of the lesson was - *solubility*. The students made experiments at their own benches for one hour. They prepared solutions, mixed, poured, even broke some test tubes, still amongst all this, one could sense a kind of commitment and concentration among these young people.

Has this lesson run out of theory? Of course not. The seventh-graders did not make any notes, they often did not even have notebooks, due to family material problems. The notes were taken on a work sheet, which contained clarification of theoretical issues – strictly in line with the core curriculum – as well as tasks for independent work. Despite the fact that the lesson was very unusual, it seemed to be kind of filled to the last minute and "tailor-made". Of course, thanks to the merits of a sensitive teacher who realised the potential of the experimental method very well. Even if none of these pupils will ever have a chemical career or any "career" at all, during this lesson the accent fell on practical learning ... in fact learning about life. The fact that the child broke the test tube, that it had to deal with the stress associated with the responsibility for school equipment, the precision learnt during trivial activities, which consisted only in pouring, mixing, stirring, confirms multi-effectiveness of the problem-based teaching method.

3. VISUALISATION FOR TEACHING CONTENT

The implementation of problem-based teaching in the didactics of chemistry, the use of experimental methods supported by scientific theory are undoubtedly a diversification of the didactic process. Let's consider if there is another factor that would be an additional asset of the above system. As mentioned at the beginning of the dissertation, chemistry is a difficult, abstract science that generates stress in young people. An incomprehensible theory, can be explained or visualized by an experiment, and especially experienced personally by a student, but teachers are not always able to apply this method. Sometimes the problem is a lack of reagents or a properly equipped chemical laboratory, sometimes the content of the teaching excludes the use of the experiment, e.g. in the school environment we cannot show the experimental method of radioactive decay, fractional distillation of crude oil, etc. It may turn out that in such a situation another medium is needed, information technology comes in handy, in our case in the form of a presentation with infographics.

Illustrations in school textbooks have been used since the beginning of their history. What could not be easily explained by verbal language was translated by images, the more so because according to the assumptions of the "bible pauperum", it was easier to reach the illiterate using pictures. A significant part of people are visuals, so learning about the world through image, colour, shape or scheme is most effective for them. The 21st century sets new requirements for school textbook designers and teachers themselves. The power to focus attention through a graphic sign has been mastered by marketing and advertising. We see colourful, attractive images on posters, billboards, shops and restaurants.

Visual experiences are very important in education. One of the facts confirming this educational trend is the phenomenon of Web 2.0 and the creation of social networks on the Internet, based largely on visual interactions of users. If this is the case, the phenomenon at the centre of interest in, among others, pedagogy may undergo a partial change. As a result, learners and teachers must acquire new skills and new competences. "Education must be able to adapt to these changes and new ways to study the interests. This is connected with the development of broadly defined media competences (Strykowski, 2004) or, in a narrow segment, of visual competences (Rogowski, 2010)" for (Leszkowicz, 2011).

Another element that changed the principles of psychophysiology of vision and at the same time influenced the quality of teaching in a modern school is infographics. At the beginning there were newspapers and magazines with not so many illustrations. The entire 20th century is actually the development of television and film, which revolutionized the media and advertising market, and at the same time became a didactic tool. In the 90's and in the early years of the new millennium TV, VHS cassettes replaced traditional TV sets, projectors and transparencies, slides, although the teaching materials were prepared much earlier. It was a time when a teacher could use films showing the experiments that were difficult to carry out in the school studio, which was very attractive and gave good results. Nowadays, every child has the resources necessary to enrich the learning process at his/her hands (Gulińska, Bartoszewicz, 2016). For example, youtube.com contains hundreds of films, good both from the perspective of content and visual quality, such as films on the "Projects – IT + WLF" channel, as well as many amateur films and animations showing chemical experiments. The question is how to find a place for interesting, encouraging, transparent and substantive images in this dense tissue of audiovisual contents that are widely available? One of the solutions may become the inclusion of good and appropriate infographics.

The infographics has become an inseparable element of attractive transfer of information. Picture culture is extremely popular, because graphics can express more than words, and the human brain reacts much faster - thus it is easier to absorb the content with the image. It is nothing more than blending in the crowd of marketing and advertising specialists with the didactic processes. It sounds a bit disturbing, but we live in media times, and what is more, children live in these times and if modern education does not catch up with the cultural and social changes, it will not be able to reach the young people and thus to teach effectively. Through professional action and cooperation between didactics specialists and graphic designers, an effective didactic medium can be created, which in the science of chemistry can form a bridge between the theory and the experiment or be a substitute for an experiment.

The principle of creating infographics is much more complicated than the principle of creating illustrations, because in this case we strive to visualize the content, to compress the text and compose graphics, illustrations and words to present coherent information, which simultaneously reduces the time needed to acquire it, and also increases the efficiency of the teaching process. In connection with the abundance of publicly available content, teaching materials should be of the best quality so that they attract the "smart" pupils, and at the same time can be understood also by the so-called "weaker" students. Infographics are not made to measure, they are universal and have to hit everyone, but they should most of all support the work of students who have learning difficulties. A talented young person will be able to efficiently implement the problem method and obtain information even from widely available sources or simply enjoy watching them in a free time. A student who has hard time learning must be properly guided on the theory - experiment path and this process should be supported by the infographic presentation of teaching content (Levine, 2006).

In connection with the development of media and the creation of e-books, the use of infographics is an excellent way to reach the student through modern multimedia devices, such as a tablet, a laptop or a Smartphone. The dynamic development of new media puts new demands on the infographics designers, namely: interactivity. Tasks that check pupils' knowledge as well as practical skills can be arranged in a well-thought-out, graphical layout. Interactive digital tasks can actually be simulations of chemical experiments, which is the next step to properly preparing students for independent experimentation and evoking their research sensitivity. An interactive computer and educational games can be a solution. Perhaps the next step in the development of new media will be AR or AI technology, and future generations will learn chemistry using 3D simulations and VR goggles. Modern technology already uses these elements. Today's teenagers spend their free time playing hyper-realistic computer games, designed on modern programming engines such as Unreal or Unity, so the requirements are huge, and the answer should be professional cooperation of educators and designers.

4. INFOGRAPHICS AND INTERACTIVE TASKS PROJECT

Based on the above assumptions, a series of infographics in the field of organic chemistry and interactive task projects were designed to be used on digital media such as a computer, a tablet and a Smartphone and placed in the Google cloud. The aim of these activities was first of all graphical visualization of organic chemistry issues at the level of the 8th grade of primary school, and also the desire to test the effectiveness of teaching using modern teaching resources in the form of infographics and interactive tasks.

Two of the prepared chemistry lesson scenarios, are presented below.

- In the first one, a teaching method was to pass the information to the pupils, illustrations and photos included in the modern textbook and the traditional tasks were used as teaching aids.
- In the second one, a teaching method consisted in the use of coherently composed infographics and related interactive tasks.

The element that checked students' knowledge was the same for both scenarios, and it consisted in designing a different character of the chemical experience. The correctness of the performed task proved the efficiency of teaching with the given method. The scenarios were implemented during a chemistry lesson in grade 7th, in which the students had not yet dealt with issues related to organic chemistry, which gave a clear view of the extent to which young people understood the new material.

5. LESSON SCENARIO – OPTION 1

(a lesson supported by working with a printed textbook (Gulińska, Smolińska, 2017).

Topic: Cellulose - compound sugar

The reference part

T: Today we are going to talk about compound sugars. Sugars are a group of compounds that belong to the Organic Chemistry department. All organic substances that made up tissues of animals, plants and other, are primarily built of carbon and so are sugars.

T: What kind of sugars are you familiar with? What did you hear about sugars? (white sugar, cane sugar, brown sugar, glucose, fructose, calories, sweets)

T: What kind of sugar is associated with cellular respiration or photosynthesis? (glucose)
T: Glucose is one of the basic types of saccharides. The structural formula of glucose looks as follows:

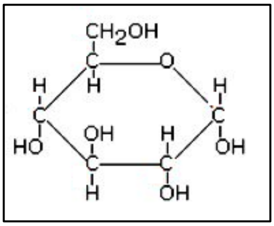


Figure 1. Drawing on the blackboard

Source: Own work

T: As you can see, glucose has a rather complicated structural formula, which we are not going to discuss in detail today.

T: We have established that glucose is a simple sugar, and today we are going to talk about cellulose, which is a what kind of sugar (*compound*).

The core content

Notes for the notebooks: Cellulose, also known as fiber, is a polysaccharide of 3,000 to even 14,000 glucose monomers (single glucose molecules) linked together by glycosidic bonds.

T: I am going to draw a piece of cellulose on the board, which shows how individual glucose molecules connect by means of glycosidic bonds:

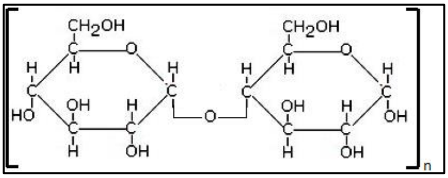


Figure 2. Drawing on the blackboard

Source: Own work

T: Who will come to show where the glycosidic bond is located?

Further note to the notebook: Cellulose is the basic substance that builds plant cell walls. Large amounts of cellulose are found in wood, stems and, moreover, in fruits and leaves.

T: What do you think: What do we use cellulose for? In what elements of everyday life can we find it? (paper, textiles, cotton wool, gunpowder, dressings).

Further note: Man and carnivorous animals do not digest cellulose, but it is an indispensable element of human diet, because it regulates the functioning of the intestines, preventing many diseases.

The presence of a glycosidic bond indicates that the sugar is compound. There is a reaction that proves that cellulose is a sugar, called the *Trommer Trial*, but for the reaction to take place in a proper manner, the cellulose should first be broken down into individual glucose molecules. Note the colour change of the substance in the test tubes before and after the reaction. After viewing the illustrations in the manual, we will make this experience together.

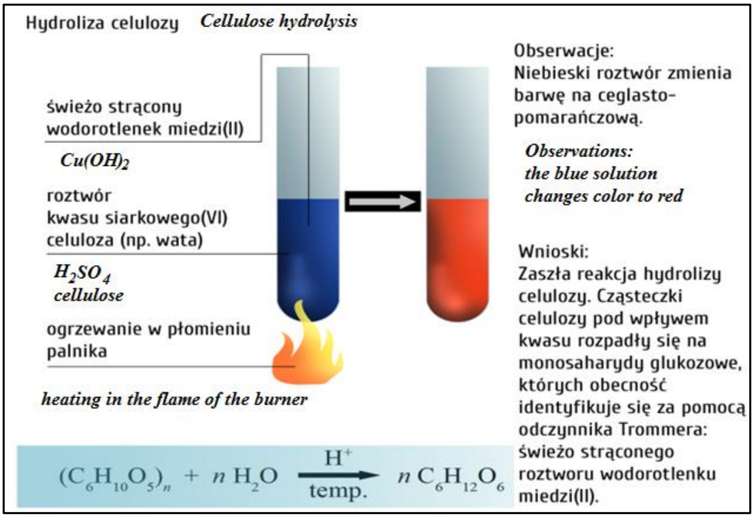


Figure 3. Drawing from the textbook – cellulose hydrolysis
Source: Own work

The summary

As a summary, each student repeats and independently performs tasks related to the lesson.

6. LESSON SCENARIO – OPTION 2

(a lesson supported by a presentation using an infographics and an interactive test).

Topic: Cellulose - compound sugar

The reference part

Today we are going to talk about compound sugars. Sugars are a group of compounds that belong to the Organic Chemistry department. All organic substances that made up tissues of animals, plants and other, are primarily built of carbon and so are sugars.

T: What kind of sugars are you familiar with? What did you hear about sugars? (white sugar, cane sugar, brown sugar, glucose, fructose, calories, sweets)

T: What kind of sugar is associated with cellular respiration or photosynthesis? (glucose)

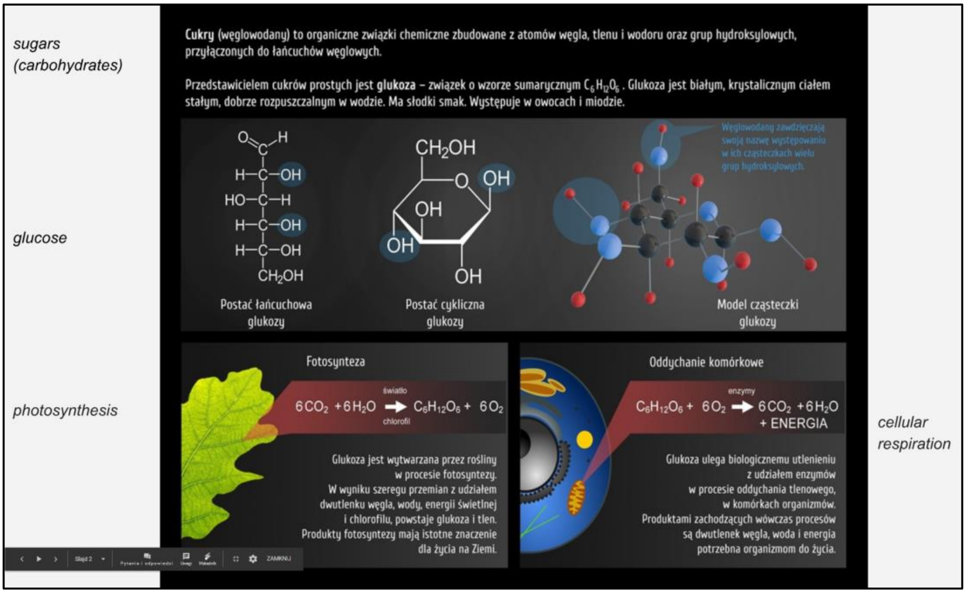


Figure 4. Fragment of presentation with infographics

Source: Own work

T: Try to graphically illustrate the process. Use your imagination and coloured pencils.

T: Glucose is one of the basic saccharides. Take a look at its structural formula (*it's complicated, it's hard to remember*)

T: Now, look again at the drawing and build a model of glucose molecule. Use sticks and modelling clay.

T: We have established that glucose is a simple sugar, and today we will talk about cellulose, which is a complex sugar. (*what does it mean?)*

T: It means that it is made of two molecules of glucose connected together. I will also give you a hint and tell you that oxygen takes part in this combination. Will you manage to propose such a construction yourself? Draw it please.

T: What raw materials are cellulose obtained from and what is it used for? (it is *obtained from wood, plant stalks, used for paper, fabric, cotton wool, materials for dressings, gunpowder*).

T: You remember what Trommer glucose test result was like for sucrose and starch. Please, design an experience that will allow us to determine if cellulose passes this test, and if so, under which conditions (*which reagents should we use*?)

T: If you do not know, analyze the records on the infographic.

The core content

In this part, students discuss the information on the cellulose infographics – occurrence, application, construction, and the Trommer test.

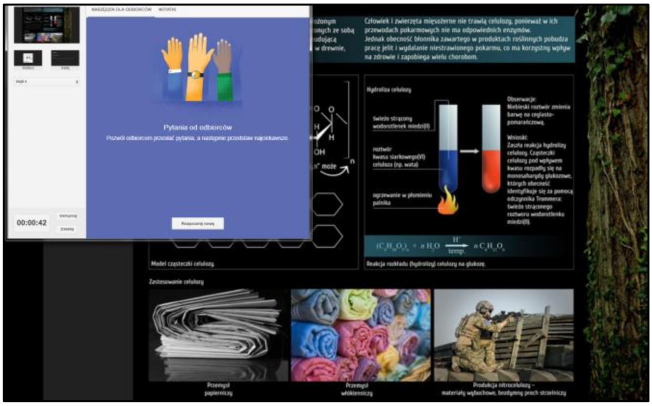


Figure 5. Fragment of presentation with infographics

Source: Own work

T: New words: glycosidic bond and monosaccharide. What is a monosaccharide?

T: Glycoside bond, is a bond connecting two molecules of glucose, who will point them?

The summary

As a summary, each student independently reviews the presentation and infographics posted by the teacher in the cloud, and then performs tasks related to the lesson on their smartphones.

7. CHECKING TASKS FOR BOTH CLASSES

At the end of the lesson, the students from both groups were solving tasks. They contained 16 elements requiring student action. Students participating in the first version of the lesson once again viewed the illustrations in the textbook and their notes and then proceeded to solve the tasks on specially prepared work sheets. Students participating in the second version of the lesson had a teacher's cloud folder with presentation and infographics made available by the teacher, and then they solved an interactive test.

Task 1. True / False. Evaluate the correctness of the sentences below by selecting TRUE or FALSE.

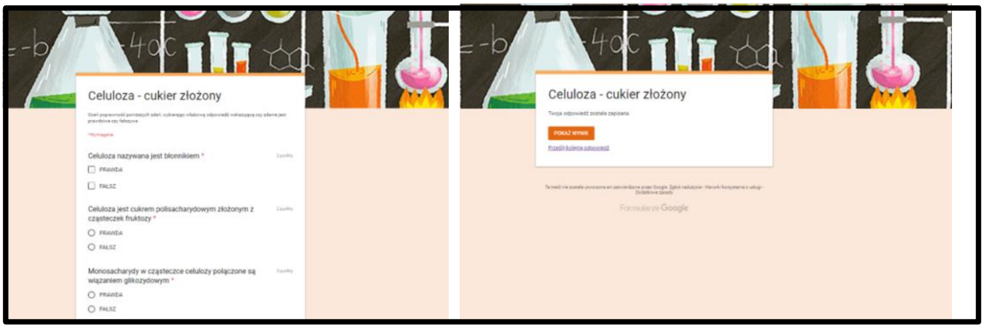


Figure 6. Interactive task

Source: Own work

Evaluate the correctness of the sentences below, highlighting the correct answer indicating if the sentence is true or false.

Celuloza nazywana jest także błonnikiem.	P	F
Celuloza jest cukrem polisacharydowym złożonym z cząsteczek fruktozy.	P	F
Monosacharydy w cząsteczce celulozy połączone są wiązaniem glikozydowym.	P	F

Figure 7. Tasks that were solved in the work sheet

Source: Own work

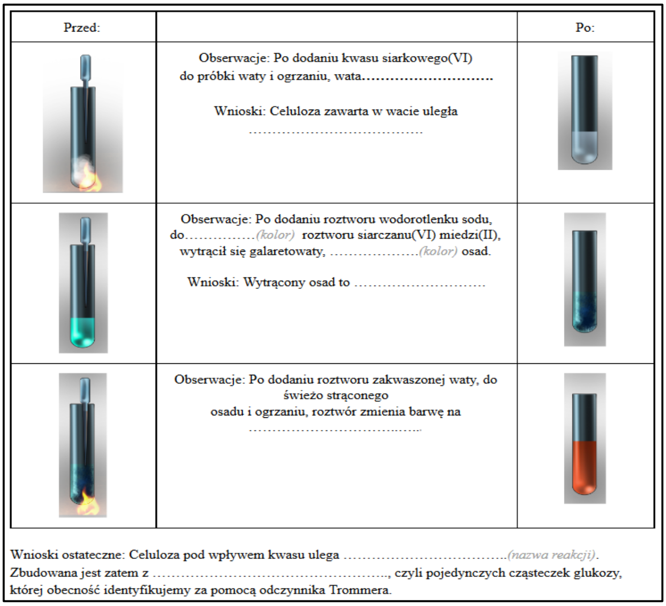
Task 2. Enter a short text: On the screen you will find individual stages of the experiment characteristic for sugars. In observations and conclusions, put the appropriate words in the gaps. Use the hints in brackets.

Figure 8. Interactive task

Source: Own work

While designing this task, the test option was used in a Google form, short answer options were selected and a few options for the correct answer were allowed. An analogous task placed in the work card is shown in Figure 9.

Insert the correct text: You have different stages of the experiment typical for sugars in front of you. In observations and conclusions, put the appropriate words in the gaps. Use the hints in brackets.



Przed:		Po:
	Obserwacje: Po dodaniu kwasu siarkowego(VI) do próbki waty i ogrzaniu, wata......................... Wnioski: Celuloza zawarta w wacie uległa	
	Obserwacje: Po dodaniu roztworu wodorotlenku sodu, do..............*(kolor)* roztworu siarczanu(VI) miedzi(II), wytrącił się galaretowaty, ...*(kolor)* osad. Wnioski: Wytrącony osad to	
	Obserwacje: Po dodaniu roztworu zakwaszonej waty, do świeżo strąconego osadu i ogrzaniu, roztwór zmienia barwę na	

Wnioski ostateczne: Celuloza pod wpływem kwasu ulega ....*(nazwa reakcji)*. Zbudowana jest zatem z ...., czyli pojedynczych cząsteczek glukozy, której obecność identyfikujemy za pomocą odczynnika Trommera.

Figure 9. Tasks that were solved in the work sheet
Source: Own work

8. RESULTS OF DIDACTIC EXPERIMENTS

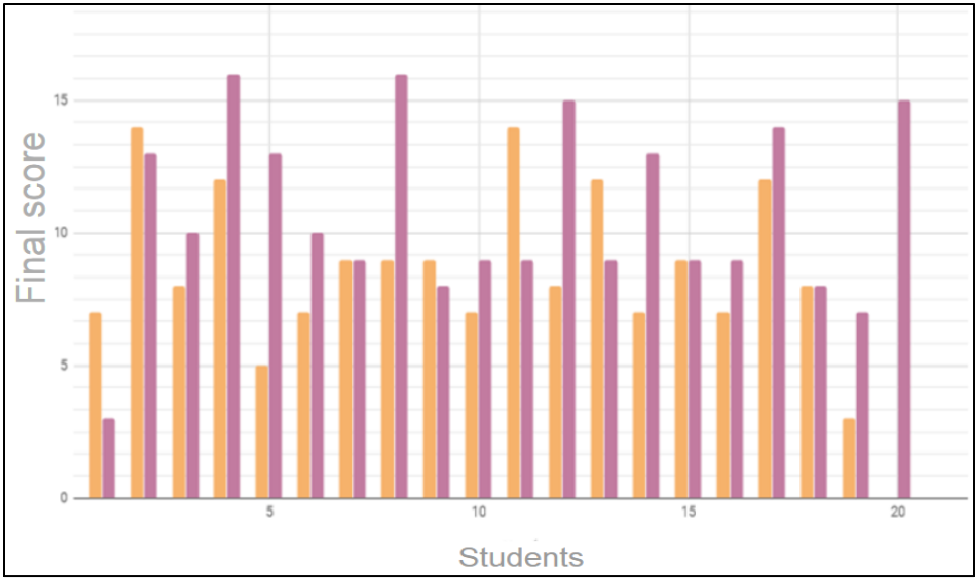


Figure 10. Comparison of the test results in the class taught according to the traditional scheme and class, in which the lesson was supported by the presentation with prepared infographics and interactive tasks.

Source: Own work

Both lessons were carried out in the 7th grade of primary school. One of the classes was 19 pupils, and the second one was 21 pupils. The material was prepared within 45 minutes, based on two lesson plans – 1) traditional with the use of teaching aids, such as a school board and textbook, and 2) with elements of a problem-based lesson with a multimedia presentation using infographics displayed during the lesson with a projector, and then during the summary made available to students in the cloud and interactive tests to be solved on Smartphones.

During the lesson there were no problems connected with pupils behaviour. The results of previous chemical education among students of both classes were comparable (insight into interim evaluations and proposals for assessments at the end of the year). In each class there was at least one student demonstrating the characteristics of an outstanding student and at least one student with both educational problems and difficulties in acquiring knowledge. The results of two tests are shown in column charts (Figure 10, Figure 11). Based on the statistical analysis of the results of the test, it can be concluded that the application of the problem-based method with the use of didactic means in the form of infographics contributed to the increased teaching efficiency in the tested group. The results of the true/false type task are proportionately higher.

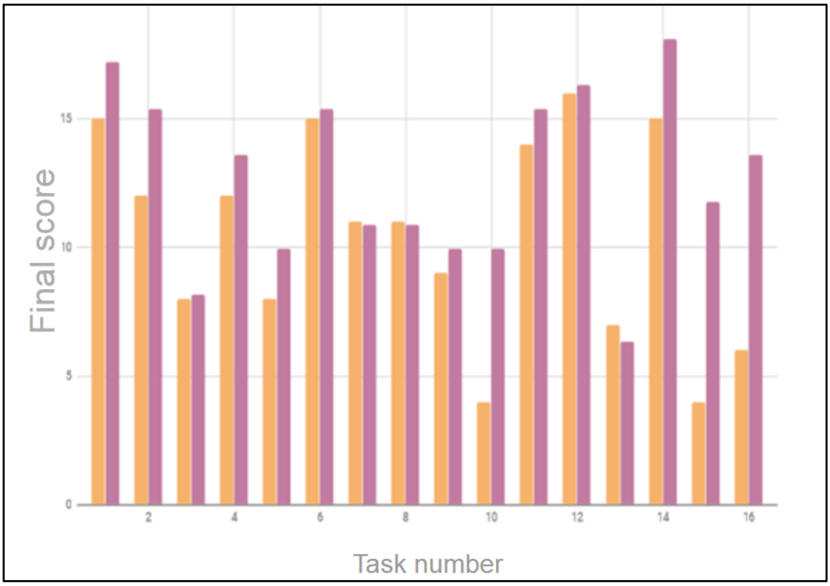


Figure 11. Comparison of the results from all tasks in the class taught according to the traditional scheme and class, in which the lesson was supported by the presentation with prepared infographics and interactive tasks.

Source: Own work

No improvement was found in the efficiency of solving the true / false type task, which belonged to the tricky commands (instructions 4 and 5). However, a significant increase was noted in efficiency of solving the task of designing a chemical experiment. Particular improvement of the results can be seen in the final part of the task, where students had to formulate observations and conclusions. The results of the task in which pupils should give the name of the chemical compound are similar. This may be due to the current backlog or efficiency of teaching by the current teacher.

The conducted research allowed to confirm the hypothesis that the designed, visual didactic aids optimize the teaching/learning process because both groups have had visual help and increase its effectiveness, improving the results obtained by students and positively influencing the development of the learner. The results of the described research regarding the use of visual techniques confirm the research of other authors that the presence of visuals in teaching gives better results in the form of shortening the time of learning, streamlining the understanding of the material taught and reducing education costs resulting from the acceleration of the teaching process (Jagodzińska, 1991, Kozielska 2015).

CONCLUSION

The contemporary man communicates with the world around him with pictures and words. As much as 95% of knowledge is obtained on the basis of the reception of information by means of sight and hearing. However, it should be remembered that the role of eyesight is 7 times greater than hearing, which has a significant impact on the popularization of visual culture. "Visual means play an important role in shaping the consciousness and behaviour of a modern student. Contemporary periodical publications addressed to the mass audience are increasingly composed of illustrations for which the text is merely an addition. Thanks to visualization, we reach real, internal and subjective emotions, sensations and images." The dynamic development of information technology has a significant impact on changes in modern education. Teaching aids currently prepared for students are mostly audiovisual materials. They require a greater amount of work from the creator, and the creation process itself is more time-consuming than in the case of traditional educational materials. The materials used by teachers should illustrate and make learning more attractive. "The explosion of digital technology we are currently experiencing changes not only the way we live and communicate with each other but also our brains, which are undergoing a rapid and profound change" (Small&Vogan, 2011: p.14). Hypertexts can lead to disruptions in understanding the content (Zhu, 1999). The division of attention enforced by multimedia reduces the cognitive abilities of learners and, consequently, also the efficiency and level of understanding. "Didacticians pointed out that the transmission of information in many forms helps in understanding – illustrations in textbooks explain and reinforce the text message. They proved that presentations with visual explanations can increase the effectiveness of learning"? (Kozielska 2015: p.176).

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SELECTED ASPECTS OF IBL IN STEM-EDUCATION

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Abstract: *This article focuses on an important category of modern education in contemporary society based on innovation as well as SMART, and analyses Inquiry-Based Learning (IBL), inquiry-based science education (IBSE), problem-based learning and project-based learning in the context of STEM education. "At the third millennium in the midst of the digital age, it is expected that emerging technologies will be able to accelerate scientific literacy and enable the majority of citizens to enjoy the blessing of STEM." (Chen, 2017: XV) Additionally, the authors analyse advantages and some aspects STEM education, contemporary trends in modern professions and present several examples of good practice. The article also presents the results of research carried out among academic staff, teachers and students on educational trends and technologies. The survey showed a huge gap between the students' needs and the proposals for organizing the educational process put forward by teachers and academic staff. Interdisciplinarity - an important concept related to STEM-education is highlighted. The authors describe and compare educational technologies, IBL, PBL, PrBL. The stages of IBL provide an opportunity to analyse and implement educational technology in the educational process. In particular, the authors offer instruments for IBL. One of them is the creation of an inquiry learning space Go-Labs that allows for connecting different applications to organize activities at all stages of the research process.*

Keywords: Inquiry-Based Learning (IBL), STEM, innovation, inquiry-based science education (IBSE), problem-based learning, project-based learning, tools for IBL

INTRODUCTION

The world revolves around innovations: new ideas, new products, new solutions to the existing problems. Science, technology, engineering, and mathematics are the foundation for innovation. The development of STEM-directions in education is crucial for the development of society.

“Today, STEM education is at the centre of educational systems all over the world. However, two international comparative studies—TIMES and PIZA—demonstrate that only a small segment of the population reach acceptable mastery of the STEM knowledge core”. (Chen, 2017: XV)

At the World Economic Forum in Davos, it was noted that the fourth industrial revolution is accompanied by radical changes in the labour market. In particular, Klaus Schwab (2016), President of the Forum, in his speech “Future of Employment“, emphasized the fundamental transformation of the quality of life in the nearest future, the changes in communication, activities and cooperation of members of society. Thus, at the beginning of 2020, a fundamental change of more than 35% of the skills of modern workers will lead to the disappearance of even some professions, and those who do not yet exist will become commonplace. It was determined that talent (intellect) would be the more critical factor of innovation production, which would lead to an increase in demand for highly skilled specialists.

1. CONTEMPORARY TRENDS IN MODERN PROFESSIONS

The survey of leading employers from around the world helped to perform the ranking of 10 required competencies by 2020, including the ability and readiness to solve complex problems (tasks), critical thinking, creativity, management, coordination, cooperation, reflection, decision-making, service orientation, negotiation and cognitive flexibility (Hassan, 2000).

In 2013, there were projected to be 1.2 million vacancies in the STEM area, which seemed to be very large. With time, this number increased to the present figure of 2.4 million.

A successful economy is based on a way of thinking based on innovation and creativity, research and development. Many successful entrepreneurs around the world have experience working with STEM, which helps them establish innovative companies or develop existing ones.

"At the third millennium in the midst of the digital age, it is expected that emerging technologies will be able to accelerate scientific literacy and enable the majority of citizens to enjoy the blessing of STEM." (Chen, 2017: XV)

In 2020, demand is expected to increase at a faster rate: 80% of fast developing professions will need fundamental knowledge of STEM disciplines (Figure 1).

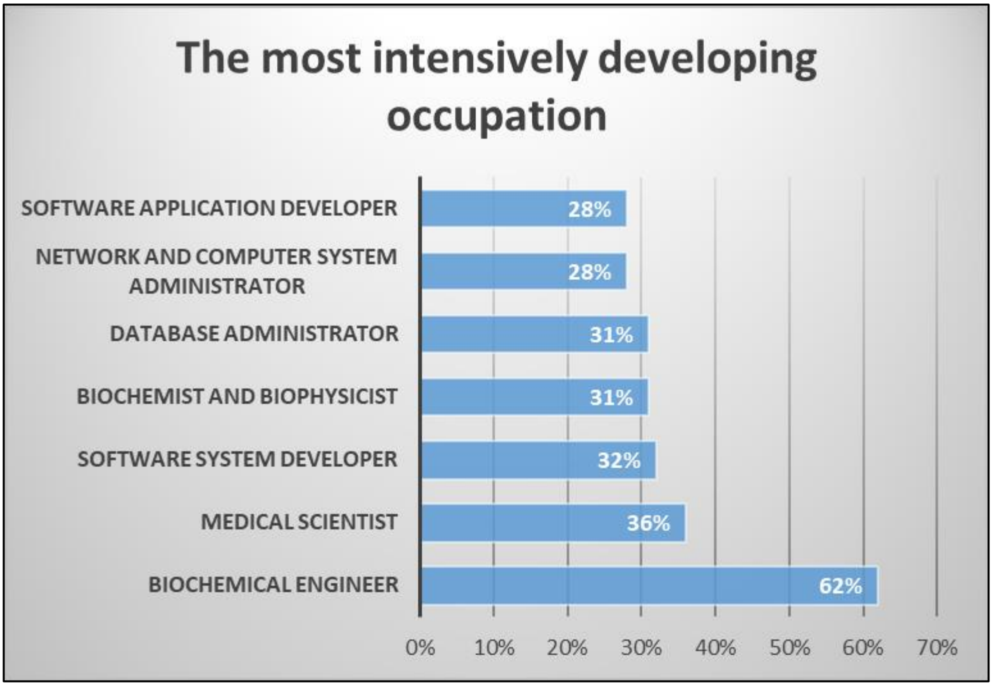

Figure 1. The most actively developing occupations

Source: Own work based on U.S. Bureau of Labour Statistics - https://www.bls.gov/

STEM education is becoming one of the most important educational trends among educators. This is evidenced in particular by the results of our survey carried out in September 2018 in Ukraine among academic staff, teachers and students. 562 academic staff, 239 teachers and 1602 students took part in the survey (Figure 2).

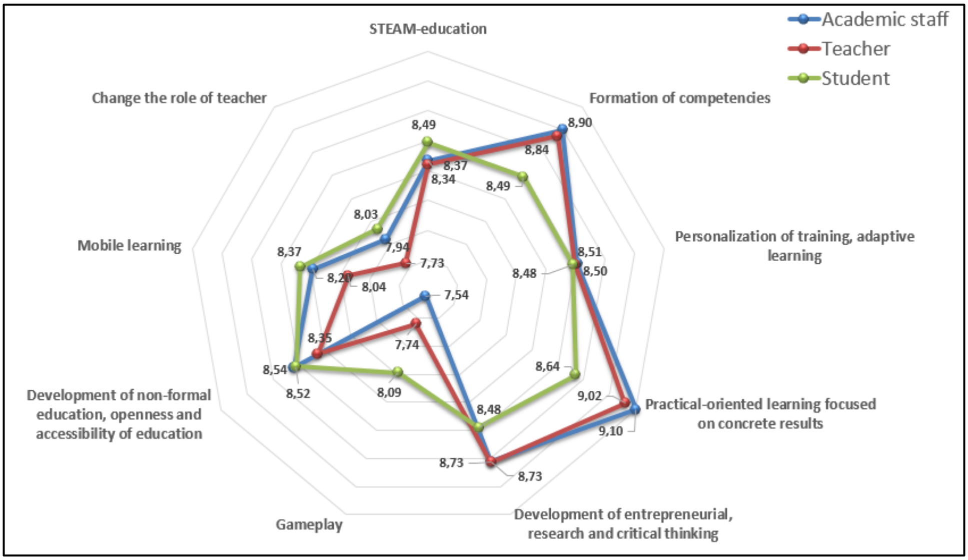

Figure 2. Determination of the priority of trends for groups of teachers, academic teachers, students

Source: Own research

2. STEM EDUCATION AND SOME OF ITS ASPECTS

An important concept related to STEM-education is interdisciplinarity.

Interdisciplinarity in education is regarded as a pedagogical innovation. A key pedagogical aspect in the development of STEM-oriented curriculum is the technology of integration of components which, on the one hand, are close disciplines, and on the other hand, are established independent ontologies: science as a way of knowledge which helps to understand the surrounding world; technology as a way of improving sensitivity to social change; engineering as a way to create and improve devices to solve real problems; mathematics as a way of describing the world i.e. "an analysis of the world and real problems with the help of numbers" (Meeth, 1978).

There are several types of interdisciplinary approach, depending on the nature of the relationship between disciplines, in particular:

- *interdisciplinary* (cross-disciplinary) approach - involves consideration of one discipline through the prism of another (for example, the history of mathematics);

- *multidisciplinary approach* - compares several disciplines that focus on one problem, but does not combine them;

- *pluridisciplinary approach* - combines related disciplines (for example, physics and mathematics, physics and engineering);

- *transdisciplinary approach* - goes beyond the boundaries of individual disciplines, focuses on a particular problem and obtains relevant knowledge (Meeth, 1978).

The advantages of STEM education are:

1. Integrated training in "topics", not subjects.

STEM-education combines an interdisciplinary and project-based approach, the foundation of which is the integration of science in technology, engineering creativity and maths. These disciplines should not be taught as separate, independent subjects. It is important to integrate science, technology, engineering art and mathematics, because these disciplines are closely interconnected in practice.

2. The usage of scientific and technical knowledge in real life.

STEM-education through practical lessons shows children the use of scientific and technical knowledge in real life. At each lesson, they create, build and develop products of the modern industry. Students carry out a specific project, and with their own hands create a prototype of the real product.

3. The development of critical thinking skills and problem solving.

The implementation of STEM education develops critical thinking skills and challenges that are needed to solve the difficulties children can face in life.

4. Increased self-confidence.

Children, when creating different products, building bridges and roads, launching airplanes and cars, testing their work and electronic games, developing their underwater and air designs, each time get closer and closer to the goal. They develop and test, develop again and once again test, and so improve their product.

In the end, solving all problems by themselves, they succeed. For children it is inspiration, victory, adrenaline and joy. After each victory, they become more confident in their abilities.

5. Active communication and team work.

STEM-learning also differs because of active communication and teamwork. During discussion a free atmosphere for discussions and dialogue is created. They are so free that they are not afraid to share their opinion; they learn to speak and present. For the most part, children do not sit at their desks, but test and develop their designs. They always interact with instructors and their teammates. When children take an active part in the process, they remember the lesson well.

6. Development of interest in technical disciplines.

The task of STEM-education at school is to create preconditions for developing students' interest in natural sciences and technical disciplines. Passion for work is the basis for the development of one's interest.

STEM classes are very entertaining and dynamic, which does not allow children to become bored. During the lessons, they do not notice how time is spent, and they are not tired at all. Building rockets, cars, bridges, skyscrapers, creating their electronic games, factories, logistics networks and submarines, they show increasing interest in science and technology.

7. Creative and innovative approaches to projects.

STEM training consists of six stages: questions (tasks), discussion, design, structure, testing and development. These steps are the basis of a systematic project approach. Coexistence or combined use of various opportunities is the foundation of creativity and innovation. Using study and science and technology implementation at the same time can create many new innovative projects.

8. The bridge between education and careers.

There are many publications that analyze the level of growth of the need for different specialties.

According to various estimates, 9 out of 10 specialties for which demand is growing at high rate will require exactly this STEM knowledge. In particular, by 2019, demand for the following specialties is expected to grow: chemical engineers, software developers, oil engineers, computer system analysts, mechanics engineers, construction engineers, robotics, nuclear engineers, architects of underwater structures and aerospace engineers.

9. Children's preparation for technological innovation in their lives.

STEM education also prepares children for a technologically advanced world.

Researchers *(Roslyn Prinsley & Krisztian Baranyai, 2015)* claim that STEAM education requires the following special skills: active learning, critical thinking, complex problem-solving, creative problem-solving, interpersonal skills, understanding how we do business, time management, occupation-specific STEM skills, lifelong learning, design thinking, knowledge of legislation, regulation and codes, system analysis and evaluation, programming.

To create such special skills, teachers should use innovative educational technologies.

The results of the survey of teachers, students and teachers indicate that the most significant for them are the following technologies: Integrated learning, IBL, PBL. Technologies for the formation of media literacy, problem-oriented learning, mixed learning. Technologies of formation of critical thinking, Technology of formative assessment, use of e-learning game environments (Figure 3).

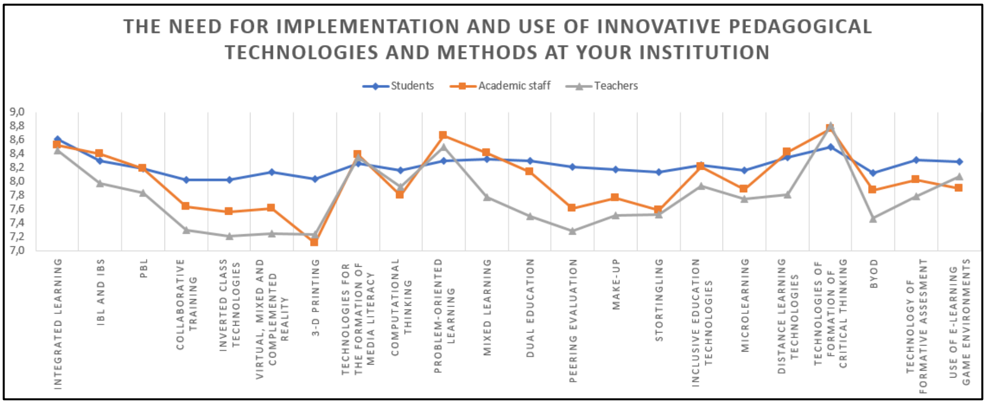

Figure 3. Determination of the need for implementation and use of pedagogical technologies and methods for lecturers, teachers and students groups

Source: Own research

To educate teachers, STEM-education should be introduced to educational technologies such as Integrated Learning, IBL, Project-based Learning (PBL), Problem-based learning (PrBL).

Let us describe and compare these technologies in order to better understand their purpose and usage.

Problem-Based Learning (PBL) is a teaching method in which complex real-world problems are used as a vehicle to promote student learning of concepts and principles as opposed to direct presentation of facts and concepts. In addition to course content, PBL can promote the development of critical thinking skills, problem-solving abilities, and communication skills. It can also provide opportunities for working in groups, finding and evaluating research materials, and life-long learning (Duch, Groh, Allen, 2001). In PBL, the teacher acts as a facilitator and mentor, rather than a source of "solutions."

Project-based learning is a dynamic classroom approach in which students actively explore real-world problems and challenges and acquire more in-depth knowledge.

Table 1 shows the common features of *Project based Learning and Problem based learning* and their differences.

Table 1.

Common features and different features of project based learning and problem based learning

Type of learning	Common features	Different features
Projects based learning	Often multi-disciplinary	Focus on an open-ended

	May be lengthy (weeks or months) Follows general, variously-named steps Includes the creation of a product or performance Often involves real-world, fully authentic tasks and setting	question or task Provides authentic applications of content and skills Build 21th century 4 C's competencies Emphasize student independence and inquiry Are longer and more multifaceted than traditional lessons or assignments
Problem based learning	More often single-subject Tend to be shorter Follow specific, traditionally prescribed steps The "product" may simply be a proposed solution, expressed in writing or in an oral presentation More often uses case studies or fictitious scenarios as " ill- structured problems"	

Source: Own work based on https://www.simplek12.com/learning-theories-strategies/project-vs-problem-based-learning/

3. INQUIRY-BASED LEARNING BACKGROUND IN CONTEXT. SOME ASPECTS

The term IBL is defined in several ways in the literature. First, it means the study of learning participants' interest in a topic in which they participated in social interaction for a common understanding (C. Pierce 1959, L.S. Vygotsky, 1978). De Jong and W. Van Joolingen (1998) defined it as an educational strategy based on the discovery of knowledge that promotes active participation and responsibility of the student. Pedaste and Sarapuu (2006) called IBL an approach by which students solve problems using their research skills.

Lately, survey education has increasingly been proposed as an effective approach to stimulating students' interest and motivation by linking academic teaching in non-formal and informal schools in everyday life (Specht, Bedek, Duval, Held, 2013). Such a strategy can help students develop their ability to work in unpredictable and complex environments, especially in a modern, ever-changing, technological society. In this context, reports based on UNESCO data (West &

Vosloo, 2013) have shown that ICTs enable students to engage in a wider range of non-formal learning activities, especially in order to teach students the responsibility for planning and implementation of educational activities. IC technologies provide opportunities for more personalized and autonomous unhindered learning in learning contexts (Thüs et al., 2012), in which students have the freedom and power to make active decisions. Sharples, Taylor, and Vavula (2005) argued that the strength of the students lies in the socio-cultural synergy between all those who want to advance knowledge, rather than relying on a certain student. Interdisciplinarity and the change in the trajectory of curricula (Chen et al., 2008, Sharples et al., 2005) can be facilitated by continuous learning projects that will make students more self-fulfilling.

IBL is an educational strategy in which students follow methods and practices, in the similar way as professional scientists do, to build knowledge (Keselman, 2003). During the inquiry process the student formulates hypotheses, tests them and carries out experiments and observations (Pedaste M., Mäeots M., Leijen Ä., SarapuuS Pedad, Meyots, Leyen and Sarapu, 2012). The proposed training emphasizes the student's active participation and responsibility for identifying new knowledge for the student (de Jong & van Joolingen, 1998) and this process is considered as an approach to developing students' ability to solve problems (Pedaste & Sarapuu, 2006). In this process, students often manage a self-regulated, partly inductive and partly deductive learning process, carrying out experiments on the study of relationships for at least one set of dependent and independent variables (Wilhelm & Beishuizen, 2003).

Other examples of the effective use of IBL method are described in their own research by F. Onder, C. Senyigit, I. Silay (2018), concerning the effect of an inquiry-based learning method on students' misconceptions about charging of conducting and insulating bodies.

Thuneberg, H.M., Salmi, H.S., Bogner, F.X. (2018) in their own study presented an informal mathematical module integrating Arts (modifying STEM to STEAM) and following an inquiry-based learning approach which was applied to a sample of more than 300 students (aged 12-13 years). Conclusions for appropriate educational settings to foster STEAM environments are discussed.

The authors presented and analysed in their own study “the EcoXPT research project, which has the goal of supporting authentic experiment-based inquiry within an immersive virtual world curriculum for middle school ecosystem science. It builds upon prior research with the EcoMUVE curriculum, which includes, as a culminating activity, student teams creating hand-drawn concept maps to represent their hypotheses about causal relationships in a virtual ecosystem.” (Metcalf et al., 2018).

IBL allows students to be involved in the learning process through real scientific discoveries. The complex scientific process is divided into smaller, logically related elements, which direct students and draw their attention to the important features of scientific thinking. These individual elements are defined as the stages of a query, and their set of links forms a cycle. The scientific literature describes different cycles and stages. For example, Model 5E of the educational cycle (Bybee et al., 2006) presents five steps of the queries (Figure 4):

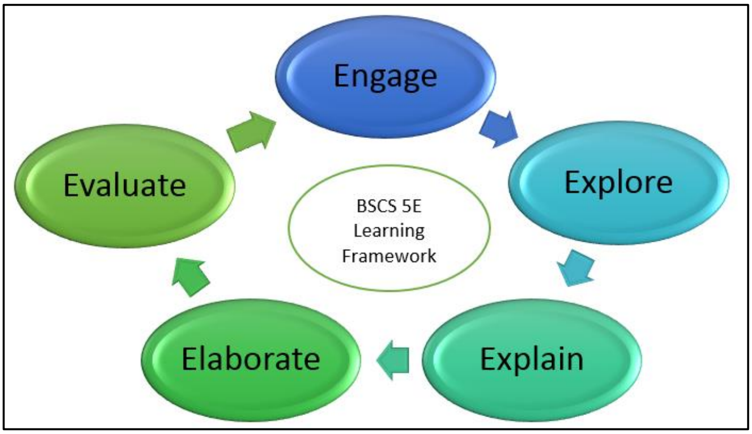

Figure 4. Five stages of queries. Conception 1

Source: Own work based on Bybee et al.,2006

According to (White & Frederiken, 1998), the Inquiry cycle has such elements: Question, Predict, Experiment, Model and Apply.

The difference between these cycles is that the primary stages of cycle 5E (Engagement and Research), start with the inductive approach, and the first two phases of the White & Frederiken 1998 (Question and Predict) cycle propose deductive approach. However, both induction and deduction may coexist in the request cycle. Scientists Klahr D., Dunbar K. describe the scientific process as a search in two environments, which they call the experiment‘s space and a simple hypothesis (Klahr, Dunbar 1988). These researchers suggest organizing the research process as the balance of inductive and deductive approaches in the request cycle.

The literature presents different terms for phases and links between phases, describes the cycles and their stages, the successful use of request cycles in different situations. These models can be used to organize classroom activity (Meyerson & Secules, 2001) for using computer environments (de Jong et al., 2010, Mäeots et al., 2011), but they all are the basis of study based on the survey.

The analysis of the descriptions and definitions of the stages of IBL presented in the articles under review led to the creation of the following structure of the IBL, which includes five general stages of the survey.

In general, this cycle is similar to the one above; but it uses the terms that were removed as the main terms from the articles in this review and covers the processes behind most of the description steps described in these articles. In addition, this cycle also covers many of the main stages of training that were not presented (Figure 5).

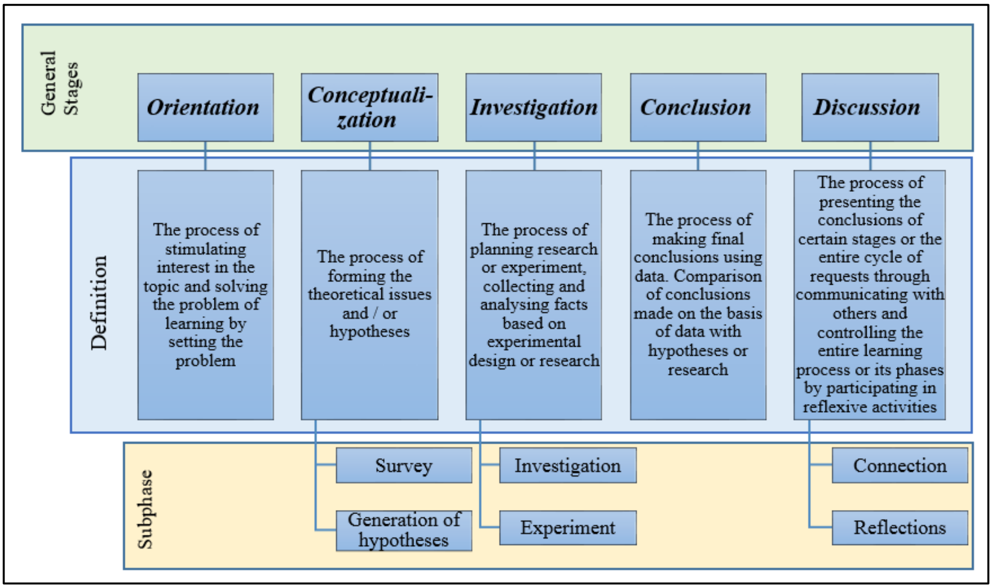

Figure 5. The main stages of learning-teaching, definition

Source: Own work based on Manoli, Pedaste, Mäeots, Siiman, De Jong, et al.2015

Inquiry-based learning for younger students should be implemented under the guidance of a teacher and with her/his participation and help. Progressive teachers, with development of technology, use opportunities of information and communication technologies (ICT) to improve the quality of didactic and methodological support of the educational process to identify the giftedness and personality of a student (Gladun, Buchynska, 2017). In most modern schools, learning activities, including research, require teachers' readiness to use ICT in their professional activities. In these circumstances, one of the priorities of modernization and promotion of research studies is the use of electronic educational resources both during lessons and outside class time. Research and use of instruments for organizing training, various virtual laboratories and integrated programs that help fully or partially to reproduce the progress of experiments, to see the results and changes in experimental conditions, to observe natural phenomena, to study the surrounding world and to be involved in a scientific experiment, will improve the quality of the didactic and methodological support of the educational process.

There are many benefits to implementing inquiry-based learning programs. These benefits include the following (Figure 6):

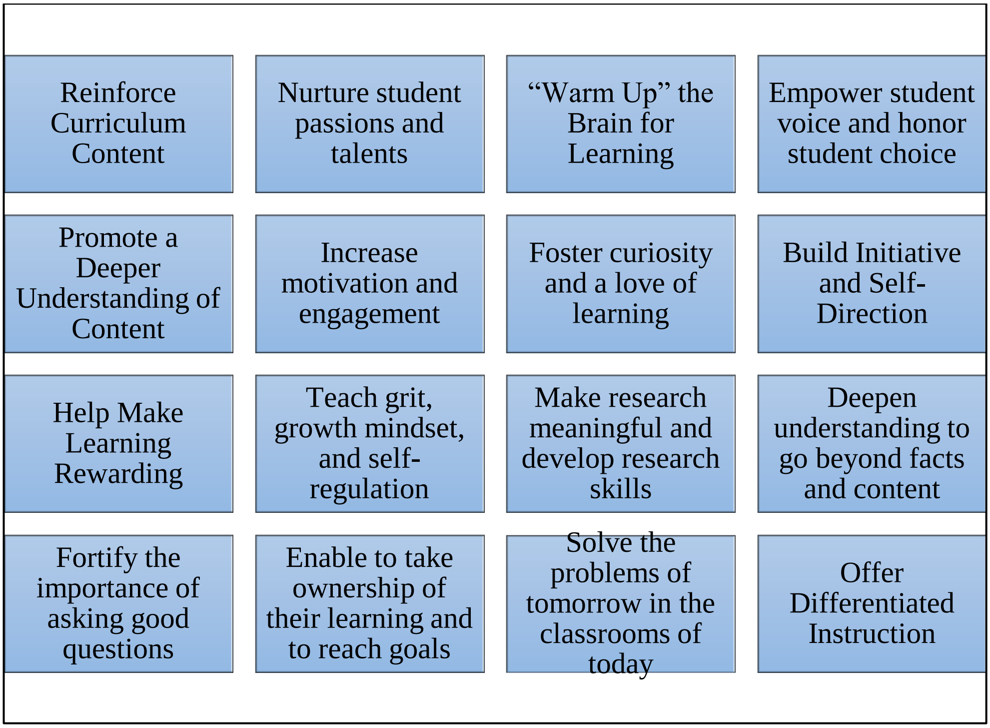

Figure 6. Benefits to implementing inquiry-based learning programs

Source: Gladun, Buchynska, 2017

Inquiry based learning will be much more beneficial for students, because involvement in learning results in improvement of the skills and attitudes possessed that permit you to seek resolutions to questions and issues while you build your new knowledge. There are many web tools that support inquiry based learning which teachers can use effectively to make all the students involve in the interaction.

In this article we have assembled a collection of some useful web tools and apps that support inquiry-based learning (Figure 7). Using these tools will enable students to engage in a wide range of learning tasks that are all driven by a sense of inquiry and questioning.

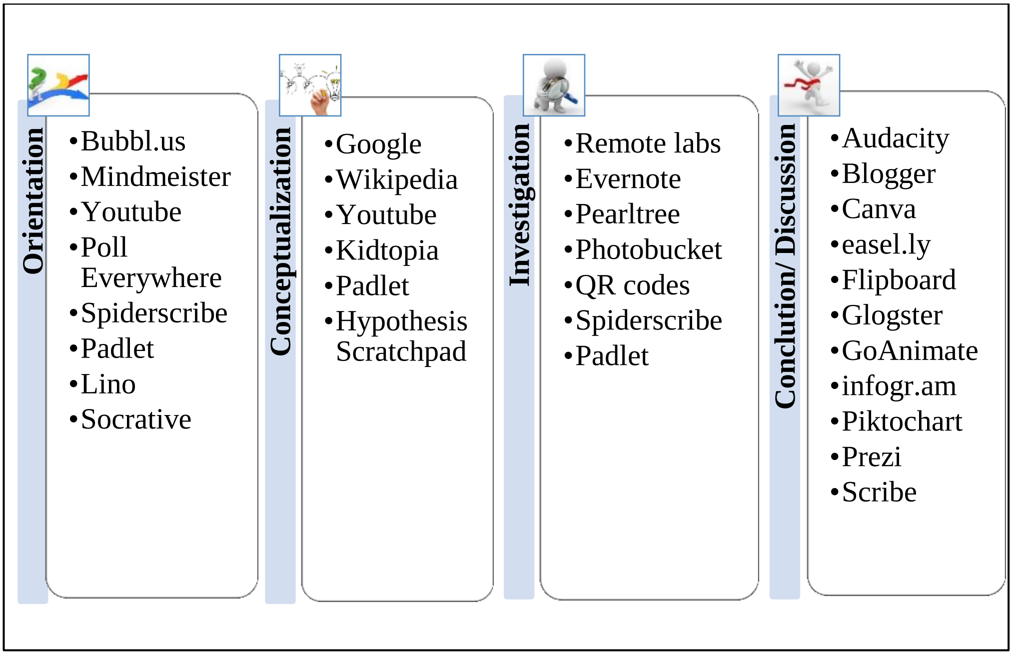

Figure 7. A collection of web tools and apps that support inquiry-based learning

Source: Own work

In our article, we mention the educational portal Go-Lab (web address: http://www.golabz.eu), which offers a unique and comprehensive set of remote and virtual laboratories. The online labs aim at supporting inquiry-based learning and providing the opportunity to conduct scientific experiments in a virtual environment. The Go-Lab project provides access to scientific databases, tools, and resources supporting student learning activities.

The educational portal Go-Lab is designed for creative and modern teachers who are eager to bring their students to the world of science, knowledge and discoveries through a comprehensive development of research tasks. Leading experts from more than 15 countries of the world have been added to the portal. When creating a learning resource, experts are added to its generation, which can competently make suggestions for improving it and only after official confirmation the development appears in free access and occupies the appropriate place in the rating.

In order for the teacher to fully use the educational portal, share experiences, participate in discussions and create a quality education product in the category Support on the site presented: User manuals, Video tutorials, Tips & Tricks tutorial, Community forum, Online course, Forum.

In order to create a complete space for research training, it is necessary to complete three stages:

1. Find the online labs aim at supporting inquiry-based learning using Go-Lab repository (web address: http://www.golabz.eu).
2. Create a unique environment for your students with a variety of files, links and applications (web address: http://www.graasp.eu).
3. Give access to the resource.

Online Labs has 1500 online laboratories (remote and virtual) dealing with Astronomy, Biology, Chemistry, Engineering, Environmental Education, Geography and Earth Science, Mathematics, Physics and Technology, which can be used in their lessons, as well as adapted to their educational needs and goals. Example:

1. Electrical Circuit Lab. In the Electrical Circuit Lab students can make their own electrical circuits and carry out measurements on them. In the circuits the students can use resistors, light bulbs, switches, capacitors and coils. The circuits can be powered by an AC/DC power supply or batteries.

2. *Acid-Base Solutions.* How do strong and weak acids differ? Use lab tools on your computer to find out! Dip the paper or the probe into solution to measure the pH, or put in the electrodes to measure the conductivity. Then see how concentration and strength affect pH.
3. *Star in a Box.* Star in a Box is an interactive webapp which animates stars with different starting masses as they change during their lives. Some stars live fast-paced, dramatic lives, others change very little for billions of years.
4. *Robotic Arm Laboratory.* Each of the sliders controls one of the six services of the robotic arm (Turn on / Turn of a led, move base, move wrist, elbow move, move shoulder, move clamp). Move each of them to define the right mix of movements in which you want to place the robotic arm.

To make your search easier, you can sort online labs using the right side navigation bar. Users have the opportunity to choose the subject area, the age of users, the language of the resource, and so on.

The Go-Lab environment also contains Apps, known as instruments or widgets which are small web applications that support certain training goals and tasks in online labs. Apps can be added to the learning space with online laboratories. The applications are grouped within the survey in the learning space according to their functionalities and goals, and are used to support specific experimental and training activities in online laboratories.

4. DISCUSSION

The major recommendations from the HLG are:

1. There is clearly a need for a common European policy in this area that goes beyond the post-Lisbon open method of coordination of national policies. Europe needs a common policy for human resources.
2. There is a need for novel instruments to measure and monitor human resources for science and technology in Europe, either as a separate entity or as part of a broader European science and technology policy.
3. Reliance on importing suitably qualified workers from outside the EU is not a sustainable, long-term solution, given the global nature of the market and the dynamics at play.
4. A better coordination of national policies and the design of a European policy to attract talented young scientists, with demonstrated potential for original research, from the rest of the world are clearly needed.
5. It is apparent that the shortage of human resources in SET is not felt across the whole of Europe, although it is argued that this in itself is not a steady state and that migration to satisfy demand will surely occur.
6. There is a general hasty conclusion which suggests that the main emphasis on closing the 3% gap lies with industry, and so industry needs to promote careers in a more attractive way to prospective SET employees.
7. The quality of SET training at universities is declining in some institutions.
8. Schools science is often taught by non-experts. All teachers should be offered CPD, and substantial incentives to attend CPD courses by salary structure.
9. Strategies for science popularisation and for the promotion of scientific culture across society are in place in most countries.
10. There is an urgent need for a comprehensive European strategy for enhancing the development of scientific culture across Europe (Gago et al. 2004).

CONCLUSIONS

This article explores aspects of IBL in STEM-education. The survey showed the need to implement IBL in the educational process as a necessary component in the formation of a highly skilled specialist in the modern labour market. Different types of inquiry models were proposed, depending on the degree to which the emphasis is placed on the study, content or study of processes and problems. There are a number of benefits to using IBL.

In recent years, many studies have highlighted an alarming decline in young people's interest in key science studies and mathematics. Despite the numerous projects and actions that are being implemented to reverse this trend, the signs of improvement are still modest. (Rocard et al. 2007)

In the digital age, the integration of technology has become a ubiquitous aspect of modern society. These advancements have significantly enhanced the field of education, allowing students to receive a better learning experience. (Levin, Tsybulsky, 2017).

Inquiry-based learning method as well as inquiry-based science education (IBSE) has proved its efficacy at both primary and secondary levels in increasing children's and students' interest and attainments levels while at the same time stimulating teacher motivation. (Rocard et al. 2007).

Developing and extending the ways in which science is taught is essential for improving student engagement. Transforming teacher practice across the EU is a long-term project and will require significant and sustained investment in continuous professional development (Osborne, Dillon, 2008).

Special instruments are chosen for creating research environment that allow you to complete each stage of the inquiry with the use of interactive techniques. In the Go-Lab environment, students can manage research in remote and virtual laboratories, make self-assessment, communicate and, most importantly, develop their ability to ask questions.

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TEACHING FOREIGN LANGUAGES TO ENGINEERS: MASSIVE OPEN ONLINE COURSES (MOOC)

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Abstract *The paper represents the massive open online course (MOOC) that is supposed to be the part of professional communicative education of engineers on the example of teaching Russian language as a foreign language. MOOCs for teaching foreign languages have their benefits. A person may get the foreign language education in any corner of the world. The results of the achievement test that were given to the students show that the MOOC-based training is more effective than the traditional training. The interviews with the engineers show that the MOOC-technology motivates their activity and that they would rather choose online learning than the classroom one.*

Keywords: MOOC, Massive Open Online Courses, teaching foreign languages to engineers, foreign engineers, e-education

INTRODUCTION

In the digitalization era, the communication between people has changed significantly. Generation Z which is currently studying in schools and universities, do not have the faintest idea what life was like without gadgets. They often spend most of the time in the media space with a smartphone or tablet but not a book. They watch films, quote them, create memes, analyze them, shoot video clips, post them on social networks, follow the latest news of bloggers and often run their blogs, in which they post media texts of their own composition. All this makes them plunge into a parallel reality, where the boundaries between the real and the virtual world, between real life and the screen are blurred.

As the experience of teaching a foreign language shows, our students often have difficulties in the perception and understanding the professionally oriented texts with a verbal linear structure. They seem to them complex and uninteresting. They understand texts with audio-visual support much faster.

Aiming to raise the effectiveness of foreign language instruction, teachers have to use different digital technologies in the process of teaching a foreign language. The transition to online mode is obvious and necessary.

1. THE STAGES OF PROFESSIONAL-COMMUNICATIVE DEVELOPMENT OF ENGINEERS

The professional-communicative development of foreign engineers in Russia may be represented as a lifelong process, regardless of whether a specialist receives methodically organized educational support after graduation or independently learns new terms, or adopts new textual genres, in other words, is engaged in professional-communicative self-education. In this incremental advance, in the continuous professional-communicative development of a specialist, the reference points are clearly marked when the goals and content, format and technologies of linguistic education are changed. This allows us to talk about the structuredness of this process, i.e., a systematically organized set of component stages in teaching foreign languages to engineers. These stages are as follows:

— Pre-university education of foreign students in Russian technical universities – *the pre-university stage of teaching Russian to foreign engineers*;

— development of foreign students during their studies in technical educational institutions of the Russian Federation – *the university (main) stage of teaching Russian to foreign engineers*;

— Post-university professional-communicative education of foreign students – *the post-university stage of teaching Russian to foreign engineers*.

At each stage of teaching a foreign language in accordance with modern educational trends aimed at its digitalization, it seems useful for students to conduct independent networking using open educational resources, remote interaction with lecturers and tutors, discussions of professional problems through video interaction, collective network communication (on forums, chats and weblogs) as well as study recorded lectures off-line and view training videos. These technologies can be implemented as part of a MOOC developed by teachers.

When teaching a foreign language, in our opinion, the most optimal means of linguistic education support will be using a massive open online course (MOOC) at any stage of teaching Russian as a foreign language to students who are going to become engineers, since special requirements are imposed on the forms and means of communicative development of a student. Firstly, they must provide effective and targeted linguistic education support for students. As a rule, engineers have no time and opportunity to improve their skills of professional communication in extensive mode. In addition, training at this stage is performed on an individual educational route; therefore, it is necessary to determine the actual starting level of foreign language proficiency of each student, to reveal his or her “personal” problems in the sphere of professional communication, and to take into account the peculiarities of his or her educational activity in the learning process. Secondly, it should be kept in mind that, at this stage, a foreign language may be learnt outside the language environment: an engineer who has graduated from a university in Russia leaves it to continue working in his own country but he needs to learn Russian as a foreign language to be able to communicate with Russian colleagues. Thirdly, training resources need to be somehow “transported” to the addressee. Finally, it is necessary to manage the educational process and check the outcomes. The “paper” format of traditional training tools is unlikely to help solve all these problems.

In order to develop a MOOC, it is necessary to know what it is and what structure it has.

2. LITERATURE REVIEW

There are numerous studies covering various theoretical and practical aspects of the development, introduction and implementation of MOOCs.

Nour Albelbisi, Farrah Dina Yusop , Umi Kalsum Mohd Salleh say that MOOC is a new online learning style with significant capability to expand free online courses to a large number of participants worldwide (Albelbisi, Yusop, Salleh, 2018). M. Ebner, E. Lackner, M. M. Kopp consider MOOCs as a trend phenomenon in electronic education (Ebner, Lackner, Kopp, 2014: 216).

V.N. Kukharenko emphasizes that a MOOC is “based on the active participation of hundreds and thousands of students who themselves organize their interaction in accordance with the training objectives, background knowledge and skills as well as common interests” (Kukharenko, 2011: 94).

Some authors describe MOOCs as “online courses with interactive participation and open access” (Lebedeva, 2015: 105), which, being the “highest point of modern e-learning, can give rise to the formation of professional online communities as well as to the expansion of international contacts among teachers of higher educational institutions” (Bugachuk, 2013: 154).

S. Alumu and P. Thiagarajan describe MOOCs most fully. In their opinion, MOOCs are a form of e-learning based on an open (public) Internet course using electronic educational multimedia content, interactive user communication and support of the community of teachers, assistants and students, with massive participation of the latter (Alumu & Thiagarajan, 2016).

S. Tang comes to the conclusion that the teaching mode of MOOC is divided into three kinds: MOOC based on content, MOOC based on network and MOOC based on task. Compared with the traditional courses, MOOC has intrinsic characteristics such as a large scale, openness, networking, personalized and participation, which includes the online learning effectiveness, the mastery learning, the interactive cooperation and the learning mechanism of complex system self-organization core (Tang, 2017).

In teaching foreign languages MOOCs play an important role. R. J. Blake and G. A. Guillen stress that as a foreign language online course MOOC includes the four major benefits of online language learning for learners: (a) flexibility, (b) personalization, (c) autonomy, and (d) automation (Blake & Guillen, 2014).

It is true because a person may get the foreign language education in any corner of the world. The courses are usually made up so that their content meets any student's level. Moreover, the participants study individually, so they can take their individual route of studying. Finally, automation influences well on the student as well because he can get immediate feedback in most cases. He doesn't need to wait until the teacher checks the paper.

3. THE STRUCTURE OF A MOOC FOR THE POSTGRADUATE STAGE OF FOREIGN LANGUAGE TEACHING TO ENGINEERS

As previously noted, the most optimal form of teaching Russian as a foreign language to these students will be a massive open online course.

There are many MOOCs on the Internet devoted to teaching Russian as a foreign language.

At the Coursera platform one may find many courses devoted to teaching General Russian at different levels. Their structure is different. It contains videofragments for learning, authentic texts for reading, grammar exercises and tests, some tasks for speaking (https://www.coursera.org/learn/russkiy-b2, https://www.coursera.org/learn/rki-b1-2).

If we analyze the courses at EdX platform on teaching Russian as a foreign language we will see not so many of them. There is a course that helps to form the skills of written scientific language. It contains videofragments and grammar exercises and tests (https://www.edx.org/course/mephix-mephi010x). The course "We learn to write scientific articles" helps the students learn how to write articles, to know the structure of it, to write an abstract, to make an article shorter (https://www.edx.org/course/Учимся-писать-научные-статьи-на-русском).

The analysis of the MOOCs shows that the goal and the structure of every course is different. Some courses are made to teach general Russian, not the professional engineering language. And some of them are devoted to develop the skills of written language. None of them do not match the requirments for future engineers that have to be able to talk on professional topics, to be able to translale technical texts and many other things.

The MOOC “Russian for foreign engineers”, developed by the Russian Language Department, Peoples’ Friendship University of Russia (RUDN University), became a pilot project of postgraduate linguistic education support for foreign engineers.

In accordance with the educational needs of foreign engineers, this course includes the following three modules: “Revising Russian grammar”, “Reading and listening to engineering news”, “Reading and translating technical texts” (for English speakers). An analysis of the most popular foreign platforms (Coursera, EdX, FutureLearn) hosting foreign language courses, allowed us to choose an optimal structure for the modules. Each module of the MOOC includes:

1. ***The organizational unit*** – a component for organizational, methodological and consultative purposes. This unit contains information and basic documents on how to organize and conduct the course, namely:

- An introduction with a brief description of the course;
- Information about the authors and teachers of the course;
- A class schedule;
- A training program (which lists the topics and the number of study hours (per week) allocated for each topic);
- Requirements for the students: A starting level of Russian language as foreign proficiency; technical means to be available for the successful mastering of the course program;
- Planned educational outcomes;
- A general glossary of the course, containing a list of key terms and concepts used;
- A “message board”.

2. ***The information-training unit,*** which presents educational information necessary for adopting didactic units of the course. The unit contains specially selected and arranged linguistic educational resources. The organizational and informative “core” of the unit is composed of video materials “reconstructing” the language environment in real time as well as multimedia presentations. These video clips last from 3 to 10 minutes. Each video is accompanied by a set of interactive tasks. The tasks of video clips vary in different modules. In the module “Repeating Russian grammar”, the purpose of the video clips is to give samples of using grammatical forms in discourse, first of all, those that are typical of engineering professional communication. In the module “Reading and listening to engineering news”, the video clips serve as a means of developing listening skills in the field of professional engineering communication. The video clips of the module “Reading and translating technical texts” contain brief lectures and instructions on the most complex issues of professional translation. Each video is accompanied by presentations reflecting its subject and visualizing information, which increases the effectiveness of acquiring the necessary knowledge, abilities and skills. The video clips of the modules “Revising Russian grammar” and “Reading and listening to engineering news” are provided with subtitles to facilitate perception of the educational material and promote the interrelated development of students’ competence in the main types of speech activity.

3. ***The training-practical unit,*** which contains tasks aimed at consolidating the acquired knowledge, correcting, forming and developing the necessary skills and abilities. Types of training tasks in each module are different: they correspond to its main purpose. For example, the module “Revising Russian grammar” contains tasks aimed at (a) making up correct grammatical forms; and (b) using adequate grammatical forms in speech. The module “Reading and translating technical texts (for English speakers)” contains a micro-system of exercises aimed at (a) training skills in translating Russian language phenomena that are absent in English; (b) training skills in translating English language phenomena that are absent in Russian; c) studying the basic aspects of translation activities; d) adopting the basic methods of translation, etc. These training tasks include macro- and microtexts to observe language units functioning in discourse. The potential of educational platforms makes it possible to include in the course micro- and macro tests, upload files with tasks, create an external link to other sites or an internal link within the educational platform, based on which the MOOC is created. Using the external and internal links in each unit, it is possible to connect additional training materials: additional lexical and grammatical tasks with online checking, texts for reading with assignments for understanding control, links to additional video clips, online dictionaries, and the MOOC glossary. We used all possible components of the content.

4. ***The controlling unit*** for checking how the course topics are learnt. The unit contains tests for the current, intermediate and final control using the techniques of self- and peer evaluations of the performed work. The control materials are multiple-choice tests, close tests, matching tests, etc. The tasks for peer evaluations (i.e., reviewing another student’s work) are relatively new; therefore, students are given instructions on how to perform them and which points to be noted. Tasks of this type allow us to develop not only critical thinking of students, but also to study the subject of the module more deeply, and also to fully apply the acquired knowledge, skills and abilities in practice. Peer evaluations also help introduce a competitive factor into the coursework and provide feedback from other participants. Similar assignments also allow students to determine their own level of Russian language proficiency, compare it with the levels of other students, greatly enhancing their motivation and thereby increasing the quality of professional-communicative training. In performing peer evaluation tasks, students are offered essays written by their peers. Using the built-in editor of the educational platform, students proofread the essays to be checked. Then the teacher checks the quality of proofreading and assigns scores for the completed tasks. Before evaluating the work of their peers, students have to write their own essays on a similar topic. Their essays are passed on to other students for checking. At the end of the course, students carry out the final test, which includes assignments covering all the course topics. After that, students receive the final grades for the passed course.

5. ***The communication unit*** provides communication between the course participants (i.e., students and their teachers) in synchronous and asynchronous modes. This unit helps realize in practice the idea of creating a virtual community of students and teachers. As a result, a linguocultural learning environment is simulated, where the participants communicate in the target language. The MOOC includes asynchronous and synchronous tools. The synchronous tools provide online communication between students and teachers, whereas the asynchronous tools are used for offline communication.

The asynchronous tools include “Forum”, where the course participants and teachers can discuss issues arising in the learning process. “Forum” provides interactivity of the linguistic education process, makes it possible to clarify difficult aspects of the program and provide students with targeted consultative support. This tool also contributes to developing discussion communication skills: in formulating and substantiating one’s own point of view; correctly requesting information; clarifying, agreeing or refuting the interlocutor’s opinion, etc.

The second asynchronous tool of the course is “Survey”. This tool is used for providing feedback to students. It allows teachers to receive students’ opinions about the course organization and conduct. Using this tool, it is also possible to vote on a certain problem. This tool allows the course to be modified or adjusted in accordance with the real educational needs of students. It is also possible to conduct a survey on the course outcomes in order to see whether it was interesting and useful for students, what difficulties they encountered during the coursework, etc. The asynchronous resource, “E-mail”, performs the functions of communication (between teachers and students on coursework issues), instruction (sending news and assignments), control (students’ delivery of completed assignments and projects) and some others.

The synchronous tools include “Instant online messaging”. This element is used as a means of quick communication with individual students in cases where it is necessary to correct an error or comment on someone’s statement.

The MOOC also allows for online video-communication between teachers and students. This function is performed by the “Webinar” tool, which is prearranged in the course schedule. The goals of webinars are different. Thus, webinars were introduced into all the modules: as consultations before the final control and practical classes conducted as discussions of topic-related issues. We deemed it necessary to include a webinar consultation in order to explain in detail the format of the final control and answer all possible questions related to its organization and conduct. It seems to us that in this way it is possible to prevent unjustified loss of the students' points, which may be caused by a lack of understanding of the purpose or format of the control.

4. METHODS AND RESULTS

The pilot MOOC-based training was conducted on the basis of the Peoples' Friendship of Russia. It involved 63 engineering residents from different countries (South Africa, Iran and China) with B2 level of RFL proficiency. The students were offered either to study the three course modules in a traditional way or register and study them online. Forty-two students preferred studying online. During the experiment, the students were offered to take a test to check their knowledge, skills and abilities. The test included three subtests. Subtest 1 was based on the materials studied in the module "Revising Russian grammar". Subtest 2 involved the materials of the module "Reading and listening engineering news". And Subtest 3 covered the module "Reading and translating technical texts (for English speakers)".Figure 1 presents the average results of the students who studied online and those of the students trained in a traditional way, respectively.

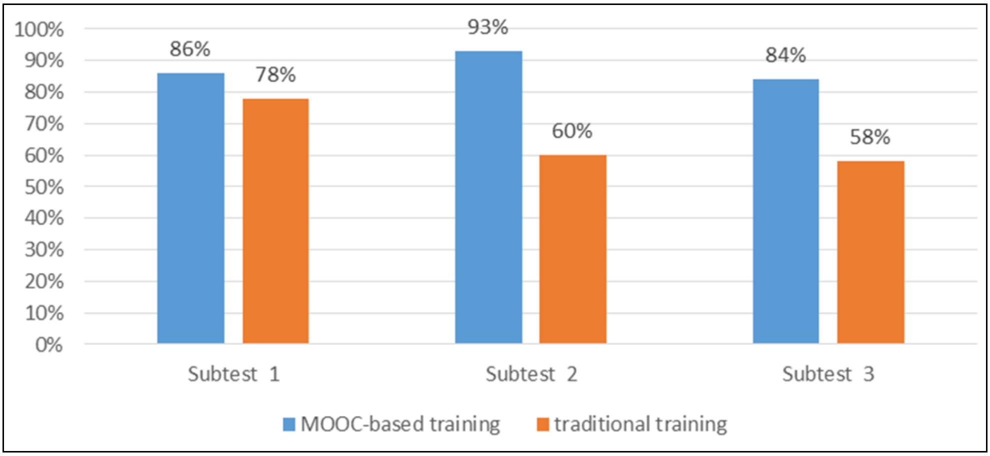

Figure 1. Testing results

Source: Own work

After the completion of the pilot MOOC, the students were asked to assess the degree of their agreement with some statements that would reveal the level of motivation of those who passed the online course. Statement 1: My proficiency in the Russian language has improved in the process of studying the online course; Statement 2: I believe that I have reached the set goals in the course of studying this course; Statement 3: The online component should be included in the TRFL course at all stages on a regular basis. When answering, the students assessed the degree of their agreement or disagreement with each statement on the Likert scale as follows:

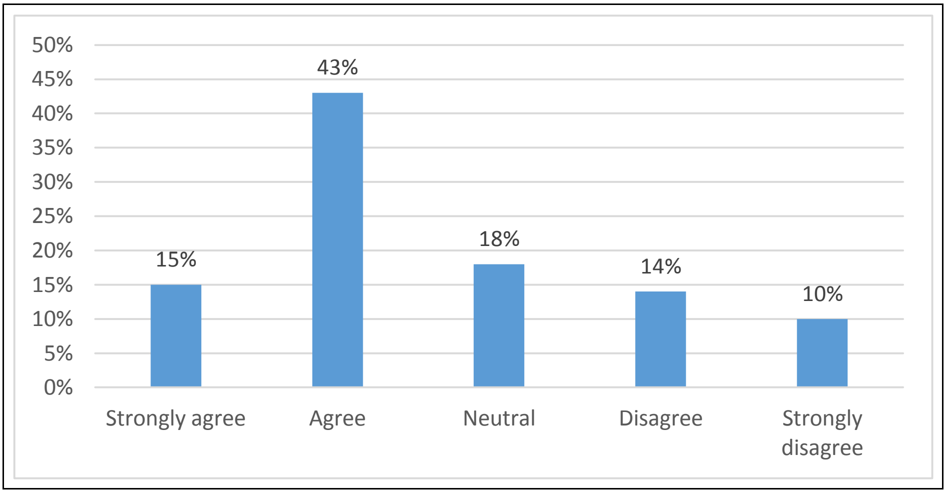

Figure 2. Students' achievements in studying the Russian language online.

Source: Own work

As for the students' opinions about their achieving the set goals, we obtained the following outcomes (see Figure 3):

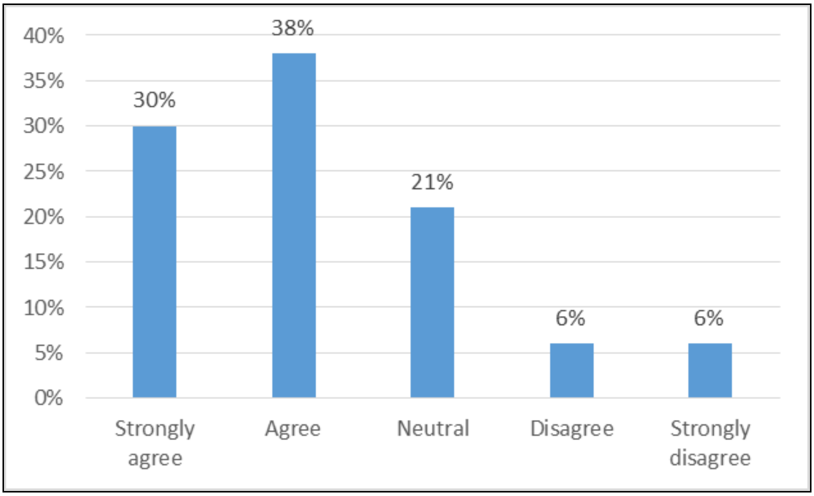

Figure 3. Achieving the set goals based on the online learning outcomes.

Source: Own work

As for the students' opinions about the need to include an online course in all training stages on a regular basis, the following answers were received (see Figure 4):

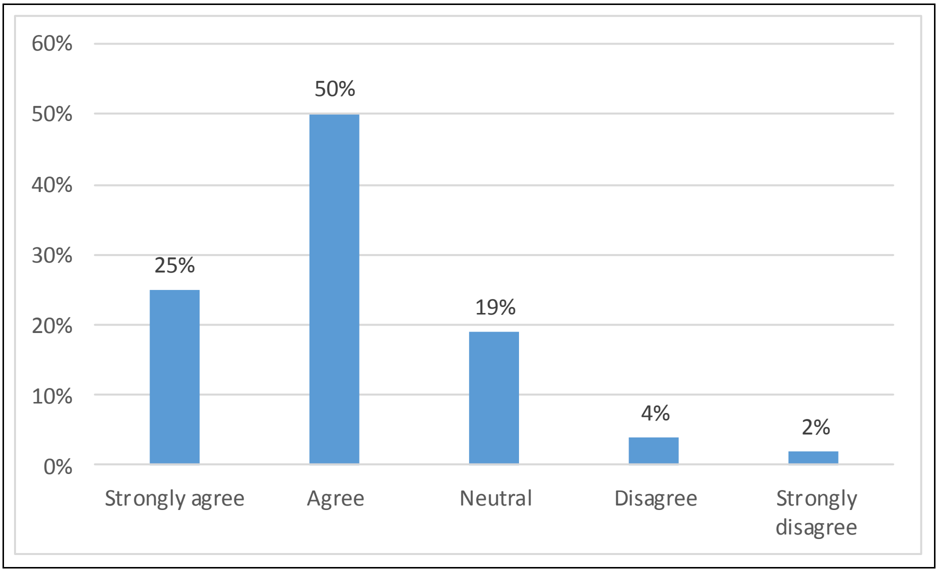

Figure 4. The need to include an online component in all training stages

Source: Own work

CONCLUSION

Thus, the MOOC "Russian language for foreign engineers", targeted at continuous professional-communicative support for foreign specialists outside the Russian Federation includes: *organizational*, *information-training*, *training-practical*, *controlling, and communication units.*

New findings of the study

We believe that a MOOC-based training program will provide:

— Individualization of professional-communicative support for foreign engineers and their educational autonomy; students' access to the course at their convenience;

— Wide geography and massive professional-communicative support; a possibility of interacting with listeners from different parts of the world;

— A sufficiently large bank of resources on topics of interest;

— An opportunity to develop grammatical and lexical skills in all types of speech activity;

— Increasing interest in learning by attracting innovative educational technologies and tools, thus providing the necessary motivation for students and, as a result, improving the quality of education.

The described pilot MOOC demonstrated a wide range of online learning opportunities and, in fact, a possibility of involving an unlimited number of participants in the educational process organized in this way.

The results obtained from the studies and the conducted testments can be used for preparing lectures on teaching professional Russian as a foreign language and developing the massive open online courses for other specialists to be able to form the commincative competency of a foreign specialist.

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WEBSITES

Coursera https://www.coursera.org/

EdX https://www.edx.org/

FutureLearn https://www.futurelearn.com/

ALGORITHMS, PROGRAMMING, FLOWCHARTS AND FLOWGORITHM

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Abstract. *The paper tries to answer the question – can the basics of algorithms and programming at faculties other than computer science (informatics) be taught more effectively using spreadsheets, computer algebra systems and e-Learning tools and materials like e-Books, software animations and specialized flowchart software. The first part of the paper gives a critical review of the literature of the subject. In the second part of the paper the programme of an applied computer science course devoted to algorithms programming is presented. The third part shows results of two surveys.*

Keywords: computational thinking, software animations, flowcharts.

INTRODUCTION

How to teach algorithms and programming as part of computational thinking (Wing, 2006) is still an open question (Wolfram, 2016). Sleeman (Sleeman, 1986) described programming as the new Latin of the school syllabus. Even there are developments in ITC programming is still causing problems (Gomes & Mendes, 2007) perhaps because of the fact that it includes knowledge of appropriate tools and languages, problem-solving skills and strategies for program design and implementation.

1. LITERATURE REVIEW

One of the first articles on experimental investigations of the utility of detailed flowcharts in programming was written in 1977 (Shneiderman, Mayer, McKay, & Heller, 1977). Later there were theses prepared on design and implementation of a tool for teaching programming (Goktepe, 1988) and about visual programming (Nickerson, 1994). There is also a whole book written on software visualization (Diehl, 2002). Baldwin and Kuljis presented in Balwdin & Kuljis (2001) the way of learning programming using program visualization techniques. Books written by Gaddis (Gaddis, 2015) and Venit (Venit & Drake, 2014) give an excellent framework for programming course on any level. A review and discussion of problems in learning and teaching programming is created by Robins (Robins, Rountree, & Rountree, 2003).

1.1 Choice of the flowchart tool

There are many flowchart-based programming environments for improving comprehension and problem-solving skills of novice programmers (Hooshyar, Ahmad, Nasir, Shamshirband, & Horng, 2015). Three of them were tested during the last few years:

- LARP - Logic of Algorithms for Resolution of Problems created by Marco Lavoie (the last version is from 2008)
- RAPTOR – Rapid Algorithmic Prototyping Tool for Ordered Reasoning created by Martin Carlisle and described in many articles (Carlisle, Wilson, Humphries, & Hadfield, 2005, Carlisle, 2009 and Thompson, 2012) (the last version is from April 2015)
- FLOWGORITHM – created by Devin Cook (the last version 2.18.3 is from November 2018).

The third one, Flowgorithm, was chosen mainly for three reasons. This was students' favourite code, it is still being developed and it was possible to create its localization (translation). The main Flowgorithm features are as follows: easy to understand output, graphical variable watch window, interactively generated code (for 12+ languages), safe recursion, loops, arrays, and flexible expressions and multilingual support. Moreover, there is an e-book created by Roberto Atzori with more than 250 flowcharts.

To some extent ALVIS Live! (ALgorithm VIsualization Storyboarder) represents a similar idea. It is the part of the VEUPL project (Visualization and End User Programming Lab), whose leader was Chris Hundhausen. The program, of which the last version is from September 2006, was described in many papers, e.g. (Hundhausen & Douglas, 2002) and (Hundhausen & Brown, 2005). More information about the flowchart-based programming environments for improving comprehension and problem-solving skills of novice programmers can be found in (Hooshyar et al., 2015). The use of a flowchart interpreter for the introductory programming course was presented by Crews and Ziegler in Crews & Ziegler (1998). Kuen (Kuen, 2011) described the learning programming concepts using flowcharting software. A similar problem – an animated flowchart with an example to teach the algorithm based courses in engineering was published by Dol (Dol, 2015).

2 FUNDAMENTALS OF COMPUTER SCIENCE

Fundamentals of the course in Computer Science at the Faculty of Civil Engineering at Warsaw University of Technology have been already described in many publications like Gajewski, Wlasak, & Jaczewski (2013) and Gajewski & Jaczewski (2014). Algorithms and programming are only a part of the course consisting of three hours of lectures and six hours of classes. The computer algebra system Mathcad Prime (Gajewski, 2014) is used for this course with some elements of blended learning. A similar approach was presented by Azemi in Azemi & Pauley (2008) and Asad Azemi, Bodek, & Chinn (2013). Basic and introductory programming courses frequently cause problems. Giannakos (Giannakos, Pappas, Jaccheri, & Sampson, 2016) tried to understand student retention in computer science education. Rahmat discussed (Rahmat et al., 2012) major problems in basic programming that influence students' performance. In another paper Zainal (Zainal et al., 2012) investigated students' perception and motivation towards programming. The answer to the question how to reduce the dropout rate in an introductory programming course (Yadin, 2011) is still open. More information about teaching and learning programming can be found in the review papers written by Ala-Mutka (Ala-Mutka, 2004) and Pears (Pears et al., 2007).

2.1 Basic Algorithmic Problems

During lectures three basic and classical algorithmic problems which do not require deep mathematical knowledge are presented. Their excellent description can be found also in Wikipedia.

Square root – Babylonian method. Algorithm is described precisely even in Wikipedia: "The basic idea is that if x is an overestimate to the square root of a non-negative real number S then S/x will be an underestimate and so the average of these two numbers may reasonably be expected to provide a better approximation"

Root of the function – bisection method is described in Wikipedia as follows. "At each step the method divides the interval in two by computing the midpoint c = (a+b) / 2 of the interval and the value of the function f(c) at that point. Unless c is itself a root (which is very unlikely, but possible) there are now only two possibilities: either f(a) and f(c) have opposite signs and bracket a root, or f(c) and f(b) have opposite signs and bracket a root. The method selects the subinterval that is guaranteed to be a bracket as the new interval to be used in the next step."

Greatest common divisor – Euclidean algorithm. According to Wikipedia definition: "The Euclidean algorithm is based on the principle that the greatest common divisor of two numbers does not change if the larger number is replaced by its difference with the smaller number. Since this replacement reduces the larger of the two numbers, repeating this process gives successively smaller pairs of numbers until the two numbers become equal. When that occurs, they are the GCD of the original two numbers." All these algorithms are discussed during lectures using Flowgorithm (see Fig. 1).

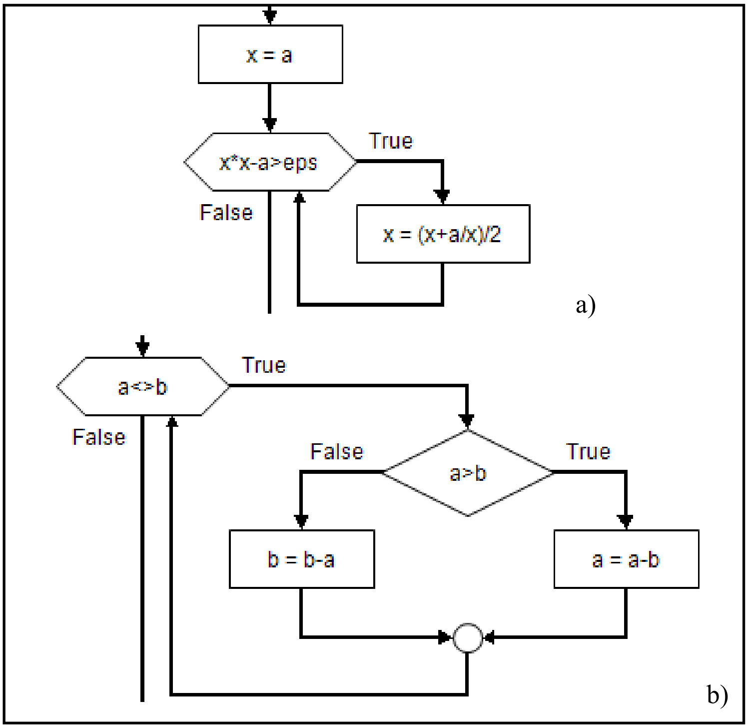

Figure 1. Flowcharts of the Babylonian method (a) and Euclidean algorithm (b)

Source: Own work

2.2 Branching

If a statement (branching) is for the first time introduced in a spreadsheet for simple problems like a function given by distinct formulas for different ranges of an argument. In the case of three intervals nested if is used (see Fig. 2).

$$f(x) = \begin{cases} -x & x < -1 \\ 1 & x \in [-1, 1] \\ x & x > 1 \end{cases}$$

```
=IF(A1<-1,-A1,IF(A1>1,A1,1))
```

Figure 2. Nested if in a spreadsheet

Source: Own work

2.3 Looping

Loops are not available directly in a spreadsheet, but in the case of iterative calculations they can be simulated by expanding formulas as for the case of a sum of elements (see Fig. 3).

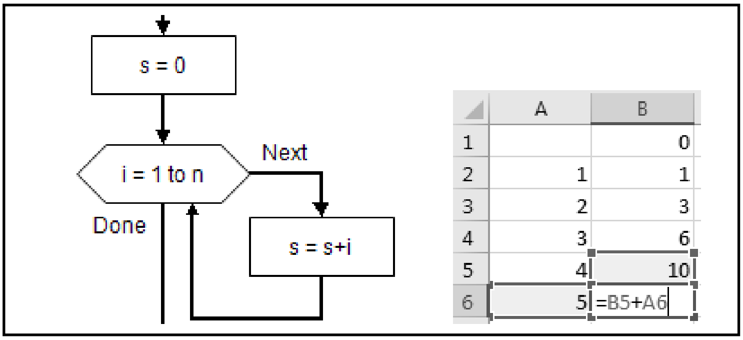

Figure 3. Sum of integers – flowchart and for loop in a spreadsheet

Source: Own work

While a loop is used for two cases of stopping condition for a sum of elements imposed on the value of added elements or on the value of a sum (see Fig.4).

2.4 Sample exam problems

All exam problems belong to one of the two groups:

- for loop together with if branching (vectors and matrices and their elements);
- while loop (sums of series, expansion to series)

Sample exam problems are as follows:

- Create function that calculates the average of matrix elements from the range (a,b);
- Create function that expands to the Taylor series centred at zero (Maclaurin series) cosine function; add only elements greater than eps.

The solution of these problems is very simple. Sample codes have only a few lines (see Fig. 5). General structure of the code can be easily memorized but a solution of each problem requires understanding of the algorithm. Flowgorithm helps to understand how algorithms work especially enabling to follow calculations in an automatic way

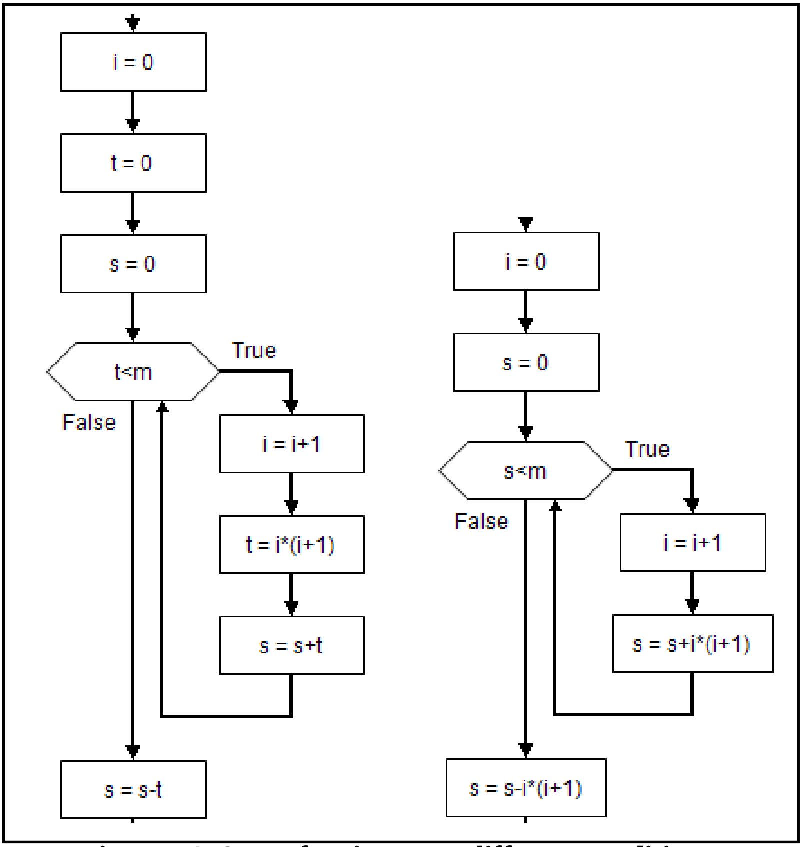

Figure 4. Sum of series – two different conditions

Source: Own work

2.5 e-Learning materials and tools

All educational resources are available on the faculty Moodle platform with materials like quizzes (self-assessment tests) and software animations. There are two books about Mathcad Prime prepared especially for the course. There is also a portal dedicated to Polish version of a book (prime.il.pw.edu.pl). In the forthcoming academic year active software simulations will also be available. All educational materials are very popular among Students but unfortunately mainly just before the exams. Students are definitely reluctant to work in a systematic way.

3 SURVEYS AND THEIR RESULTS

In order to learn what students' experiences are like in designing algorithms and programming, difficulties with different teaching topics and favourite learning resources two surveys were conducted.

```
f(M,a,b) := | r ← rows(M)
            | c ← cols(M)
            | s ← 0
            | l ← 0
            | for i ∈ 1..c
            |   for j ∈ 1..r
            |     if M_{i,j} > a ∧ M_{i,j} < b
            |       s ← s + M_{i,j}
            |       l ← l + 1
            | s ← s / l
```

```
f(x,eps) := | i ← 0
            | s ← 0
            | t ← 1
            | while |t| > eps
            |   s ← s + t
            |   i ← i + 2
            |   t ← (−t·x^2) / (i·(i−1))
            | s
```

Figure 5. Solution of sample exam problems

Source: Own work

3.1 Surveys methodology

Surveys took place at the very end of semester in January 2017. Participation in the surveys was not compulsory but students were asked to participate in them in order to improve quality of the classes. Anonymous questionnaires were filled by 136 students out of 186 attending classes. The whole process was partly automatic – Google Forms were used to collect the data. For all surveys Cronbach's α coefficients (Cronbach, 1951, Cronbach & Shavelson, 2004) as a lower bound estimate of the reliability of psychometric test were calculated. This coefficient should be at least 0.6.

3.2 First survey

The first survey was based on Konecki's research described in (Konecki, 2014), (Konecki, 2015) and (Konecki & Petrlic, 2014). Likert scale was used for all given questions (1-strongly disagree, 10-strongly agree). Results for questions concerning experiences in designing algorithms and programming (Table 1) are different than obtained by Konecki, whose research was conducted among 190 students of information science. This is mainly due to the facts that civil engineering students do not like algorithms and programming. Cronbach's α is for this test 0.8301.

3.3 Second survey

The second survey was based on another questionnaire (Malik & Coldwell-Neilson, 2016). In the first part of the second survey the five-point Likert scale is used, from very difficult to learn (1) to very easy to learn (5). The answers to the questions regarding difficulties with different teaching topics (Table 2) show that repetition and selection as well as functions belong to the group of very difficult to learn topics. This was visible during practical tests. Choice of an appropriate loop (for or while), was the biggest problem for students. Cronbach's α is for this test 0.7927.

Table 1.

Reported experiences in designing algorithms and programming

Questionnaire Item	Mean
I have no difficulties in understanding of programming problems that are presented to me	4.000
When solving programming task, I have difficulties in understanding the task itself	5.471
I have difficulties in drawing a diagram or writing a pseudocode of a given programming task's solution	5.434
I have more problems in visualizing and designing a conceptual solution in a pseudocode than in understanding and remembering programming language syntax	5.397
Designing of algorithmic solutions is difficult and not intuitive to me	5.610
The main problem I experience is remembering programming language syntax	5.169
The main problems I experience refer to understanding and visualizing programming tasks and designing their algorithmic solutions	5.518

Source: Own work inspired by Konecki

Table 2.

Teaching topics

I found…	Mean	Very difficult to learn	Difficult to learn	Neutral	Easy to learn	Very easy to learn
Arrays	3.345	11	13	48	43	21
Expressions	3.463	4	18	48	43	23
Functions	2.845	19	37	38	30	12
Operators	3.434	7	15	48	44	22
Parameters	3.338	3	23	49	47	14
Repetition	2.904	14	37	45	28	12
Selection	3.074	10	32	50	26	18
Variables	3.346	5	21	52	38	20

Source: Own work inspired by Malik & Coldwell-Neilson

In the second part of the survey the five-point Likert scale is used. Questions related to the learning situation use a scale of never (1) to always (5). The answers to the questions regarding learning situations (Table 3) show, that lectures never or rarely helped in learning programming. Students treat programming as something practical, so they do prefer to learn programming during lab sessions. Cronbach's α is for this test 0.4866.

Also in the last part of the survey the five-point Likert scale is used. Questions relating to the teaching materials use a scale of useless material (1) to very useful material (5). The answers to the questions regarding teaching and learning resources (Table 4) show, that students treat the introductory course book and lecture notes as mainly useless, not very useful or somewhat useful. Software animations (movies), exercise questions and answers and example programs are treated as useful or very useful resources. Students rarely attend lectures and they do prefer to watch in a passive way movies rather than actively read a book. Cronbach's α is for this test 0.6746.

Table 3.

Learning situations

I learned about programming…	Mean	Never	Rarely	Sometimes	Often	Always
In lectures	1.889	64	37	24	8	3
In lab sessions	3.434	6	19	43	46	22
While studying alone	3.456	6	20	43	40	27
While working alone on programming coursework	3.485	5	21	41	41	28
In exercise sessions in small groups	2.397	42	31	38	17	8

Source: Own work inspired by Malik & Coldwell-Neilson

In the next phase of this research self-assessment of the course using Bloom's revisited taxonomy like in Alaoutinen & Smolander (2010) and investigation of test reliability including Guttman's lambda-2 (Guttman, 1945) are planned. Moreover multiple choice tests will be used to evaluate student understanding during computer programming classes (Kuechler & Simkin, 2003).

Table 4.

Teaching and learning resources

I found the…	Mean	Useless	Not very useful	Somewhat useful	Useful	Very useful
Introductory course book	2.449	38	36	35	17	10
Lecture notes	2.073	58	27	36	13	2
Exercise questions and answers	4.058	3	8	23	46	56
Example programs	3.926	6	5	29	49	47
Still pictures of programming structures	3,250	10	22	50	32	22
Interactive visualizations	3.324	15	15	44	35	27
Movies (software animations)	4,132	2	9	23	37	65

Source: Own work inspired by Malik & Coldwell-Neilson

CONCLUSION

This research was inspired by the Cognitive-Affective Theory of Learning with Media (CATLM) created by Moreno and presented in Moreno (2005, 2006). CATLM represents an expansion of the popular Cognitive Theory of Multimedia Learning (CTML) reported by Mayer in his book “Multimedia Learning” (Mayer, 2001) and later by Sorden in “Handbook of Educational Theories” (Sorden, 2013). CATLM assumes that students need to become motivated to make full use of their cognitive resources (Park, Plass, & Brünken, 2014). All tutors in the presented course were specialists in Computational Thinking but perhaps students had not enough motivation for learning which was the reason of problems and bad results.

The question raised five years ago – ”how to motivate digital natives to learn” (Wlasak, Jaczewski, Dubilis, & Warda, 2013) is still open. Students are generally against programming. They are absolutely satisfied even by their poor knowledge of IT limited to some basic editing skills. Results of 258 tests and retakes in Mathcad clearly show it.

The examination consisted of twelve problems – ten devoted to calculations and two to programming. The total score is fourteen points – ten from calculations and four from programming. Results of these tests show that students try to avoid problems in programming and do prefer to gain points from simple calculation problems.

According to OECD Report "Students, Computers and Learning - Making the Connection"(OECD, 2015) students who use computers at school only moderately score the highest in reading. Moreover, students who do not use computers in maths classes score higher results in mathematics. Perhaps the same observation is valid for algorithmics and programming. Overuse of technology can lead to worse results.

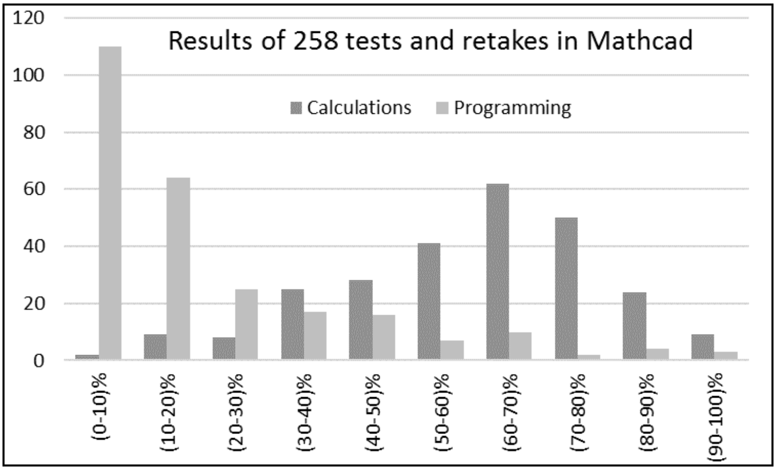

Figure 6. Results of tests in Mathcad

Source: Own work

Flowgorithm proved to be a very effective lecture tool allowing to present algorithms and their results. During laboratories Flowgorithm was used mainly only when students were obliged to do this, which is the result of negative attitude to programming. Flowgorithm enabled to distinguish between programming (creating an algorithm) and coding (representing an algorithm in a particular programming language) and concentrate on algorithms and programming. The next question – how to assure digital natives that computational and algorithmic thinking as well as programming skills are essential for all engineers is also open.

How to use in effective way algorithm animations for teaching and learning is still an open research question (Fleischer & Kucera, 2002), (Végh & Stoffová, 2017). Another important research issue is Technology Acceptance Model (TAM) (Adams, Nelson, & Todd, 1992) used to measure and evaluate perceived usefulness, ease of use, and usage of information technology. TAM can be exercised to measure continuance intention to use MOOCs (Wu & Chen, 2017) and to measure users' acceptance of e-Learning (Tarhini, Hone, Liu, & Tarhini, 2017).

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INTERNET OF THINGS ECOSYSTEM SUPPORTING E-LEARNING

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Abstract: *The paper presents the Virtual Education Space (VES) implemented as an Internet of Things (IoT) ecosystem. The basic components of the space are described in more details. Furthermore, the usage of the space is demonstrated for implementing a disabled student scenario. The VES architecture presented in the article allows for integration with different IoT systems to be used for formal and informal learning. In the paper also is present the implementation of intelligent tourist guide that intend to support lifelong learning in Virtual Education Space.*

Keywords: IoT, Cyber-Physical Space, VES, Calculus of Context-aware Ambients (CCA)

INTRODUCTION

The Virtual Education Space (VES) is being developed in the "Distributed eLearning Center (DeLC)" Lab of Plovdiv University “Paisii Hilendarski”. The space is a successor of the DeLC e-learning environment providing electronic teaching material and electronic services (Stoyanov, 2012), (Stoyanov, 2010). DeLC supports the internationally accepted standards SCORM 2004 for self-space learning and Question and Test Interoperability - QTI 2.1 for electronic testing. The environment is used to support the educational process at the Faculty of Mathematics and Informatics of Plovdiv University “Paisii Hilendarski”.

Although DeLC is a successful project providing effective use of information and communication technologies in education, its significant disadvantage is the lack of suitable integration of its virtual environment with the physical world where the real learning process takes place. Enhancing the environment and transforming it as a cyber-physical space would extend the possibilities of adapting and personalizing of the content and services, especially for disabled people. The new infrastructure known as Virtual Education Space is being built as an Internet of Things (IoT) ecosystem (Stoyanov, 2016), (Stoyanov & al, 2016). VES continues to develop and improve as an e-learning environment and also as an experimental ecosystem for IoT applications.

The VES architecture presented in the article allows for integration with different IOT systems to be used for formal and informal learning. The cultural and historical heritage of Bulgaria is part of the common European cultural tradition and history. For the digital presentation of cultural and historical heritage, the BECC (Bulgarian Electronic Cataloguing Cultural) environment was developed more than ten years ago (Trendafilova, 2007). Cultural and historical objects were presented according the Cataloging Cultural Objects (CCO) standard. The system was updated in connection with the development of an e-learning environment VES. The space provides e-learning services and learning content for blended, self-paced, and lifelong learning. The Lifelong Learning Program provides electronic content on the subject of Cultural and Historical Heritage. According to VES, we develop an intelligent tourist guide that takes into account various factors - the tourist's preferences, location, time available, and the presence and location of cultural and historical objects in the area to propose virtual or real cultural and historical routes. Currently, the guide is being implemented as an IoT application.

This paper presents the architecture of VES as an IoT ecosystem. The rest of the paper is organized as follows. A short review of cyber-physical spaces is considered in Section 1. This is followed by an overall description of the VES architecture in Section 2. Section 3 demonstrates the usage of the space for implementing a disabled student scenario. In Section 4 is present the implementation of intelligent tourist guide as a part of lifelong learning in VES.

1. CYBER-PHYSICAL SPACES

The comprehensive use of the Internet and its gradual transformation into IoT, as well as the globalization of cyberspace, are a prerequisite for the rapid development of Cyber-Physical Spaces (CPS). CPS are engineering systems built and operating by the synergy of computational and physical components. In this sense, physical means elements of the system occupying physical space while cyber refers to the computational and communication components of a system (Bradley & Atkins, 2015). CPS enable the physical world to merge with the virtual world by integrating computational and physical processes and in this way facilitating close integration of computation, communication and control in their operation and interaction with the environment which they are located in (Guo, Yu & Zhou, 2015). CPS are an area of growing scientific and practical interest. Research in this area highlights the need for new models, abstractions, methods and techniques to integrate various components of a system in an intelligent way.

Due to an unprecedented impact of CPS on the way people interact, human and social aspects have to be taken into account. We have reached the point where social and human dynamics become an integral part of the CPS; so inclusion of social dimension is fully justified, i.e. the concept of Cyber-Physical-Social Spaces (CPSS) (Wang, 2010). Moreover, already the concept of Cyber-Physical-Social-Thinking hyper-space (CPST) is already emerging as an expression of the close merging of cyberspace, physical space, social space, and thinking space as the basis for building intelligent worlds (Ning et al., 2015).

Often all these spaces are described as Intelligent Spaces (IS). Building an intelligent space requires considerable effort for system integration. There are also specific issues that are subject to intensive research such as intelligent devices, sensors, and gathering significant data from the physical world; dynamic communication infrastructures connecting spatially distributed devices; system architecture and middleware; understanding of information and interfaces; decision-making and action planning. Intelligent spaces have a wide range of applications - current and potential. For example, they can include robotics, personal assistant with a variety of applications (especially for disabled people), intelligent healthcare, intelligent homes and cities, optimal use and energy saving, intelligent monitoring and environmental control, critical infrastructure protection.

2. ARCHITECTURE OF THE VES

The VES architecture consists of three logical layers (Figure 1.) briefly presented below.

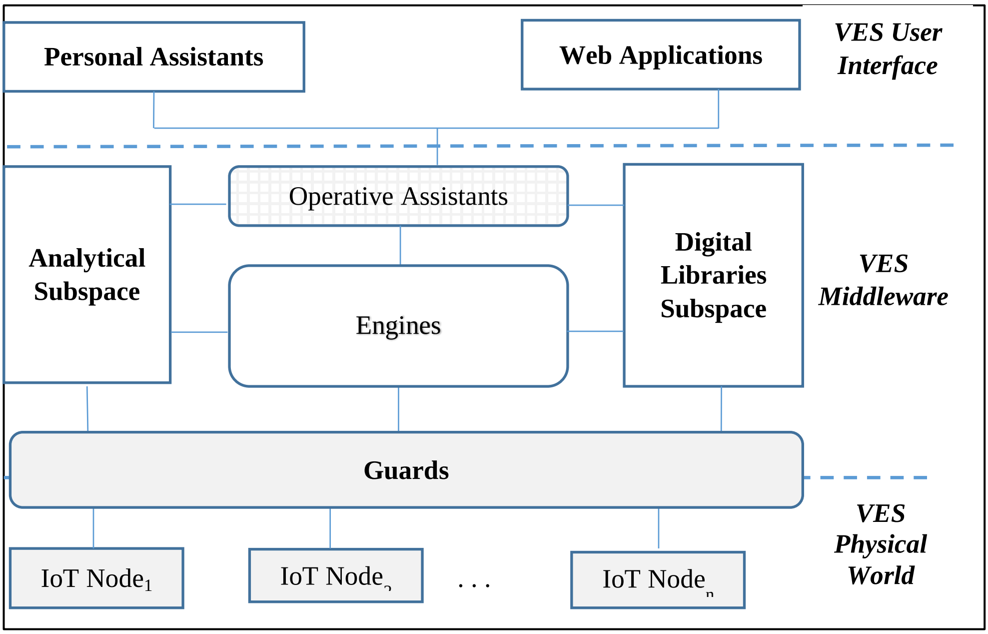

Figure1. Logical Architecture of the Space
Source: Own work

2.1. VES User Interface

Access to information resources and services of the space is basically through *Personal Assistants* (PAs). The main purpose of the PAs is to assist users (in this case students and teachers) in their work with the space; i.e. they act as personalized entry points of VES. The users are provided with their own personal assistant during the first registration in the space. For this purpose, a genetic assistant is maintained that generates a user-specific PA interacting with the education portal and the registration module. A prototype of the PA for students known as LISSA was created in the current version of the VES (Todorov & al., 2017).

Currently, four specialized Web applications operate at this level. DeLC 2.0 is an educational portal providing education services and electronic teaching material to support various kinds of e-learning (blended, self-paced, e-testing, and lifelong). PROJECTS is a site that presents space-related projects. CHH is a specialized project for lifelong learning in the area of cultural and historical heritage using semantic modeling and virtual reality technologies. PUBLICATIONS is a system for scientific publications. The apps interact with the VES middleware by help of operative assistants. PAs and operative assistants are implemented as BDI (Belief–Desire–Intention) rational agents.

2.2. VES Middleware

One of the most interesting (and most complex) components of the ecosystem is the analytical subspace performing two basic functions. The first one is to support modeling of "things" taking into account factors such as events, time, space and location. The Analytical Subspace provides means for the preparation of domain-specific analyses supported by four modeling structures. ONet (Ontologies) is a hierarchy of ontologies to represent the essential features of things. Furthermore, the relationships between the “things” are specified in the ONet. ENet (Events) models various types of events and their arguments (identification, conditions for occurrence and completion) representative of the field of interest. TNet (Temporal) provides an opportunity to present and work with temporal aspects of things, events and locations. In ANet (Ambients), the spatial characteristics of the "things" and events can be modeled as ambients. The work with these structures is supported by specialized interpreters known as Engines, based on the formal specifications Interval Temporal Logics -ITL (Moszkowski, 1998), Calculus of Context-aware Ambients -CCA (Siewe, Zedan & Cau, 2011) and Event Model -EM (Guglev & Doychev, 2017). The second is to provide tools for preparing analyses, statistics, suggestions for improvement of the processes in the specific problem area - in this case the learning process. In the current version, two such tools are developed - a student's book and a teacher’s notebook. The student’s book suggests solutions to improve students' success using appropriate background knowledge and up-to-date information on the learning process; the book saves also the entire history of student’s learning activity. The teacher's notebook collects, summarizes and analyses information about the success of a group of students in a particular discipline. For example, the notebook is able to analyse the learning material personally for each student or for a whole group interacting with the SCORM 2004 Engine (Figure 2). Furthermore, it offers solutions to improve the performance of teaching activities and interacts with the student's books.

Conducting and analysing of the education process are supported by background knowledge saved in the Digital Libraries Subspace (partly satisfying DSpace specification) and by the actual data supplied by the guards. In our case, digital libraries store electronic content, test questions, publications, diploma works, and course projects. A meta-level implemented as interrelated ontologies supports intelligent search and comfortable work with this subspace.

The operative assistants provide access to the resources of both sub-spaces and accomplish interactions with personal assistants and web applications.

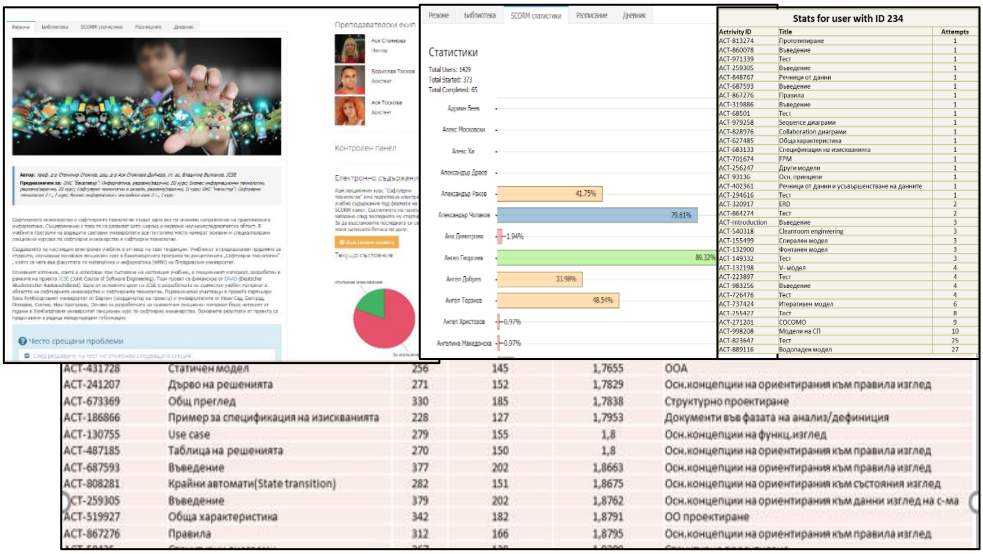

Figure 2. Success rate analyses in one discipline

Source: Own work

2.3. VES Physical World

Guards operate as a smart interface between the virtual and the physical world. They provide data about the state of the physical world transferred to the virtual environment of the space (both sub-spaces). There are multiple IoT Nodes integrated in the architecture of the guards that implement access to sensors and actuators of the "things" located in the physical world. The sensors-actuators' sets are configured in accordance with the application. The communication in the guard system operates as a combination of a personal network (e.g. LoRa) and the Internet.

In addition, the guards identify and localize events that could hinder the normal course of the learning process and react activating sutable emergency scenarios.

3. IMPLEMENTATION OF SAMPLE SCENARIO FOR DISABLED STUDENTS

VES offers a variety of services for all students, such as electronic lectures, e-tests, e-scheduling, etc., but changes in the physical world are especially important for students with disabilities. Therefore, we will look at an example scenario for students with motor problems. The student with mobility disabilities participates in the space with his wheelchair, which provides him/her a specific support environment. Upon entering in the education university zone, the personal assistant PA starts a two-way communication process, providing the student with both standard educational services and some specific ones connected with movement of wheelchair in the campus's physical environment. We will look at a specific service for students with mobility disabilities: ensuring a convenient route for moving the student’s wheelchair to the study hall or lab. The student with movement difficulties is introduced into the system through his smart wheelchair and through his mobile device. We will use CCA formalization to model the service.

3.1. CCA - algebraic semantics of contexts

The Ambient plays a major role in Calculus of Context-aware Ambients modeling. We can treat it as a limited space in which certain actions are carried out. Each Ambient has a name, a boundary, and may contain other ambients in itself, and be included in another ambient. Between two Ambients there are three possible relationships: parent, child and sibling. Each Ambient can communicate with other Ambients around it by sending and receiving messages. The notation "::" is a symbol for sibling Ambients; "↑" and "↓" are symbols for parent and child; "<>" means sending, and "()" - receiving a message. The Ambient can be mobile, i.e., to move within the surrounding space. In the CCA, four syntax categories can be distinguished: processes (P), capabilities (M), locations (α) and context expressions (k).

3.2. CCA modelling of intelligent wheelchair

The wheelchair has a variety of physical sensors that collect information about changing environmental parameters and interact with the modeled virtual educational space. We will consider the wheelchair (and the active area that it creates) as a separate Ambient, with internal Ambients: the student’s mobile device and the personal assistant PA that communicates with VES. When the wheelchair physically enters the university campus, an automatic identification process is started. After verification, VES sends a response to the student's PA, containing a list of appropriate services for him/her. When a wheelchair enters in the active campus zone, a guard assistant (GA) is activated to provide information on the activity and performance of the important zones for the wheelchair. Upon leaving the university campus, the active area of the wheelchair stops interacting with the learning space and follows the student's automatic logout, which terminates the use of the provided services.

The student with mobility disabilities gets all learning services from the educational space. After recognizing the wheelchair (and the student in it), the system activates Personal Assistant (PA) of the student, which takes care of the delivery of all the educational services and learning resources to the mobile device, like all other students. The specific services that the environment will provide to this student are mainly related to his / her mobility in the physical space of the university campus. Once the student receives the list of all services (sList) from his PA, he / she understands at which floor and in which room the relevant training session or exam will be held. This information must be delivered at a certain time before the event begins so that the student with the wheelchair can move to the appropriate room in the university building. The wheelchair has to pass through a series of important points (zones) such as ramps, lifts, opening doors and more. Each of these important points is provided with a collection of sensors that dynamically provide actual information to Guard Assistants (GA).

Once the PA receives information about the upcoming event, it sends a message to AmbiNet Ambient (ANet) in the Analytical Subspace asking for an appropriate route to be generated. ANet starts a bidirectional communication process with the corresponding GA for providing of up-to-date information from the physical world. After receiving the list of currently active zones from the GA, ANet Ambient generates a list of appropriate routes and sends it to the student's PA. From the received information, the student chooses a route and sends it to the Cart ambient. When the wheelchair moves in the physical campus, GA tracks its location and, when it is close to some of the important zones, activates the sensors associated with opening the doors, providing a lift, etc. If in real time any of the important zones changes its status and becomes inactive, GA promptly informs PA, which expects the student to choose a new route.

For the presentation of the CCA model of this service, we will use the following ambients: PA-personal assistant; AS-Analytical Subspace; ANet; GA; IoTN- IoT Nodes in real world. Let's imagine that the personal assistant received information about the lecture on Artificial Intelligence, which will take place in a 422 study hall at 10 o'clock. CCA processes of these ambients can be modeled as follows:

$$\mathrm{P}_{\mathrm{PA}}= \begin{pmatrix} !::(lecture\_AI, room\_422, time\_10).AS::<location, room\_422, PAi>.0 \mid \\ !AS::(listRoutes).0 \end{pmatrix}$$

$$\mathrm{P}_{\mathrm{AS}}= \begin{pmatrix} !PA::(location, room\_422, PAi).ANet\downarrow<location, room\_422, PAi>.0 \mid \\ !ANet\downarrow(listRoutes, PAi).PA::<listRoutes>.0 \mid \\ ANet\downarrow(room\_422, PAi).GA::<room\_422, PAi>.0 \mid \\ GA::(listIZ, PAi).ANet\downarrow<listIZ, PAi>.0 \end{pmatrix}$$

$P_{ANet}= \begin{pmatrix} !AS \uparrow (location, room\_422, PAi).AS \uparrow < room\_422, PAi >.0 \,| \\ !AS \uparrow (listIZ, PAi).AS \uparrow < listRoutes, PAi >.0 \end{pmatrix}$

$P_{GA}= \begin{pmatrix} !AS :: (room\_422, PAi).IoTN ::< PAi >.0 \,| \\ IoTN :: (listIZ, PAi).AS ::< listIZ, PAi >.0 \end{pmatrix}$

$P_{IoTN}= \left(!GA :: (PAi).GA ::< listIZ, PAi >.0\right)$

3.3. Verification scenario by ccaPL – simulator

For describing of CCA processes, the programming language ccaPL was created. The interpreter of ccaPL has been developed as a Java application. Based on the main version (Al-Sammarraie, 2011), we developed a special simulator for verifcation the scenario described above. The notation "A === (X) ===> B" means that Ambient "A" sends an "X" message to Ambient "B". "Child to parent", "Parent to child," and "Sibling to sibling" provide information about the relationship between sender A and recipient B according to the hierarchy of ambients. The scenario that we presented has the following ccaPL program realization:

PA

[AS::send(location,room_422,PAi).0|AS::recv(ListRoutes).0]|

AS

[PA::recv(location,room_422,PAi).ANet#send(location,room_422,PAi).0|

ANet#recv(room_422,PAi).GA::send(room_422,PAi).0|

GA::recv(ListIZ,PAi).ANet#send(ListIZ,PAi).0|
ANet#recv(ListRoutes,PAi).PA::send(ListRoutes).0|

ANet

[AS@recv(location,room_422,PAi).AS@send(room_422,PAi). 0|

AS@recv(ListIZ,PAi).AS@send(ListRoutes,PAi).0]]|

GA

[AS::recv(room_422,PAi).IoTN::send(PAi).0|

IoTN::recv(ListIZ,PAi).AS::send(ListIZ,PAi).0]|

IoTN[GA::recv(PAi).GA::send(ListIZ,PAi).0]

Implementation of the CCA-model in the ccaPL environment allows to track the processes of the participating ambients as well and the sequence of the sent and received messages between them. The animator allows visualization of the participating ambients, their location and processes.The processes of all participating ambients can be traced to each step of the scenario implementation, which makes it possible to immediately identify inconsistencies, errors and inaccuracies (Figure 3).

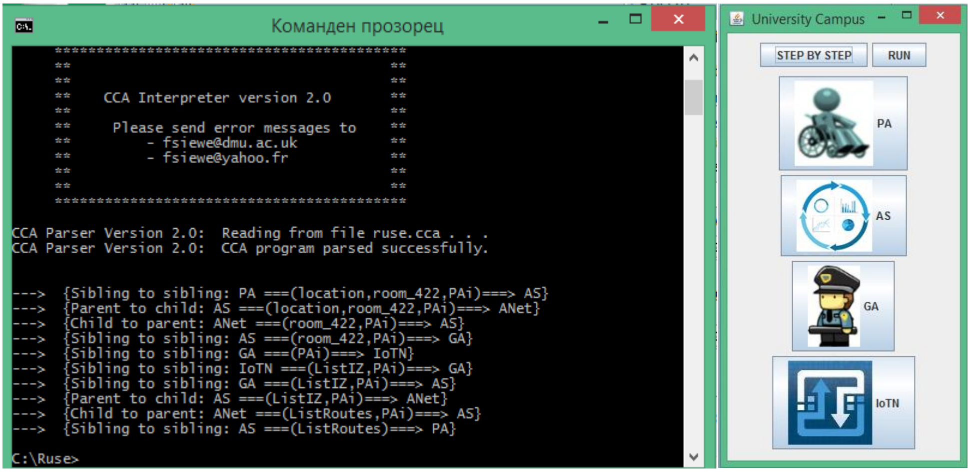

Figure 3. Implementation of the scenario in the simulator

Source: Own work

4. IMPLEMENTATION OF THE TOURIST GUIDE IN LIFELONG LEARNING IN VES

The main objective of LLL (Life Long Learning) is continuous personal development. This determines the vast variety of pedagogical technology and educational systems. LLL integrates equally all categories of educational activity (formal, non-formal and informal) and provides an opportunity for education and training of individuals from an early childhood age throughout their entire conscious life.

The basic architecture of VES is built up of different intelligent assistants, which can assist these directions for lifelong learning. Informal education is inherently self-training or self-education. As part of the realization of the module for informal education in VES a tourist guide is being developed for the cultural and historical heritage of Bulgaria. The Tourist Guide (TG) is a specialized assistant intended to support lifelong learning in VES (Ivanova, Toskova, Stoyanova-Doycheva & Stoyanov, 2017). Its main task is to generate a tourist route for users according to their wishes and location. The route includes cultural historical objects and information about them. In this way, the user enriches his / her knowledge of the region for which the route is generated. The TG can be used in defferent educational organizations for informal learning in Biology, Geography and other natural and social subjects.

The life cycle of the TG includes the following basic steps:

- A tourist inquiry – in order to "get acquainted" with the tourist, the TG conducts a brief survey, which gathers information about the tourist's personal preferences and interests, as well as the time available to him or her.
- Selection of appropriate cultural and historical objects – using the information from the survey, the guide chooses objects to visit in the area that would be of interest to the tourist.
- Generation of a tourist route – from the selected set of cultural and historical objects, the system prepares a route taking into account the physical characteristics of the area to visit, such as its location, distance, working hours, and time available to the tourist. Because of any planned or occasional events (e.g. incidental failure to view the object), individual objects can be excluded. The route also offers a sequence for viewing the selected objects.
- Route realization – the tourist can choose one of the two options to realize the route: virtual tour – the TG provides information about selected cultural objects in the form of text, photos and videos, depending on the information stored on the system server; real walk – the TG assists the tourist during their visit and viewing of the objects.

Each object has two types of presentation on the guide's server:

- A cultural and historical object (CHH objects) – depending on the nature of the presentation, it includes different features in accordance with the CCO standard.
- Ambient – for characterization of the location and condition as a physical feature in a real location (area) of a separate CHH object or a group of CHH objects, designated as an exposition.

In reality, the TG is a multi-agent system that includes intelligent and executive (reflex) agents. The life cycle architecture includes two basic components:

- back-end component: it consists of different modules, distributed in two layers – a knowledge base and operational assistants performing the tasks of gathering information for the client's needs and generating it in an appropriate cultural and historical route;
- Front-end component: it consists of an intelligent assistant that takes care of presenting the route and object information to the client's mobile device using the information generated by the operational assistants in the back-end layer.

The active modules of the back-end component are the following assistants (Figure 4):

- QGA (Questioner Generation Assistant) – the responsibility of this operational assistant is to generate and conduct a survey with the tourist to identify his or her preferences, wishes, and time available. The survey results are used to generate a tourist profile.

- KGA (Knowledge Generation Assistant) – using the tourist profile, the assistant selects the elements of the primary route. The primary route elements are expositions or separate CHH objects.
- CCAA (Calculus of Context-aware Ambients Assistant) – it generates a final route by completing the primary route with additional information such as the location and status of the expositions (or individual objects), the working time, etc. The assistant uses the ambient presentation of the CHH objects included in the primary route. In fact, the final route is a set of possible sequences for viewing the objects.

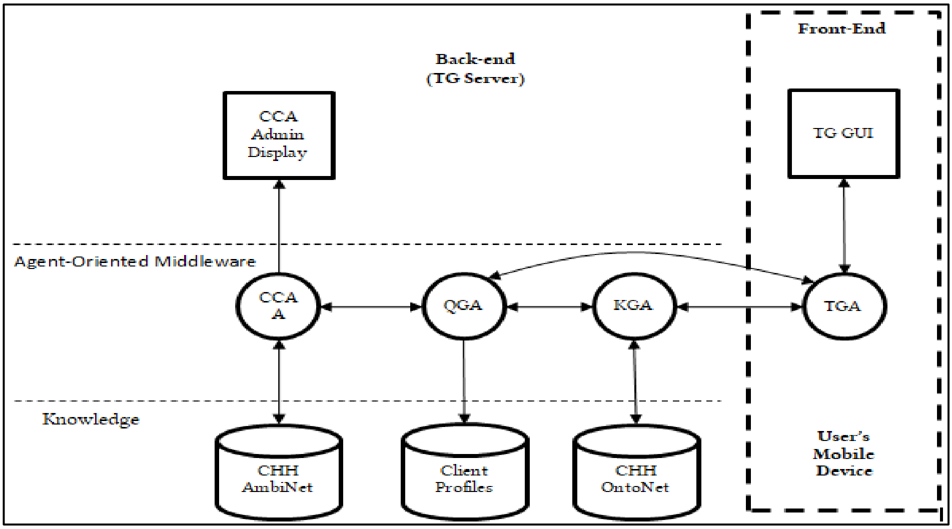

Figure 4. General architecture of the TG

Source: Own work

The TGA (Tourist Guide Assistant) operates in the Front-end component and performs the following basic functions:

- It serves as a tourist's GUI – the tourist can only communicate with the guide through this assistant. This agent is responsible for the proper visualization of the information received from the operating agents on the client's mobile device. It visualizes the questions that the QGA generates and returns the received answers back to it. It is responsible for visualizing the information about the various cultural and historical objects and for visualizing the route generated by the CCA.
- Establishing the tourist location – by using the GPS capabilities of the client's mobile device to determine his or her position.
- Life Cycle Management – it prepares a "schedule" for visiting the cultural objects and follows its observance.

4.1. The ontology knowledge base - CHH-OntoNet

CHH-OntoNet tourist guide is a server component, which takes place into Knowlage base is a repository implemented as a network of ontologies. It has two main functionalities:

- Defining expositions of interest to the tourist;
- Preparing information about the objects included in the offered tourist route.

Ontologies are developed in accordance with the Cataloging Cultural Objects (CCO) standard, which contributes to the easy and convenient dissemination and sharing of data between different systems, communities, and institutions. Currently, there are ten ontologies that have been developed. Almost all of them represent different aspects of the CHH objects and one, titled Meta-ontology, that contains information about the other ones. The purpose of Meta-ontology is to support working with the ontology network, especially when the survey is created.

The ontologies that describe CHH objects are Costumes, Expositions, Museums, Objects, Materials, Locations, Folklore Regions, Agents, and Subjects. The division of the knowledge into multiple separated ontologies is important for two reasons. First, it makes it easier and more convenient to follow the requirements of the CCO standard. And second, it is an effective way of distributed maintenance and editing the knowledge in the ontologies. Also adding new knowledge to one or more ontologies is relatively easy. Currently, the CCH objects stored in the ontologies are traditional Bulgarian costumes, along with information about the expositions and museums in Bulgaria where they are kept.

One of the important things about developed ontologies is that all of them are interrelated. For example, Costumes is one of the main ontologies and contains descriptions of the Bulgarian costumes. It references knowledge from other ontologies – for example, clothes as a type of object (along with their basic characteristics) are described in the Objects ontology. The Objects ontology, in turn, uses concepts about materials (needed for the object creation). These terms are defined and described in the Materials ontology. The descriptions of the folklore regions of Bulgaria, represented in the Folklore Region ontology, use knowledge from the Locations ontology (cities within the regions, mountains, rivers, plains, and other geographical locations). The museums with their architecture and history are described in the Museums ontology. They are regarded as objects of cultural and historical heritage but also as the place where the expositions or costumes are preserved and can be seen. Accordingly, some of the knowledge needed to describe the museums is also defined in other ontologies, for example the materials for the construction of a museum are contained in the Materials ontology. Expositions with their characteristics and objects included in are described in the Expositions ontology. The museums and exhibitions as an object were created by someone, i.e. knowledge from the Agents ontology is used and, by analogy to costumes, they are also defined in the Objects ontology. The

Subjects ontology contains knowledge about the historical period of the described objects, which is used in the Costumes, Museums and Expositions ontologies.

The CCO standard uses two components required for describing data: work records and authorities. Work records all items or records that are described. Currently, three types of work records are presented in the ontologies. The first one is Bulgarian traditional costumes used in different folklore regions of Bulgaria. The second type of work record is the expositions that contain the costumes. And the last one is museums where expositions, respectively costumes, are located. The last two objects are considered as stand-alone work records because of the characteristics they have. But also they can be regarded as Personal and Corporate Name Authority. All left ontologies that described some of aspects of Bulgarian cultural-historical heritage represent some authority. For example, Locationas and FolkloreRegions ontolgoies correspond to the Geograhy Place Authority.

4.2. CHH AmbiNet

To model the scenarios in the CHH AmbiNet we will use the Calculus of Context-aware Ambients (CCA), which enables mobile ambients to respond to environmental changes. Contextual expressions are used to ensure the fulfillment of a given option only under certain environmental conditions, i.e. in a particular context.

In the CHB AmbiNet (Figure 5) we realized CCA modeling of the following service: Generating a route with a visit to requested objects determined by a tourist survey. The following figure presents the main ambients in the CHH AmbiNet and the interaction between them.

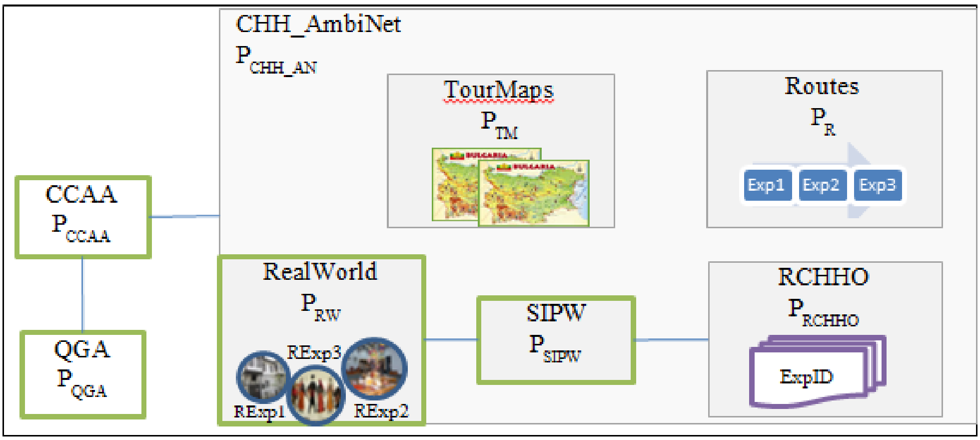

Figure 5. CHH AmbiNet

Source: Own work

The search for suitable tourist routes can be realized through different algorithms. Since the tourist map with the location of all objects is known, one way to improve the search efficiency is to set a limited number of open-to-visit expositions with tourist objects (islands) through which the search is done with fewer steps. For example, if we are looking for a path between a tourist's current location and the furthest tourist destination, it is appropriate to limit the search to a few steps: first to the nearest object, then to some of the other ones and so on, to the furthest object. Intuitively, these particular positions are the Search Graph islands, which are required to be a mandatory part of the route to move from a location to a destination. Once the islands are identified, we can break the common problem of searching into several simpler problems. This reduces the search space because, instead of dealing with one solving problem, a few simpler ones are considered.

This helps to reduce the search volume and is an example of how we can dynamically use the incoming information from the real world to improve the search efficiency. The search for a path between the current location and the destination by using this approach is realized using the following formally described algorithm:

- Identify a set of objects (islands) $i_0,\ldots,i_k$
- Find paths from a location to i_0, from i_{j-1} to i_j for each j, and from i_k to a destination.

Each of these problems is expected to be simpler than the common one and therefore easier and quicker to solve. The preliminary identification of the islands is of particular importance, as the use of inappropriate islands can make the problem even more difficult than the original one. It is also possible to determine an alternative decomposition of the problem by selecting a different set of islands. For each selection of islands, the complexity of the algorithm is different. This algorithm does not guarantee the detection of an optimal route but it ensures the discovery of one or several possible routes. If we want to provide the tourist with the optimal route, we need to additionally implement an optimization algorithm. In the presented model, the time for providing a route is limited, and so are the computing resources, which determine the choice of the considered search method.

4.3. CCA Admin Display Module

The CCA Admin Display module is designed to track the processes in the scenario implementation. For this purpose, simulators of the presented tourist services have been developed. We will look at a simulator described in the presented CCA model which tracks the processes of searching and discovering a tourist route.

Based on the basic version of ccaPL environment, a special simulation is developed to track the processes of the personalized contextual-sensitive tourist guide. The output data from the environment is difficult to read without prior knowledge of the CCA formalization. For ease of use, an animator for the ccaPL environment has been developed.

The System administrator can track the implementation of a model scenario in simulation mode both via a console and the animator in the ccaPL environment.

For example, after a dialogue with the tourist, let the QGA identify three objects for a visit in the primaryRoute – traditional costumes from the Rhodope region, traditional crafts and Renaissance houses, and let the tourist's mobile device identify his or her location in the town of Smolyan. The QGA transmits the location and the primaryRoute to the CCAA, which transfers this information to the CCA_AmbiNet. There, after a dialogue between the ambients described, it is established that the three desired objects are physically located in three separate expositions that are currently open for visits. The search method described defines the location of the nearest exposition, then the next one, and so on, until generating several possible visit routes – the ListFinalRoutes. This list is transferred to the tourist and after he or she chooses a route, the PTG launches the next services related to visiting the objects (Figure 6).

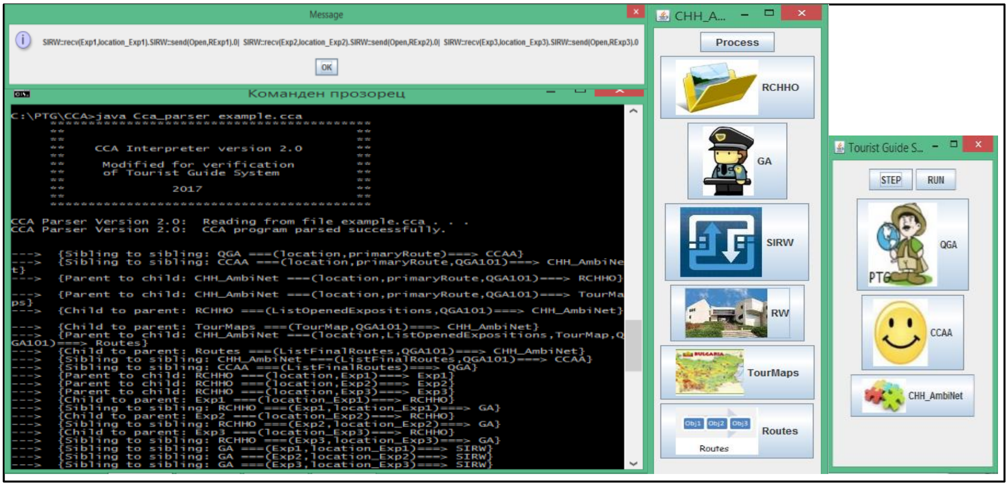

Figure 6. An animated ccaPL simulator of LLL Tourist Guide

Source: Own work

CONCLUSION AND FUTURE WORK

For years, VES has been used to support the educational process at the Faculty of Mathematics and Informatics of Plovdiv University. The space is supported by various types of components. The active components are personal and operative assistants specified as rational BDI agents (Wooldridge, 2009). The agents are implemented by help of the JADE (Bellifemine, 2007) and JADEX (Pokahr, 2003] development environments. Because agents are not suited to provide functionality, they are combined with services including micro-services. Furthermore, two different applications of the VES are presented in more detail.

There are several directions for the development of the VES. One of these is a transformation in a reference architecture applicable to new domains such as smart city, smart environment, and smart medicine. With respect of the Touristic Guide, we are going to extend the repository with new objects belonging to the Bulgarian cultural and historical heritage.

Acknowledgements

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E-LEARNING APPROACH IN MATHEMATICAL TRAINING OF FUTURE ECONOMISTS

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Abstract: *The inclusion of e-learning methods in education enables teachers to create modern learning resources, to provide support in the self-study of students, and motivate them to acquire knowledge actively. The main objective of this paper is the analysis of possibilities of adopting the e-learning approach in mathematics education. The research sample was focused on students in economic bachelor study program that includes compulsory mathematical subjects. Through the survey, we examined whether students use electronic materials in mathematics study. Via a statistical two sample t-test we evaluated students' exam outcomes in mathematical subjects.*

Keywords: mathematics teaching, e-learning, LMS Moodle, exam outcomes, two-sample t-test.

INTRODUCTION

The university education of new experts in the field of economics and management has undergone various changes and modifications. They reflect the process of transformation of education, which is related to changes in educational content and also to modernization in the forms of education. Results of the development and implementation of information and communication technologies are recognizable at all levels of education: elementary and secondary schools, universities and lifelong learning. The requirements of the current society for the training of professionals are also changing the process of mathematical education.

There are many different factors in the learning process that represent the subjects, means and circumstances of learning. Therefore, education analysis involves the effects of many factors and often brings new observations and findings. The integration of modern educational tools and methods into teaching is a part of the work of the university teacher. The role of teachers is to explore the interaction between traditional and modern teaching methods.

Everyone who comes in contact with school education (teachers, parents, education authorities, etc.) is aware that the learning process is also dependent on the following factors (Průcha, 2005): what students are taught, how many students are in the study group, whether the teacher is an experienced teacher or a novice teacher, whether the learning process is equipped with good textbooks and study materials, and so on. The mentioned factors belong to the input determinants of educational processes that affect the level of the educational process. In a wider sense, the quality of education is also conditioned by another determinant, which is the level of information technologies and the degree of their implementation in the activities of the educational process. The significant features of new media are:

- Transmitting of information by interactive means,
- Double-sided communication,
- Combined information including image, sound and traditional text,
- Multilevel information: user can follow the text in different directions (hypertext),
- Networks, e-mail and multimedia and combine forms of data storage on media,
- Mobile resources and access to study materials "anytime and anywhere".

Study materials in electronic form are created and used at all universities and for all taught subjects included in the study programmes. Some study materials and books are available on the Internet in pdf format, in the form of web pages, or we can study books in electronic form directly through so-called "readers". Pedagogical empirical research and practical experience of educators confirm that students in both the daily and external forms of study are interested in learning with e-learning methods with the use of information technology (IT) (Országhová et al., 2010).

Due to the dynamic development of mobile technologies, the current student is not bound to one place and a specific computer in e-learning form of study. Many educational institutions or providers of distance learning forms are aware of the possibilities of mobile technologies and adapt the form of materials suitable for to the method of M-learning (mobile learning).

The use of Learning Management Systems in higher education has greatly increased and has a strong impact on the educational process from the aspect of both the educator and the educated student (Cerezo et al., 2016). In addition, as it is stated by Alajbeg et al. (2017), the implementation of LMS in the teaching process offers a wide range of benefits: reducing the administrative work of teachers, reducing the possibility of errors in the preparation, execution and evaluation of examinations; eliminating the subjectivity of the teacher during the assessment phase; reducing inappropriate student actions during examinations, etc.

In many studies it is confirmed that one of the main tasks of education should be the increase in student's motivation to learn and motivation factors influencing the student's learning, include internal motivation of students, teacher's personality, suitable educational methods, attractive educational environment and other (Ferenczi Vaňová et al., 2014).

Nowadays, the information and knowledge society requires a modern teacher to master and use available IT resources to form new opportunities for students to realize creative self-study. Activities such as virtual meetings, learning management systems for educational process support, online tutoring, and social media are also part of the teachers' activities (Smyrnova-Trybulska et al., 2017).

1. MATHEMATICS STUDY COURSES IN LMS MOODLE

Implementation of information technology into mathematics teaching brings a number of professional and didactic tasks. The basic scheme of the contemporary university education (Figure 1) integrates IT - supported study with the contact teaching and self - study.

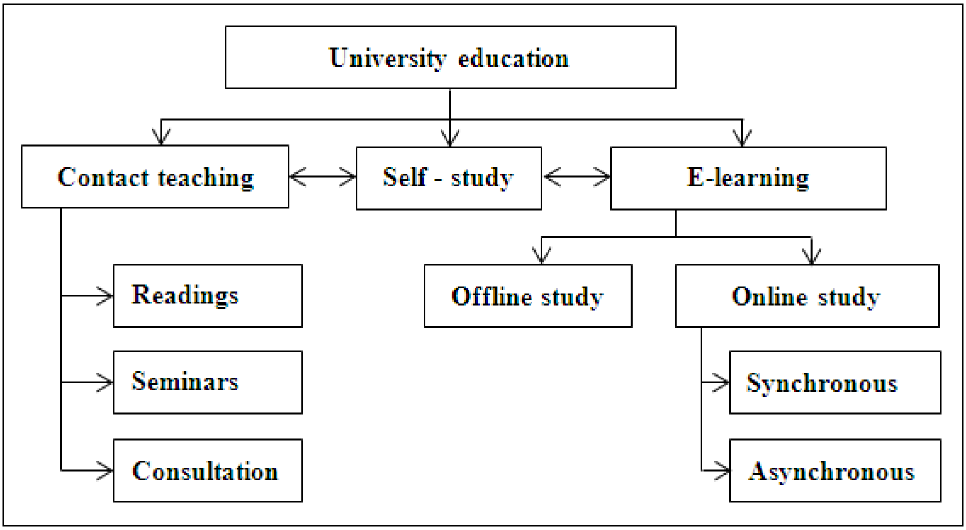

Figure 1. The scheme of university education
Source: Own work

As Turek (1997) states, we can use programmed instruction to implement e-learning, which is based on the following main principles: the principle of small steps, the principle of active response, the principle of immediate fixation, the principle of individualization and the principle of evaluating and improving the programme.

The research work material for this paper was obtained from the teaching of compulsory subjects Mathematics IA and Mathematics IB at the Faculty of Economics and Management (FEM), the Slovak University of Agriculture (SUA) in Nitra. The methodological approach is based on the analysis of lectures, exercises and exam outcomes, which are presented also in graphic form. Next material was received from the research projects of the Department of Mathematics, which were focused on the implementation of IT tools in education and from conducted survey about usage of electronic study sources by students of the Faculty of Economics and Management.

Teachers from the Department of Mathematics SUA in Nitra created in LMS Moodle electronic courses for mathematical subjects taught in the Slovak language:

- Course "Exercises in Mathematics (Winter Term)" for the study subject Mathematics IA,
- Course "Exercises in Mathematics (Summer Term)" for the study subject Mathematics IB,
- Special course for seminary projects: students get seminar assignments and submit solutions via tools of LMS Moodle.

The content of the next course "Mathematics" (Figure 2) is in line with the study subject Mathematics that is taught in English: Matrices, Systems of Linear Equations, Functions of one real variable, Limit of the function of one real variable, Derivative of the function of one real variable and applications, and Indefinite and definite integrals of the function of one real variable.

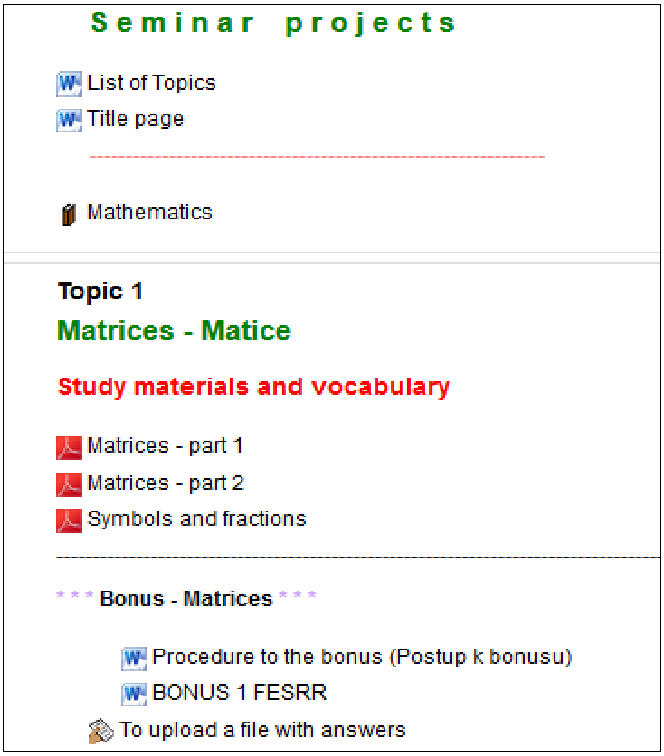

Figure 2. The topic "Matrices" in LMS Moodle course "Mathematics"
Source: Own work

Technically, LMS Moodle provides a user-friendly interface that does not impose special requirements on users, teachers and students. The user applies an Internet browser environment and uses hyperlinks.

2. APPLICATION OF ELECTRONIC LEARNING SOURCES

2.1 Survey about information and study sources for students

The Department of Mathematics SUA in Nitra has been using LMS Moodle in mathematics teaching for several years. Tools of LMS Moodle are effective for teachers who can realize the blended learning in mathematics. Electronic support in a mathematical study can be applied during lectures, seminars and individual study and elaboration of seminary projects. Special activities were created in this system, and during the semester students could earn bonus points for work in LMS Moodle counted in the final evaluation.

The most effective common used tools in the creation of the electronic courses for mathematics are:

- Resources (File, Folder, Page and URL),

- Activities (Assignment, Questionnaire, Quiz and Upload a single file).

During the academic years 2015/2016 and 2016/2017, we have conducted a survey among students of the study program Business Economics, which was focused on the usage of electronic learning resources. The survey was realized in the summer semester of each academic year, when students master the LMS Moodle tools from the winter semester and have information about educational materials. The main objective of the survey was to find out the extent of use of available study materials in electronic form in LMS Moodle, especially during the preparation of students for the mid-term test and for the exam. The survey included 143 students of the first year of the Business Economics study program; we received 78 answers in 2016 and 65 answers in the 2017. The distribution of the research sample by gender was as follows: men 29 % and women 71%. The responses were processed using descriptive statistics and the final results are presented in the graphical form.

2.2 Analysis of the survey outputs

In this part we present the evaluation of three selected questions of the survey.

Question no. 1:

Please, indicate which school information sources/systems are you using?

- E-mail to the teacher,

- E-mail to students,

- LMS Moodle,

- Web page of the faculty,

- University information system (UIS).

Students could indicate all the options they use. The obtained results are demonstrated in Figure 3. University information system is used almost by all students (98% in 2017 and 96% in 2016). This information source is followed by faculty web page (more than one half of students). The usage of LMS Moodle was declared by 39% of students in 2017 and 45% in 2016; in general we can say that less than half of the students of this research sample. This value is followed by mail communication between classmates and teachers. Electronic math communication via mail is difficult because mathematical formulas require special editors and browsers. Students write simple text in the mailbox, and the most they ask for organizational teaching matters.

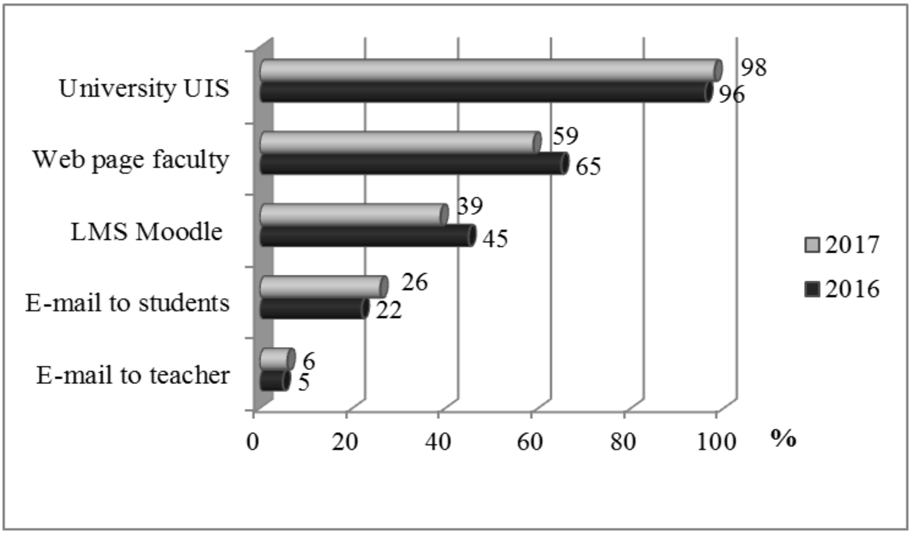

Figure 3. Usage of information sources/systems by students

Source: Own work

Question no. 2:

Please, state how often do you use math's study materials in LMS Moodle in individual activities?

- During the semester: a) often, b) rarely, c) never,

- In preparation for the exam: a) often, b) rarely, c) never,

- When developing a seminar project: a) often, b) rarely, c) never.

The responses to the second question (Figure 4) show that during the semester students did not use very often the study material in the LMS Moodle, only a part of the students mentioned this activity (15%). Only one fifth of the students (22%) actively use the LMS Moodle system to develop a seminar project. In the study for the exam, educational materials in LMS Moodle are used approximately by one third of the students (29%). More than half of the students said they did not use LMS Moodle during the semester (52%). We can conclude from these answers that it is necessary to create more mandatory activities in the LMS Moodle system during the semester (e.g. individual study assignments) that will be evaluated by teacher and the student will acquire so-called bonus points for the interim evaluation.

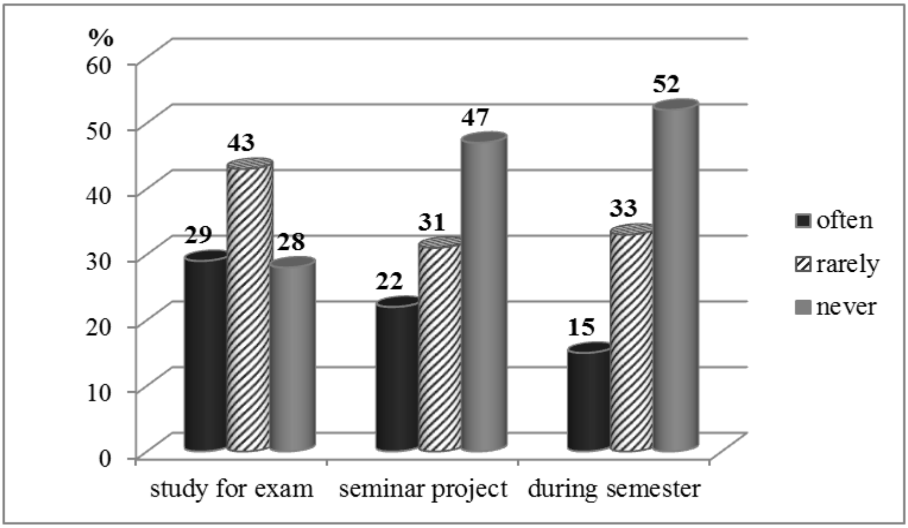

Figure 4. Frequency of the usage of LMS Moodle in mathematics study

Source: Own work

Question no. 3:

Please, declare your use of the learning resources in the mathematics study (together 100%):

a) Notes from classes,

b) Notes from lectures,

c) Printed textbooks,

d) Study materials in LMS Moodle,

e) Other resources (e.g. Internet, classmates ...)

In this question the students were asked to rate the extent of the usage of available learning resource in the study of mathematics. They proportionally divided the value of 100% and the results confirm (Figure 5) that they mostly use their own written notes from classes (43%) and lectures (28%). This is followed by printed learning materials (15%), and materials in LMS Moodle are used to a lesser extent (only 9%). This result corresponds to the character of the subject matter, because mathematics requires in particular the practice of computations in examples and graphical interpretation of mathematical objects (e.g. function graphs). This is also the reason why students have assignments in LMS Moodle, math tasks and exercises in a print-ready format to use them in their homework and study.

In this research sample the results confirm that most students use general information from the University Information System (UIS), in which they also have e-mail accounts and access to e-mails of their teachers and classmates. They use LMS Moodle, but some of the activities are not mandatory, so they do not use them often during the semester or in the exam preparation. We assume that their activity can be increased and the created materials can be used to improve and motivate the individual study of students.

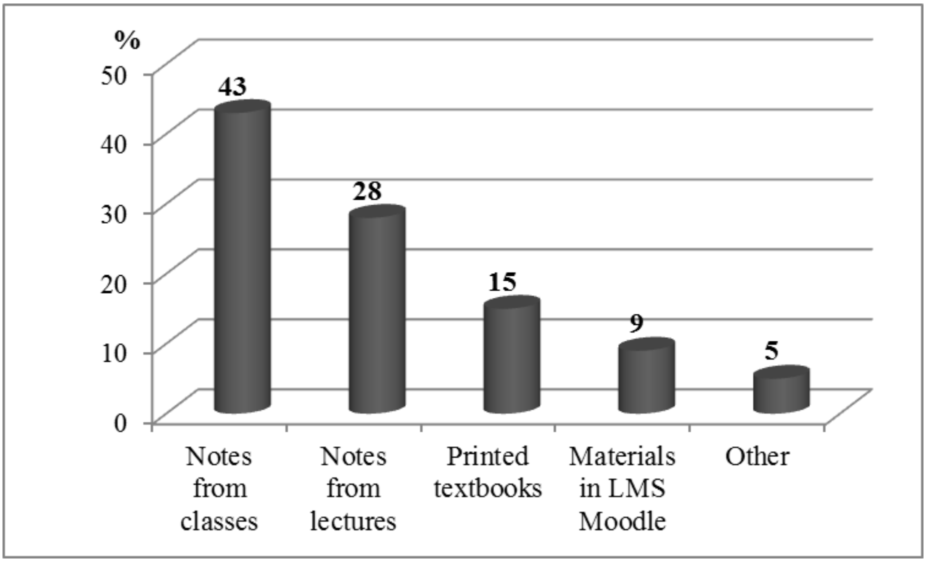

Figure 5. Usage of mathematics study materials

Source: Own work

3. ASSESSMENTS AND EXAMS IN MATHEMATICS

3.1. Analyzed research sample and statistical methods

During two academic years 2015/2016 and 2016/2017 a survey about exam outcomes was carried out at the Faculty of Economics and Management. The main objective was to compare the results of the exam grades of compulsory mathematical subjects. The research sample was created from students of this faculty, specifically of the study program “Business Economics” in the 1st year of bachelor degree study.

The statistical evaluation of the exam grades was realized via the two sample t-test. We tested the null hypothesis $H_0 : \mu_1 = \mu_2$ versus the alternative one $H_1 : \mu_1 \neq \mu_2$.

As a test criterion we applied:

$$t = \frac{\overline{X} - \overline{Y}}{\sqrt{S_p^2 \cdot \left(\frac{1}{n} + \frac{1}{m}\right)}},$$

where $\overline{X}, \overline{Y}$ are selection averages, S_p^2 is mutual variation. Critical region is the set $W_\alpha = (-\infty, -t_\alpha(n+m-2)) \cup (t_\alpha(n+m-2), \infty)$, where $t_\alpha(n+m-2)$ is the critical value of Student's *t*-distribution with $n+m-2$ degrees of freedom.

3.2 Comparison of exam outcomes in compulsory mathematical subjects

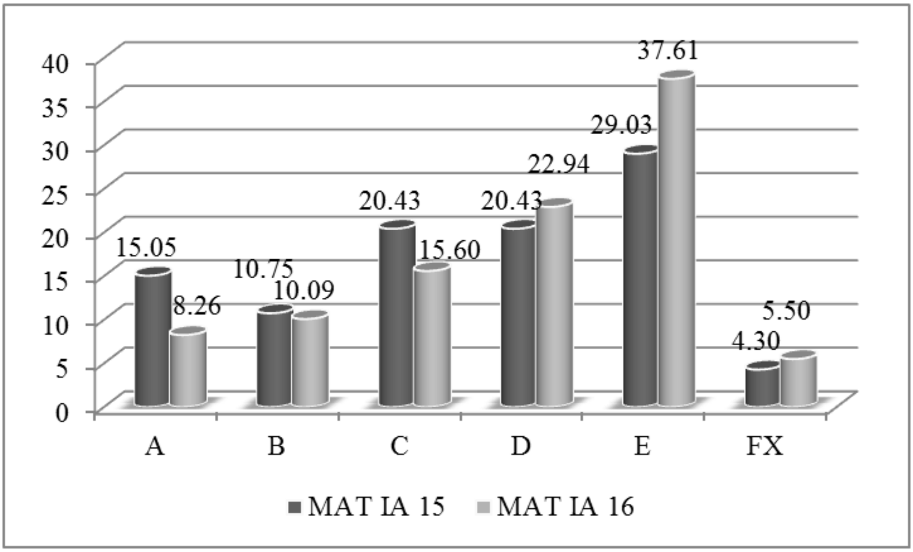

Figure 6. Comparison of exam grades in Mathematics IA (percentage)

Source: Own work

In study programme "Business economics" there are involved two compulsory mathematical study subjects: Mathematics IA (MAT IA) and Mathematics IB (MAT IB). We present the statistical analysis of exam grades of these subjects taught in academic years 2015/2016 and 2016/2017. We have two statistical samples of range $n_1 = 180$ (in academic year 2015/2016) and $n_2 = 208$ (in academic year 2016/2017). We analyze two statistical attributes – the first one signed by MAT IA is the exam grade of the subject Mathematics IA (winter semester), the second one signed by MAT IB is the exam grade of the subject Mathematics IB (summer semester). The standard evaluation scale is from A(1) to E(3) and FX(4) mean failed. Figures 6 and Figure 7 display the graphic presentation of exam outcomes in academic years 2015/2016 and 2016/2017. To compare the success of the students on the exam, we have expressed the number of individual grades in percentage.

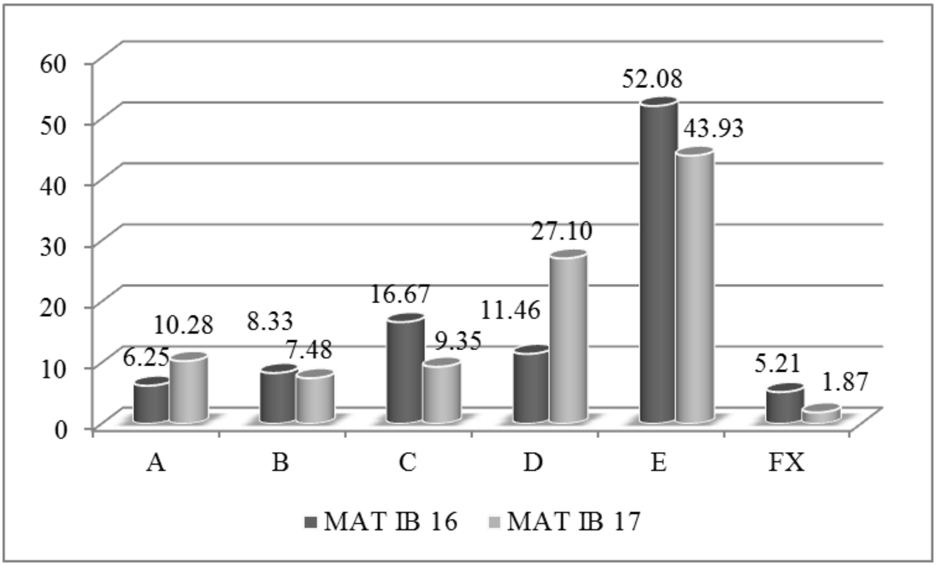

Figure 7. Comparison of exam grades in Mathematics IB (percentage)

Source: Own work

In the Table 1 there are average grades of analyzed study subjects. We can also conclude the decreases in the value of the average mark between study subjects, even between years (Table 1).

Table 1.

Average grades in study subjects Mathematics IA and IB

Year	**2015/2016**		**2016/2017**		**2015 - 2017**	
Subject	MAT IA	MAT IB	MAT IA	MAT IB	MAT IA	MAT IB
Average grade	2.2	2.5	2.38	2.44	2.29	2.45

Source: Own work

It is evident that in both academic years the final exam evaluation by the grade E(3) is the most common in examined subjects (Figure 6, Figure 7, Figure 8).

The presented comparison confirms that in the summer semester students have worse grades evaluation (MAT IB) than in the winter semester (MAT IA). Average grades are in the range from 2.2 to 2.45, which is approximated by the exam grade D (2.5). Very important is the fact that a part of students drop out after the first semester because they have inadequate knowledge and study habits from the secondary school.

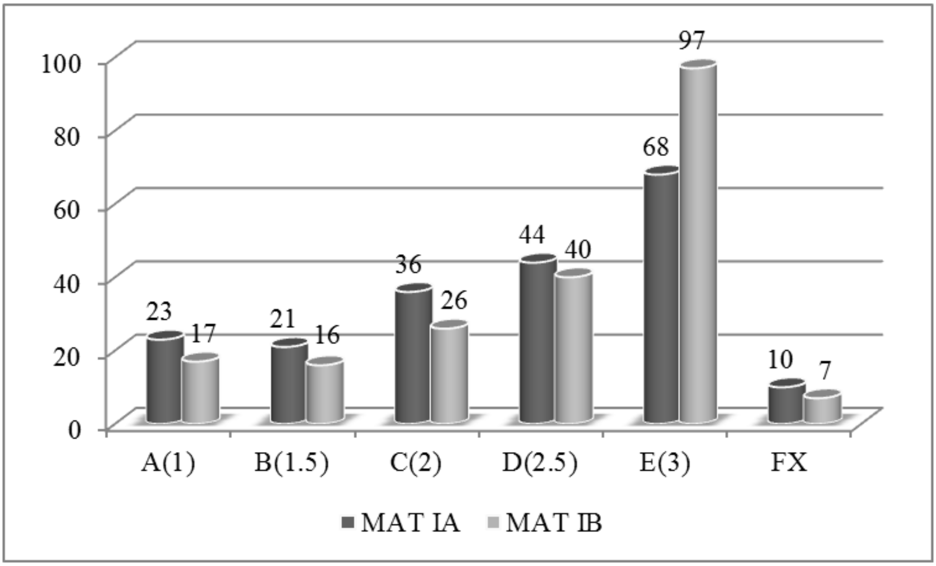

Figure 8. Exam grades in MAT IA and MAT IB (absolute frequency)

Source: Own work

3.3 Statistical analysis of exam grades

Using the method of a two sample t-test (listed above) we verified null hypothesis.

H_0: Students achieve the same level of exam assessment in Mathematics IB as in Mathematics IA.

In the Table 2 there are summarized presented results of statistical hypothesis testing. The level of assessment is represented by exam grades in mentioned study subjects. We tested the data about students' exam grades and we did not take into account the evaluation FX. The calculations of statistical characteristics were performed using the table processor MS Excel 2010.

In the academic year 2015/2016 the null hypothesis is not accepted at the significance level $\alpha = 0.05$ because the value (two-tail) $P = 0.003 < 0.05$; therefore differences between exam grades in Mathematics IA and Mathematics IB are significant.

In the next academic year 2016/2017 the null hypothesis cannot be rejected at the significance level $\alpha = 0.05$. We have obtained the result for P value (two-tail) $0.48 > 0.05$; therefore differences between exam grades in given subjects are not significant. Because the calculated value of the test criterion $t = 0.697$ did not exceed the critical value of Student t-distribution 1.971, the null hypothesis cannot be rejected.

Table 2.

Results of two-sample t-test on exam grades in Mathematics IA and IB

Year	2015/2016	2016/2017	2015 - 2017
Observations	MAT IA: 89	MAT IA: 103	MAT IA: 192
Observations	MAT IB: 91	MAT IB: 105	MAT IB: 196
t Stat	-2.98	-0.697	-2.52
P(T<=t) one-tail	0.0016	0.24	0.006
t Critical one-tail	1.65	1.65	1.64
P(T<=t) two-tail	0.003*	0.48	0.012*
t Critical two-tail	1.973	1.971	1.966

Source: Own work

When we tested exam grades together for both years, 2015/2016 and 2016/2017, we found that the differences in grades are significant. The null hypothesis cannot be accepted at the significance level $\alpha = 0.05$ because the value (two-tail) $P = 0.012 < 0.05$. The test criterion $t = 2.52$ exceeded the critical value of Student t-distribution 1.966 and therefore we reject the null hypothesis.

The winter and summer term are interconnected in different thematic areas. For example, properties and function graphs in the theory of functions (winter term) are used in the tasks with definite integrals for calculating the area of planar body. The graphical outputs for this issue are available to students in LMS Moodle courses. The assessment of the students' knowledge level is the important part of the educational process. However, the obtained data indicate that teachers and students cannot be satisfied with study outcomes, especially with the average exam grade.

4. DISCUSSION

Průcha (2005) defines the effects of education as "indirect implications of the interaction between learning outcomes and the social environment". He further states that the education has a considerable impact in many practical fields: professional careers, the complexity of the work performed, wages of workers, employment, education and media behavior of people and others. Changes in demographic trends, the structure of population, the population mobility and other factors influence the process of university education in its qualitative and quantitative aspects (Papcunová and Gecíková, 2012).

Majherová (2010) states that technologies have become the part of the implementation of many tasks contained in current education. And the author continues that the findings of the revised Bloom's taxonomy extend the digital application of the Bloom's taxonomy for new learning conditions, created by the Churches (2008). It consists in interconnecting the individual levels of Bloom's taxonomy to specific pupil's/students' activities when using ICT; e.g. digital extension of the level "remember" means "find, highlight and create a bookmark".

The digital literacy includes the ability to understand information and use it in various formats from various sources presented through ICT. Based on Bloom's digital taxonomy via e-learning we can effectively apply such activities as: "apply, understand and remember" also in mathematics.

As Burgerová and Adamkovičová (2014) report, e-learning is the education realized in an environment supported by information and communication technology (ICT); this form of education is applied in university education especially for the following reasons:

- Reduction of hour range of the contact teaching,

- Increased requirements for self-study and individual student activities,

- Innovation of study programmes,

- The new demands of the young generation on education,

- Faculties' sustainability due to the demographic decline in the number of students,

- Virtualization of the learning process as well as the processes of everyday life.

Education becomes the key factor in the information society, and its aim is to ensure that people are able to find and understand the information, and then apply them correctly. A great advantage of the implementation of IT tools into the process of mathematics education is better explanation and visualization of the mathematical concept (Országhová, 2017).

The contemporary educational process includes more and more effective and different teaching and learning tools. Pupils in elementary and secondary schools have experience with educational games which can eliminate cognitive shortcomings in attainments (Hosťovecký et al., 2015). Interactive tasks that use information technology, mathematical software and programming elements have practical applications in computational modeling that helps solve practical issues with scientific methods (Kočí et al., 2017).

Many research studies compare used media in e-learning; the research with meta-analysis of obtained data indicates that games as a special medium of education assist in efficient learning (Clark et al., 2016). In the university study the application of mathematical programs, online calculators and interactive tools is the part of many taught subjects (Majovska, 2017).

We suppose that the phenomenon of e-learning approach will become increasingly important in the modern education. Therefore it is necessary for both teachers and students to have necessary information competences and skills.

CONCLUSION

Information technology tools create conditions for changes in the process of teaching and learning. The university mathematics education is not possible without information technology tools. The current generation of students is technologically capable, they perceive electronic learning positively. Self-learning methods associated with e-learning mean searching for knowledge, their targeted processing by subjects of learning, and the creation of new knowledge through student activities.

In mathematics an e-learning approach means the detailed explanation of studied topics for students. Activities for "applying, understanding and remembering" are available in electronic courses and study materials that are created with an aim to increase the success of students in the mathematics study and in the preparation for the exam.

The presented results of the survey on the mathematical electronic courses in LMS Moodle have shown that the students' usage rate is low; 22% of students use available materials in the seminary project preparation and 29% of students in the exam preparation.

One possible solution of how to stimulate interest of students in e-learning activities is to incorporate them in the education as mandatory; their evaluation will give students the opportunity to gain points that can improve their final exams.

Using the two-sample t-test we tested the differences in exam grades between compulsory study subjects Mathematics IA and Mathematics IB. The results form academic year 2016/2017 proved that differences in exam grades are not significant. In two cases, the significance of the differences in given grades was confirmed; in academic year 2015/2016 and in the case of a sum of exam grades for both academic years together.

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ONLINE COLLABORATIVE PROJECTS TO ENHANCE SOFT SKILLS

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Abstract: *Students working in a web-enhanced environment have the chance to develop hard and soft skills. With web-enhanced components, a university course offers more versatile learning opportunities than face-to-face classes, which may result in undergraduates becoming more competent and competitive workers in the years to come than those who lack the experience. By using online tools to collect data and information, they learn in a new active way that is appealing to future engineers. These ideas are supported by students' opinions and attitudes expressed in the surveys conducted at Gdansk University of Technology in June 2018.*

Keywords: web-enhanced learning, online tools, soft skills, e-learning, academic education, collaborative project

INTRODUCTION

Blending face-to-face methods with e-learning technologies, i.e. Web 2.0 tools, can lead to a successful outcome if the blend is aimed to produce high-quality educational programmes engaging students in various interactions, resulting in them developing both hard and soft skills. University courses are more likely to arouse interest, stimulate to work and lead to satisfactory progress both from the students' and the teachers' viewpoints when they are run in environments structured around pedagogical methodologies based on active learning and collaborative achievements (Kołodziejczak, Roszak, Ren-Kurc, Kowalewski, Półjanowicz 2015). When the focus in education shifts from distribution of a vast amount of information and rote learning to problem-based learning and complex skill development, new web tools can help to create an educational environment responsive to new challenges. With the capacity for versatile interactions, such programmes can better satisfy the needs, expectations, and learning styles of the new generation of students, i.e. Generation Z (Beall 2016). Not only do they enable them to access a substantial number of up-to-date resources, but they also provide functionalities that give plenty of opportunities to increase learning experiences inside and outside the classroom. This may allow university course participants to study in an engaging way based on more genuine interactions than those available in a traditional, face-to-face approach (Kołodziejczak, Mokwa-Tarnowska, Roszak 2017; Kemp, Grieve 2014).

The paper aims to show how to enhance English for Specific Purposes classes with web-based learning, how to create a project-based environment that can raise students' interest and increase their satisfaction, and how to engage them in an active and collaborative development of various competences needed also in other courses and in the work context. Moreover, it attempts to investigate how undergraduates perceive the inclusion of e-learning tasks in the curriculum and whether they can work collaboratively to develop soft skills through research and learning online. The presented hypotheses are supported by survey results and the observation of students' behaviour in class and during online activities.

1. WEB 2.0 TOOLS TO SUPPORT PROJECT-BASED LEARNING AND SOFT SKILLS DEVELOPMENT

There is a variety of Web 2.0 tools to enhance classes for university students attending regular courses (Mokwa-Tarnowska. 2017b). The ones that support collaboration, particularly communication, productivity and creativity, e.g., text based tools, image based tools and multimodal production tools can increase learning experiences. With their various functionalities, they offer more opportunities for teachers who can engage their students in interactions that are not available in a typical, traditional, instructivist classroom setting (Kołodziejczak, Mokwa-Tarnowska, Roszak 2017; Mokwa-Tarnowska, Kołodziejczak, Roszak 2018). They can stimulate learning by doing and help students develop both hard and soft skills. The latter are numerous, ranging from collaborative, communicative, reflexive, and critical ones to time management and work-life balance (Doyle 2017). They seem to be more difficult to target, and employers across the world constantly complain that university graduates are not equipped well enough with them (Callaghan 2017, Sander 2016). Poor soft skills have been reported to be the reason why young workers have difficulty adapting to a new work environment. Thus, to prepare students for future challenges in the labour market, universities should change their course curricula to also accommodate for the needs of employers seeking soft competencies (Mathur 2017; Rima, Syeda, Lubna 2017).

1.1 Traditional ESP Classes Enhanced with Web Technology at GUT

Over the last six academic years different short online components have been designed to enhance learning opportunities for students attending courses in English offered by the Language Centre at Gdansk University of Technology. First they aimed to introduce novelty into teaching and learning English for specific purposes and to prepare students for blended programmes and self-directed learning. Then another goal emerged, namely to teach undergraduates professional English in the context of their interest.

The last few years have seen the emergence of different Web 2.0 tools, which has resulted in a growing interest in using them in university education (Noskova, Pavlova, Yakovleva, Gutiérrez-Esteban, Martin-Espada, Cubo-Delgado, Arias-Masa, Delicado-Puerto, Alonso-Dias and Yuste-Tosina 2017). The tools that have been chosen to deliver a web-enhanced study programme, due to their functionalities, support the development of different soft competencies. First of all collaborative, analytical, critical-thinking and reflective skills have been targeted. To create a new environment in the academic year 2016/2017 and the first semester of 2017/2018, website creation and data publishing technologies such as the *Moodle wiki* tool and *Thinglink* were selected to support short project-based tasks. Then in the second semester of the academic year 2017/2018 other free online tools were suggested to students working collaboratively on their 3-week projects, namely *mural, quip and easel.ly*.

1.2 Design and Implementation

Since October 2016 around 160 students have been developing online materials using different Web 2.0 tools. In the first semester of the academic year 2016/2017, for the first time, two groups of Civil Engineering students attended web-enhanced classes structured around a curriculum that included collaborative projects. The first project involved preparing an interactional poster using Thinglink (fig.1). The students were asked to find information on accidental discoveries or inventions and choose a specific topic to examine. Then, they produced a multimedia poster, presented it in class, and hosted a discussion based on it. The second project was considerably more creative than the first one and involved compiling specifications of an apparatus or equipment invented by the students themselves in the form of a wiki in Moodle (fig. 2). All the participants knew how to move around the LMS, as the university requires the first-year students to pass a test on how to use it, but they had not authored material before. The second stage of the task was to advertise the product in class. It ended with a competition designed to increase student engagement. The task helped to move control over the learning process to the participants, as well as to create a positive atmosphere and the sense of community. All the projects lasted one week.

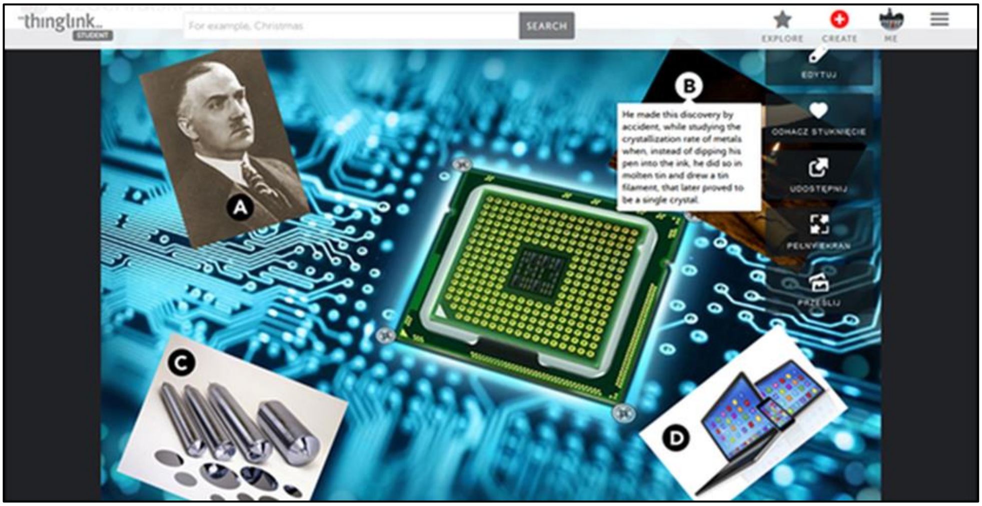

Figure 1. Group project assignment – Thinglink

Source: Based on students' collaborative work https://www.thinglink.com/scene/842780152407523329 (accessed 10 July 2018)

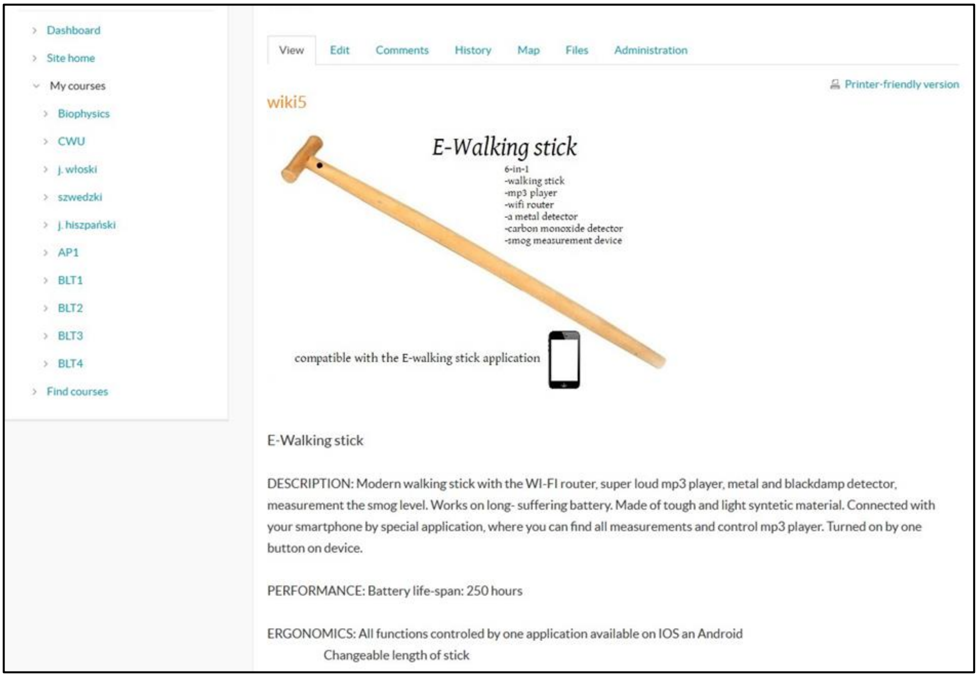

Figure 2. Group project assignment – Moodle wiki

Source: Based on students' collaborative work

In the second semester of the academic year 2017/2018 longer, 3-week projects were incorporated into the ESP course curriculum for three GUT groups. They required more involvement and more effort on the part of the participants in comparison with the short ones assigned previously. During a traditional class the students were divided into groups of three or four to work on each project. They were first introduced to the idea of online collaborative work and then they were presented with some general information about the topics of their projects, which included short films about theory and practice and suggestions for research. One group worked on future applications of virtual reality and augmented reality, and two on specifications of machines to ease life's problems. The next phase focused on collecting data on which to base designs and choose an online tool for collaborative work from the ones suggested, i.e. *mural*, *quip* and *easel.ly* (figs. 3, 4). For each group a wiki in Moodle was created, which they could use to share ideas and gather important information. After a week the teacher checked progress and the students informed her in class which tool they had chosen. The choice they had was limited to three online tools to save time on testing and finding the best one. Besides, the ones suggested seemed to be easy to use and adequate for the task.

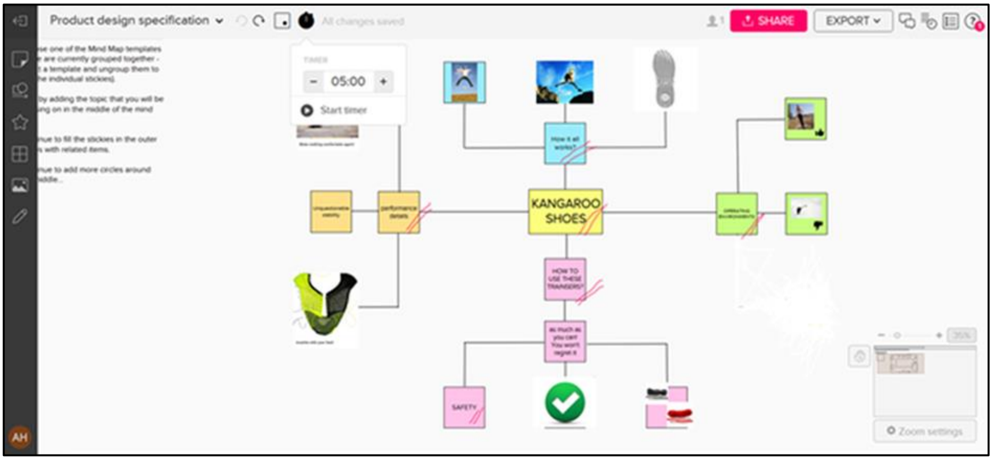

Figure 3. Group project assignment - mural

Source: Based on students' collaborative work https://app.mural.co/t/arnold3855/m/arnold3855/1528722732706/456beb6 adab629be20f4bc91a92bda5469315e6b (accessed 10 July 2018)

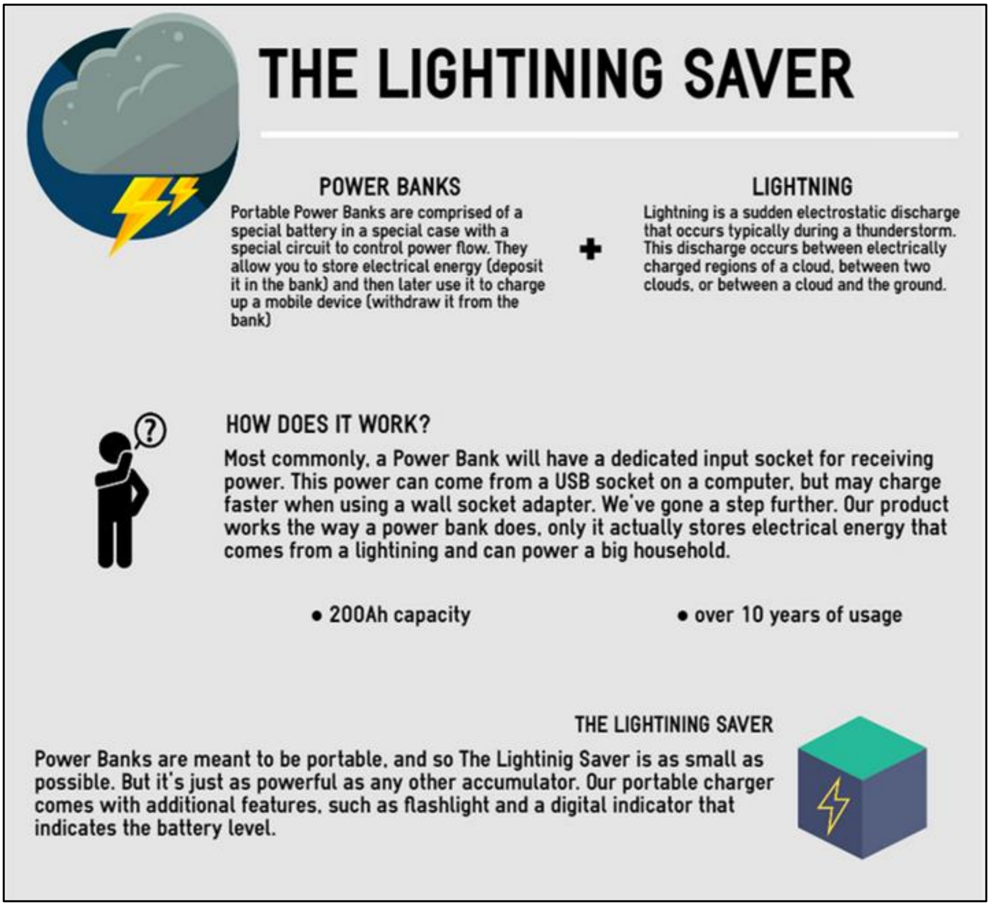

Figure 4. Group project assignment – easel.ly

Source: Based on students' collaborative work https://www.easel.ly/browserEasel/7651264 (accessed 10 July 2018)

Some students decided to prepare their final presentations with another tool, e.g. Google Docs (fig.5). Each group worked on their project for another two weeks and on completion the results were presented in class.

Figure 5. Group project assignment – Google Docs

Source: Based on students' collaborative work https://docs.google.com/presentation/d/175H7lF6rm6YYEUF5JKp0ydXM73wUAwjYfxH1_rekR84/present?token=AC4w5ViOC9eIR96n9RpTcc4QAYGGr5OkOQ%3A1528791392522&includes_info_params=1#slide=id.g3c4e07e2a9_0_61 (accessed 10 July 2018)

1.3 Research Questions and Methods

The qualitative and quantitative research into the nature of web-enhanced language classes at GUT and their impact on an increase in student competencies was initiated four years ago. Student's opinions and motivations shown in comments presented in class as well as answers to open-ended questions have already helped to uncover some trends to be further tested using quantitative research. Two basic tools have been used so far to produce a qualitative analysis: direct observation and group discussions. The quantitative research in each phase involved a paper survey. The research questions targeted in the second phase were as follows:

- What are the students' attitudes to online collaborative work?
- How effectively can the students work collaboratively in an online environment?
- How can an online environment created to enhance traditional classes help them to develop soft skills?

It can be assumed that the composition of each study group was homogeneous with respect to many factors: age, intellectual capacity, interest in science and engineering. Moreover, all 61 respondents were regular BSc students of the same university, whose level of English ranged from B2 to C1 according to the Common

European Framework of Reference for Languages. The only major difference was that two groups consisted of first-year students, i.e. the students of Mechanical Engineering and the students of Telecommunication and Electronics, and one consisted of second-year students, i.e. the students of Automation and Robotics, and Medical Engineering. It can be assumed that the participants of the latter group knew each other better and had more experience working together as it was the third semester of an ESP course that they had attended as a group.

The analysed data are presented as medians, minimum and maximum values or percentage, as appropriate. The comparison of two groups was analysed with the Mann-Whitney U test. The relationship between variables was tested with the Spearman's rank correlation coefficient. All results were considered significant at $p<0.05$. The statistical analyses were performed with STATISTICA 12.0 (StatSoft Inc.).

2. RESULTS AND DISCUSSION

2.1 Findings – long projects

The observation of the students' behaviour during all the stages of the project and after-the project discussions prove that a web-enhanced ESP course can include online project-based learning to satisfy various needs. The students enjoyed producing and presenting their collaborative work. The outcome was very satisfactory in terms of engagement and soft skills development. The productions included well-contextualised professional vocabulary and adequate grammar structures, as well as showed innovative solutions. Thus, they added to an increase in professional knowledge.

The students who participated in the long online projects stated that the task allowed them to improve their collaborative skills (table 1). More than half of the first-year students were satisfied with their progress. Some of them commented that they already possessed such competencies and they needed no further training. The second-year participants from the Automation and Robotics, and Medical Engineering specialisation showed more satisfaction from what they had learnt – as many as 80.77% chose the *definitely yes* and *probably yes* answers. It can be explained by the fact that the previous semesters of the English course involved individual work to a large extent, and that other coursework did not significantly contribute to an increase in the collaborative skill either.

Table 1.

Online project and increase in collaborative skills

Did the online project task allow you to	Definitely yes (%)	Probably yes (%)	Probably no (%)	Definitely no (%)	I do not know (%)	Total number of students

improve your collaborative skills?						
Mechanical Engineering	5.88	47.06	23.53	11.76	11.76	17
Telecommunication and Electronics	27.78	27.78	22.22	16.67	5.55	18
Automation and Robotics, and Medical Engineering	26.92	53.85	7.69	–	11.54	26

Source: Own work

The students could use the Moodle wiki tool, which was meant to support their work in the first phase of the project before they decided which additional tool to choose. However, most of them did not feel the need to share information using it (table 2). Only the Mechanical Engineering group regarded it as a convenient means to collect data and even to produce a final poster presenting their collaborative work (70.59% saw its suitability). The Telecommunication and Electronics group virtually did not use the Moodle tool – 66.67% had no opinion and said in class that they had not needed it. Almost half of the second-year students noticed the suitability of the wiki tool. In the questionnaire and during class discussions they stressed that they liked its simplicity. Yet, some of the respondents complained about the tool's functionalities and the limited editing possibilities.

Table 2.

Suitability of Moodle wiki for collaborative projects

Is the Moodle wiki tool suitable for collaborative projects?	Definitely yes (%)	Probably yes (%)	Probably no (%)	Definitely no (%)	I do not know (%)	Total number of students
Mechanical Engineering	17.65	52.94	11.76	5.88	11.76	17
Telecommunication and Electronics	5.55	5.55	11.11	11.11	66.67	18

Automation and Robotics, and Medical Engineering	15.38	26.92	19.23	11.54	26.92	26

Source: Own work

Two out of five Telecommunication and Electronics teams and four out of six Automation and Robotics and Medical Engineering teams used the *mural* tool to compose the final version of the project. Two teams, one Mechanical Engineering and one Automation and Robotics and Medical Engineering, chose *easel.ly*. The other ones decided to work on their projects using *Google Docs or wiki* and communicate via Facebook. They knew the tools, particularly *Google Docs*, and they stated in the questionnaire and during class presentations that they did not want to test any new solutions, which was a clear violation of the rules established for the task. They felt uncomfortable working together and they did not want to try any new environment. This was particularly seen in the case of the Mechanical group. Nevertheless more than half of the respondents (table 3) saw the suitability of the tool they had chosen for online collaborative work (ME: 58.82%, TE 66.67%, ARME: 84.61%). It must be emphasised that *mural* was the most popular tool and the best to produce a poster presenting the final version of the project.

Table 3.

Suitability of other online tools for collaborative projects

Is the tool you used suitable for collaborative projects?	Definitely yes (%)	Probably yes (%)	Probably no (%)	Definitely no (%)	I do not know (%)	Total number of students
Mechanical Engineering	23.53	35.29	5.88	–	35.29	17
Telecommunication and Electronics	50.00	16.67	16.67	5.55	11.11	18
Automation and Robotics, and Medical Engineering	46.15	38.46	15.38	–	–	26

Source: Own work

A substantial number of the respondents from each group (76.47%, 66.67%, 84.61% respectively) stated that an online collaborative task was an interesting addition to a face-to face class (table 4). The majority also pointed out that it increased their interest in learning Technical English, and that they would like to participate in similar activities at least once a semester.

Table 4.

Online tasks to enhance face-to-face classes

Is an online collaborative task an interesting addition to a face-to-face class?	Definitely yes (%)	Probably yes (%)	Probably no (%)	Definitely no (%)	I do not know (%)	Total number of students
Mechanical Engineering	52.94	23.53	11.76	11.76	–	17
Telecommunication and Electronics	38.89	27.78	16.67	11.11	5.55	18
Automation and Robotics, and Medical Engineering	46.15	38.46	7.69	3.85	3.85	26

Source: Own work

The majority of the students who participated in the survey think that collaborative projects should be included in the curricula of university courses (table 5). Only two students out of the total of 61 are rather against collaborative work in university education and another five have no opinion about it. It can be said that the students understand the importance of being able to work collaboratively, and they would like to master the skill when doing a degree. Their comments show that they lack sufficient practice and some of them even asked at the commencement of the activity if they could work individually on their projects. The reason they gave was that they did not like working in groups.

Table 5.

Collaborative tasks in university course curriculum

Should university course curricula include collaborative projects?	Definitely yes (%)	Probably yes (%)	Probably no (%)	Definitely no (%)	I do not know (%)	Total number of students
Mechanical Engineering	35.29	52.94	5.88	–	5.88	17
Telecommunication and	38.89	44.44	5.55	–	11.11	18

Electronics						
Automation and Robotics, and Medical Engineering	53.85	38.46	–	–	7.69	26

Source: Own work

The students also stated in the questionnaire that online tasks could contribute to the development of analytical and critical thinking skills (table 6). A positive attitude was expressed by 76.47%, 72.22%, 69.23% respondents respectively. Their understanding of the possibilities of an online learning environment seems to be based on the activities in which they were engaged. They involved analysing data collected in Internet research and critical discussion to be followed by creative productions. The tasks also added to an increase in students' media literacy skills as the majority of the data they studied came from films, documentaries, interactive poster presentations and infographics.

Table 6.

Online group tasks to develop analytical and critical thinking skills

Can online group tasks included in the curriculum of an English course help you develop analytical and critical thinking skills?	Definitely yes (%)	Probably yes (%)	Probably no (%)	Definitely no (%)	I do not know (%)	Total number of students
Mechanical Engineering	35.29	41.18	11.76	–	11.76	17
Telecommunication and Electronics	11.11	61.11	16.67	11.11	–	18
Automation and Robotics, and Medical Engineering	23.08	46.15	15.38	3.85	11.54	26

Source: Own work

Not only do the course participants perceive the impact of online tasks on the development of analytical and critical thinking skills, but they also understand that other soft skills can be improved due to online interactions. Table 7 shows that as many as 88.24% of the students from the Mechanical Engineering group, 72.22% from the Telecommunication and Electronics group and 80.77% from the Automation and Robotics and Medical Engineering group think that online tasks on an English course can help develop different soft competencies. The students were familiar with the concept of soft skills as they were introduced to it in class prior to the commencement of their projects.

Table 7.

Online group tasks to develop soft skills

Can online group tasks included in the curriculum of an English course help you develop soft skills?	Definitely yes (%)	Probably yes (%)	Probably no (%)	Definitely no (%)	I do not know (%)	Total number of students
Mechanical Engineering	47.06	41.18	–	5.88	5.88	17
Telecommunication and Electronics	22.22	50.00	11.11	–	16.67	18
Automation and Robotics, and Medical Engineering	26.92	53.85	3.85	–	15.38	26

Source: Own work

The students' experience in using online collaborative tools was limited, which is clear from their comments in the questionnaire. The only tool some of them had used before was *Google Docs*, and they emphasised its usefulness and easiness to work with. From table 8 it can be seen that 15 students altogether (23.53%, 16.67% and 30.77%) out of the total of 61 had no experience collaborating using an online tool.

Table 8.

Experience in using collaborative tools

Have you used any online collaborative	Yes, often (%)	Yes, seldom yes (%)	Only once (%)	Definitely no (%)	I do not remember (%)	Total number of students

tools before?						
Mechanical Engineering	5.88	41.18	17.65	23.53	11.76	17
Telecommunication and Electronics	50.00	22.22	11.11	16.67	–	18
Automation and Robotics, and Medical Engineering	23.08	34.61	7.69	30.77	3.85	26

Source: Own work

2.2 Findings – comparison between short and long projects

The second stage of the research also focused on the comparison of the long, three-week, and short, one-week, projects with respect to students' attitudes towards online collaborative work, online tools and soft skills development. First, responses to four questions were analysed (Table 9). They targeted students' perception of collaborative skills, the *Moodle wiki* tool, other tools used for the projects and soft skills. Then, a correlation analysis was performed for the input data (Table 10).

Questionnaires completed by 134 respondents were statistically analysed – 73 (54%) came from the short project participants and 61 (46%) from the long project ones. The group sizes are unequal, which results from data availability.

Table 9.

Comparisons of results between short and long projects

Question	Number of participants in study		p-value	Interpretation
	Short project (academic year)	Long project		
Moodle	32 (2017/2018)	61	**0.019**	**Significant difference**
Tools	41 (2016/2017)	61	0.625	No difference
Collaborative skills	73 (2017/2018 & 2017/2018)	61	0.285	No difference
Softs skills	32 (2017/2018)	61	0.304	No difference

Source: Own work

When compared with the previous research stage, it can be noticed that there is no difference (medians = *rather yes*, p=0.304) between the way the participants of short projects and the long ones perceive their suitability for soft skills development (Figure 6).

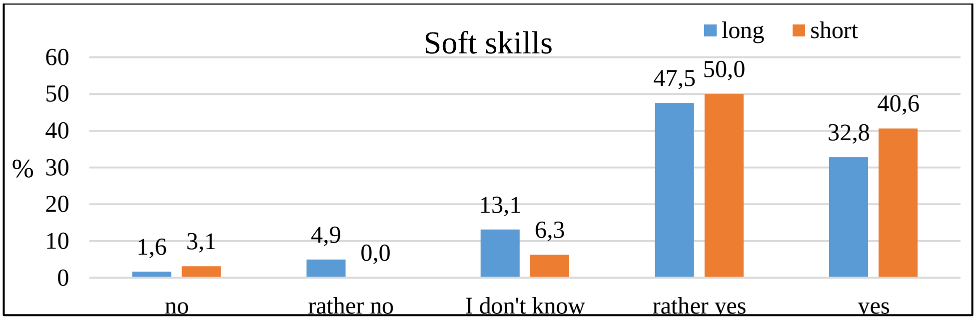

Figure 6. Distributions of answers about online group tasks to develop soft skills – short and long projects

Source: Own work

The students who filled in questionnaires on completion of their online group assignments in the academic year 2016/2017 and in the first semester of 2017/2018 stated that their short e-learning tasks contributed to an increase in their collaborative skills (medians = *rather yes*, p=0.322). A statistical analysis shows also no significant difference (p=0.285, p>0.05) between the answers of the short project participants and the long project ones in relation to collaborative skills (Figure 7).

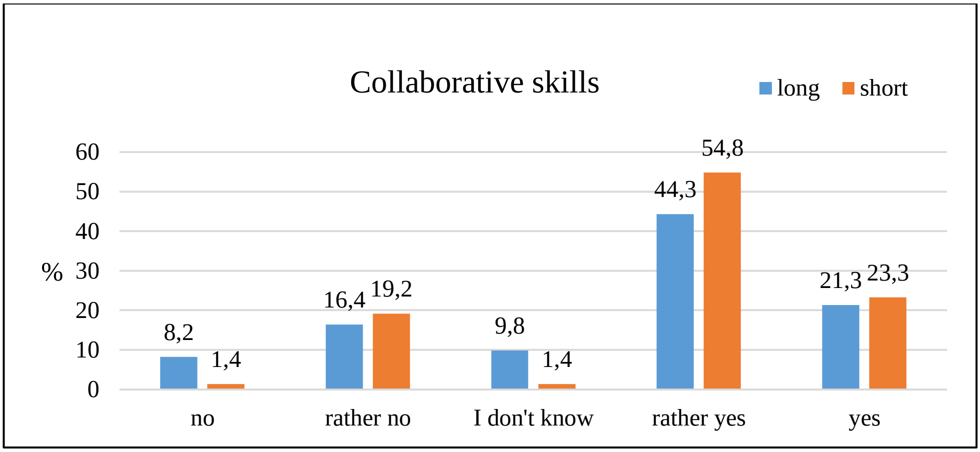

Figure 7. Distributions of answers about online projects and increase in collaborative skills – short and long projects

Source: Own work

In the students' opinions the online project activities they were engaged in supported soft skills development, which means that not only did their collaborative skills improve but they also felt more experienced in analytical and critical thinking competencies. These are the soft skills that the online tasks targeted.

Moreover, all the participants agree that the tool they used was suitable for online collaboration (Figure 8, medians = *rather yes*). In the case of the short projects it was *Thinglink* – the tool was non-negotiable and it was the teacher's decision. The students who completed long projects had a choice and most of them selected either *easel.ly* or *mural*, *mural* being the most favourable for that purpose. A statistical analysis shows no significant difference between the answers ($p=0.625$, $p>0.05$).

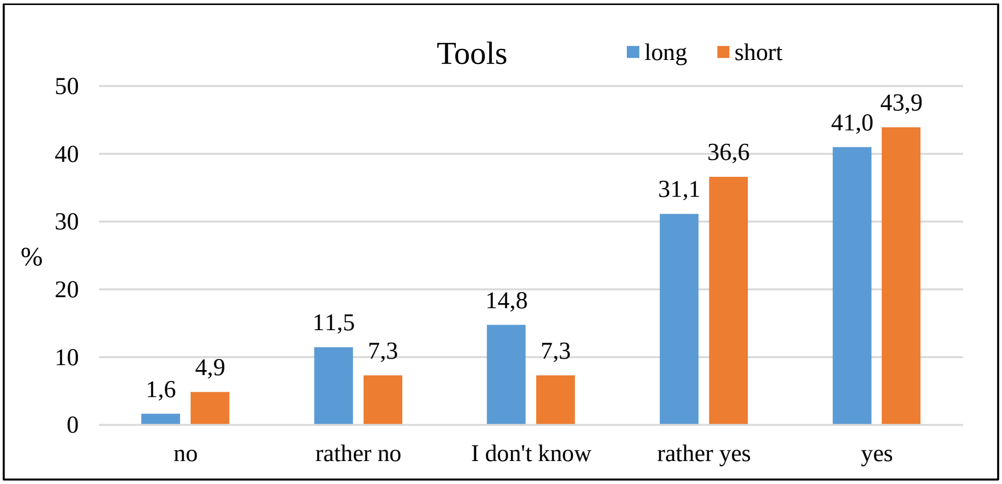

Figure 8. Distributions of answers about suitability of other online tools for collaborative projects – short and long projects

Source: Own work

All the tools were simple to use. However, *mural* offered more functionalities and was more visually appealing to the students.

As far as the *Moodle wiki* is concerned, there is a statistically significant difference between the responses ($p=0.019$, $p<0.05$). The short project participants rated its usefulness higher (median = *rather yes)* than the long project ones (median = *I don't know)*, which can be explained by the low complexity of the one-week assignments and the students' experience in work with *Moodle* (Figure 9).

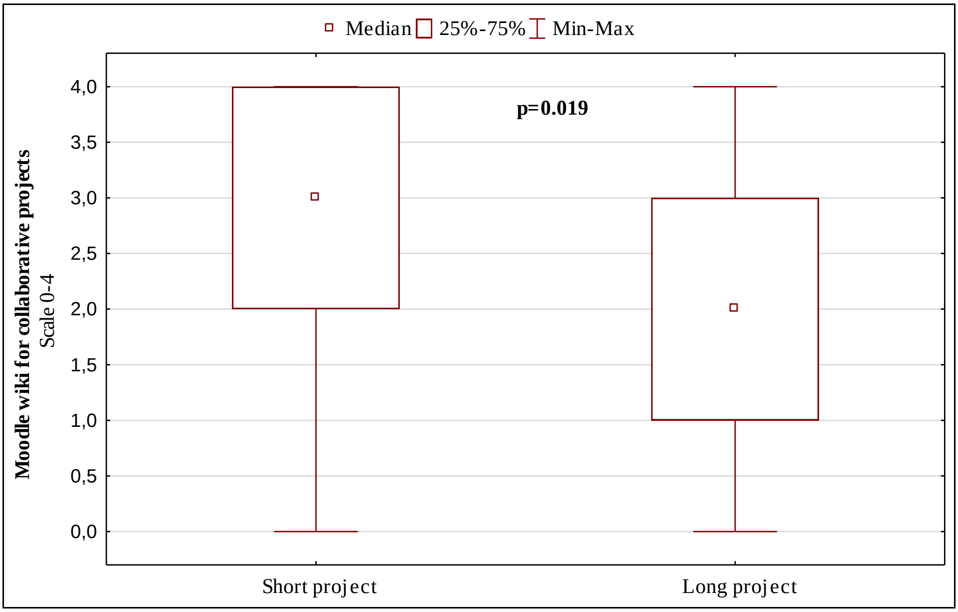

Figure 9. Comparisons of answers about suitability of Moodle wiki for collaborative projects – short and long projects

Source: Own work

Composing the final results of their research and making a presentation with any other tool required from the students much more involvement. There is a significant correlation between the students' evaluation of the *wiki* tool and soft skills development ($p<0.05$) – the higher they rated the Moodle tool and the group tasks, the more they appreciated the possibility of working on assignments to develop collaborative skills (Table 10).

Table 10.

Correlations between data from table 9

Sample size	Group	Variables	p-value	Correlation coefficient R
93	All (Long project & Short project 2017/2018)	Moodle & Soft skills	0.018	0.24
		Collaborative skills & Soft skills	0.002	0.32
32	Short project 2017/2018	Moodle & Soft skills	0.016	0.42
		Collaborative skills & Soft skills	0.011	0.44

61	Long project	Collaborative skills & Soft skills	0.032	0.29

Source: Own work

3. DISCUSSION

With their coursebook activities, traditional language classes offered by universities may become a regular and monotonous routine for students of science and technology, who have been learning English for many years, usually since the beginning of primary school. The presented research shows that educational programmes supplemented by web-based tasks, online group assignments in particular, may stimulate better engagement in course activities (Woo, Mehringer, Agostinho, Reeves 2007). They encourage students to explore up-to-date topics related to their study area, and motivate them to develop various soft skills.

The participants of the projects improved their collaborative, analytical and critical thinking competencies, which was observed in the comments they made both in class and in the questionnaires. It can be assumed that the survey and the experiment itself helped the students develop also their reflective skills. After responding to the questions their meta-awareness of the learning process increased, and they should better self-direct their education in the future.

Both short and long projects stimulated an increase in the soft skills they targeted. There is no significant difference between the way the short project participants and the long project ones perceived the suitability of the activities they were involved in. It can be assumed that it was not the length that impacted an increase in soft skills – it was the structure of the assignment and the character of the environment that contributed to it and to the students' satisfaction with being engaged in an innovative learning experience.

CONCLUSION

Since using Web 2.0 tools to enhance regular university courses is a relatively new phenomenon, only limited research has been conducted on their impact on soft skills development (Wawrzyniak-Guz 2016, Kołodziejczak, Roszak, Kowalewski, Ren-Kurc 2014). The research findings presented in this paper show similarities in the way students of different GUT faculties perceive web-enhanced collaborative learning. They treat it as a valuable addition to regular traditional classes. On the one hand, this may result from them being accustomed to using various technologies in many life contexts. On the other hand, it may prove that they understand that innovative methods of teaching and learning, and new educational environments can create opportunities for developing soft skills, whose possession is desired by employers.

The format of online activities may differ, but it is the inclusion of web-based tasks that seems to add value to university courses (Hamzah, Ariffin, Hamid 2017). A carefully structured environment can result in better learning outcomes measured by instruments available through the use of online tools. However, it is not sufficient to replace some traditional resources and activities that have always taken place in the traditional classroom with their equivalents developed in an innovative technology-based environment. An online component for use in class or outside it has to be incorporated into the learning design in a meaningful way so as to enhance and improve the learning experience (Mokwa-Tarnowska 2017).

By adding variety to the curriculum, by creating a web-enhanced environment, educators can develop a programme that will better motivate students and engage them in developing both hard and soft skills. Such instructional design may contribute to raising the quality of teaching and learning. New opportunities to develop different competencies may result in graduates being better prepared for professional challenges, but this is an area that has to be researched further.

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EMPLOYING REMOTE ACCESS TEACHING SYSTEM FOR DIODE MEASUREMENT

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Abstract: *The paper describes a system used for real remote measurements in teaching of electrical engineering. A series of cooperating applications were designed in LabVIEW environment. They are based on Data Socket and Remote Panel technology, while the new idea lies in modular structure. Several couples of modules (called GO and DO module) are needed for a remote operation. GO modules are identical for all workplaces and can be redesigned in the future using other programming tools without modifications of DO modules. The system is suitable for teaching especially in distance learning or as a supporting tool for full-time study. For better interactivity support for web camera was added to our DO module. An overall effect of this educational tool was evaluated using a questionnaire.*

Keywords: LabVIEW, Data Socket, remote experiments, measurement, IMAQ.

INTRODUCTION

Department of measurement belongs to Institute of Electrical Engineering at the Faculty of Electrical Engineering and Information Technology in Bratislava. We are dealing with subjects of measurement and electrical engineering. It is inevitable for an electrical engineer to have deep knowledge about electrical phenomena and components. Depending from specialization our students need to obtain skills with real measurement instruments and knowledge about measurement devices and principles. A thorough study of electrical phenomena is also important for students to be able to understand an inner construction of an instrument.

In the best case every student comes with similar knowledge and could have his own workplace in the laboratory where he/she is present at the right time. However, level of initial knowledge of students entering our subjects is very different. Remote access software system designed at our institute can serve here as an additional tool for home study. It allows access to real measurement instrument and brings more working time.

For the development of the software system we used experience of our department especially with LabVIEW environment. It is one of the best programming environments for measurement applications (Mokhtar, Mikhail, Seong-Joo (2014); García-Guzmán, Villa-López, Vélez-Enríquez, García-Mathey, Ramírez-Ramírez, 2017). We chose modular structure for our design allowing addition of modules programmed in other languages. Furthermore, the way of cooperation of modules achieves high software security and simplifies the design of new workplaces controlled by so-called DO modules. In this case we designed a DO module for measurement ampere-volt characteristic. Using this module after measuring in the faculty laboratories students can continue with the work from home and supplement the knowledge.

1. CONCEPT OF REMOTE ACCES SYSTEM

In the academic community, some developments have already taken place in the field of remote measurement. There are authors like (Samuelsen, Graven (2016)) describing design based on original web-publishing tool integrated in LabVIEW (known as a remote panel) as outdated because it is based on non-http protocol requiring installation of LabVIEW Run-Time Engine on client side which is furthermore not available in mobile phone version. However, there are many other new works based on this technology, e.g. (García-Guzmán, Villa-López, Vélez-Enríquez, García-Mathey, Ramírez-Ramírez, 2017) or (Singh, Chatterji, Shimi, Gaur, 2015). The reason for this contradiction is the fact that LabVIEW offers high efficiency for development of small applications interacting with laboratory equipment especially for non IT oriented community while usage of more programmatically oriented tools for web publishing of final application depreciates this advantage. Then, relevant problem for some universities is also to keep IT-area oriented stuff which can find very attractive workplaces in commercial sphere. And designers are naturally looking for tools intended for the same environment which they use for the type of work – like Matlab2Web for Matlab in (Gula, Žáková, 2017); this topic also reflects the general issue that dedicated web publishing tool is in development and there is no steady solution. If a department decides to invest time and money into more sophisticated system of applications with the front-end Learning Management System (LMS) usually based on HTML5 like in (Luthon, Larroque, 2014), it is still possible that LMS just redirects the client to URL of selected workplace where against the designer needs take care about web publishing strategy. And we still need to keep in mind the problem of security (Mokhtar, Mikhail, Seong-Joo, 2014; García-Guzmán, Villa-López, Vélez-Enríquez, García-Mathey, Ramírez-Ramírez, 2017) usually skipped in paper presentations but often limiting the real life usage of the system.

Considering of all described attitudes we decided to design a modular system of applications with remote access. For developing phase we use just LabVIEW environment, however the modular structure described in (Červeňová, Králiková, Kamenský, 2016) allows later addition of modules designed in another environment. Our system is based on pairs of GO and DO module. To access the remote workspace or the target application called DO module the user communicates over a superior GO module, which is placed on a dedicated server computer. Its purpose is to accept commands from a remote user and forward them to a target application or to distribute results to the remote user. The user actually accesses remotely one of the GO modules placed on the server computer while the connection with the PC controlling requested workplace is managed by the GO module application. For every DO and GO module pair the GO module is identical. As we divided the part controlling measurement from the module providing web publishing, once a GO module will be updated, it can be employed for all DO modules without any code change.

DO modules are unique, every carrying its own identifier (ID). On the central server computer several copies of GO modules are running allowing connection to the target DO module with the right ID. The target application could be located on any computer within the local network, which stays not directly visible from outside and hence protected against software attacks.

LabVIEW programming environment with graphical G language offers features which shortens initial time of system development. It is intuitive and includes libraries for interfacing the PC with measuring equipment and for processing of the data to evaluate measurement output. E.g. for analogue interfaces it supports data acquisition cards (DAQ) mostly with USB, PCI or PCIe interface. For communication with standalone digital laboratory devices we can employ VISA (Virtual Instrument Software Architecture) library covering GPIB, USB, LAN or RS-232 interfaces or even lower level GPIB library. On the other hand two important technologies available in LabVIEW significantly simplify network distribution of measurements: Data Socket and Remote Panel. DataSocket is a software interface that provides easy access to several I/O mechanisms without low-level programming and was used for communication between GO and DO modules. Remote Panel already discussed above is a simple and popular way how to publish the front panel of a LabVIEW program for use in a standard Web browser. If remote connection without local installation of LabVIEW Runtime Engine is required (Samuelsen, Graven (2016)), similar tool AppletVIEW could be considered instead (Mokhtar, Mikhail, Seong-Joo, 2014).

The internal concept of a DO module for measurement ampere-volt characteristic is presented by the block diagram in Figure 1. Similarly to the GO module (described in (Červeňová, Kamenský, Králiková (2016)) it works as a state machine. A state is called mode here and modes 1 till 5 are designed for managing communication with GO module. The application starts in mode 0 waiting for initial command coming into opened DataSocket buffer. In mode 1 the application is prepared for cooperation with GO module, especially other DataSocket variables are initiated, as we use separate variables for commands and data and for every direction. In this phase we want to initiate also button labels visible for remote user therefore we send the "Button Init" command to GO module and jump to mode 6 where the labels are sent over data variable. Mode 2 is then dedicated for maintaining of the communication checking if a new command was received or time expired which means the connection with GO module is interrupted. Note that every data exchange is initiated by GO module which also has to send "Refresh" command within time out for the case there is no action from a remote user. Otherwise the connection and the variables are closed in mode 3. After regular command was received in mode 2 it is subsequently recognized in mode 5.

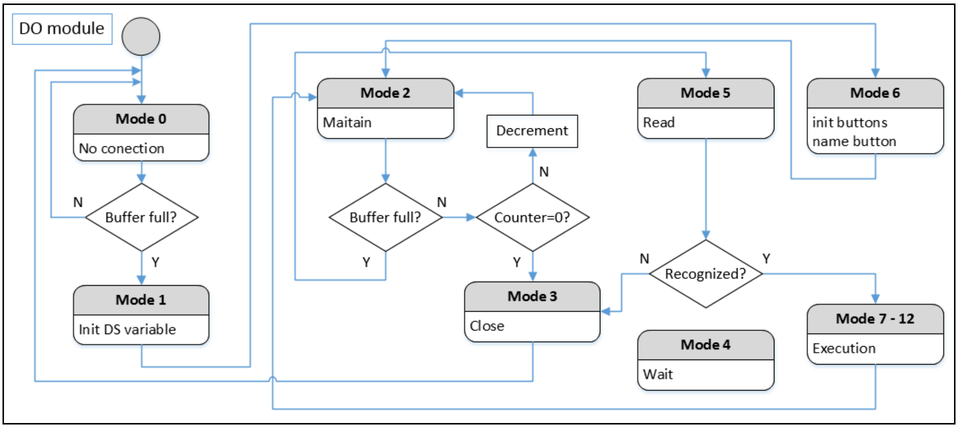

Figure 1. Block diagram of DO module
Source: Own work

According to the command value the application jumps from mode 5 to one of execution modes starting from 6. Actually mode 6 was already used for sending initial button labels, however it is generally possible to jump again into mode 6 and resend those labels. In our case we do not change labels after initialization and we jump to modes 7-12 during execution of GO module commands in reactions to user actions. (Mode 4 is skipped and can be implemented later e.g. when the system functionality will be extended by command sequencing.) Despite this is a structure of our particular DO module it can serve as a guide for other DO module designers.

2. DESIGN OF WORKPLACE

One of most important topics of our basic laboratory courses is measurement ampere-volt characteristic. It teaches the students principles of semiconductors as an inevitable step for later study of complex inner circuits of precise devices. On the other hand it is good laboratory for learning operation of digital multimeter (DMM), bench top DC power supply or more complex source measurement units (SMU). We usually use this measurement for teaching programming of measurement instruments too when DMM and DC source are connected to a PC and controlled from LabVIEW via SCPI (Standard Commands for Programmable Instruments) commands. Therefore such workplace with remote control has widespread usage at our institute.

For the particular case described in this paper we connected DMM HP 34401A and DC Power Supply Agilent E3640A to PC over GPIB interface for measurement of diode characteristics. The workplace is represented by schema in Figure 2. It is controlled by DO module placed on local PC, while the user interface (UI) for remote user is given by front panel of GO module – like the one depicted in Figure 4. Therefore operation of DO module application has to refer to UI graphical components. The UI comprises five buttons for general usage, three tabs (Graph, Listing, Image) and edit line. Labels of buttons indicating their function are sent in initialization phase of modules communication as described above. Those labels sent in mode 6 are: *Initialize, Measure, Listing, Image, Clear Data, Help*.

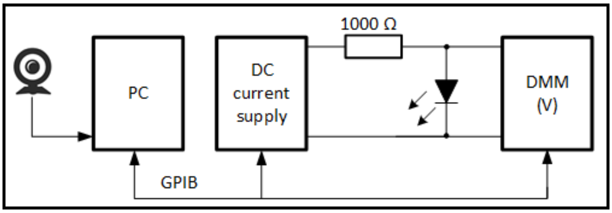

Figure 2. Schema of workplace
Source: Own work

The main portion of functionality of the workplace is accomplished in mode 7 after *Measure button* is pressed. Here new point of ampere-volt characteristic is measured and added to the internal array. The application exists in tree versions (one selected by internal parameter) differing in mode 7 implementation. In all cases it engages number entered by the user and shifted from the edit line of UI (*Parameter*). In simulation version the voltage is determined by the user and the current (mA) is calculated by internal mathematical equation. In voltage source version the parameter is sent via VISA Write function and SCPI command "*volt Parameter*" to DC source as desired output voltage. Subsequently current is measured with a query "meas:curr:dc?". In this voltage source version a protective resistance Rs is supposed to be connected in series with the measured component, therefore the voltage drop on Rs is finally subtracted from DC output voltage before using for ampere-volt characteristic. In the case of current source version of DO module the input parameter is limited to predefined range and sent to DC source as requested current using SCPI command "*curr Parameter*". The voltage is then directly measured with a query "meas:volt:dc?" and no serial auxiliary component is supposed to be connected in the circuit. After measurement the graph is refreshed. If the user wants to see besides the graphical characteristic also the measured number in written form, the array of measured results is displayed in the listing in mode 8 after *Listing button* was pressed. The internal array is cleared in mode 10 (*Clear Data button*).

To see the impact of voltage and current combination on measured component especially if it is LED the camera image is obtained and sent to image tab of UI in mode 9 activated with Image button. The critical part of the block diagram of mode 9 is shown in Figure 3. National Instruments offers plenty of functions for working with cameras and images in NI Vision Acquisition Software (VAS). The NI-IMAQdx driver software is needed to use third-party image acquisition for USB 2.0 Cameras Supporting Microsoft DirectShow. Figure 3 shows how the camera can be used for Grab acquisition. After opening the camera session the function IMAQdx Configure Grab starts capturing the image to an internal software buffer. The IMAQdx Grab function copies one image to a LabVIEW image buffer and can be called multiple times for capturing several subsequent images. Finally the camera is closed. The output of grab is converted into form suitable for displaying in Image tab of our front panel.

If a student needs help with the remote measurement the help can be shown in the same *Image tab* by pressing *Help button* causing jump to mode 11. Finally the mode 12 is selected after "Refresh" command was received in DO module and it just writes information string "Communication refreshed at TIME", where TIME is obtained by LabVIEW function Get Date/Time String.

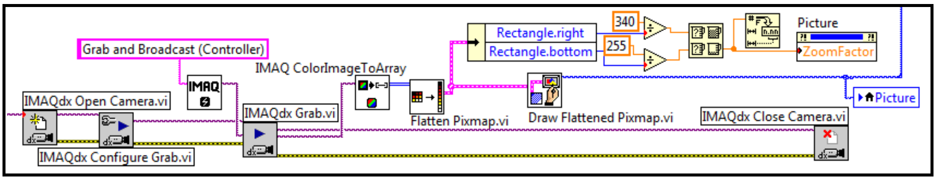

Figure 3. Sequence of blocks for obtaining image from web-camera
Source: Own work

3. USAGE OF THE SYSTEM IN EDUCATION

Designed remote access system can help teaching in different ways. It can be employed during laboratories to allow access to unique equipment over local network, when every student could acquire data to his/her PC from the seat. It can also add additional working time even for home study. Similarly when used before laboratories it can serve for preparation for a topics. The open and modular structure of the system gives the prospect of creating a wider community of designers also from different institutes and universities which can provide the opportunity to work on special devices located outside our institute.

The remote access system with DO module for measurement of diode ampere-volt characteristic was in our case used after laboratories to offer more working time especially for students with lower level of initial knowledge. In subject "Electrical engineering 1" students measured ampere-volt characteristic of a rectifying diode during laboratories. Before leaving the room they obtained special links for access to two separate workplaces installed permanently at our institute. One of them was installed with similar rectifying diode, the other one with LED. During one next week they were allowed to perform remote measurements and collected data which has been obligatory added to their report.

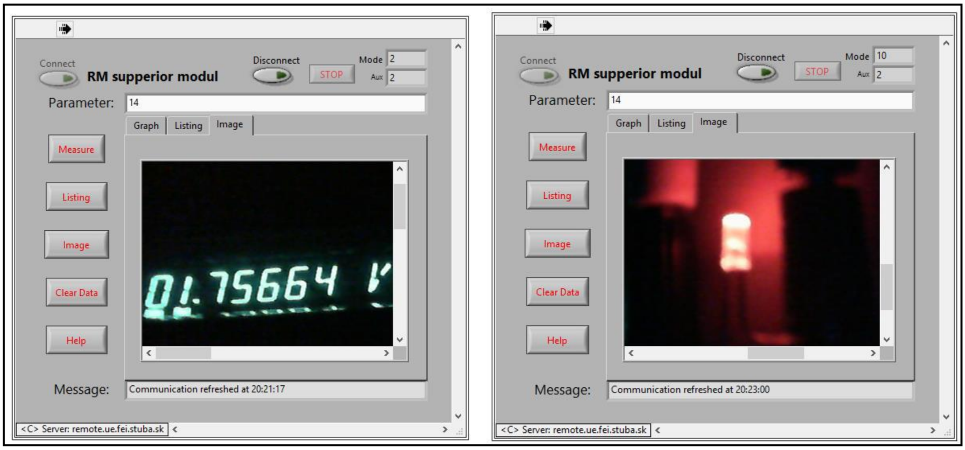

Figure 4. Left - View to multimeter display, Right - View to lighting LED diode *Source: Own work*

In Figure 4 left a GO module connected to the workplace of rectifying diode is presented. After pressing *Measure button* new point for current shifted as parameter (14 mA in this case) is added to characteristics in *Graph tab*. For numeric listing of all collected points *Listing button* has to be pushed. The *Image button* shows snapshot grabbed from web camera in *Image tab*. We can see measured voltage directly on display of the multimeter. For the case of LED measurement (Figure 4 right) also actual diode light can be observed. The graph is cleared after pressing *Clear Data button* when also internal array is erased. *Help button* offers useful hints for the user displayed in *Image tab*.

Inspired by (Tripathi, Mohan, Gangadharan (2012); Luthon, Larroque (2014)) we prepared a questionnaire completed by our students after laboratories. They presented opinions about the usage of designed remote access system. They answered following questions:

a) Benefit: The use of remote access to the workplace within the exercise is in your opinion: (great benefit - little benefit - unnecessary burden). See Figure 5 left.

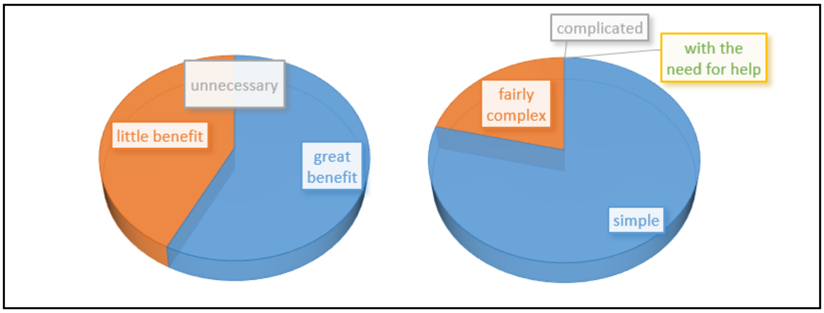

Figure 5. Benefits and orientation in app of remote measurement
Source: Own work

b) Learning: Remote measurement of ampere-volt characteristic of diodes helped you understand the subject: (better - less - not at all - not interested). The answer depended on whether students from a technical school or grammar school had come. For students from technical schools it was not a big benefit, for other it was good help.

c) Simplicity: The orientation in the app was for you: (simple - fairly complex - complicated - with the need for help). See Figure 5 right.

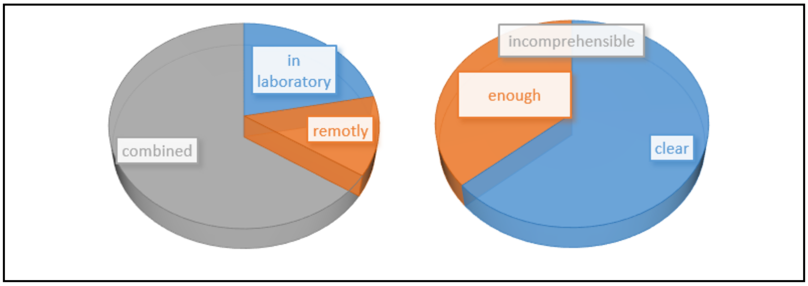

Figure 6. Preference of measurement and understand ability
Source: Own work

d) Clarity: Has your guide been understandable: (enough - sufficiently comprehensible - incomprehensible). See Figure 6 right.

e) Preference: If you could choose which exercise method would you prefer? (attendance - distance - combined: more presence measurements - more remote measurements). See Figure 6 left.

f) Contribution: Specify the advantage / disadvantage of remote access for you personally - it was good for student to measure out of the house at any time. They considered as a disadvantage that they could not personally ask questions.

Students also proposed in questionnaire new suitable topics for remote access. The results encourage us to continue in preparation of other topics and workplaces into the system especially as support mean employed in combination with standard laboratory exercises. One of advantages of our system is the same GO module type and hence unified user interface of applications (including both presented here) which finally reflected in positive votes of Clarity and Simplicity. The problem of need of LabVIEW Run-time Engine did not much influenced Simplicity votes probably because there is university licence and our students are using LabVIEW to a great extend during education process. However, for the future we plan to find the best solution how to update or rebuild GO modules to allow remote connection from Android devices.

CONCLUSION

Practical experience with our remote access teaching software system has been presented in this paper. The system is based on communication between DO module controlling a workplace and GO module for distribution of data and access. We designed a complex software DO module controlling workplace for ampere-volt characteristic measurement. This DO module represents a pattern for other designers of workplaces and of their control within our modular system.

The system was employed in the subject "Electrical engineering 1" as a tool offering additional working time after laboratories of diode measurements. The system has stable functioning during one week of remote usage while the students were collecting data for their laboratory reports. The feedback from student experience was taken over a questionnaire. According to their opinions we can claim it has significant meaning especially for students with lower level of initial knowledge about electronics and skills. We plan to design next set of DO modules paired with GO modules all running at the same server computer and just a simple step is needed to comprise all GO modules into a simple Learning Management System.

Acknowledgements

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IMPLEMENTING SP4CE LEARNING ROOMS CONCEPT AND AUTODESK ONLINE CERTIFICATION IN THE PREPARATION OF A NEW GENERATION OF ENGINEERS

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Abstract: *In academia, educators do not always cope with rapidly changing technologies. Yet keeping up with new trends is essential to graduates' success in a competitive job market. In the article, the author will answer the question of how Autodesk University Open Educational Resources and Certiport exams including GMetrix can enhance students' academic progress and prepare them for future career. The concept of co-operation between Authorized Autodesk Training Centre at Gdansk University of Technology and Faculty of Management and Economics will be proposed based on experiences gathered in the ERASMUS+ SP4CE project.*

Keywords: Autodesk, SP4CE, e-learning, certification, culture of participation

INTRODUCTION

E-learning courses at Gdansk University of Technology have come a long way from being plain file repositories to environments that enable learning through interaction with highly qualified instructors and other course participants. Students can develop skills with sample exercises that emphasize real-world applications (TeleCAD, SP4CE). They can also work simultaneously on a group project that is stored in cloud (Fusion 360). Before taking an exam and earning a valuable certificate of completion that is recognized in an engineering profession (Open Doors, Certiport), students can prepare themselves by taking part in online trail exams (GMetrix). In the article the model for supporting online certification at the ACSA PG is proposed. In order to build the model mixed method research (quantitative and qualitative) was used.

1. HISTORICAL BACKGROUND

1.1. The pioneers of e-learning at Gdansk University of Technology

Implementing e-learning at Gdansk University of Technology started from a TeleCAD project (Teleworkers Training for CAD Systems' Users). The idea of the TeleCAD course evolved from an AutoCAD course delivered since 1996 in Open Distance Learning mode for students from Civil Engineering Department at Gdansk University of Technology. The TeleCAD project was co-financed by the European Union Leonardo da Vinci Programme and developed by Gdansk University of Technology in co-operation with four institutions from Greece (IDEC, ZEUS), Finland (Pekkala Software Oy), Italy (ARGO) and Poland (Young Digital Poland S.A.). The project had two main objectives. First, it had to develop a Learning Management System (LMS), which is an online platform for preparation and delivery distance learning courses. Secondly, to use this newly created environment to produce an AutoCAD training (Grabowska, 2001).

The course materials consisted of 10 modules that covered basic skills of drawing in AutoCAD. Every module included a set of exercises with description of an appropriate solution. Course materials were prepared as HTML pages available both on and off-line. The participants had to hand over the final project sending it by e-mail through LMS TeleCAD to the assigned instructor. To prove authorship, students were asked to make changes in their projects in the presence of the instructor. At the end of the training participants filled in survey questionnaires to assess the quality level of materials, instructor's knowledge and commitment, the amount of acquired knowledge and skills, course organisation, etc. (Grabowska, 2014).

TeleCAD was an inspiration for implementing distance education and blended learning at the Gdansk University of Technology. Not only was it used to teach AutoCAD, but also for examining students in the Basics of Computer Science and as support environment for students of Faculty of Civil Engineering at the Gdansk University of Technology. By 2002, more than 1000 students used it. In 2003, TeleCAD was replaced by Moodle due to sustainability reasons (Grabowska, 2003; Grabowska, 2012).

1.2. A difficult road towards certification

Authorized Autodesk Training Centre at Gdansk University of Technology (ACSA PG) was established in 1995. In 2002, ACSA PG added AutoCAD to its course offer. Even though they were not free of charge, online AutoCAD training courses became quite popular. Between the years 2003 and 2017 ACSA PG issued 1802 AutoCAD certificates as shown in Table 1.

Table 1.

The number of participants of Autodesk certifications between 2003 and 2017

Year	AutoCAD	3D Max	Revit Inventor Fusion 360	Total number of certificates
2003	90			90
2004	91			91
2005	151			151
2006	216			216
2007	301			301
2008	180			180
2009	91			91
2010	100			100
2011	88			88
2012	137			137
2013	118			118
2014	69	4		73
2015	64	11		75
2016	46	3		49
2017	60		54	114

Source: Own work

The small offer of ACSA PG certificates has been gradually expanding. Since 2016 ACSA PG has had a statute of the Authorized Academic Partner, which means that for educational purposes participants can have a free access to Autodesk's design software, creativity apps and learning resources (Autodesk University).

In 2017, Autodesk Open Doors was held at the Gdansk University of Technology. The event was related to conducting a series of examinations from individual Autodesk programs: Autodesk Certified User (ACU) or Autodesk Certified Professional (ACP). If they passed, students received certificates issued by Certiport. Established in 1997, Certiport has a network of over 14,000 Authorized Testing Centers in 148 countries and is a world-recognized certification brand. Among Certiport‘s associates are Microsoft, Adobe, Autodesk and Quickbooks. Organization of the Autodesk Open Doors 2017 required the cooperation between Autodesk Authorised Academic Centre, Faculty of Management and Economics with representatives of Autodesk as well as institutions like Certiport that deal with online certification. Preparations for the exam took place in a specially prepared learning room on the SP4CE platform. The examinations were carried out in the computer laboratories of the Faculty of Management and Economics of the Gdansk University of Technology under the supervision of proctors. The experience gained during Open Doors event were helpful for establishing a broader cooperation with the institutions responsible for ACU and ACP certification and developing a plan to conduct a series of exams for a greater number of instructors and students.

Owing to the Autodesk course offer students have a chance to familiarize themselves with important software solutions that are not included in their formal academic study programme. Through Certiport, their hard-earned certificates will be widely recognized in industry. Unfortunately, as can be seen in Table 2, learning independently is challenging and does not always lead to gaining a certificate.

Table 2.

Examination results between 1st November 2017 and 18th July 2018

Exam	Number of passed attempts	Number of failed attempts
Inventor Certified Professional Exam		1
3d Max Certified Professional Exam		1
Certified Professional: Revit for Mechanical Building Systems - Metric Exam	1	
Autodesk AutoCAD Certified User Exam	2	
AutoCAD Certified Professional Exam	4	2
Fusion 360 Certified User Exam	1	1

Source: Own work

1.3. The concept of Learning Rooms - a space created for learning

Traditionally LMS was always administered by the institution without leaving too much autonomy to students. However, learners should no longer be perceived as merely information consumers. The passive methods of lecturing do not promote skills that are highly regarded in real life such as: problem solving, critical thinking and creativity. In virtual "knowledge rooms" rather than just accumulating knowledge, students learn how to manage it (Weigel, 2001). Learning is moving from the classroom into individual's space making it a more personal experience. In a Personal Learning Environment (PLE) students actively use social media such as Facebook, Wiki, Google Calendar, blogs etc. to seek, create and share knowledge (Dabbagha et al., 2012).

The concept of using LMS as PLE was utilized in ERASMUS+ SP4CE project. SP4CE stands for Strategic Partnership for Creativity and Entrepreneurship and addresses directly aims and needs on enhanced European cooperation in vocational education and training. The project was funded with support from the European Commission under the ERASMUS+ Programme (1.09.2014 - 31.08.2017). Project's activities were connected with career-oriented continuing VET (C-VET) principles. All project results and actions are connected with promoting take-up of innovative practices in education, training by supporting personalised learning approaches, collaborative learning and critical thinking, strategic use of Information and Communication Technologies (ICT), Open Educational Resources (OER), open and flexible learning, virtual mobility and other innovative learning methods. The SP4CE portal provides space for problem solving, answering questions, creation of the teams which want to work towards the problem solution, work for teams or individuals to develop the solution, mentoring and coaching, presentation of developed solutions, publishing of the chosen solution (Grabowska et al., 2015; Grabowska et al., 2016; Czaja et al., 2017; Czaja et al., 2018). Learning Rooms work as SPOCs (Small Private Online Courses) where each room is dedicated to different problem with limited number of users (Sanchez-Gordon and Lujan-Mora, 2014).

In the period from March 27 to June 7, 2017 ACSA PG in cooperation with a training company called SchemOUT (http://www.pozaschematem.pl/) offered seven courses in blended learning mode (including AutoCAD, Revit, and Inventor) to Gdansk University of Technology students. Both organisations have a statute of the Autodesk Authorised Academic Partner. ACSA PG carried out the process of student evaluation and certification. SchemOUT was responsible for delivery traditional courses. During the training, students were required to actively participate in classes and to archive their work in a dedicated Learning Room. After completing the training, students had one month to complete their Learning Room portfolio to take part in the certification process carried out by ACSA PG instructor. The process of individual evaluation and certification began on June 12, 2017. From 96 students who qualified for the certification process. 65 students got certificates of completion.

2. A PROPOSED MODEL

In 2017 face to face interviews with students were held. Statistics such as number of passed exams, number of retaken exams etc. were analyzed. A model for supporting online certification at the ACSA PG was created. As shown in Figure 1 model depends on SP4CE Learning Rooms acting as a gateway for information passage between system users.

From the organizer's point of view it is difficult to gather a sufficient number of participants, establish an exam date that fits everyone and give support to student's need to successfully finish the training. All these issues can be addressed by creating dedicated Moodle Learning Rooms. Each Learning Room should be aimed at specific exam. Users will enrol without extra effort on the organizer's part. Once the sufficient number of interested parties is ensured and all formal requirements are met the learning room can be set to private. The date could be established by voting. Important data like learning materials, dates, etc. will be stored in the Learning Room space. Managing information flow would be easy since all participants' contact information will be kept in one place.

Since preparing for the exam is crucial, all users will be offered access to Autodesk University resources. Dealing with the vast number of learning materials in the limited time learners have is challenging. To solve this issue students will be encouraged to share the best Autodesk's content in their Learning Room for everyone's benefit. Uploading their own work, discussing different solutions and sharing materials from different sources (YouTube, Google, etc.) will be encouraged, since research has shown that active learning approach is essential to maintain high level of engagement (Fisher, 2010). Learning Rooms will become cMOOCs reinforcing culture of participation in which students learn from and support each other.

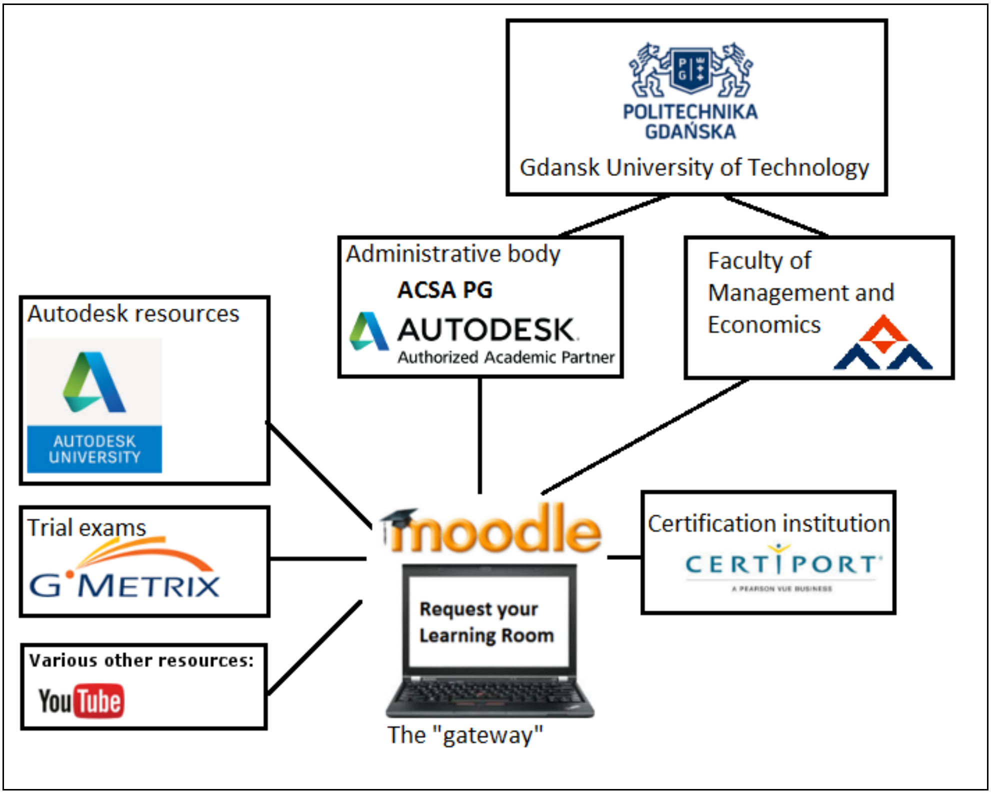

Figure 1. A proposed model

Source: Own work

Registered users will be granted admission to GMETRIX system. This way they will have the opportunity to take a few mock exams before the proper one. Through their Learning Room participants will also get access to Certiport system where their knowledge will be tested and certificates issued. Additionally after each exam participants will be asked to fill up a survey questionnaire. That way the model will get a chance to improve.

CONCLUSION

Since November 2017, ACSA PG has been working at implementing Certiport certification. Because gaining a certificate is a big challenge ACSA PG will propose GMetrix software in order to gain more practice before taking the Certiport exam. GMetrix provides educational tools designed to prepare individuals for the effective use of technology in the business environment. It is planned to involve five instructors in the evaluation of GMetrix tool as a support for those who plan taking part in Certiport exams.

In July 2018 Autodesk announced the publication of a complete Fusion 360 online training course, geared towards Fusion 360 ACU exams (Certiport). It is available free of charge to the Autodesk Learning Partner network. This course can be integrated with Autodesk Authorised Academic Partners' own content. It consists of 27 videos and a total of 160 minutes of content. The next step will be incorporating Autodesk University Open Educational Resources by ACSA PG instructors (Gdansk University of Technology teachers) in their own e-learning courses or MOOCs in order to support their professional development (Smyrnova-Trybulska et al., 2016). Dedicated Learning Rooms and MOOCs will be located in MoodleCloud. Such a solution should help Gdansk University graduates to succeed in a competitive job market.

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DEVELOPMENT OF DIGITAL COMPETENCES OF FUTURE TEACHERS

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Abstract: *The article discusses the problem of development of digital competences of future teachers in the context of Digital Competence Framework for Educators (DigCompEdu). Particular attention is paid to the analysis of the European system of digital competences of teachers in order to adapt it to the national system of higher pedagogical education. The paper focuses on the study of the levels of Volodymyr Hnatiuk Ternopil National Pedagogical University students' digital competences formation. The authors reveal the peculiarities of the created method of formation and development of digital competences of teachers in terms of DigCompEdu.*

Keywords: digital competences, DigCompEdu, teachers, research, methodology for digital competences development.

INTRODUCTION

The increased attention to the problems of pedagogical education is resulting from the new civilizational challenges facing man and society and from the modernization of educational institutions in connection with the rapid development of digital technologies. Reformers in different parts of the planet are trying to define and formulate the digital competences necessary to ensure the preparation of the younger generation for life in the 21st century.

Thus, in a joint report on the implementation of the strategic framework for European cooperation in the field of education and training, the need for the formation of digital competences and positive contribution of digital technologies to teaching have been emphasized (Declaration on Promoting citizenship and the common values of freedom, tolerance and non-discrimination through education. Informal meeting of European Union education ministers 2015).

Understanding digital competences has undergone significant changes in recent years. For our study, we consider the definition of digital competence, which includes a sure, critical, responsible use and interaction with digital technologies for learning, work and public engagement (Ferrari 2013).

In particular, according to the most recent framework document (Proposal for a Council Recommendation on Key Competences for Lifelong Learning 2018), citizens of the modern information society have to:

- understand how digital technologies can support communication, creativity and innovation;
- understand general principles, mechanisms and logic underlying digital technologies;
- understand the possibilities and limitations of digital technologies;
- approach to credibility, reliability and impact of information and data from a critical standpoint;
- create, program and distribute digital content;
- manage and protect information, content, data and digital identities;
- work effectively with programs, devices, artificial intelligence and robots;
- understand legal and ethical principles associated with the use of digital technologies.

From our point of view, special attention should be paid to the ability to use digital technologies to support active citizenship and social integration, cooperation with others and creativity to achieve personal, social or commercial goals (Balyk & Shmyger 2018).

We note that teachers are active citizens of digital society, so their digital competences should be flexible enough to be relevant both now and in the near future. Considering this, there is a problem of restarting all pedagogical education and analyzing theoretical and practical approaches to the development of digital competences of future educators.

A comprehensive solution of this problem is possible providing the development of teachers’ digital competences based on the DigCompEdu framework and its projection on the national education system. We also need to change university curricula, programs and teaching methods in accordance with the current state and trends of digital technologies development, and increase the level of digital competences of university professors.

The purpose of the article is to analyze the domestic and foreign experience of determining theoretical and practical aspects of the development of digital competences of future teachers. We aimed to study the level of students' digital competences formation in the context of the European Digital Competence Framework for Educators (DigCompEdu), and describe the developed methodology for developing their digital competences at the Volodymyr Hnatiuk Ternopil National Pedagogical University.

1. THEORETICAL BASIS OF THE STUDY

Scientists from many countries have been developing an approach to competency-based training as a modern teaching standard for teachers training. The categorical and conceptual apparatus of the competency-based approach is considered in different scientific studies (Bykov & Ovcharuk 2017), (Morse, Barna, Kuzminskaya & Vember 2017), (Ovcharuk 2005), (Wolfe & Steinberg 2014), (Johnstone & Soares 2014). For example, the authors (Smirnova-Trybulska, Stec, Studenska, Noskova, Pavlova, Yakovleva & Delgando 2017) define competence as an individual potential to adapt to environmental conditions, to implement creative changes and to act effectively.

J. Gervais constructed an operational definition of competency-based education. In particular, CBE is defined as an outcome-based approach to education that incorporates modes of instructional delivery and assessment efforts designed to assess the mastery of learning by students through their demonstration of the knowledge, attitudes, values, skills and behaviors required for the degree sought (Gervais 2016).

Scientists consider the problem of identifying key competences in the field of digital education and teacher training (Crick 2008), (Smyrnova-Trybulska 2007). The aim of the study (Svensson & Baelo 2014) was to determine teachers' understanding of digital competences for developing their future profession. The review (Pettersson 2018) focuses mainly on how digital competences in educational contexts have been regarded in international research over the past 10 years in terms of politics, organizational infrastructure and strategic leadership.

R. Hall, L. Atkins, and J. Fraser have reviewed a variety of frameworks (Hall, Atkins & Fraser 2014). These frameworks are structured around three or four levels, which tend to reveal a deficit model at the lower levels and determine critical digital engagement on the progress of the very basic requirements to the demonstration of expert, transformational skills, practices and knowledge. For example, the levels defined in the DigEuLit project (Martin & Grudziecki 2007) move from 'digital competence', generic skills and approaches to 'digital usage', the professional application of these skills and finally to 'digital transformation', where innovation and creativity occurs.

The model for integrating digital competences into the professional development of teachers is analyzed in the study (Pozos 2010, UNESCO 2008). The model contains a framework of 7 digital competences, 78 units of digital competences distributed over three levels of competences development: Basic Knowledge, Knowledge Deepening and Knowledge Generation.

The work (Balyk & Shmyger 2017) reveals the process of forming teachers' digital competences at the smart university as well as defines organizational and pedagogical conditions, principles and pedagogical methods of their development and presents a three-dimensional model for the formation of digital competences in the context of creating new knowledge.

2. THE PRESENTATION OF MAIN RESULTS

2.1. Digital competences. Teacher Training

Modern society should promote the development of digital competences necessary for lifelong learning. Teachers play an important role in the process of mastering these competences by the younger generation. Therefore, appropriate conditions must be provided to properly motivate and train future teachers. Without professional growth and continuous training, teachers will not be able to integrate correctly the topic of digital competence into the context of their disciplines.

Reform of higher education in Ukraine requires changes in the system of training of young people. These changes, along with other social and economic challenges, require an adequate response from higher education. Realizing the importance of a teacher in developing students' digital competences, we offer a study that aims to promote the development of digital competences of future educators.

To implement our research, we have focused on the digital competences identified by the European Digital Competence Framework for Educators. DigCompEdu outlines the tools needed to increase teachers' digital competences level.

The DigCompEdu framework involves a common EU approach to defining and describing the main areas of teachers' digital competences and provides a common focus at the European level. The framework views six different areas of competences.

The first area is focused on the professional environment. The second one is related to digital resources search, creation and exchange; the third area is related to the management and use of digital teaching tools and the fourth one deals with digital tools and strategies to improve evaluation. The fifth area is connected with the use of digital tools for expanding pupils' capacities. The sixth area concerns students' acquisition of digital competences. Areas 2 to 5 form the pedagogical core of the framework. They detail the competence that teachers need to develop in order to exercise effective, inclusive and innovative learning strategies using digital technologies (DigCompEdu 2018).

2.2. Research methods

We will present a methodology for the preparation and conduct of the research, the experimental base and its participants, and indicate the levels of digital competence and the indicators by which they were evaluated

During the experiment, we used a set of research methods, namely:

- theoretical – analysis of scientific and educational-methodical literature, official documents of the European Union and the Ministry of Education and Science of Ukraine to determine the theoretical foundations of the problem solution;

– empirical – observation to determine the state of levels of formation of digital competences of future teachers; development of experimental research methodology; detecting the effectiveness of experimental work;

– a pedagogical experiment, which allowed to investigate the real influence of the developed methodology on the process of preparation of future teachers;

– statistical methods of mathematical processing of scientific data for the analysis and interpretation of research results.

The research was carried out in the course of the following stages:

1. Identification of indicators and levels of digital competence.
2. Creating a questionnaire. Formulating allegations that measure the indicators value and levels of digital competence.
3. Carrying out the ascertaining stage of the experiment in order for students to self-assess their level of formation of digital competences.
4. Adaptation of university educational programs in the field of information technologies to the DigCompEdu Framework, development of a methodology for increasing the level of students' digital competences.
5. Carrying out the formative stage of the experiment so that students can self-assess their level of the formation of digital competences.
6. Statistical processing of results and summing up.

First-year students assisted with the study. The survey was conducted among the students so they self-assessed their level of the formation of digital competences. A control group (CG) of 53 students and an experimental group (EG) of 54 students were selected.

At the initial stage of the study, a questionnaire was created based on the Digital Competence Framework for Educators (DigCompEdu) in order to determine the level of formation of the digital competences of future teachers. It assesses five areas of competences: professional development, digital resources, student learning and assessment, students’ digital competence formation, teacher in the information society with 22 descriptors which are: organizational communication, professional cooperation, reflexive practice, continuous digital professional development, digital resources selection, creation and change of digital resources, management, protection and exchange of digital resources, training, management of learning process, organization of joint training, organization of reflexive learning and self-control, evaluation strategies, analysis and interpretation of digital data, feedback and planning, accessibility and inclusion, differentiation and personalization, active engagement of students, interactive and active student learning, information and literacy in the media, digital communication and collaboration, digital content creation, responsible use of digital content, digital problem solving.

Therefore, the questionnaire generally contains 22 questions pertaining to each of the descriptors. The evaluation was conducted on a four point scale (1 – low, 2 – medium, 3 – high, 4 – creative). The following question template was used: «Evaluate, please, what is your skill level...»? Here are some examples of questions from the questionnaire: «Evaluate, please, what is your skill level in digital student assessment strategies»? «Evaluate, please, what skill level in digital technology you have for the purpose of organizing student cooperation»?

2.3. Research results

Let us outline the main results of the study. The ascertaining stage of the experiment was conducted in control and experimental groups in the beginning of the first semester of computer studies learning. Summarizing the data of the ascertaining stage of the experiment, the total indicators of the levels of formation of digital competences of students were calculated. Their arithmetic mean values are given in Table 1.

Table 1.

General indicators of the level of students' digital competence formation before the experiment (%)

Digital competence	Levels							
	low		Medium		high		creative	
	CG	EG	CG	EG	CG	EG	CG	EG
Professional growth	40,9	41	37,2	37,4	13,5	13,2	8,4	8,4
Digital Resources	12,2	12,3	45,6	45,5	36,5	37,2	5,7	5
Training and assessment of students	40,3	40,6	38,5	39,2	15,8	16,4	5,4	3,8
Students' digital competence formation	34,3	35,8	39,7	40,1	18,4	19,3	7,6	4,8
Teacher in the information society	18,1	19,3	34,5	36,4	38,6	39,5	8,8	4,8
Average value	**29,16**	**29,8**	**39,1**	**39,72**	**24,56**	**25,12**	**7,18**	**5,36**

Source: Own work

We should note that the results of the ascertaining stage of the experiment gave the opportunity to conclude on the quantitative and qualitative characteristics of the formation of the digital competences of future teachers in the process of studying digital technologies at the pedagogical university.

Thus, the formation of digital competences after calculating the total indicator (consolidated figures), followed by simple averaging, is at a low level in 29.8% of respondents, at an average level in 39.72% of respondents, at a high level in 25.12% of respondents, and on creative level only in 5.36 % of respondents.

The analysis of the results of the ascertaining stage of the experiment showed that the control and experimental groups have rather low percentages of students with a high or creative level of the formation of digital competences.

Proceeding from these results, we have upgraded university curricula and developed a suitable methodology for raising the level of students' digital competences. It includes forms, methods, training devices and digital tools aimed at developing and correcting levels of digital competences development.

The established teaching methodology makes it possible to combine different learning methods that do not focus on one single approach (so-called open concept): project learning technology, e-learning, collaborative learning, transdisciplinary STEAM projects, case study, design thinking, etc.

This methodology also implies development of a skill to choose digital tools that are optimal for each specific context, allowing you to deepen the learning outcomes and solve problems creatively, stimulate innovation by building partnership between students and faculty, while enhancing the level of digital competence of all involved parties.

The initiative for the development of digital competence at the Volodymyr Hnatiuk Ternopil National Pedagogical University is based on the use of the model of mutual learning, which allows teachers to find new variants of the application of educational technologies that meet their interests and goals.

The proposed methodology was tested in the experimental group in the end of the second semester in the process of computer studies learning.

The purpose of the formative stage of the experiment was to determine the effectiveness of the implemented methodology, aimed at developing digital competences of students. For this, after the formative stage of the experiment, we conducted a repeated questioning of the students of control groups (CG) and experimental groups (EG), and carried out mathematical processing of the results. In Table 2, we offer a results summary of the diagnosis on five indicators after the formative stage of the experiment.

Table 2.

General indicators of the level of students' digital competence formation after the experiment (%)

Digital competence	**Levels**							
	low		**medium**		**high**		**creative**	
	CG	**EG**	**CG**	**EG**	**CG**	**EG**	**CG**	**EG**

Professional growth	37,5	23,5	39,3	51,2	14,2	15,4	9	9,9
Digital Resources	11,4	9,5	44,3	45,5	37,6	37,2	6,7	7,8
Training and assessment of students	38,2	18,2	39,4	49,2	15,8	25,1	6,6	7,5
Students' digital competence formation	32,5	14,9	39,9	42	19,1	29,4	8,5	13,7
Teacher in the information society	17,8	8,6	33,7	38,5	39,2	40,9	9,3	12
Average value	**27,48**	**14,94**	**39,32**	**45,28**	**25,18**	**29,6**	**8,02**	**10,18**

Source: Own work

The results of the experimental work are illustrated using histograms (Figure 1, 2). Their analysis shows that after the experiment there have been positive changes in the formation of digital competences in EG of future teachers because of the application of the developed teaching methodology. In contrast, minor changes were recorded in CG.

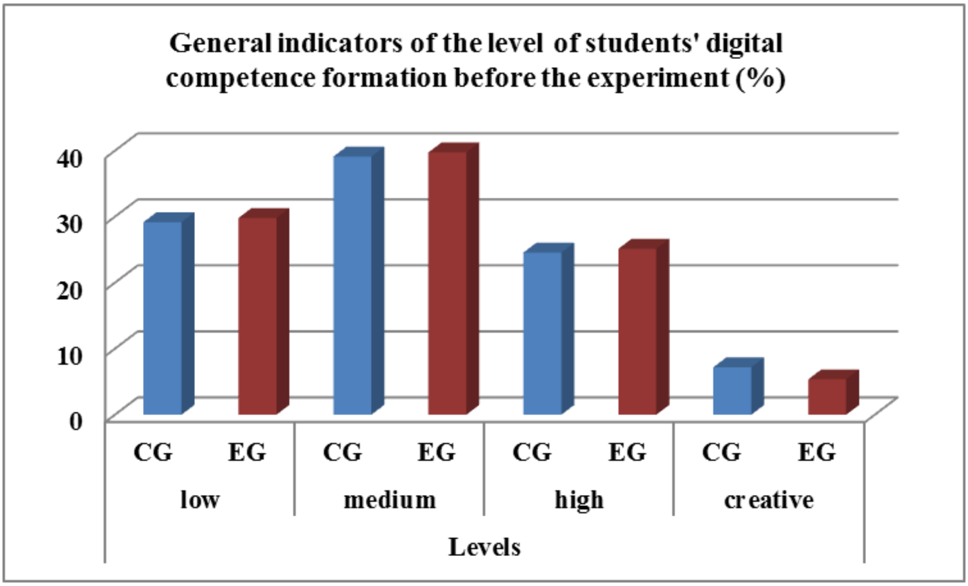

Figure 1. General indicators of the level of students' digital competence formation before the experiment
Source: Own work

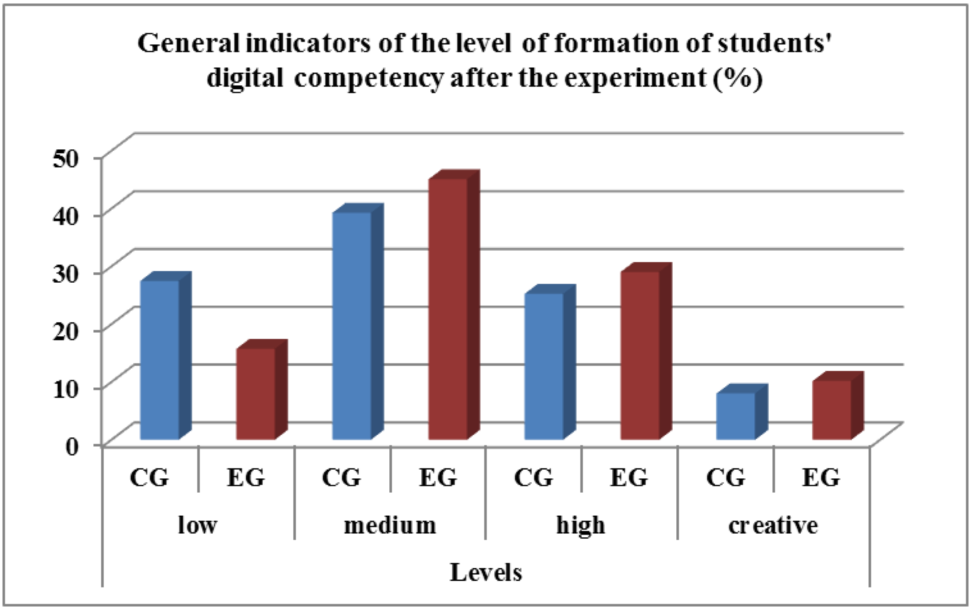

Figure 2. General indicators of the level of students' digital competence formation after the experiment
Source: Own work

To test the null hypothesis H0 for the absence of significant differences between the obtained indicators of levels of digital competence in EG and CG after the formative stage of the experiment, we use the statistical criterion χ2 (Pearson criterion). To achieve this, we will calculate the empirical value of the criterion according to formulas (1) and (2) and compare it with the critical according to statistical tables.

$$\chi^2_{emp} = \sum_{i=1}^{n} \frac{(f_{ei} - f_{ci})^2}{f_{ci}} \quad (1),$$

where f_{ei} is the relative frequency of *e*-value (experimental) on the *i*-th interval, f_{ci} is the relative frequency of *c*-th value (control) on the *i*-th interval.

The relative frequency of f_{ei} on the i-th interval is determined by the formula

$$f_i = \frac{F_i}{\sum F_i} * 100\% \quad (2),$$

where F_i is the frequency of occurrence of value (*e* – experimental, *c* – control) on the *i*-th interval, and acquires values from 1 to *n* (in our case *n* = 4, which is the number of intervals). The change in the levels of the formation of digital competences and the calculation of the empirical value of the criterion $\chi 2$ are presented in Table 3.

Table 3.

The change in the levels of the formation of digital competences and the calculation of the empirical value of the criterion $\chi 2$

№ of interval	Relative frequency f_e, %	Relative frequency fc, %	$f_e - f_c$	$(f_e - f_c)^2$	$\frac{(f_e - f_c)2}{f_c}$
1	14,94	27,48	-12,54	157,25	5,7224
2	45,28	39,32	5,96	35,522	0,9034
3	29,6	25,18	4,42	19,536	0,77587
4	10,18	8,02	2,16	4,6656	0,58175
All					χ^2_{emp} **=7,98341**

Source: Own work

For the degree of freedom n–1 = 3 according to the table, at the level of significance α =0.05 we find that χ^2_{crit} =7,8. We got that $\chi^2_{emp} > \chi^2_{crit}$.

Thus, the null hypothesis is rejected. Instead, an alternative hypothesis is adopted, namely: the differences between the obtained indicators of the level of the formation of digital competences in CG and EG are not random (with a probability of 95%), which justifies the effectiveness of our proposed methodology.

CONCLUSION

The development of future teachers' digital competences is a topical issue of theory and methodology of education. The methodology for the formation and development of digital competences should be considered in terms of integration of the European Digital Competence Framework for Educators (DigCompEdu) and national standards and training programs.

In the context of developing digital competences of teachers, a methodology based on an open concept of learning – e-learning technology, collaborative learning, transdisciplinary STEAM projects, case study, design thinking – has been developed.

The conducted experimental research testifies to the effectiveness of our proposed methodology. This study contributed to the change in university curricula and teacher training programs and the development of their digital competences. The modernization of the University's curriculum based on the DigComp standard has contributed to the creation of innovative educational initiatives.

The long-term goal of this study is to facilitate the development of a methodological framework for the integration and development of digital competences in teacher training programs and in developing relevant methodological recommendations.

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METHODOLOGICAL APPROACHES TO THE SELECTION OF LEARNING MANAGEMENT SYSTEMS FOR USE IN THE EDUCATIONAL PROCESS

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Abstract: *The article proposes a methodology for comparative analysis of learning management systems (LMS) for their selection as a means of studying and as a goal of studying in educational institutions. The methodology is based on the criteria: open source / freeware; architecture; ease of installation/administration; set of services; possibility of localization; interface. The most well-known LMS with Ukrainian localization are analyzed and selected for use in the educational process. The results of the students' study are analyzed and LMS that are the most suitable for application in their future professional activity are clarified.*

Keywords: educational process, learning management systems, software selection.

INTRODUCTION

The global process of transition to the information society requires significant changes in many areas of activity. Thus, it is considered necessary to ensure the development of education on the basis of new progressive concepts, introduction of the latest pedagogical technologies and scientific and methodological achievements in the educational process, and the creation of a new system of information provision of education. The development of the educational system should lead to:

– expanding access to all levels of education for a large number of people;

- the implementation of the system of continuous education, which opens the opportunity for permanent deepening of general education and professional training, achieving of integrity and continuity in education and upbringing;
- individualization of training.

In today's Ukraine, the use of e-learning systems is spreading, and when developing training courses, the problem of selecting appropriate systems among existing systems with Ukrainian localization becomes a topical issue. We have proposed criteria for selecting LMS for use in the educational process, and we focus not only on the educational aspect of products, but on IT aspects, in connection with the training of specialists in education and computer science, which will mainly create the structure of the courses and will serve them. At the same time, content and educational aspects of courses concern the competence of specialists of the relevant subject areas. The aim of the work is to determine the appropriate criteria for selecting LMS, to evaluate the systems commonly used in Ukraine in accordance with these criteria and to define the LMS that enables future specialists to acquire competences for the creation and administration of electronic courses.

Due to the development of the Internet and modern methods of communication and data exchange, the popularity of e-learning is growing. It becomes possible to create and apply more qualitatively: electronic workbooks, encyclopedias, tests, glossaries, questionnaires, virtual laboratories, etc. Elements of e-learning (computer-based learning) are widely used in distance education.

At present, there is a large number of Learning Management Systems (LMS) that include tools both for organizing and monitoring the use of training courses, and for administering the educational process as a whole.

One can distinguish several basic types of e-learning support software: authoring software for creating learning resources, Learning Management System (LMS), Computer-managed instruction (CMI), Content Management System (CMS) and Learning Content Management Systems (LCMS). Interpretation of terms relating to e-learning in some countries is given in Smyrnova-Trybulska, E. et al., 2017.

To a greater or lesser extent, the basic functions of such systems are defined as 3R (Registration, routing and Reporting) (Smyrnova-Trybulska, E., 2007).

These systems have a similar structure that contains the following common elements:

The subsystem of registration provides registration of new users (students, pupils), and also registration of a session of work of an already registered user. In addition, this subsystem can provide import / export of user accounts from other / to other sources.

The subsystem of routing provides the start of learning and the learning process itself, directing the student through the sections and stages of the system, providing him with the necessary elements of the interface. In addition, this subsystem can provide the choice (change) of the path of learning based on certain logical conditions (test results, a list of previously studied topics, etc.)

Subsystem of reporting provides students with the opportunity to get information about the results of their studies, assessments. The teachers additionally receive a complete picture of the work of students (pupils) and a statistical analysis of the data on the learning process in general.

1. GENERAL STRUCTURE OF LMS

Taking into account a large number of e-learning systems, one should examine some very important elements that need to be considered when choosing such a system.

The structure of the e-learning system should provide the creation and conducting of courses that take into account the specifics and features of users. Such a system should not only offer services of sending data and materials, but also provide necessary formation of practical skills.

Providing different ways of communication between students, as well as between the student and tutor will give one an opportunity to understand the teaching material easily, through the possibility of exchanging views (in the forum, in chat, through mail). In addition, a knowledge validation system, that provides the teacher with the ability to assess students' knowledge online, is also important. Typically, such a system includes tests, tasks and control of students' activity.

One of the essential elements implemented in the systems is the element of exploration of the entire learning process. All events related to the course must be registered. Due to this, the teacher can analyze the operational data about the results obtained by the students.

An important role in choosing a system plays its cost (Horoshko, Y. et al., 2010). The cost consists of the cost of the system itself, as well as the cost of its implementation, the development of courses and support, the presence or absence of restrictions on the number of licenses for students.

The correspondence of the system to The Sharable Content Object Reference Model (SCORM) and the Aviation Industry Computer-Based Training Committee (AICC) is quite important. This ensures compatibility of courses carried out on different systems, as well as control over the student's learning achievements. The SCORM standard is based on the XML language and describes the internal representation of the courses in the system. If any two systems of distance learning support this standard, then there is an opportunity to immediately move the entire course from one system to another.

From the student's point of view, the convenience of use of the system is important. This is a significant parameter, because potential students will never use a technology that seems cumbersome or difficult to navigate. Learning technology should be intuitive. The training course should provide the opportunity to simply find the help menu, easily switch from one section to another and communicate with the instructor.

The presence of a national product localization is important. The localized version of the product is more user-friendly both for administering, courses, and for end users of educational services.

Also significant is the system updatability. New, improved versions of the system with the support of new technologies, standards and tools should be issued regularly.

2. CRITERIA FOR SELECTION OF LMS FOR USE IN EDUCATIONAL PROCESS AND THEIR APPLICATION FOR ANALYSIS OF WIDESPREAD LMS

At present, there have been developed many of such systems, provided with a large number of management and use services. This necessitates their comparative analysis in order to select distance learning systems as a means of learning and as a goal of studying in different types of educational institutions.

The comparative analysis of LMS used in the universities of Sri Lanka is given in (Thuseethan, S. et al., 2015). The comparison of different LMS mainly in terms of their productivity is given in (Kor & Tanrikulu, 2008).

We propose the following methodology for conducting such a comparative analysis based on the criteria:

- open source / freeware
- architecture;
- easement of installation / administration;
- set of services;
- possibility of localization;
- convenience of the interface.

Let's consider the main characteristics of the most used LMS, using the specified criteria.

2.1 Moodle

MOODLE (www.moodle.org) - Modular Object-Oriented Dynamic Learning Environment. The MOODLE software platform is free and open source software, which is distributed free of charge and with open source software and complies with the SCORM standard.

Some practical recommendations for effective use of MOODLE are provided in (Drlik et al., 2017).

MOODLE is in a Learning Management Systems (LMS) class or Virtual Learning Environments (VLE). In Ukraine such systems are often referred to as Distance Learning Systems (DLS), as it is with the help of such systems, many educational institutions have organized distance learning. The notions of LMS, VLE, DLS are often used synonymously.

MOODLE is written in PHP using the SQL database (MySQL, PostgreSQL, MariaDB, Microsoft SQL Server or Oracle) and is a multi-platform, so it can be installed on a computer with appropriate software.

To install the system, depending on the software on the computer, the developers offer either sets of source files for installation on a computer with a debugged WEB server, or additional installation packages that contain a portable WEB server and allow installing MOODLE on personal computer. The installation and initial debugging process itself is not complicated, since it is accompanied by text comments and explanations of the debugging elements. After installing, the administrator needs to perform only simple actions relative to users' work, but the system can also be used with the default settings. If necessary, almost all the parameters can be changed, but for the beginner it can cause some difficulties, because there are a lot of parameters and it is difficult to orientate at once in them.

The MOODLE system is widely used in many universities in the world and has a large number of localizations, including Ukrainian.

MOODLE is a toolkit for developing both individual on-line courses and educational Web resources. The use of LMS MOODLE provides an opportunity: to place interactive educational materials on the network; to organize independent work of students, to differentiate access to educational materials; to provide control over the process of studying the material and the execution of tasks; automate the evaluation procedure; to organize the distance interaction of the participants of the educational process; student portfolio management; preserving the history of learning.

The teacher can use both thematic and calendar structuring of the course at his own discretion. In thematic structuring, the course is divided into sections by subject. In calendar structuring, each week a course study is published in a separate section. Such structuring is convenient in the distance learning organization and allows students to properly plan their educational work.

LMS settings allow at any time to change the look and structure of the distance learning course, which makes it easy to update the content of disciplines. Editing the content of the course is conducted by the course author in an arbitrary order and can be easily implemented directly in the learning process. It is very easy to add different elements to the electronic course: lecture, task, forum, glossary, wiki, chat, etc. For each electronic course there is a convenient page for viewing the latest changes in the course. Thus, LMS MOODLE provides the teacher with a powerful toolkit for presenting educational and methodological materials of the course, conducting theoretical and practical classes, organizing educational activities, both individual and group.

Since the main form of knowledge control in distance learning is testing, LMS MOODLE has a great tool for creating tests and conducting training and control testing. A large number of question types in test tasks (multiple choice, relevance, true / false, short answers, essay, etc.) is supported in the system. MOODLE provides many features that make testing easier. The system contains advanced tools for statistical analysis of test results and, most importantly, the complexity of individual test questions for students.

Most elements of the e-course in the LMS MOODLE can be evaluated. The teacher can create and use different assessment systems within the course. All ratings are collected in a general log, which contains convenient mechanisms for summarizing and reporting. MOODLE provides an opportunity to control attendance, student activity, time of their academic work in the network, provides the efficiency and comfort of the process of independent work.

Learning LMS, and in particular MOODLE, in the process of training future educators always entails certain difficulties. This is due to the fact that for such systems quite often there are no recommendations for a single look, no translation into the Ukrainian language, no matching services. There is no commonly used terminology. Each particular system is installed, adjusted and refined in different ways. However, this has its advantages, because one site SUN is not similar to another.

2.2 eFront

eFront (https://www.efrontlearning.com/) is an open system that combines the functions of the Learning Management System (LMS) and the Learning Content Management System (LCMS).

The eFront system is written in PHP using the SQL database (MySQL) and is a multi-platform, so it can be installed on a computer with the appropriate software. The system is developed using a paradigm of object-oriented programming, and its architecture is based on a three-tier design approach, which separates the representation of the system from its logic and data.

With regard to the installation of the system, eFront in this sense is very different, and, for the better, from the considered above MOODLE system, because it requires much less technical skills. The system is easy to install on the Windows operating system; Ubuntu or other GNU / Linux operating systems, if required software has been previously installed. Moreover, all processes are documented and described in detail. That is, any user, even technically weakly trained, is unlikely to have problems with installation. Once installed, system settings can be changed, and their change is more understandable, in our opinion, in comparison with MOODLE. At present, in addition to installing the system on the servers of the educational institution, the registration and placement of the training portal on the eFront resource is provided. However, such a service is not free; therefore it is not always suitable for non-commercial educational institutions.

The eFront system has a large number of localizations, including Ukrainian.

In the eFront system there is a large number of parameters for adapting the look and structure of the training portal, which facilitates the integration of the system into the WEB-resource of the educational institution.

The use of the LMS eFront provides the opportunity to solve the problems of organizing the educational process in educational institutions, as well as training, certification and selection of employees in organizations of different sizes.

Due to the flexible organization of the structure of the system, there are wide opportunities for determining the roles for users and, accordingly, delimiting their access to the elements of the system. The system has the ability to create dynamic groups, that is, users can be divided into segments that are logical for an educational institution and will display its hierarchy.

The system provides a very easy way to fill the course with study materials that may include: hypertext pages, attached files, links to external resources, glossaries, wiki, forums, etc. Also, the course author may use materials from previously placed courses or, if necessary, edit the content of the course, even directly in the learning process.

For evaluation of theoretical knowledge and practical skills of students, the possibility of conducting individual or group surveys, assignment of tasks, the results of which students can transmit in various formats (typing text, sending files, links) is provided. Also, the system provides the ability to create test questions of different types. Based on the results of the tests, various reports can be generated, either by individual tests or courses, or by individual users.

A quite important element of the system can be considered the possibility of creating rules for the course. These rules will control access of users to the elements of the course, determine the order of passing all the elements of the course and the terms of completion of the course as a whole.

It can be noted that the DLS eFront is primarily intended for the academic sector. However, there is also the possibility of commercial use, as there is a corresponding set of services in the system, namely the registration of staffing, tracking career changes, etc. In general, LMS eFront is a very high-quality and functional system, which undoubtedly deserves a lot of attention.

2.3 ATutor

ATutor (http://www.atutor.ca/) is an open-source web-based learning management system (LMS).

The ATutor system is written in PHP using the SQL database (MySQL) and is a multi-platform, so it can function on a computer with the corresponding software. And since the system is modular, that is, it consists of separate functional units - modules, then it is open for the modernization and expansion of functionality.

Installing the system, as well as the process of updating it, is not complicated. For further work it is necessary to take several steps, in the process of that the system will check the installed software and the parameters with which it operates. All stages of installation are documented and described in detail. The ATutor system has a large number of localizations, including Ukrainian.

ATutor supports the ISM and SCORM specifications to ensure compatibility with courses for other distance education systems.

ATutor supports three types of users - the administrator, the instructor (teacher) and the student. Depending on the role of the user, he is given the appropriate set of services. After installing the system, the administrator has a fairly limited interface, despite a large number of rights granted to him. So the main tasks of the administrator are to update the system, to change localization, to correct personal accounts, to change the privileges of access, to install new themes. And, most likely, the most inconvenient one is that the administrator should create categories of courses (Kostiuchenko, A., & Shkardybarda M., 2013).

When creating training courses, the teacher can use both a built-in editor of materials and download files with the necessary training material, for example, with text of lectures, practical classes, etc. in a variety of formats. In addition to the actual teaching materials, the courses may include dictionaries of terms, lists of literature and the period of familiarization with them, invaluable surveys, students' opinions on a particular topic.

In order to provide communication between the participants of the educational process, the system has both synchronous (chats, teleconferences, whiteboards) and asynchronous (ads, forums, internal messages, e-mail, blogs, wikis, comments in file exchangers) means.

Students in the course can be tested, although with a small number of types of questions (multiple or single choice, question type true / incorrect, and open questions to which the student himself must write a response). As a result of tests, reports can be generated. Also, for the analysis of students' work, the system provides the possibility of reviewing used materials.

ATutor is a complete and free distance education system that is easy to expand and adapt and can be successfully used both for internal use at educational institution and for access to materials on the Internet.

2.4 Prometheus and Google Classroom

At present, not only fully-fledged training management systems that require installation and debugging can be used to conduct distance learning, but web resources that are already prepared for common use. Such resources allow the organization of an educational environment on their basis. Thus, there is no need for an educational institution to host and administer a remote environment using a ready-made platform. Among such portals, we would like to draw attention to the systems Prometheus and Google Classroom that are widely used in Ukraine.

Prometheus (https://prometheus.org.ua) is a public project for mass open online courses to provide the creation and placement of such courses on its own online platform.

Prometheus not only creates and hosts mass open online courses on its own site, but also provides a free opportunity for universities and organizations to publish and distribute courses. So a university, organization or company can become a member of the Prometheus project, get its own page on the online platform, and the right to free courses. Important in this regard is the preservation of intellectual property rights for courses by those who create them.

The system assumes the availability of educational material both in the form of texts, and in the form of video lectures. For discussions with other students and teachers, it is possible to create forums for specific courses. The consolidation and verification of the knowledge gained in the system is ensured through a variety of interactive tasks and tests. The "Prometheus" system provides not only the possibility of obtaining new knowledge for students, but also the possibility of obtaining certificates as a result of successful training.

Google Classroom (https://classroom.google.com/) is a free service for educational institutions and nonprofit organizations that can be used to support distance learning. In fact, Google Classroom provides the opportunity for teachers to organize a standard online learning process.

Classroom is another service from Google. This service aims to provide users with a versatile tool for working by quickly integrating other Google services: Gmail, Docs, Calendar, Drive, and more.

To work with Google Classroom, one needs to create a free G Suite for Education account for the educational institution and determine which Google services will be available to teachers and students.

The teacher can create so-called classes, which can be structurally related to a certain discipline. When creating a class, a unique code is generated so that students can use to join this class. This approach dismisses the teacher from the need to create accounts for students.

After creating a new class on the teacher's Google Drive, a corresponding folder is created in which the teacher will be able to post the teaching materials. When students enter a class, they get the appropriate folder on their Google Drive with subfolders for each class they join. With the further creation of tasks from the teacher in the form of a Google document, the platform provides distribution of individual copies of the document for each student in the class. In addition, when creating a task, the teacher should specify the timing of its execution, which will be displayed in the student's calendars, and they will be able to see and control the process of their execution. The reports on completed tasks are updated in the teacher's panel in real time, and he can check the work and evaluate it.

With the combination of notices made by a teacher and the ability to comment on tasks, teachers and students always have the opportunity to stay in touch and keep abreast of the status of each task.

However, it's worth noting that Google Classroom does not provide the ability to create test tasks, and therefore some external services will need to be used to control the learning.

3. COMPARISON OF SELECTED LMS

After the analysis, the full-featured DLS MOODLE, e-Front and Atutor were selected to form the contents of the course "Creating and Administration of Distance Educational Resources".

More detailed comparative characteristics of the selected DLS are given in Table 1.

Table 1.

Comparison of Open Source Learning Management Systems

System element	MOODLE	eFront	ATutor
Division of courses into categories	+	+	+
Availability of change roles for users	+	–	–
Distribution of users by groups	+	+	+
Placement of text materials	+	+	+
Placement of multimedia materials	+	+	+
Conducting polls, questionnaires	+	+	–
Organization of chats and forums	+	+	+
Videoconference (teleconference)	+	–	+
Creation of collective design work	+	–	+
Feedback	+	+	+
Tests	+	+	+
Reuse test questions (single query base)	+	–	+
Tasks for performing on-line	+	–	–
Ability to download files by students	+	+	+

Rules for passing the elements of the course	–	+	–
Keeping statistics (scores, marks)	+	+	+
Availability of reports	+	+	+
Compliance with the SCORM and AICC standards	+	+	+
Ability of extensions by additional modules	+	+	+

Source: Own work

After studying the course "Creating and Administration of Distance Educational Resources" students of the Taras Shevchenko National University "Chernihiv Collegium", were asked to answer a number of questions to identify their assessment of the features and capabilities of various distance learning systems.

When conducting the survey, students were offered to evaluate the functional capabilities of distance learning systems, the convenience and intuition of the actions of the administrator, teacher and student on a five-point system (from 1 to 5). The survey was attended by 64 graduate students in educational specialty (31 students in the 2016-2017 academic year, 33 students in the 2017-2018 academic year).

In the course of studying "Creating and Administration of Distance Educational Resources", students worked with LMS in three roles such as administrators, teachers and students. As administrators, they installed and configured appropriate systems. As teachers, they created and filled out distance courses and further analyzed results of study. As students, they learned studying the courses of other students.

The results of these surveys are presented in Tables 2, 3 and 4.

Table 2

Set of services of the system (score from 1 to 5)

System element	**MOODLE**	**eFront**	**ATutor**
Administration of the system	4,8	4,3	3,8
Work with users	4,7	4,2	3,8
Services for creating educational materials	4,9	4,1	3,2
Reporting services	4,7	4,3	2,7
Services for student analysis	4,7	3,9	2,5

Source: Own work

Table 3

Convenience and intuition of actions performed by the administrator and teacher (score from 1 to 5)

System element	MOODLE	eFront	ATutor
Installation and initial administration (the minimum necessary to set up the system for work)	3	4,8	3,5
Deep administration (conducting additional debugging of individual elements of the system)	2,2	4,3	3,5
Work with users (creation / registration, distribution of roles, enrollment on the course)	3,9	4,0	3,8
Filling with educational materials	4,8	4,6	3,9
Filling with reporting elements (tests, surveys, tasks)	4,0	4,3	2,8
Conducting an analysis of student activity	4,2	4,2	3,9

Source: Own work

Table 4

Convenience and intuition of student actions (score from 1 to 5)

System element	MOODLE	eFront	ATutor
Convenience and intuition of the interface	3,8	4,6	2,8
View educational materials	4,6	4,6	3,8
Passing tests	4,7	4,5	4,2
Analysis of own activity at the course	4,8	4,8	4,3

Source: Own work

CONCLUSION

As a result of learning on the course "Creating and Administration of Distance Educational Resources", students gained competences in working with selected LMS and created real distance courses that could be used by them in their further professional activities.

The results of the research (analysis of Tables 2, 3, 4) revealed the necessity of making partial changes to the work program of the course "Creating and administering distance education resources" to increase the learning time for the study of the LMS MOODLE, since in the aggregate of indicators this system was rated by the students the highest. The updated work program focuses on the study of the characteristics of systems that have proved to be the most difficult for students and received lower marks.

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EXPERIENCING HAPPINESS AND COPING WITH STRESS AS THE KEY FACTORS IN THE DEVELOPMENT OF INTELLIGENT ORGANISATIONAL CULTURE IN ENTERPRISES APPLYING THE IDEA OF E-LEARNING

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Abstract: *Contemporary literature studies concerning the essence and importance of organisational culture increasingly present the discussed concept as ambiguous or even controversial. This fact makes the discussion of organisational culture extremely inspiring, opening many new areas for scientific exploration. The aim of the article is to present intelligent organisational culture and the key determinants of the effectiveness of the process of creating its model in enterprises applying the e-learning idea, with the emphasis on the essence and importance of two research categories: experiencing happiness and the ability to cope with occupational stress.*

Keywords: E-learning, happiness, intelligent organisation, occupational stress, flow experience

INTRODUCTION

In the contemporary world of rapidly developing information technologies, where distance learning is more and more often used, not only in school education but also in business, the basic values which determine human (mental) well-being are increasingly at risk. Such values definitely include experiencing happiness and the ability to cope with stressful situations. Therefore, it seems extremely important to study the issue concerning experiencing happiness, which is the key element of well-being, and coping with the 21st century's omnipresent stress in the context of intelligent organisational culture of enterprises applying the e-learning idea. Experiencing happiness understood as *flow experience* is a concept considered one of the most important approaches to the conceptualisation and evaluation of educational activities and the possibility of improvement of teaching and learning methods, not only in school but also in business (Yi Maggie Guo, Young K. Ro, 2008). Therefore, it is worth analysing the relationships between experiencing happiness (understood as flow experience and the ability to cope with stress) and the development of intelligent organisational culture in companies applying the e-learning method as one of the basic tools of knowledge acquisition and raising employees' competencies. The main aim of the article is to highlight the new problem - how modern technologies, particularly as popular as e-learning, may influence the level of experiencing happiness and stress in the workplace. The above-mentioned, very important, problem may be treated as a research gap. The present article is theoretical in nature. The methodology used in it is based on the synthesis of the subject literature and its critical analysis. Such a method may be a good way to use, in next steps of the scientific exploration, induction methods and advanced empirical research. Final results of them are highly anticipated.

1. EXPERIENCING HAPPINESS IN THE CONTEXT OF THE USE OF E-LEARNING IN CONTEMPORARY ORGANISATIONS

Worldwide development of modern information technologies, also occurring in organisations and enterprises, usually results in limited direct interpersonal contacts. Consequently, nowadays we can see an increasing crisis of fundamental values, often resulting in emotional problems and reduced well-being. Therefore, it seems vital to discuss the problem of relationship between well-being (whose key component is positive experiences, e.g. experiencing happiness) and the use of contemporary IT solutions, such as e-learning, i.e., education via modern information technologies (Łysek 2005).

The analysis of this relationship is also important because research results prove that the benefits from having positive emotions, satisfaction with life and optimism are measurable and objective, and happiness is like a lottery ticket – it gives us an opportunity to win (Czapiński 2004 p. 237). Research carried out so far clearly shows that happy people have more successes and generally do better than unhappy ones (Czapiński 2004; Porczyńska-Ciszewska 2013), which undoubtedly affects the functioning and development of enterprises they work for. Empirical studies confirm that people who frequently experience happiness enjoy more satisfying interpersonal relations, better health and longer lives, as well as higher income and professional successes, for the very reason that they are happy (Danner, Snowden, Friesen 2001; Czapiński 2004; Pressman, Cohen 2005; Marks and Fleming 1999; Porczyńska-Ciszewska 2013). Professional successes, always depending on people, are an important element of the functioning and development of enterprises, indirectly contributing to the formation of intelligent organisational culture.

Analysing the relationships between experiencing happiness (which is the key component of well-being) and the formation of intelligent organisational culture in enterprises applying the e-learning idea, first we need to explain what the experience of happiness really is.

As we know, many scholars and philosophers have tried to define happiness, but nobody has been able to produce a single, unquestionable definition, and although scholars have been studying the matter of happiness since ancient times, the problem is still unresolved. Hence, it needs to be emphasised that as we discuss happiness, we need to remember how obscure the term is and distinguish between different ways of understanding it. Still, despite the variety, all definitions have one common feature: they all refer to something positive and valuable (Tatarkiewicz 1979).

Psychologists are also constantly arguing about what happiness is, formulating numerous concepts and theories to explain the phenomenon of "experiencing happiness". Given the diversity of views of the nature of happiness and concepts explaining its essence with regard to the discussed problem, we would like to point to one of the most original concepts of happiness, proposed by Mihaly Csikszentmihalyi (1990): the concept of *flow experience*, also known as the flow concept or the engagement concept. The flow experience concept of happiness, understood as the "optimal experience", is considered extremely useful by psychologists studying the sense of happiness, satisfaction with life and internal motivation, sociologists who interpret it as the opposite of anomie and alienation, and anthropologists dealing with phenomena of collective joy and rituals (Porczyńska 2013).

However, because the employee's engagement in the work they are performing is highly valued (Armstrong 2011), in a study concerning the formation of intelligent organisational culture in enterprises applying the e-learning idea it seems relevant to refer to the concept of happiness as the concept of engagement by M. Csikszentmihalyi.

According to him, the term 'flow experience' means the state in which the person's skills are just at the level needed to carry out the task. Experiencing happiness, which M. Csikszentmihalyi calls flow experience, is the state when people feel deep satisfaction, and the mental state called flow means concentration to the point of complete immersion in the present activity. Usually it is connected with the feeling of strength, freedom, lightness and effortlessness. Someone who is experiencing happiness has the impression of controlling the situation, has no doubts or complexes, and uses their abilities to the full. The person loses the sense of time and emotional problems and feels wonderful, complete joy (Csikszentmihalyi 1997). We can say, then, that it is the state of maximum engagement in the present activity.

As proved by scholars, flow experience involving concentration, control and pleasure may lead to better learning effects in business education (Yi Maggie Guo, Young K. Ro 2008). The most important conditions that must be met to experience happiness in the meaning of flow, such as balance between the challenge and skills, feedback and goal transparency are the elements that link optimal experiences with learning, also learning with the use of modern IT methods.

Dynamic development of technology in the contemporary quickly changing world definitely forces business workers to engage even more in raising their competencies and qualifications, often using distance learning (e-learning) methods, understood as the process of transferring selected information via different electronic means (Penkowska, 2010). In this context, it seems that people who often experience happiness in the meaning of M. Csikszentmihalyi's concept of engagement will be more willing to engage their time and energy in improving their skills and raising competencies, both hard ones (i.e., expertise, computer literacy, foreign languages) and soft ones (i.e., creativity, time management, communicativeness or coping with stress), using not only traditional methods but also modern methods of distance learning, thus contributing to the development of intelligent organisational culture. It is noteworthy that apart from threats such as alienation or problems with interpersonal communication, modern technology undoubtedly ensures the right conditions for the transfer and popularisation of knowledge with the use of distance learning techniques.

It appears that acquiring knowledge and raising competencies through e-learning courses has some common features with flow experience. The scholars who study the phenomenon of flow experience have observed that the feeling of flow occurs when the person is faced with clearly formulated goals, which require specific behaviours. Usually, e-learning courses are designed exactly this way, to make the recipient's goals and tasks clear and precise. Moreover, typical of acting in flow is the presence of immediate feedback: when doing something, the person knows immediately how well it is going. This aspect also occurs in e-learning, since the student usually receives feedback after each task done as part of the course. Scholars also add that the feeling of flow mostly appears in situations when the person's skills are fully used, when overcoming difficulties or accepting extremely difficult challenges. Optimal experiences are generally characterised by a kind of balance between the requirements, challenges and capabilities of the person (Csikszentmihalyi 1997). These conditions also seem to be met in e-learning, which usually includes activities relevant to the student's abilities, and according to M. Csikszentmihalyi (1988), such activities give us the greatest satisfaction and lead to the state of engagement, or flow experience.

Therefore, it seems that people who use modern distance learning technologies can more often experience maximum engagement, i.e., flow experience, which according to M. Csikszentmihalyi are tantamount to experiencing happiness, and as we have already mentioned, well-being is the cause of prosperity (Czapiński

2004), which means that happy people fare better, have more successes, also professional ones, and as a result they have higher self-esteem and better cope with stress than people who do not experience happiness so often. We may presume, then, that experiencing happiness, which is an indicator of well-being, is related to effective coping with stress and has an influence on the form of intelligent organisational culture of enterprises that apply the idea of e-learning.

2. AREAS OF STRESS AND COPING WITH STRESS IN LEARNING ORGANISATIONS USING THE E-LEARNING METHOD

From the point of view of an individual, in the process of work every factor connected with carrying out professional tasks may be the source of stress (Zimbardo, Ruch 1994). Work-related stress generates a whole range of problems, not only for the very individual but also for the organisation, and as a result, for the whole community. Occupational stress is currently very common, and its indices do not only remain high but are also constantly and considerably growing (Le Blanc, de Jonge, Schaufeli 2003). Obviously, work can arouse ambivalent emotions: on the one hand, it can provide satisfaction, opportunities for development, and enable people to satisfy many significant needs, such as the need of security or the sense of belonging, thus promoting health. On the other hand, work can cause many mental burdens and lead to serious emotional problems, being strongly pathogenic for organisational, social and family functioning of the person (Ogińska-Bulik 2006; Bańka 2001). It seems that for most employees work-related stress is a negative experience connected with the expectations and demands they face in their working environments. The available studies on stress also focus on negative effects of stress (Hellriegel, Slocum, Woodman 1995). Actually, occupational stress should be understood and regarded as sure and inevitable. Every day, a worker needs to confront difficult task areas and other people, who are the source of stress for them (Oyster 2002).

In many independent studies on stress at work a significant relation was found between the person's job and their mental and physical state. For example, a study carried out by Northwestern National Life showed that 40% employees consider their jobs very stressful, and the World Health Organization points out that nearly half of all working people feel unhappy at work. Studies by Stanford Prevention Research Center show that stress disturbs the functioning of the human organism, causing so-called stress-related disorders referred to as psychosomatic disorders (Białek 2012, Le Blanc, de Longe, Schaufeli 2003, Michie, Williams 2003). Apart from the medical effects of stress, an important stress-generated factor is the mental burden experienced by employees. It directly contributes to increased absence from work, constantly intensifying rotation of employees, lower productivity, an increased number of conflicts between employees, and reduced morale of work teams (Noblet, LaMontagne 2006).

Occupational stress factors are classified in source literature using many different criteria. It seems, however, that even solid arrangement of the criteria in specific theories is less important than the determination of space where stress can be discussed with reference to the specificity of contemporary organisations (Kraczla, 2016). Generally, there are four areas associated with work: the content of work, working conditions, employment conditions and social relations at the workplace (Le Blanc, de Jonge, Schaufeli 2003). Apart from these traditional, well-known and recognisable planes of stress, there are some organisational factors resulting from the new "face" of contemporary organisations.

It must be emphasised that the level of stress in contemporary organisations is growing steadily. It is connected with the popularisation of new forms of work and working hours arrangements. It also results from growing globalisation and introducing innovative solutions or modern technologies in interpersonal communication. As shown by research results, if the level of innovation is too high, this may generate excessive stress and as a result lead to reduced performance (cf. Cowan, Sanditov, Weehuizen 2011, Moreno, Cavazotte, Alves 2017, Pocztowski 2003). A modern form of reaction to intense changes in the world is so-called learning organisations, which have developed the ability of constant adaptation and change, as this is the only way contemporary organisations can survive for a long time (Kim 1993). In the face of challenges they meet, this appears to be the ideal model. However, its success depends on the proper course of many processes, inter alia the ability to develop intelligent organisational culture (Kofman, Senge, 1993).

Organisational cultures in contemporary public and business institutions are beginning to have a specific character determined by new technological resources. The workers of modern intelligent organisations can no longer imagine their functioning without technology and the freedom it gives. At the same time, this technology causes some problems resulting from excessive presence in the workers' lives. As electronic hypercommunication is increasing, working environments are undergoing significant transformations, generating sources of tension and frustration unknown before. In assumption, modern technologies are to facilitate life and functioning and be a considerable help, making our actions faster. However, the technological advancement within the last decade has changed the mode of interpersonal contacts: instead of face to face, we now communicate remotely. And this has some disturbing consequences. Two conditions must be met for interpersonal contact: physical presence and emotional and intellectual attention. The replacement of such contacts with various technologies results in the fact that people feel lonely, isolated and feel confused at the workplace. This alienation at work paradoxically does not result from insufficient communication but from the excess of new, "virtual" communication, which lacks many signals inherent to direct contacts. This arouses anxiety and confusion and generate fears connected with the uncertainty of correct understanding of the message content (Hallowell 1999).

The inventory of modern electronic ways of communication, such as e-mail, text messages or voice mail, is now extended with developmental and educational technologies: audio or video conference lectures, forum of chat room discussions, virtual consultations and diverse multimedia educational materials. These solutions are no longer technological novelties but are the organisational reality of numerous companies and institutions, following the idea of e-learning. In publications devoted to this topic we can find different definitions of and approaches to e-learning (Hedge, Hayward 2004, Sauer 2001, Jones, Reid, Bartlett 2008). The very term 'e-learning' refers to a complex process of education with the use of modern information and communication technologies. The idea of e-learning (or distance learning) can be interpreted as an interactive process of education, allowing easy access to knowledge from any place and at any time (Hedge, Hayward 2004, Sauer 2001).

E-learning as a remote education mode has multiple advantages. First of all, it makes education flexible, generating significant time and financial savings. Naturally, e-learning also has many disadvantages, the most important of which is the limitation of interpersonal contacts. Furthermore, people need to activate their internal motivation in order to acquire knowledge this way, and this depends on the level of self-awareness and self-discipline (Newton, Doonga 2007, Oterholm 2009, Brown, Charlier, Pierotti 2012). Students' skills in operating the e-learning platform, as well as the platform's technological friendliness and usability, also play a role (Gaskell, Mills 2014, Moreno, Cavazotte, Alves 2017).

We may say that the above-mentioned modern trends in learning and development based on e-learning programs are already a typical feature of contemporary enterprises. These tools undoubtedly offer many opportunities and facilitate learning at the workplace. At the same time, they may make a new – yet unexplored but increasingly important – area of stress, being a challenge for employees and whole organisations in terms of achieving balance between traditional and modern forms of organisational participation.

3. DEVELOPMENT OF INTELLIGENT ORGANISATIONAL CULTURE BASED ON E-LEARNING METHODOLOGY

As an open system, every organisation is under constant influence of both its internal subsystems and elements and the factors that affect it from the outside. An interesting view of the specificity of the environment of contemporary organisations is proposed by Bauman (2011, p. 5), who claims that it is more and more liquid, because like a liquid, it is unable to stay unchanged and maintain the same form for a long time. Other authors, e.g. Sull (2009) and Sun Young Sung (et.al., 2015) also point to the great dynamics of the environment, emphasising that we can now see the collapse of an organised structure of events, omnipresent transition and turbulence. Urbanowska-Sojkin (2014) refers to the 21st century environment as chaos, and Sztumski (2006) calls it turbo-world. The survival of an organisation in this environment full of pressure and instability, as well as the achievement of competitive advantage, is only possible when the pace of its activity matches the dynamics of environment development and the specificity of changes in it (Cyfert 2013; Wilden & Gudergan 2015). This, however, causes certain implications for employees and provides a new image of the working environment, whose key characteristics are high dynamics, flexibility, creativity and the ability to obtain, collect and apply knowledge, i.e., high level of intelligence (Zukauskas et al. 2018, Dźwigoł-Barosz 2015). Intelligent enterprises are expected to display systemic thinking, open communication, synergy of autonomous teams, personal mastery and fluency, as well as internal entrepreneurship (Ziębicki 2000; Zimniewicz 2009). It is crucial to be open to new trends, to be an ambidextrous organisation, i.e., an enterprise that simultaneously and successfully engages in exploration and exploitation, both using the existing competencies and discovering and creating new opportunities (Cao et.al. 2009), able to achieve short-term goals (survival) and long-term goals (growth and development), incremental and radical innovations, at the same time using transactional (market) and relational (network) opportunities (Luo & Rui 2009). The company's ability to act in different (opposing) directions at the same time requires excellent leadership, strategic refinement, considerable resources, thorough knowledge, dual structures and adaptive systems (Cao et.al. 2015); it also calls for the ability to cope with constant pressure and stress (Semmer et al. 2015; Sonnentag&Frese 2013; Semmer&Beehr 2014) disturbing the sense of happiness at work. Currently, a special challenge to intelligent organisations is the extremely dynamic global digital transformation. The development of information technologies has recently led to popularising the so-called third ICT platform, referred to as SMAC (*Social*, *Mobile*, *Analytics*, *Cloud*), making a specific ecosystem of IT solutions which allows organisations to develop their activity with lower expenditure and the maximum range of influence. The platform is a natural expansion of possibilities concerning digital maturation of an organisation by offering new opportunities, including the improvement of e-learning methodology. The ever-growing amount of data provided by mobile devices, social media platforms, Internet browsers and loyalty programs make a new model of business based on information generated by the economic circle, creating a novel model of intelligent organisation. According to Cisco Global Cloud Index (Cisco Global Cloud Index 2013–2018, p. 77), at the end of 2018, half of the world's population will have access to the Internet, and more than 53% will use tools to store data in the "cloud" via mobile devices (Adamczewski 2018; Denecken 2015; Corcoran&Datta 2016). Practical shortening of the time needed to do anything in the cyber space and the irrelevance of geographical boundaries considerably accelerate business processes in global logistic chains and create new challenges to the model of organisational culture of an intelligent organisation. The traditional approach to the essence of organisational culture understood and interpreted in very diverse ways by different authors, e.g., as 'organisation's personality', 'philosophy behind the organisation's policy', 'core values that determine the company's philosophy or mission', 'customary and traditional ways of thinking and action', 'organisational climate', 'symbols, language, ideologies, routines and myths', 'values, standards and knowledge', 'thinking patterns', or 'speech or jargon' (Zbiegień-Maciąg 1999, p. 17; Srokowski 2011, p. 26; LaMontagne 2016, p. 9; Wudarzewski 2013, pp. 59-78; Schneider et al. 2013, pp. 361-388), is now beginning to evolve, exposing new directions of exploring the concept, inclined toward the identification of characteristics of intelligent organisational culture. The extremely inspiring character of search of these characteristics must inevitably draw the researcher's attention to humans and human capital as the key determinants of creating the model of intelligent organisational culture based on the use of e-learning methodology. The huge role of human capital in the process, including knowledge, is emphasised by many authors (Ertemsir&Bal 2011; Navimipour et al. 2015; Aparicio et.al. 2016; Stone et. al. 2015). According to Koźmiński (2012, p. 24), knowledge is a primary resource, one that controls the processes of multiplication and change of configuration of other resources and is their necessary component. Thus, on the one hand, knowledge is a category of key importance in the process of modelling intelligent organisational culture, and on the other hand, intelligent organisational culture is a factor that stimulates the effectiveness of knowledge management. Digitization in business, including the development of e-learning techniques, significantly affects the effectiveness of both processes. It is emphasised in source literature that knowledge is a social entity (Białynicki-Birula 2014), and its importance for the organisation results from being able to use it, not from just having it. Only then can it be valuable for the organisation (Lenart 2014). In this context, knowledge management, and particularly knowledge sharing, becomes especially important (Witherspoon et al. 2013, p. 250). But the process of knowledge sharing, so significant for intelligent organisations, can be disturbed by a number of factors. Some internal factors are demographic characteristics, individual features, attitudes, approaches and intentions (Bock et al. 2005, pp. 88-89), and emotions (Tenorio et al. 2017, p. 1). External factors include the support of the managerial bodies, leadership, organisational culture and climate, the system of rewards (Li et al. 2014: 554), team characteristics and trust (Słocińska 2016: 89) and authority (Ajmal et al. 2010: 161). The factors which have a destructive influence on the process of development of intelligent organisational culture applying e-learning definitely include employees' level of stress and happiness at work.

CONCLUSION

Organisational culture always refers to a set of basic characteristics valued by the organisation. Its understanding and definition is not easy due to a number of underlying determinants. In addition, in the structures of the contemporary world this process must take into consideration the modern phenomena integral to sets of cultural meanings. Nowadays, the methodology of e-learning, implemented in modern, intelligent organisations and based on advanced ITC technologies, is one of such phenomena. E-learning programmes at work are supposed to help employees learn faster to improve their skills and as a result ensure better organisation performance. The design and implementation of e-learning education surely shapes the new dynamics of opportunities for the employees and the whole organisation. However, we should bear in mind that technological innovations in communication and in the process of development are also a new source of stressors that have never occurred before. A contemporary worker needs to be able to cope with them and learn to reduce the level of anxiety and isolation resulting from the excessive use of modern electronic communication tools. Coping with stress is closely connected with experiencing happiness, a category of high importance for building an organisation with intelligent culture. The research curiosity of the Authors of this study directs the discussion from the theory to the area of empirical exploration so as to confirm the relationships between experiencing happiness and the ability to cope with stress in the development and growth of intelligent organisational cultures which have included e-learning in the process.

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THE CONSTRUCTOR OF MULTIMEDIA LECTURE PRESENTATIONS AS A MEANS OF STUDYING THE DISCIPLINE "METHODOLOGY OF TEACHING MATHEMATICS AT PRIMARY SCHOOL"

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Abstract: *As a result of the confirmatory experiment, the necessity to use multimedia lecture presentations by the teachers of the discipline "Methodology of Teaching Mathematics at Primary School" was recognized. The analysis of the normative discipline programmes of 12 universities of Ukraine has shown differences both in the structure and content of the educational material. In view of this, the constructor of multimedia lecture presentations, its structure and content was developed. For the practical use of the construction of presentations with the aim of preparing lectures, methodological recommendations for teachers were developed. The implementation of the constructor into the educational process of the pedagogical faculties of 3 universities in Ukraine has shown increasing effectiveness of training future primary school teachers in teaching mathematics.*

Keywords: teacher training, primary school, methodology of teaching mathematics, lecture, multimedia presentation.

INTRODUCTION

The training of future primary school teachers in teaching mathematics to pupils takes place within the framework of the course "Methodology of Teaching Mathematics at Primary School". Taking into account the modern approaches and technologies of teaching primary school pupils, the specificity of giving lectures on this discipline requires demonstration and a wide use of a variety of teaching aids, including subject and schematics, textbooks, manuals, lesson study aids, normative documents regulating the process of teaching mathematics at primary school, video fragments of real mathematics lessons, etc.

The results of a survey of twenty teachers of the methodology of teaching mathematics (University of Odesa (Odesa), Kherson State University, Berdiansk

State Pedagogical University, Vasyl Sukhomlynsky Mykolaiv National University, Vasyl Stefanyk Precarpathian National University, Taras Shevchenko Chernihiv National Pedagogical University, Ivan Franko Lviv National University, Bohdan Khmelnytsky Cherkasy National University, Pavlo Tychyna Uman National Pedagogical University, Mykhailo Drahomanov National Pedagogical University (Kyiv), Anton Makarenko Sumy State Pedagogical University, Oleksandr Dovzhenko Hlukhiv National Pedagogical University, Bohdan Khmelnytsky Humanities and Pedagogical Academy, Lviv, Zaporizhzhia, Cherkasy regional institutes of postgraduate pedagogical education, Kherson Academy of Continuing Education and Odesa Institute of Teachers' Training) conducted within the confirmatory experiment showed that all the teachers who participated in the survey (100% of respondents) believe that an increasing quality of the results of the students' grasp of the methodology of teaching mathematics can be achieved through the teaching means, created on the basis of information technologies. Besides, most teachers (95%) are confident about the relevance of using information technologies, precisely during lectures. That is why all interviewed teachers expressed the need to use multimedia lecture presentations on the methodology of teaching mathematics. However, not all teachers have the skills and experience in creating presentations, so only 20% of the respondents confirmed that they always use them during lectures.

So, as a result of the confirmatory experiment, we confirmed the relevance of the development of multimedia lecture presentations, in which the educational content is presented in the structured form; methodological approaches are illustrated with colours and animation effects; the methods of work on certain mathematical problems are given by means of dynamic deployment of the solution; the natural visuality is replaced with electronic and the methods of working with it are demonstrated with the animation effects; hyperlinks to electronic versions of normative documents and mathematics textbooks for primary school are placed, links to the video fragments of real mathematics lessons at primary school, demonstrating an appropriate element of the educational content (structure of a lesson, teaching technology, etc.), as well as video fragments with students' thinking, demonstrating ways of calculating , work on tasks, etc.

Also, within the framework of the confirmatory experiment, a comparative analysis of the normative curriculum "Methodology of Teaching Mathematics" was done, approved at the M. Drahomanov National Pedagogical University; developers - V. Chaichenko, O. Kondratiuk; at the Kostiantyn Ushynsky South Ukrainian National Pedagogical University; developer - S. Skvortsova; at Berdiansk State Pedagogical University; developer - L. Koval; at the Taras Shevchenko Chernihiv National Pedagogical University; the developer - S. Strelets; at Kherson State University; developer - V. Tsys; at the Vasyl Stefanyk Precarpathian National University, developer - R. Romanishin; at the Bohdan Khmelnytsky Cherkasy National University; developer - T. Zorokhkina; at the Anton Makarenko Sumy State Pedagogical University; developer - O. Vasko; at Donbas State Pedagogical

University; developer - N. Liashova; at the Vasyl Sukhomlynsky Mykolaiv National University; developer - K. Avramenko; at the Oleksandr Dovzhenko Hlukhiv National Pedagogical University; developer - H. Nepomniashcha; at the Bohdan Khmelnytsky Humanities and Pedagogical Academy; developers - N. Kravchuk, T. Schuper. As a result of the analysis, there was a significant difference in the distribution of content and time for mastering particular questions of the course, significant differences between the number and distribution of hours for lectures, practical and laboratory classes at these universities (Skvortsova, 2015). Therefore, it is impossible to unify the process of training future primary school teachers in teaching mathematics to pupils through the creation of a unified system of lecture presentation on the methodology of teaching mathematics. In addition, according to the survey, most of the teachers (85%) prefer to use just slides for lecture presentation with animation, with the possibility of independent design of the lecture.

So, in our research, we have resorted to creating the constructor of lecture presentations, using which the teacher selects those slides which, from his point of view, will give him the opportunity to explain the topic, provided by the course programme. In addition, the teacher can make changes in the constructor of lecture presentations, taking into account the individual characteristics of students, creating conditions for satisfying cognitive needs.

1. THE CONSTRUCTOR OF LECTURE PRESENTATIONS ON THE EDUCATIONAL DISCIPLINE "METHODOLOGY OF TEACHING MATHEMATICS"

1.1 Structure and contents of the constructor of lecture presentations

The term *constructor of lecture presentations on the discipline "Methodology of Teaching Mathematics"* means the catalogue of files, structured according to the three thematic sections related to the specific content of the above mentioned educational discipline. Moreover, the content of each section is fully disclosed in the system of multimedia presentations on topics. Thus, the first section contains one topic: "Methodological system of teaching mathematics to primary school pupils". The content of this topic reveals the following issues:

1. Methodology of teaching mathematics as a science and as a school subject.

2. The purpose and tasks of teaching mathematics at primary school according to the new edition of the State standard of primary school (2018).

3. The contents of teaching mathematics at primary school. Typical educational programme for 1 to 2; 3 to 4 forms.

4. Methods and forms of teaching mathematics at primary school. Modern teaching technologies in teaching mathematics at primary school. The model of the lesson, constructed according to different educational technologies.

5. Means of teaching mathematics at primary school.

The second section also contains one topic: "Modern lesson of mathematics at primary school". The topic is presented in several issues:

1. Calendar-thematic planning of mathematics lessons.

2. Purpose and objectives of the mathematics lesson.

3. Structure of the combined mathematics lesson.

4. Motivation of educational and cognitive activity of pupils.

5. Actualization of reference knowledge and pupils' ways to act.

6. Familiarization with the new educational material and its mastering.

7. Repeating. Formation of skills and abilities.

8. Reflection of educational and cognitive activity of pupils at the lesson.

The third section is structured in six chapters, each containing several topics.

1. Methodology of actualization and systematization of mathematical representations of first-graders obtained at the pre-school period.

2. Methodology of teaching numbering and arithmetical actions on numbers in the course of primary mathematics. This unit provides studying a number of topics: "Methodology of teaching the numbering of the first ten"; "Methodology of formation of computing skills of addition and subtraction within 10"; "Methodology of teaching numbering of the first hundred"; "Methodology of forming computing skills of addition and subtraction within 100 without passing through the place"; "Methodology of forming computing skills of addition and subtraction within the limits of 20 with passing through the place"; "Methodology of forming computing skills of addition and subtraction within the limits of 100 with passing through the place"; "Methodology of computing skills of table multiplication and division"; "Methodology of studying the numbering of numbers in the concentrator "Thousand"; "Methodology of forming computing skills of addition and subtraction within 1000"; "Methodology of forming computational skills beyond table multiplication and division"; "Methodology of studying the numbering of multi-digit numbers"; "Methodology of forming computational skills in a concentrator" Multi-digit numbers"; " Methodology of forming the concept of parts of value"; "Methodology of forming the concept of fraction".

Moreover, each topic is shown through the system of issues: 1) the contents and results of studying the topic by the Typical educational programme; 2) visual training aids and didactic material; 3) the order of studying the subject by the current textbooks; 4) methodology of studying individual issues of the subject; 5) implementation of the content of the new curriculum in the current textbooks.

3. Methodology of teaching values and their measurement. This unit covers the topics: "Methodology of teaching the main values and their measurement: length,

weight, capacity; time", "Area of the figure". The first topic contains the following issues: 1) the values in the course of primary mathematics; 2) contents and results of studying; 3) methodology of learning particular issues of the programme: 1st grade; 2nd class; 3rd grade; 4th grade.

4. "Methodology of teaching mathematical expressions, equations and inequalities". The section deals with the topic: "Algebraic material in the course of primary mathematics". Its content reflects the following issues: 1) the content of the algebraic material of the primary course of mathematics; 2) mathematical expressions: numeric and alphanumeric; 3) numerical equality and inequality; the dependence of the result of the arithmetic action on the change of the component; 4) the equation; 5) solving tasks using equations; 6) inequality with a variable.

5. Methodology of solving story problems. This section represents the topics: "General questions of teaching methodology of solving mathematical story problems", "Methodology of forming skills for solving simple problems in the 1st grade"; "Methodology of forming skills of solving simple problems in 2nd grade"; "Methodology of acquaintance with the concept of "a completed task"; "Methodology of forming skills for solving simple problems in 3 and 4 grades"; "Methodology of forming skills for solving complex problems in 3 grade"; "Methodology of forming skills to solve problems, finding the 4th proportional"; "Methodology of forming skills to solve tasks on a double summary to one"; "Methodology of forming skills to solve tasks on proportional division", "Methodology of solving tasks to find unknown by two differences"; "Methodology of forming skills for solving tasks for joint work"; "Methodology of forming skills in solving problems in motion".

The content of each topic related to the methodology of forming skills for solving typical tasks, reveals a number of issues: 1) the contents and results of learning topics by the new program; 2) the contents and methodology of preparing work; 3) familiarization with a new kind of tasks; 4) formation of the ability to solve tasks.

6. Methodology of studying spatial relationships and geometric figures contains the topic: "Methodology of teaching elements of geometry in the course of primary school mathematics", which is revealed through the issues: 1) the content of the geometric material of the primary course of mathematics; 2) the order of studying elements of geometry at primary school; 3) the methodology of formation of geometrical representation and concepts: the formation of ideas about the point, line, line curve, segment and brake; formation of ideas about polygons and their elements; formation of ideas about the angle, types of angles; formation of the concept of a rectangle and a square; forming an idea of the circular disk and circle and their elements; geometric shapes in space.

Consequently, the content of each topic in a generalized form can be given as follows:

- contents and results of learning the subject according to the new programme;

- visual training aids and didactic material;

- the order of studying the subject by the current textbooks;

- methodology of studying individual issues of the topic;

- implementation of the content of the new curriculum in the current textbooks.

We included these elements in the presentation of the multimedia lecture on each topic. It should be noted, that in the construction of lecture presentations the content of these elements is also structured in a certain way, and provides the levels of lower order: on the first, the list of individual issues of the subject, each of which is disclosed at the next, lower level. For example, the methodology of studying certain issues of the subject involves the content and methodology of preparatory work, the methodology of familiarization (can be given in several variants) and the formation of pupils' concept, skills or abilities of a particular action.

At the same time, certain units have peculiarities. For example, the methodology of numbering numbers at different concentrators involves consideration of issues: the formation of a number; the order of placing numbers in a natural sequence; reading and writing a number; composition of the number; comparison of numbers; arithmetic operations with numbers based on numbering, etc.

Methodology of forming the computing skills of addition and subtraction involves clarifying the issues: the list of methods of calculation in a certain concentrator ("Ten", "Hundred", "Thousand", "Multi-digit numbers"), the order of their consideration; formation of a certain method of the calculation: the theoretical basis of the method; actions and operations from which the method consists; preparatory work for the introduction of computing; familiarization with the method of calculation; the formation of a computing skill, etc.

Methodology of solving tasks (simple tasks, complex tasks, typical tasks) is directed at: the consideration of theoretical foundations (mathematical structures of tasks and methods of their solving); preparatory work; familiarization with the task; formation of skills to solve tasks; studying the task after its solving, etc.

Thus, the constructor of lecture presentations on the educational discipline "Methodology of Teaching Mathematics" represents the clear hierarchical structure in which the level of the lower order is separate presentations that detail the content of the issues of the topic and can be used by teachers to create their own multimedia lecture presentations.

Each topic in the constructor of presentations is a separate multimedia presentation, built on a single problem lecture scheme, and the issues of the topic are represented through hyperlinks. The structure of the presentation on each topic contains the following mandatory slides: a slide with the title of the theme (Fig. 1), a slide with problematic questions (Fig. 2), a slide with the recommended literature (Fig. 3), a slide with the lecture plan, which contains hyperlinks to individual presentations that reveal the content of each issue of the plan (Fig. 4), as well as the last slide summary and reflection of students' educational and cognitive activity (Fig. 5).

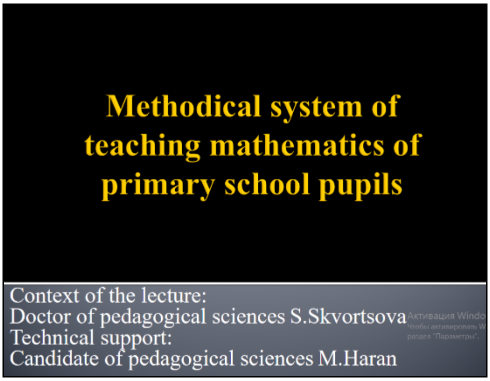

Figure 1: Theme of the lecture

Source: Own work

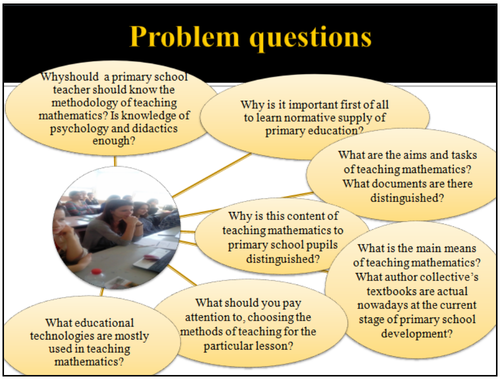

Figure 2: Problem questions

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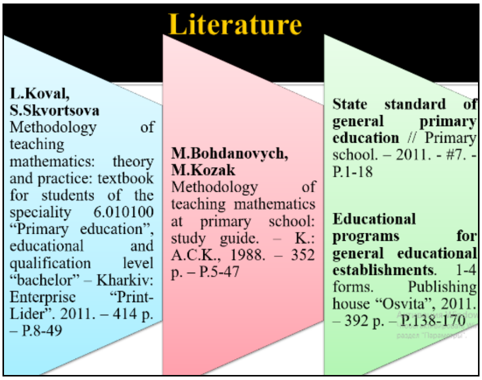

Figure 3: References Literature

Source: Own work

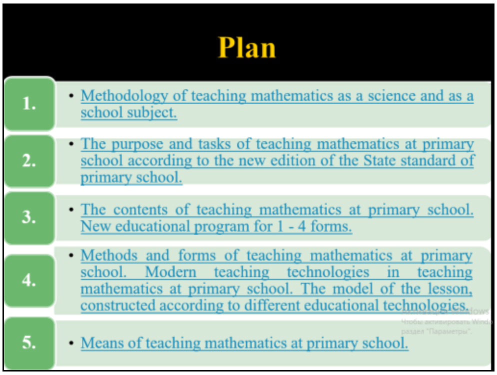

Figure 4: Plan of the lecture

Source: Own work

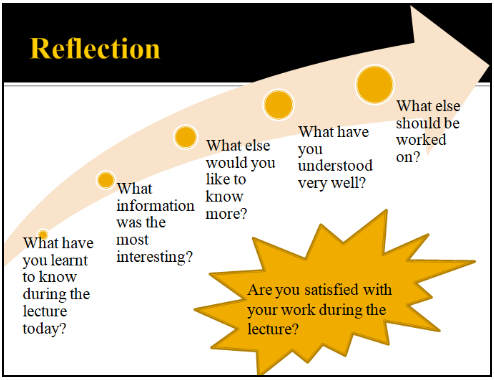

Figure 5: Reflection

Source: Own work

We should note that each question of the lecture plan also represents the multimedia presentation, which in its turn may contain hyperlinks to normative documents, current textbooks, videos of math lessons at primary school, presentations for mathematics lessons, conducted by teachers and students, etc. It should be mentioned, that issues that include hyperlinks to other files, in addition to the presentation file, also include document files, textbooks, video fragments of real math lessons at primary school, etc., presented in the same archive.

Constructing lectures with the help of the constructor of lecture presentations, the teacher can not only select topics, separate questions, slides in accordance with his / her normative / work programme of the discipline, but also make adjustments to them.

1.2 Methodical reference point of organization of a lecture session on the methodology of teaching mathematics using the constructor of lecture presentations

The constructor of lecture presentations on the discipline "Methodology of Teaching Mathematics" is one of the components of the multimedia methodical discipline complex (Skvortsova, 2017), which operates on the basis of the "Moodle" platform in the distance education system "KSU Online". To work with the constructor, go to the link http://ksuonline.kspu.edu/course/view.php?id=1078, select the necessary section and the subject of the training content (Fig. 6), and go to the block "Constructor of lecture presentations" (Fig. 7).

It should be noted that the entire complex in general, and the constructor of lecture presentations in particular, is available without registration. In this case, the teacher of methodology of teaching mathematics can use the presentation constructor online or download it to the computer.

Let us consider the teacher's actions to prepare a multimedia presentation supporting the lecture with the help of the constructor of presentations.

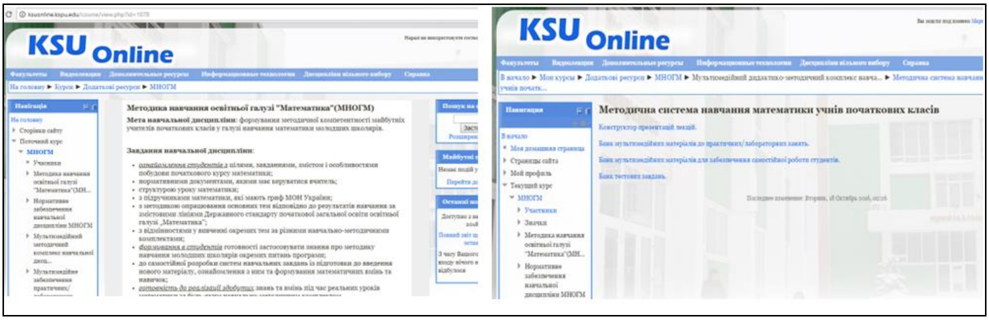

Figure 6: Multimedia Methodological Complex of the discipline

Source: Own work

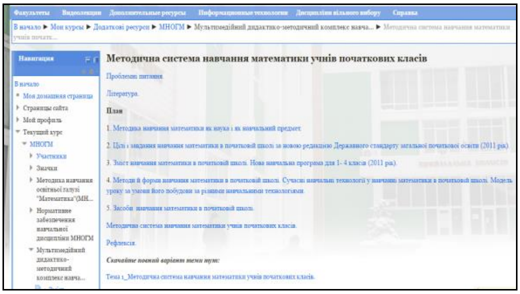

Figure 7: Constructor of lecture presentations on the topic "Methodical system of teaching mathematics to primary school pupils"

Source: Own work

As it was mentioned above, the constructor of lecture presentations in accordance with each topic, contains an ordered set of presentations that the teacher can use to create his own lecture presentation. In order to create a presentation supporting the lecture, using the materials of the constructor, the teacher of methodology of teaching mathematics, first of all, must take into account the normative / work programme of the discipline "Methodology of Teaching Mathematics", and according to it, outline the topic and the list of issues that reveal its contents; determine the number of lecture hours planned for mastering the topic, and only then start a multimedia presentation for the lecture / lectures on the topic (Haran M., 2016).

Preparing a lecture on the methodology of teaching mathematics using the constructor of lecture presentations, the teacher must find out if he is going to use a multimedia presentation throughout the class, or only at a particular stage. If the lecturer plans to illustrate a separate stage of the multimedia presentation, then he chooses the questions from the theme of the constructor to help to realize this goal. When the teacher is going to provide multimedia support throughout the lecture, he includes the system slides related to the organization of educational and cognitive activities of students (recommended literature, problem questions, lecture plan, reflection of educational activity, Figures 1-5) in the lecture presentation, adjusting them if it is necessary.

It is worthy of note that the content of the topic in the constructor of presentations is as complete as possible, it is obvious that the teacher plans to analyse perhaps not all the issues of the lecture. Therefore, having familiarized himself with the plan of the theme in the constructor (fig. 1), the teacher should compare it with the content of the topic described in his own normative / work programme of the discipline "Methodology of Teaching Mathematics", on the basis of this, choose points of the theme plan from the constructor of presentations. In the constructor of presentations, the plan items of the lecture reflect the problematic issues that motivate students' learning and cognitive activity. During the next step, based on the chosen plan items, the teacher, if it is necessary, corrects the question on the motivational slide (Fig. 2), on the slide with the recommended literature (Fig. 3) and on the slide with the lecture plan (Fig. 4).

As noted above, next to the motivational slide, given to each topic, the constructor of presentations has a slide, associated with it, the purpose of which is to summarize the lecture and reflect students' own educational and cognitive activity (Fig. 5). Reflection occurs after considering all questions of the lecture; it allows students to speak about how they understood and mastered its content, but also to talk about their satisfaction from their own educational and cognitive activity at the lecture, to analyse why this happened one way or another; to explore the connection between what is already known and what else you need to learn, outline new topics for reflection, and so on. Obviously, the teacher should motivate students to evaluate judgments with questions, such as: "What have you learnt today during the lecture?", "What information was most interesting?", "What else would you like to know?", "What have you understood well?", "What else should you do?", "Are you satisfied with your work during the lecture?" Meanwhile, the lecturer can supplement or, conversely, reduce the list of questions, taking into account their own vision of this stage of the lecture and the educational and cognitive needs and opportunities of students.

The list of basic and additional literature, links to Internet resources are given in the normative / work programme of the discipline "Methodology of Teaching Mathematics". Guided by this list, the lecturer chooses on the slide with the list of recommended literature the sources that he considers necessary to recommend students for their independent work. It is worthy of note that the teacher can add other sources. If a source from the given list is, in his opinion, not appropriate, then the teacher can remove it or replace it with another.

Having found out the issues of organization of educational and cognitive activity of students (in particular, motivation and reflection), having characterized the content of the topic by the Typical educational programme, having chosen the recommended literature and the plan of the lecture, the teacher should familiarize himself with the content of the above-mentioned plan issues of the topic in the constructor of presentations. Every issue in terms of the theme in the constructor is also a multimedia presentation and can be shown by the hyperlink, going to which the teacher can analyse the content of the slides, choose those, which in his opinion, reflect the content of the question.

As teaching mathematics at primary school is accompanied by visibility, slides with visual aids and didactic material are suggested for each topic in the constructor of presentations, which the lecturer can also change according to his own understanding of this issue.

It should be mentioned, that each topic of the constructor of lecture presentations on the methodology of teaching mathematics contains issues related to the programme requirements and the order of studying the topic by the current textbooks. The teacher can include these slides in his presentation of a lecture or offer students for independent work.

It should be noted that creating a presentation of a lecture with the help of the constructor, the teacher has the opportunity to make changes in the content of both presentations and individual slides, in accordance with the cognitive needs of students and their own vision of the content of the lecture. Thus, the lecturer can, for example, reduce the number of examples given to solve certain tasks, show not all of them, but only individual methodological approaches, etc.

We emphasize that each topic is shown completely in the constructor of presentations, pointing out the various methodological approaches, a sufficient number of examples of handouts, including examples of educational tasks and their solutions that are both, ready and with dynamic development of writing the solution. However, paying attention to the limited time of a lecture, a teacher, creating his own lecture presentation with the constructor may take only a few slides and other content to leave to students' independent work or suggest to learn them during a practical lesson. On the other hand, in order not to destroy the integrity of the tasks aimed at the formation of a certain skill or abilities, while also reducing its processing time, the teacher can show some solutions, given in the constructor in dynamic or statically, changing the animation settings.

In addition, if it is necessary, the lecturer can create his own lecture presentation directly from several themes of the constructor. For this purpose, the teacher should choose from the certain themes of the constructor those questions that he plans to reveal during the lecture, taking into account only the logical combination of the material. The final presentation will have a complete and finished look, as all presentations of the constructor have the same design, the same SmartArt templates for structuring similar issues and common stylistic design (Meixner, 2017).

Consequently, the constructor of lecture presentations used for teaching the discipline "Methodology of Teaching Mathematics" gives a lecturer the opportunity to create his own lecture presentations without any excessive efforts, choosing separate questions on the topic in accordance with the normative programme. In addition, the teacher has the opportunity to use the lecture presentation, in which all the questions are presented entirely with the help of the existing hyperlinks. Such a presentation is provided in the constructor as an archive (Haran, 2016).

It should be mentioned that the constructor is only an auxiliary means of acquiring educational information by students. The teacher of methodology has certain degrees of freedom in his own comments, as the contents of the presentation is presented briefly and concisely, without unnecessary text arrays, in order to minimize a theoretical aspect, and through the practical demonstration the use of basic methods to facilitate students' perception and comprehension of the educational information.

1.3 Organization of experimental training with using the constructor of lecture presentations

The formative stage of the pedagogical experiment lasted for four academic years (2014-2018). Since the academic discipline in different universities is taught for 2-3 semesters, two streams of students in each of the educational institutions were involved in the experiment. In total, 6 teachers (lecturers) of the methodology of mathematics teaching participated in the experiment: Kostiantyn Ushynsky PNPU (1 teacher), KSU (1 teacher), Vasyl Stefanyk PNU (2 teachers), Bohdan Khmelnytsky Cherkasy National University (1 teacher), Izmail State Humanities University (1 teacher).

To choose the control and experimental groups that participated in the experiment, a survey of teachers of the discipline was conducted in the form of a questionnaire before its beginning. As the sense of the experiment was in the creation and use of multimedia lecture presentations, the purpose of the questionnaire was to find out the level of using computer technologies by respondents, the projector and, above all, the program for creating and editing presentations - Microsoft Power Point.

According to the results of the survey it was determined that all teachers (100%) have computer skills and have experience in using the computer and the projector in their professional activities. When determining their own level of computer skills on the scale "bad / mediocre / good / perfect", all respondents answered "good". Similarly, all lecturers indicated that they had the skills and experience with the Microsoft Power Point program. In particular, they can use Power Point templates (100% of respondents); execute text on slides (100%); add and format images (100%); add video and sound (83.3%); adjust the transition animation between slides (83.3%); add tables, graphs, charts (66.7%); add hyperlinks and controls (66.7%); use SmartArt objects (50%); adjust the animation of the text (50%) (see Table 1).

Table 1.

Ability to use, work on presentations in the program Power Point (Smyrnova–Trybulska E., 2016)	**Teachers, participating in the survey**					
	K.Ushynsky PNPU	KSU	V.Stephanyk PNU 1	V.Stephanyk PNU 2	B.Khmelnytsky Cherkasy National University	Izmail State Humanitarian University
use templates	+	+	+	+	+	+
fill out the text on the slides	+	+	+	+	+	+

add video and sound	+	+		+	+	+
customize the transition animation between slides		+	+	+	+	+
add tables, graphs, charts	+		+	+		+
customize text animation	+	+				+
add and format images	+	+	+	+	+	+
add hyperlinks and elements of control	+	+	+		+	
use SmartArt objects	+	+		+		

Source: Own work

Thus, it was stated there is approximately the same level of the basic skills of working with the Microsoft Power Point software and the computer in general among all the interviewed teachers, so a control and an experimental group of teachers were formed. The experimental group included the teachers of the Kostiantyn Ushynsky PNPU, KSU, and one of the lecturers of the Vasyl Stefanyk PNU. The control group consisted of teachers of the Bohdan Khmelnytsky Cherkasy National University, Izmail State Humanities University and Vasyl Stefanyk PNU. Each group included 3 teachers.

It should be mentioned, that all participants of the research, prior to its beginning, had conducted lectures mainly without any use of information technologies. In the course of the forming experiment, teachers of the methodology of teaching mathematics conducted lectures with multimedia presentations, while the teachers of the control group tried to create lecture presentations on their, without any use of the constructor of lecture presentations, while the teachers of the experimental group used the constructor of multimedia presentations to create their lecture presentations.

The lecture presentations created by the teachers of both groups were analysed according to the results of the experiment. The main feature of the presentations, created by the teachers of the control group, is the large text arrays (the presentation slides represent almost the entire summary of the lecture). While there are almost no texts in the experimental group, the material is structured using SmartArt templates. Regarding the presence of animation effects, we noted that the presentations, created by the teachers of the control group, are mainly characterized by the lack of animation effects, presentation in the final form of the content of the lecture fragment on the slide, available only in coloured underlining. Instead, there is a widespread use of animation effects (selection, movement, appearing and disappearing in the presentations of the experimental group participants); a gradual deployment of the content is achieved with the help of animation effects and so on.

Obviously, the presentations of the control group of the teachers demanded from the students certain efforts to understand and understand logically the content of the lecture. The presentations of the teachers of the experimental group helped students to perceive and understand the educational information without making much effort on the part of the sense organs. It should also be pointed out that there were differences in the form of presentations. There were presentations for individual lectures, done with using different design options in the control group, in experimental - the only design for all presentations, and in accordance with generally accepted requirements for the slide appearance.

Upon completion of teaching the methodology of teaching mathematics, a questionnaire was offered to both groups of lecturers meant to find out the features of preparing and conducting lectures. Questionnaires were aimed at identifying both objective (the time spent for preparing a lecture presentation, the pace of the lecture, the volume of the content of the topic that is outlined during the lecture, the students' activity during the lecture, the clarity of the content of the lecture) and subjective (assignment for the teacher, freedom in the teaching content, attachment to the text of the lecture, the opportunity for creativity, informal communication, satisfaction from their own work) characteristics.

So, assessing the time spent preparing the presentation for the lecture, the teachers of the experimental group took an average of 0.5-2 hours, while the teachers of the control group indicated from 3 to 6 hours. Although participants in both groups received an increase in the content of the lecture, 100% of the teachers of the experimental group achieved a significant increase of the pace of the lecture using the presentation, unlike the usual lecture, while the teachers of the control group did not see a significant increase in the pace, only a third indicated the faster rate of the lecture. All the teachers of the experimental group noted that students during the lecture are much more active than usual. However, in the control group, only 33% of the teachers noted an increase in student activity. During the lecture, teachers constantly give feedback, therefore, all without exception, pointed out that delivering lectures with the help of presentations contributed to a better understanding of the educational content. In addition, students' comments about the results of their own educational and cognitive activity during the lecture at the reflection stage indicate more conscious and meaningful perception of the educational material.

Analysing subjective characteristics, all participants of the experiment (100% of respondents) achieved a decrease in the teacher's load during the lecture. And the teachers of the experimental group even pointed out that using lecture presentations, they could enjoy the freedom in teaching educational content, as it is presented in structured form on the slides of the multimedia presentation, so there is no need to read arrays of text from the slide of the presentation; the teacher should concentrate enough on commenting on certain slides. Also, using multimedia lecture presentations offers an opportunity to suggest students analyse and comment on some slides of the presentation to raise their educational and cognitive activity. Teachers from both the control and experimental group stated that using presentations makes it possible not to depend on the text of the lecture (or even not to use it at all) because the lecture plan and its main points are presented in the presentation. The teachers also mentioned that the slides of the presentation always return to the educational contexts and do not give an opportunity to move away from the topic of the lecture. It should also be noted that most of the teachers (67%) of the experimental group indicated an increase of satisfaction from their own work.

So, all the interviewed teachers confirmed that the presentation of the lecture material in the form of a multimedia presentation facilitated the better and more informed perception and mastering of the material by future teachers of primary school. And the teachers who created their presentations with the help of the constructor of lecture presentations summarized the level of attention and activity of students during the lesson was higher in comparison with the traditional lecture. The motivation of students to master the methodology of teaching mathematics was significantly higher, according to the teachers of the experimental group, than of previous courses, where teaching was carried out without using the lecture presentations. Teachers indicated that using presentations, created with the help of the constructor, the pace of lectures increased, which allows them to consider more questions during the lesson, illustrate them with more examples, and so on. Consequently, using the constructor of lecture presentations on the methodology of teaching mathematics contributes to an increase in the intensity of teaching.

In addition, the lecturers noted that using the constructor of lecture presentations reduces the teacher’s load during the lecture, as they only have to comment on the slides of the presentation, without making any effort and not being distracted to make notes on the board.

Thus, the results of the research indicate that the developed constructor of lecture presentations on the methodology of teaching mathematics helps to organize the educational process better and increase its efficiency.

CONCLUSIONS

Application of information technologies in the sphere of presentation of educational information, in particular in the form of multimedia presentations, is one of the ways to increase the efficiency of lectures.

The necessity to create presentations and their use during the course of teaching methodology of teaching mathematics was recognized based on the survey of teachers. The analysis of the normative and work programmes of the discipline "Methodology of Teaching Mathematics" led to the conclusion that significant differences in the content and amount of the educational material made it impossible to create the system of lecture presentations which would simultaneously correspond to all normative curricula of the discipline used during the training of students of the specialty "Primary Education" at different universities of Ukraine. Instead, these differences highlighted the need to build a flexible logically structured constructor, enabling the user (the teacher of the methodology of teaching mathematics) to create a perfect presentation for the lecture, selecting those slides that, in his opinion, reveal the topic in the amount provided by the course programme, spending pursuing this task a minimum amount of time and effort. Thus, the constructor of multimedia lecture presentations on the discipline "Methodology of Teaching Mathematics" and the methodological guide for creating own lecture presentations and organizing lectures based on the constructor were developed.

According to the results of the implementation of the constructor of lecture presentations in the educational process of 3 Ukrainian universities preparing students of the specialty "Primary education", the teachers of the discipline "Methodology of Teaching Mathematics" acknowledged the increase of the intensity and quality of education. Thus, the constructor of lecture presentations is an effective means of providing instruction on the methodology of teaching mathematics.

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IV. EFFECTIVE DEVELOPMENT OF TEACHERS' SKILLS IN THE AREA OF ICT AND E-LEARNING

BIG DATA IN EDUCATION. ATTITUDES OF TEACHERS TOWARDS THE APPLICATION OF BIG DATA TECHNIQUES

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Abstract: *We live surrounded by huge amounts of data. We have been producing more information in the last two decades than in thousands of previous years of Humanity's existence. And the quantities multiply exponentially. Thanks to Big Data technologies companies we can predict our buying behavior, analyze our mood or establish new models of interaction between users. However, we have not yet been able to introduce all this technology into the educational world. Is this useful and viable? What do teachers think about it? The objective of this study is to know the opinions and attitudes that the University faculty and a group of teachers from different educational levels have towards the use of Big Data technologies in their classrooms.*

Keywords: Big Data, Innovation, Teachers, Learning Analytics, Educational Technology.

1. INTRODUCTION

1.1 What is Big Data?

In 1998 the American John Mashley, theoretical computer scientist, published an article in which he predicted the immense wave of data that was coming. Subsequently, in 2013 the term "Big Data" was included in the Oxford dictionary and was defined as: "Extremely large data set that can be analysed computationally to reveal patterns, trends and associations, especially in relation to human behaviour and interactions”.

Google Executive Director, Eric Schmidt said in a "Techonomy" conference that "we generate more information, in two days, than in our entire history until 2003". Such a volume of information represents an authentic revolution that can completely transform the world.

But… How do companies use Big Data? An IBM article called "The use of Big Data in the real world" (2012), talks about how the concept of "Big Data" has become a business priority, given its ability to profoundly influence trade at global scale. Companies that want to succeed and grow must adapt to these new models of complex algorithms and data analysis (Evans, 2015).

One of the most important uses of Big Data is the "monetization" of the data, (García, 2017). How many times have you searched a product in google and from that moment all the advertising does not stop chasing you? This concept is called "reorientation" and its objective is to remind users interested in a specific product that the product is there with an interesting offer for them (Abad, 2015).

1.1.2 What does Big Data know about you?

Currently, consumers surf the web leaving a trace on: who they are, what they are interested in, whom they are related to, where and when they buy, (Gázquez, 2016). All data is collected to become purchase patterns. In 2017, the newspaper "El Mundo" published an interview about Martin Hilbert, who said: "With 150 likes the automated learning algorithm can detect your personality, with 200 you know more than your partner and with 250 likes you can know more about yourself than yourself". The objective of Big Data is to convert the data into information, an information that facilitates the making of important decisions, even in real time (López, 2014).

However, all those apparent wonderful advantages can also work against us. It has created a huge business of companies that "sell" the data circulating on the networks, data that citizens have given and that, properly packaged and selected for what and for whom, are sold at the price of gold to other companies or institutions (Francese Valls, 2017). In exchange for browsing for free, we give away our data, free of charge, only for others to use our fingerprint. For example: Can the use of "Big Data" make a president win the elections? Remember the Donald Trump Election as President of the USA, the English Referendum favourable to Brexit, etc. Martin Hilbert (2017) stated that during the American presidential elections, one in five messages on Twitter or Facebook were false messages. For all this, and many other security problems, governments are being forced to regulate all this data transit, without authorization, from users, with specific laws for the use of Big Data. Two years ago, Europe created Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and the free movement of personal data. This data and repealing Directive 95/46/EC, General Data Protection Regulation, which is being applied since May 25, 2018 in the 28 countries of the European Union. In Spain, we have the Spanish Data Protection

Association (AEOD) that regulates the data protection law both in companies and in educational centres.

1.1.3 Big Data in education

Everything students do is made up of data (Kalota, 2015). What they learn and what they do not, the correct or incorrect exercises, the number of times they participate in class, the students that drop out, the frequency and causes, the scores, the times of the day in which most receivers are found, etc. And if we are able to interpret them correctly, the educational system can be enormously strengthened. In the United States, a pioneering movement of schools based on learning with technologies, called "AltSchool", has emerged. These schools collect data on what students do in their training centres and extract useful information that allows them to maximize their learning. Currently, it is necessary to create new methods based on technology to monitor students, predict academic risks or simply understand the behaviour of school groups, among many others benefits. Now we have methods such as: Adaptive learning, Flipped classroom, Combined learning, E-learning, Mobile learning, and platforms such as: Moodle, ClassDojo, Google Classroom ... among others (Salazar, J 2016).

1.1.4 What does Learning Analytics mean?

Students, as users of technological devices and social networks, are contributing, consciously or unconsciously, valuable data, the so-called "fingerprint", which after being analysed and processed statistically, serve to identify trends and predict behaviours. That data provides valuable information to design and customize the educational offer. This is called "learning analytics" and is the result of the application of Big Data to improve training and learning (Martínez, Raidell, & Duart, Josep M, 2016).

Education today has passed the transmission of knowledge, because it is very extensive and fully accessible thanks to internet, to another more creative education, based on preparing people to learn, to be autonomous in the process of access/selection of relevant information, and to adapt to the changing needs throughout life (Cobo and Moravec, 2011). The "Learning Analytics" is a technique that is still in its infancy but that provides the educator with a better vision of how students develop and progress, offers a personalized support, allows to evaluate which activities and exercises can be more effective, detect problems and above all look for solutions.

With this background, the research presented poses the following objectives and hypotheses:

1.2 Objectives

General objectives are as follows:

- Deepen the concept of Big Data and its applications.

- Know some opinions and attitudes towards the Big Data.

Specific objectives are as follows:

- Show the attitudes of university teachers and educational centres in Extremadura towards the use of new Big Data technologies.
- Analyse the acceptance and viability of the Big Data in education.
- Analyse the previous knowledge of the teaching staff towards the term Big Data.

1.3 Hypotheses

There were seven hypotheses stated in this research:

1. The faculty of University knows more about the concept "Big Data" than teachers of other educational levels.
2. The University faculty considers the "Big Data" technology more useful and viable than teachers of other educational levels.
3. Teachers, under the age of 40, think that it is more useful and viable than older teachers.
4. There are no differences of opinion between men and women about Big Data technology.
5. Teachers with more than 16 years of experience have a less favourable opinion about Big Data technology.
6. Teachers of higher levels (Secondary Education, Baccalaureate and University), consider that the use of Big Data in Education will bring situations with greater school success compared to the teachers of lower levels (Infant and Primary).
7. The specialists of Therapeutic Pedagogy (TP) and Hearing and Language (LA) consider that the use of Big Data technologies could reduce the difficulties in learning compared to the teachers of Early Childhood Education and Primary Education.

2. MATERIAL AND METHODS

2.1 Participants

The sample consisted of 119 teachers. The age range was from 22 to 65 years old from the University of Extremadura and from 6 educational centres of Extremadura. The type of sampling is of convenience, with the selection of centres according to their availability to participate in the study, with a similar percentage between the participating university faculty and the teaching staff of educational centres.

Table 1.

Analysis of the sample.

GENDER		PROVINCE		EDUCATIONAL LEVEL	
Men	45	Cáceres	57	TP/LA	7
Women	74	Badajoz	62	Pre-Primary Education	20
				Primary Education	34
AGE		TEACHING EXPERIENCE		Secondary Education	7
< 30 years old	10	0-5 years	16	Baccalaureate	6
From 30-40	26	6-15 years	31	University	45
From 41-50	41	16-25 years	42		
> 50 years old	42	26 or more	30		

Source: Own work.

2.2 Instrument

After carrying out an extensive bibliographical review, no instrument was found that was related to the object of the research. Therefore, a questionnaire was designed to measure the attitudes of the teaching staff towards the Big Data and subsequently, 11 experts were asked and experts the validation of it. Once the evaluations were received, the items that had received a lower score by the validators were modified or eliminated. The validation occurred at the end of May 2018.

Secondly, after modifying the questionnaire, it was sent by "e-mail" in the month of June 2018, to the professors of the University of Extremadura and to teachers from 6 educational centres, obtaining a response rate with a volume of 119 subjects, which have been taken into account in the sample for the investigation. This questionnaire was answered anonymously, following the ethical values required in research with people, being informed of the objective of the study. The questionnaire consisted in the visualization of a video of 3 minutes, created expressly for the participants, in which was detailed what is the Big Data and what it is being used for (Link to the video: https://www.youtube.com/watch?v=uacXhStmu1Q).

Next, there were 5 sociographic questions and 10 Likert-type questions about the opinion, the usefulness, the viability of Big Data in Education and, finally, a last section of comments. The reliability and internal consistency was ascertained by the Cronbach alpha statistic whose results show high reliability, with a resulting data of 0.86.

3. ANALYSIS AND RESULTS

3.1. Descriptive analysis

To carry out the descriptive analysis, graphs of all the items of the questionnaire were made. In the following graphs we can see the results obtained in each item of the questionnaire:

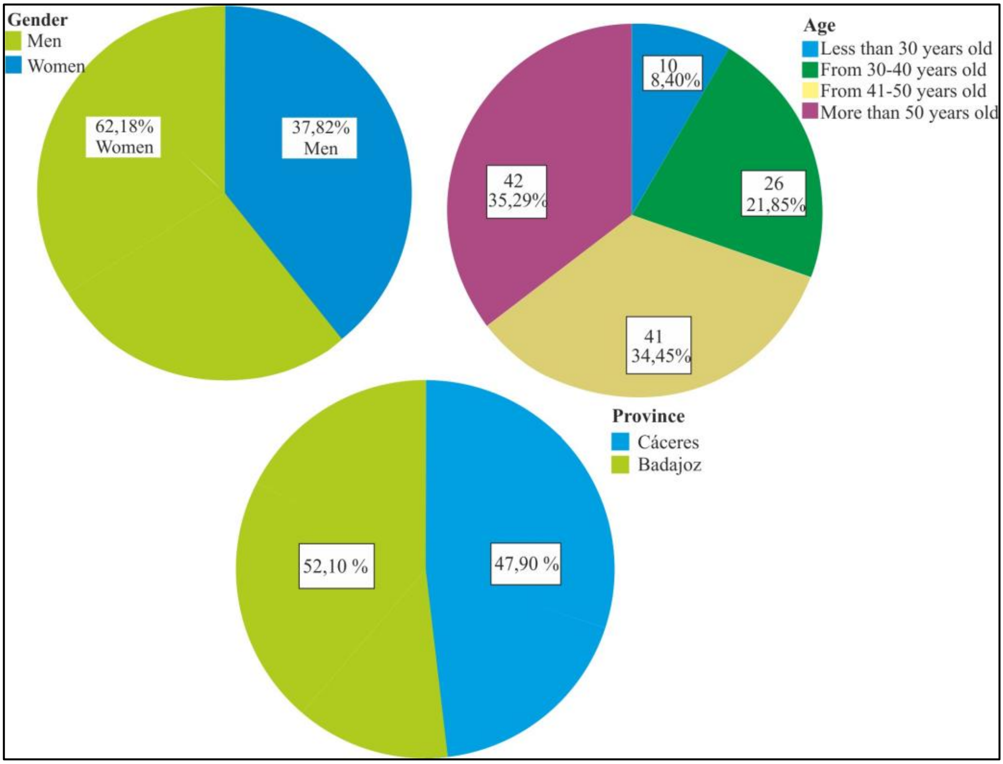

Figure 1. Graphs of the items Sex, Age and Province

Source: Own work

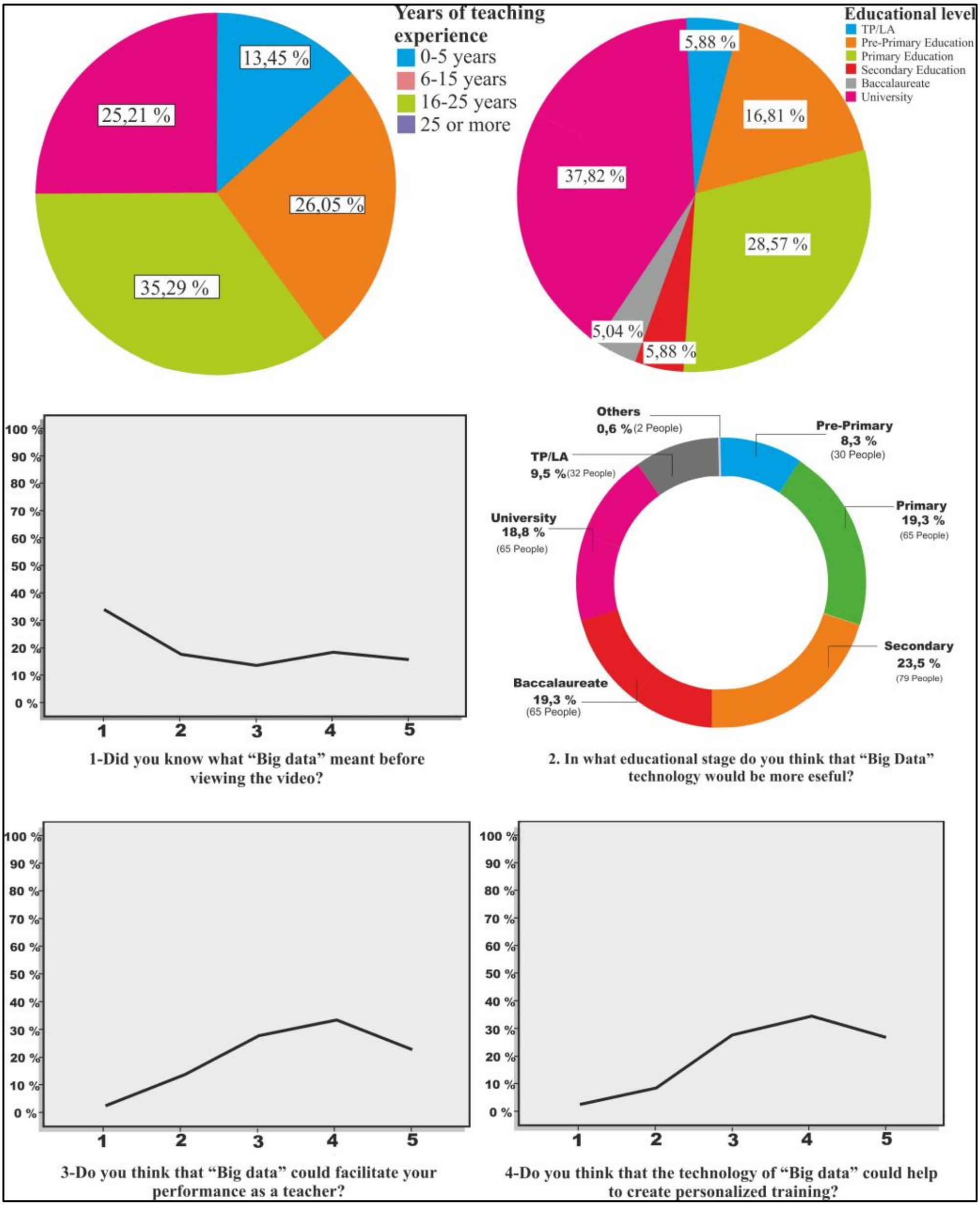

Figure 2. Graphs of the items Experience, educational level, question 1, 2, 3 and 4

Source: Own work

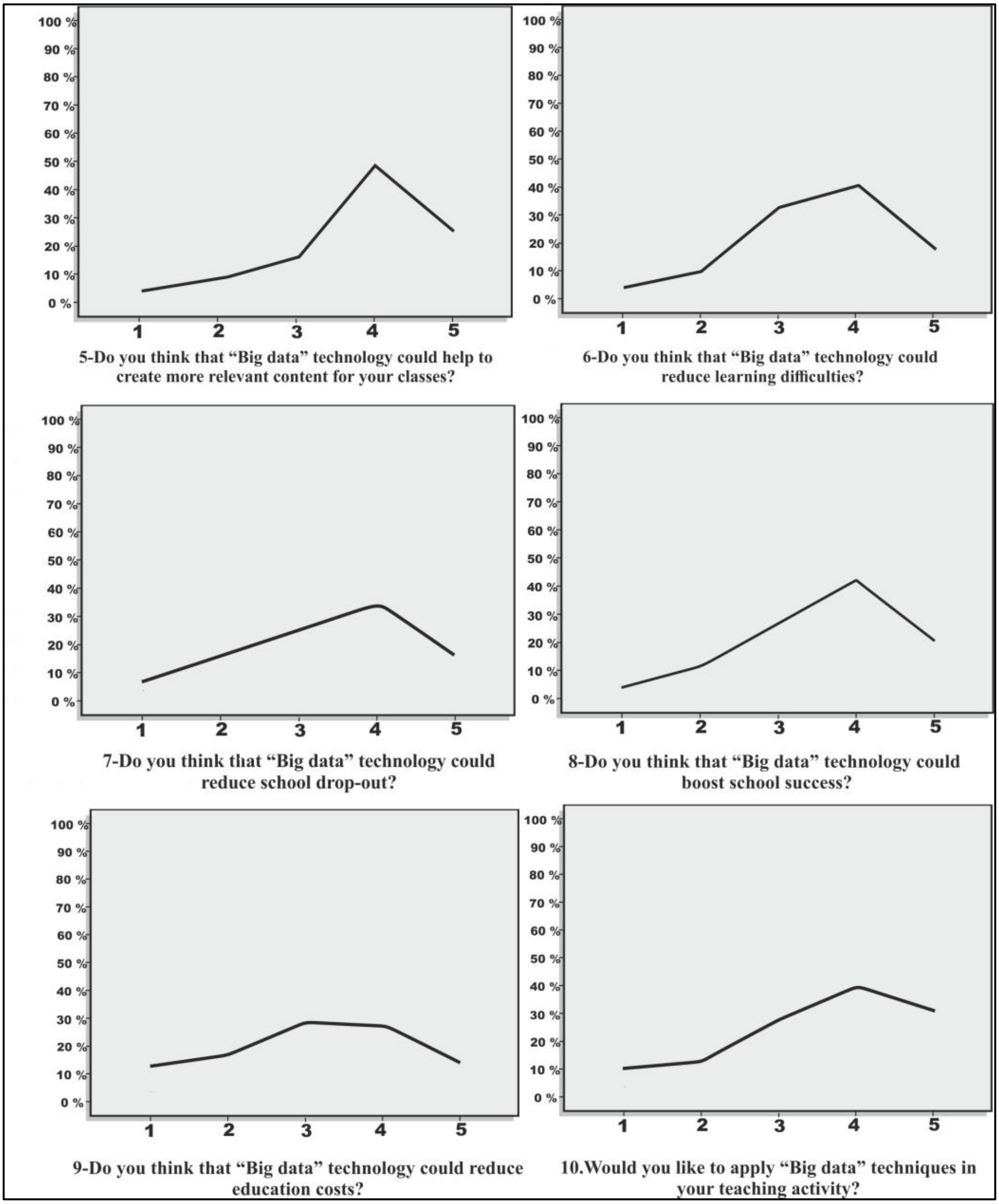

Figure 3. Graphs of the question 5, 6, 7, 8, 9 y 10

Source: Own work

The most significant results of these graphs are the following:

In the first question "Did you know what Big Data is before viewing the video?" Most of the respondents did not know this concept. However, that is the only graph whose values have been more negative. The rest of the graphs are quite similar, the scores begin to rise, from 3 to 5 on the Likert scale, coinciding with positive opinions towards the use and implementation of "Big Data" techniques. For example, we can find high scores in the opinion that Big Data could facilitate the performance as teachers, help create personalized training and relevant content, reduce difficulties in student learning, reduce abandonment school and boost school success, and in general, the majority of respondents would like to be able to apply Big Data techniques in their teaching activity.

On the other hand, they were also asked about the educational levels they considered most viable for the application of Big Data techniques and the results showed, with higher scores, that the most optimal educational levels to use the Big Data would be: Primary Education, Secondary Education, Baccalaureate and University.

3.2. Inferential Analysis

For the inferential analysis, the same procedure was followed for each of the 7 hypotheses formulated. First, a graph was made about the variables involved in each hypothesis and then, when the variables were quantitative, continuous and at least interval, K-S, Rachas and Levene tests were applied to check if the data allowed to apply parametric tests. Once the values were obtained and the type of test that was applied was decided, the tests were carried out. The tests were T-Student for independent samples in case of parametric tests and Mann-Whitney U for nonparametric tests.

Table 2.

Inferential analysis of hypotheses.

HYPOTHESIS	MODEL	DEGREE OF SIGNIFICANCE	RESULT
1. University faculty knows more about the Big Data concept than teachers from other educational levels	U de Mann-Whitney	0,000	H_0 is rejected (p <0.05), thus accepting the working hypothesis. There are statistically significant differences. The faculty of University knows more the concept Big Data than the professors of other educational levels.
2. University teachers consider the Big Data technology more useful and viable than the teachers of other educational levels.	U de Mann-Whitney	Utility: 0,095 Viability: 0,047	"We accept the H_0 (p> 0.05) for the utility analysis and we reject the H0 (p <0.05) for the feasibility analysis, that is, there are no statistically significant differences for" utility "but if they exist in the case of "viability".

HYPOTHESIS	MODEL	DEGREE OF SIGNIFICANCE	RESULT
3. Teachers under the age of 40 think that it is more useful and viable than professors older than 40 years.	U de Mann-Whitney	Utility: 0,289 Viability: 0,374	We accept the H_0 ($p > 0.05$), so no statistically significant differences are observed between the different ages and what they think about the usefulness and viability of the Big Data.
4. There are no differences of opinion between men and women about Big Data technology.	T-Student for Independent samples	0,002	H_0 is rejected ($p < 0.05$), that is, there are statistically significant differences between what men and women think about the use of Big Data technologies.
5. Teachers with less than 16 years of experience have a more favorable opinion about Big Data technology.	T-Student for Independent samples	0,535	The H_0 is accepted ($p > 0.05$), so no statistically significant differences are observed between the years of experience and the teachers' opinion towards the use of Big Data technologies.
6. Teachers of higher levels (Secondary Education, Baccalaureate and University), consider that the use of Big Data in Education will bring situations with greater school success compared to teachers at lower levels (Infant and Primary).	U de Mann-Whitney	0,094	The H_0 is accepted ($p > 0.05$). Therefore, it is observed that there are no statistically significant differences between the educational level and the belief that the use of Big Data in Education will bring about situations with greater school success.
7. The specialists of Therapeutic Pedagogy (TP) and Hearing and Language (LA) consider that the use of Big Data technologies could reduce the difficulties in learning compared	U de Mann-Whitney	0,587	The H_0 is accepted ($p > 0.05$). Therefore, it is observed that there are no statistically significant differences between the educational level and the belief that the use of Big Data in Education will bring about reductions in learning

HYPOTHESIS	MODEL	DEGREE OF SIGNIFICANCE	RESULT
to the teachers of Infant Education and Primary Education.			difficulties.

Source: Own work

3.3. Analysis of frequencies of the comments of the participants

The survey included a section dedicated to comments for all Education professionals who had something to object about the study, whether they were opinions or suggestions, etc. Of 119 subjects surveyed, 61 answered this section with very different comments. For this analysis, a frequency chart of the comments of the participants has been designed. These comments have been grouped into 4 categories: The use of Big Data techniques seems to me ... very interesting, interesting, uninteresting and not at all interesting. In the following figure 4 you can see the results.

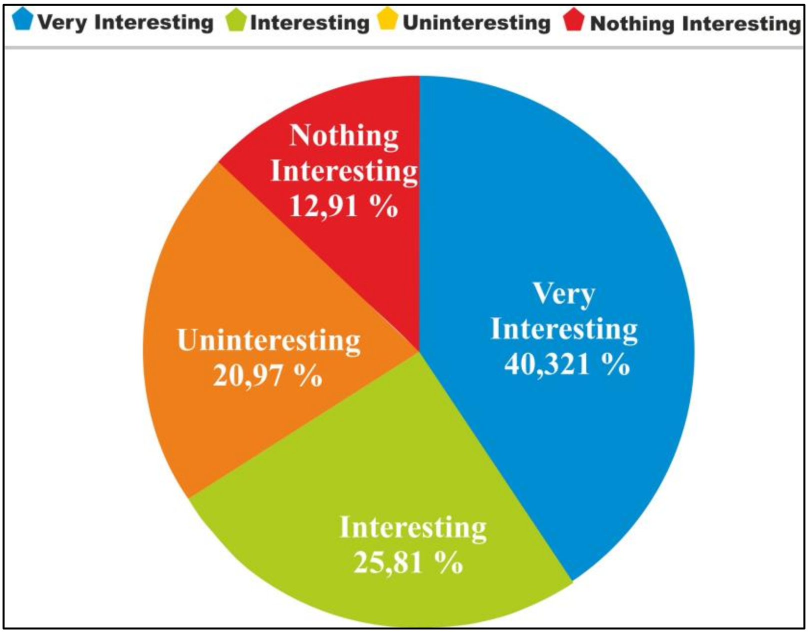

Figure 4. Graph of the frequencies of the comments of the participants

Source: Own work

CONCLUSIONS

In accordance with the proposed objectives, we can deduce the following conclusions:

In the first place, after an extensive literature review it can be affirmed that the concept of “Big Data" has been deepened and its applications at a general level and more specifically at an educational level.

Regarding the concept that teachers have towards the use of Big Data techniques, we can affirm that, thanks to this study, it has been possible to know the attitudes of University professors and Educational Centres in a more concrete way.

In third place, after analysing data of the results obtained in the questionnaire, we can conclude that the acceptance and feasibility of Big Data in education has been analysed. After the results obtained in the graphs we can affirm that in general there is a great acceptance and that the majority of the participating professors considers it viable.

And finally, after the study, it has been possible to analyse the previous knowledge of the teaching staff towards the term Big Data, which was not known by the majority of the teaching staff.

Regarding the hypothesis that were raised at the beginning of the investigation, it can be concluded that:

The first hypothesis suggested that the faculty of the University knew more about the concept of Big Data than the teachers of other educational levels, after the analysis of the data obtained through the questionnaire, this hypothesis can be confirmed since the most favourable results in this question could be related to the greater investigative spirit that is supposed to the faculty of the University and to be more up to date in the new tendencies.

The second hypothesis suggested that university faculty considered Big Data technology more useful and viable than faculty from other educational levels. However, this hypothesis has been partially accepted, since the faculty of the University sees it as more viable than the faculty of other educational levels, but, on the other hand, it sees it as less useful than the faculty of other educational levels. No studies have been found to support this result, so it could be inferred that it may be due to the variability of the sample.

The third hypothesis proposes that age is a determining factor for the conception of Big Data as useful and viable. This hypothesis suggested that teachers under the age of 40 think that it is more useful and viable than older teachers. However, after the analysis of the data, it can be stressed that, in this case, there are no significant differences so that age is not an influential factor to determine a more or less positive conception, the utility and the viability of the Big Data. This statistical equality in the criterion towards the usefulness and viability of the Big Data would be determined by the scarce knowledge on the subject and the lack of information on the benefits of its application in the classrooms. However, in both cases, they consider that this issue, as a technological renovation, will end up being necessary and inexorably implemented in the classrooms. On the other hand, the sample used contemplated a much higher percentage of people over 40 years compared to those less than 40 years.

The fourth hypothesis proposed that there would be no differences of opinion between men and women about "Big Data" technology. However, it can be affirmed that there are differences of opinion regarding gender. According to the graph, women are slightly more optimistic. This may be due to the fact that in the questionnaire the percentage of women who participated is higher than that of men, as it is evident in the current education system, where female teachers far outnumber the number of men, as reflected in the study carried out by the Junta of Extremadura in 2008 (Training Guide for the incorporation of equality in public administration).

The fifth hypothesis proposed that teachers with more than 16 years of experience would have a less favourable opinion about Big Data technology. However, it has been verified that, since there were no differences of opinion regarding the Big Data, the years of experience have not been a determining factor in this case. As it happened in hypothesis 3, the experience, normally a consequence of age, does not show a special predilection towards the uses of Big Data, which may be due to the variability of the sample and the insufficient information that teachers have yet on the subject.

The sixth hypothesis suggested that teachers at higher levels (Secondary Education, Baccalaureate and University) would consider the use of Big Data in Education as a tool that would bring situations with greater school success compared to the teachers at lower levels (Children and Primary). In this case, after analysing the data, this hypothesis is rejected. It could be inferred that the information that gives us the use of Big Data is currently much higher in higher education and university levels since higher level students have greater access to computers, social networks, smartphones, video games, etc. and all those "Actions" give us a large volume of data and behavioural reflexes. Therefore, the rejection of this hypothesis could be due to the variability of the sample used.

Finally, the seventh hypothesis stated that the specialists of Therapeutic Pedagogy (PT) and Hearing and Language (LA) considered that the use of Big Data technologies could reduce the learning difficulties, in comparison to the teaching staff of Education Infant and Primary Education. However, this hypothesis is rejected as well, since, according to the data, it is the teachers of Early Childhood and Primary Education who turn out to be more optimistic in the use of Big Data technologies. Contrary to the result of this hypothesis, it is considered that one of the great benefits that Big Data can bring to the education system is in favour of the personalization of learning. Therefore, this particular result may reflect poor information on the subject.

Regarding the analysis of the comments that the participants wrote in the questionnaire, it could be said, on the one hand, that more than 66% of those 61 subjects considered that it is a very interesting, innovative topic and it is worth putting it into practice; however, others were more reluctant, (the remaining 34%) considering the implementation of training plans for teachers in this matter of vital importance.

Other teachers thought that the educational system should be reformulated to use methodologies based on Big Data and, finally, a smaller group of teachers said that Big Data has many disadvantages, considering this type of education as impersonal and saying that it loses the personal discovery factor.

However, there is great uncertainty and in some cases fear of the use of Big Data in the educational context, since some subjects considered that managing a personalized education for all students of an educational centre is practically impossible and would require a significant increase in specialized teaching staff. In any case, the majority thought that it is a very interesting topic but for this it is necessary to obtain more information about its uses and possibilities and to study in depth the ethical aspect and the protection of data before putting it into school practice.

To conclude with this study, we can point out that there is a long way to go with the Big Data. It is necessary to continue researching in this field and promoting educational plans, new methodologies, teacher training and new resources and tools that allow teachers to know and implement Big Data techniques in their classes in order to boost school success and personalized education. Therefore, we can suggest various lines of research in the future.

The first future line of research would be to replicate this study with a more representative sample. On the other hand, it would also be convenient to replicate the research incorporating the qualitative methodological approach, which would provide a more holistic perspective on teachers' attitudes towards the use of Big Data technologies. And finally, carry out an intervention project on the Big Data in education, to put into practice what in theory this concept proposes and contributes, verifying if the results and attitudes of the students are improved, or not, significantly, as well as the teaching work.

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STUDENTS' DIGITAL PORTFOLIO AS A TOOL FOR DEFINING GENERIC COMPETENCES

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Abstract. *The materials of the article are devoted to determining the potential of using an electronic portfolio in the educational process of preparing masters of higher education as a means of forming and measuring general competencies. The authors compiled the master's profile, that was established in accordance with the general competencies of the Tuning project. The compliance of the general competencies according the Tuning project of ISTE standard has been established. The criteria of evaluation and levels of formation of general competencies are determined. The results of the students' attitude toward the use of electronic portfolios in the* educational process and suggestions on the use of external experts are presented.

Keywords: Higher education, Generic competencies, E-portfolio, Reflection**.**

INTRODUCTION

Modern digital technology is a catalyst for the transformation of the world ("World Economic Forum", 2017). Recommendations of the EU for monitoring digital economy and society of 2016-2021 highlight the indicators for measuring digital skills because employment opportunity, education, leisure, involvement and participation in society - all these areas and many other aspects of society's work are transformed through the wide introduction of digital technologies ("Monitoring the Digital Economy & Society 2016-2021", 2015). As a result, digital competence - or the confident and sound use of information and communication technologies - is vital for participation in today's socio-economic life. In this regard, the problem of improving (transforming) the education system as a social institution for human development for the training of competent specialists, taking into account the needs of the market and the current trends in the development of digital technologies, is being actualized.

According to many leading scholars opinion of the modern world, the universities that can create that knowledge economy, which will lead to the further effective development of the education system in the country, its exit from the crisis state of finding its own identity. The implementation of the problem of integration of science and education relies on the preparation of masters of higher education institutions, since it is the masters who must meet the requirements of society for the qualification of modern graduates of higher education. A graduate of a magistracy must have the necessary knowledge and skills to conduct fundamental and applied research in his subject field; the skills of individual and collective work, including through digital technologies, the ability to self-education and reflection, the study of excellence in the professional field.

The competent approach, which is defined not only as a result of higher education, but also life-long learning ("Council recommendation on Key Competencies for Lifelong Learning", 2018) ensures clarity and comparability of learning outcomes, acquired competencies and qualifications, and thus creates a solid foundation for European and world integration. The analysis and definition of the list of basic general competencies that characterize the universal skills and abilities, assessment, carried out in the framework of the project Tuning ("Tuning Educational Structures in Europe", 2008). There are also individual studies on the definition of standards for the training of specialists and the measurement of their competencies. Example, the ISTE Standards ("The International Society for Technology in Education", 2016) provide a framework for rethinking education, adapting to a constantly changing technological landscape and preparing students to enter an increasingly global economy.

The European Digital Citizens' Competence System, also known as DigComp, allows for a common approach to defining and describing key areas of digital competence of citizens, and is a global reference point at European level ("The Digital Competence Framework for citizens", 2017). At the same time, the search for ways of forming and measuring competencies of representatives of various branches, in particular education, does not lose its relevance.

In the education systems of many countries, authentic evaluation is widely used to determine the level of competence development. This type of assessment involves measuring the skills and abilities of students in terms of immersing them in a situation that is as close as possible to real professional life. One of the most widespread types of authentic assessment in Western Europe and the United States is the portfolio method (Lorenzo, Ittelson, 2005). In the university education of foreign countries, it becomes a mass character (Fitch, Peet, Glover Reed, Tolman, 2008; Hallam, & Creagh, 2010; Buyarski, Aaron, Hansen, Hollingsworth, et al., 2015), in the post-Soviet countries it is introduced episodically (Petrenko, 2013, Morze, Varchenko-Trotsenko, 2016). However, in terms of digitization of the economy and society ("Europe 2020 strategy", 2015), first of all pay attention to the electronic portfolio as a summary of the new generation ("Digital competence", 2017). Through ePortfolio you can accumulate information about your achievements, professional and general competencies, starting university, in the future to use in job placement and career development throughout your life.

The purpose of this research: theoretically substantiate the use of an electronic portfolio as a tool for assessing the level of formation of masters' general competencies.

1. MASTER'S DEGREE IN HIGHER EDUCATION THROUGH THE PRISM OF GENERAL COMPETENCIES

Modern society propose fundamentally new demands on workers, and, accordingly, the education system, in particular, at the higher level. Nowadays employers have priority for graduates who have a certain understanding of their goals, ability to work in a team, an appropriate level of professional competence formation, and the existence of a plan for their own professional growth.

That is how future skilled workers take into account labour market demands for self-education, self-development and self-presentation competencies.

The training of a competitive specialist should be based on a competent approach based on the use of technology in teaching and learning (technology integration) ("The International Society for Technology in Education ", 2016).

According to the recommendations of the Tuning Project (Sánchez, & Ruiz, 2008), in the branch standards of higher education the two main groups of competencies are allocated: general and special (professional). The study of general competencies was one of the main tasks of the Tuning project. The results of rating received from it among graduates and employers are presented in the form of a list of groups of general competencies (Table 1). The above competencies also correlate with the ISTE standard for students, consisting of 7 components: 1) Empowered learner; 2) Digital citizen; 3) Knowledge Constructor; 4) Innovative; 5) Computational; 6) Creative Communicator; 7) Global Collaborator (http://www.iste.org/standards/for-students).

Table 1.

Compliance with the overall competencies of the Tuning project of the ISTE standard

Classification basis Tuning)	General competencies	Compliance with the ISTE standard

Instrumental (I)	I1. Ability to analyze and synthesize. Problem solving	Empowered Learner (1a); Knowledge Constructor (3d); Computational Thinker (5a, 5c); Innovative Designer (4d)
	I2. Skills of using digital technologies	Empowered Learner (1b); Digital Citizen (2d); Knowledge Constructor (3c); Innovative Designer (4b); Computational Thinker (5b); Creative Communicator (6b)
	I3. Information management skills.	Knowledge Constructor (3c, 3a); Digital Citizen (2d); Empowered Learner (1b)
	Ability to work independently	Computational Thinker (5b)
	I4. Ability to organize and plan. Ability to design and manage projects	Computational Thinker (5c); Innovative Designer (4a, 4b,4c); Knowledge Constructor (3a, 3d); Empowered Learner (1a); Global Collaborator (7c)
System (S)	S1. Ability to learn and self-improvement	Empowered Learner (1a, 1b,1c); Digital Citizen (2a); Creative Communicator (6d); Global Collaborator (7a, 7c)
	S2. Ability to apply knowledge in practice	Global Collaborator (7b,7d); Creative Communicator (6b,6d); Computational Thinker (5d); Innovative Designer (4a); Knowledge Constructor (3d); Empowered Learner (1b)
	S3. Ability to adapt to new situations. Caring for quality	Empowered Learner (1c); Digital Citizen (2c); Knowledge Constructor (3a,3b); Computational Thinker (5b, 5d); Creative Communicator (6a)
	S4. The desire to succeed in the profession	Empowered Learner (1a); Digital Citizen (2a)
	S5. Ability to lead research	Global Collaborator (7d); Computational Thinker (5a, 5b,5c,5d); Innovative Designer (4b); Knowledge Constructor (3a,3b, 3c,3d); Digital Citizen (2b)
Interpersonal (In)	In1. Work in group	Global Collaborator (7a, 7b,7c); Creative Communicator (6a, 6b,6d)
	In2. Ability to communicate with specialists in their field	Global Collaborator (7b, 7c); Creative Communicator (6a); Empowered Learner (1b)

Source: Own work

As for professional competencies, it is obvious that due to their specificity, there cannot be any generally accepted list of them. However, within the framework of various professional associations, international projects, national quality assurance agencies, a number of internationally recognized lists of specific branches / specialties (subject areas) have been developed, which can be used both for the development of national standards (in terms of normative learning outcomes and competencies), as well as in the design of educational programs by specific institutions of higher education. At the same time, the European e-Competence Framework ("European e-Competence Framework 3.0", 2014), which is recognized as a company producing services and products for ICT, as well as institutions, can be used to develop a model of professional competencies of a specialist (master's) that is correlated with the requirements of the digital economy, which use ICT in their core business.

An example of developing a model for professional competencies of managers in electronic learning management and its formation in university education is presented in the article by the authors (Morze, Glazunova & Kuzminska, 2018). We will define the master's profile in this study, which is based only on general competencies, grouped by the lines according to the directions of activity (Table 2).

Table 2.

Master's Profile

Line	**General competencies**	**Indicator of measurement**	**Indicator**
Scientific	I1., I2, I3, I4 S3, S4, S5 In1, In2	• Scientific conferences, seminars • Scientific projects • Scientific articles • Scientific competitions	• Quantitative (participation) • Qualitative (reviews, honors, articles, certificates)
Professional	I1, I2, I3 S1, S2, S3, S4 In2	• Professional certification • Internship • Professional experience	• Quantitative (participation) • Qualitative (reviews, honors, certificates)
Communicative	I1, I2, I4 S2, S3 In1, In2	• Mobility Programs • Social initiatives and projects	• Quantitative (participation) • Qualitative (reviews, honors)
Managerial	I1, 2I2, I4	• Data and people management	• Quantitative (participation)

	S1, S2, S3, S4 In1, In2	(organization of social actions, communities, circles, etc., student self-government) • Improvement of qualification (knowledge management)	• Qualitative (reviews, honors, certificates)

Source: Own work

It should be noted that the formation of general competencies takes place on the subject content and personal experience of students, that is strongly correlated with the formation of professional competencies. After all, the professional line is professionally oriented, scientific - scientific-oriented, communicative and managerial - practical-oriented. Thus, it can be argued that the proposed model also reflects the level of experience in acquiring professional competencies (qualitative indicators). This level indicates the way in which a person is able to integrate the skill or ability into his / her life (or some facet of it: academic, interpersonal, social etc.) and is able to demonstrate this ability. The essential feature of this level is the use that the person makes of the competence in a professional question.

The introduction of competence based learning requires good planning in the strategic plans for the university, which then are transferred to the plans and projects of the university's different centers, faculty institutes for acceptance and incorporation into their daily tasks (*Sánchez & Ruiz,2008*).

When we analyze the requirements for an organization (university, faculty) we can use general offers (http://wp1087322.server-he.de/) and develop their own content. In our opinion, it is necessary for universities to consider the following components (e-Competence Framework Functional):

1. Company overview: Description of company management; Description of company organization / departments.

2. Innovation and research.

3. Business environment and business competencies: Business model and business processes, Human resources.

4. In order to measure the level of students' acquisition of competencies, criteria should be developed and appropriate methods selected.

2. PORTFOLIO AS A TOOL FOR ASSESSING THE LEVEL OF MASTERS' COMPETENCE

Modern society focuses on quality in everything, including in education. Therefore, measuring the results of a scientific and pedagogical worker and student is very important in our time. Without claiming the final solution to this problem, we propose to consider a portfolio as a pedagogical technology for forming the competence system of future specialists and a tool for evaluating individual achievements.

We understand the student portfolio (master's) as a means of demonstrating materials that allow us to determine the performance of the student's educational and scientific activities and to follow the dynamics of his achievements for a certain period of study. In our view, a portfolio can simultaneously be used as: a control device and monitoring individual achievements, a tool for evaluation and self-assessment, an alternative test form, technology for tracking learning outcomes and their dynamics, etc. In developed economies, active work has been launched to create the infrastructure necessary for the formation and use by citizens of electronic portfolios for their own development. In other words, the electronic portfolio is an organized collection of completed works presented in digital format (Batson T., 2002).

The process of developing, testing and implementing electronic portfolios can be tracked on the websites of the International Organization of the EuroPortfolio Consortium, the Inter / National Coalition for Electronic Portfolio Research, the Danish Consortium for ePortfolio. These international organizations, with the support of students, administrations of higher education institutions, are studying the impact of e-portfolio technology on the learning process and the professional development of future professionals. For example, the experience of using a portfolio to evaluate students at university is presented in the works by Omar M. Mahasneh & Odeh S. Murad (Mahasneh & Murad, 2014). The impact of the mobile portfolio (M-Portfolio) supported by the mastery learning model on student achievement and their attitudes towards using the Internet was considered by O. Ozdemir, H. Erdemci (Ozdemir & Erdemci, 2017).

Electronic portfolios do not necessarily have a web presentation. In particular, the International Association for Technology in Education ("The International Society for Technology in Education", 2016) has developed standards for e-portfolio templates for various formats. These templates can be viewed on the site of Professor Helen Barrett, one of the most famous experts in the field of electronic portfolio (Barrett H., 2016). An e-portfolio can also be placed in the LMS Moodle environment or as a separate page on the university department's website; to create a personal website or blog; to use the Mahara tool or to post on the Wiki-portal of the high school. Some universities are developing their own information systems for the portfolio (Morze, Varchenko-Trotsenko, 2016) since it is believed that the synergy of e-portfolio will create a single educational e-space -

the virtual community (virtual community, online community, online group), which can be used by all citizens without exception regardless of age. At the same time, there is also a transformation of the learning process, provided that the subjects of the educational process have a sufficient level of acquisition of digital competencies.

The researchers consider different approaches to the modelling of the structure and content, the stages of application and positioning of the portfolio. The organization of work on the conclusion of the portfolio is carried out according to the following scheme:

1. Motivation to create a portfolio. At this stage, students define the purpose of creating a portfolio for themselves and benefit those who need to get acquainted with its content. This is a prerequisite for achieving successful results in future professional activities.

2. Definition of the structure, format of submission of materials and criteria for their evaluation.

3. Planning activities for the collection, registration and preparation of presentation materials.

4. Generalization, systematization and design of a portfolio. At this stage, there is also counselling and adjusting (if necessary) the contents of the portfolio.

5. Presentation within the purpose of creating and using a portfolio.

6. Evaluation and reflection.

Regarding the structure, there are 3 to 8 sections of the portfolio of the student, among which are necessarily present: "Exhibition Portfolio" (letters, diplomas, awards, certificates, information indicating the personal training initiative: courses, training); "Work portfolio" (a collection of works showing the progress of the author in the study of the future profession); «Portfolio of reviews» (contains reviews, reviews, reports, various forms of self-assessment of own achievements)?

The composition of a portfolio depends on specific goals. In this study, we propose to consider a portfolio as one of the tools for measuring the general competencies of masters (Table 2).

The levels of the formation of general competencies correspond to the formation of indicators by criteria, which we clearly explain by means of a single circle. The quarters on which the circle is divided reflect the lines of formation (development) of the general competencies of the master: scientific, professional, communicative and managerial (Table 2). In each quarter of the ideal segmented model, we have four points that interpret the formation of the components of general master's competencies according to the criteria: motivation, activity, productive, reflexive (Figure 1). Consequently, the general master's competencies are then formed at a high level, when in each quarter is possible to distinguish four points per unit circle.

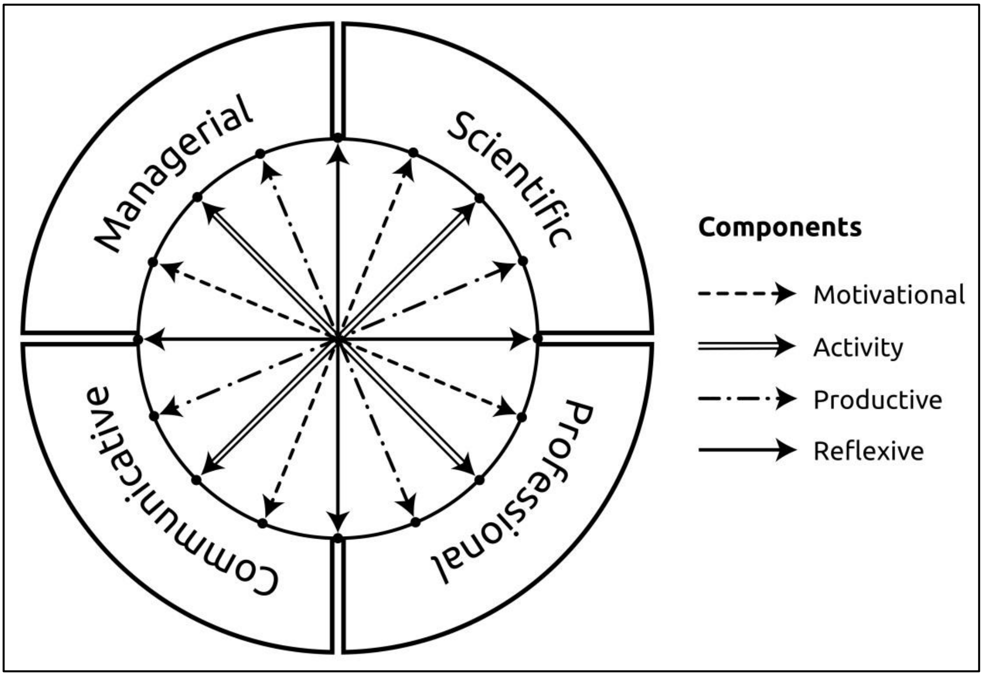

Figure 1. The ideal segmented model of general master's competencies

Source: Own work

Thus, we have identified the following levels of formation of the general master’s competencies (Figure 2):

• *Awareness*, which can be marked with four points per unit circle;

• *Experience*, which can be interpreted on a single circle by eight points;

• *Mastery*, which makes it possible to mark twelve points per unit circle;

• *Expert* - the indicators of all the criteria are available, so it is possible to mark sixteen points on the unit circle, reflecting the ideal segmented structure of the master's general competence.

Interpretation of the levels according to the ideal structure and selected criteria in our study is given in figure 2.

Number of criteria (n)	$n = 16$	$\begin{cases} n \geq 12 \\ n < 16 \end{cases}$	$\begin{cases} n \geq 8 \\ n < 12 \end{cases}$	$\begin{cases} n \geq 4 \\ n < 8 \end{cases}$
Level	*Expert*	*Mastery*	*Experience*	*Awareness*

Figure 2. The ratio of levels of formation of general competencies depending on the criteria

Source: Own work

Each criterion for the formation of the general competencies of masters determines the formation of each of these lines (Table 2). According to the logic of our study, the diagnosis of the levels of formation of general competencies of the Master, we conducted according to the formula

$$GMC = 4 * (S + P + C + M) \qquad (1),$$

where GMC - general master's competencies; S - scientific line of formation (development) of general competencies; P-professional; C-communicative; M-managerial.

If competencies are formed on all lines, that is, each one corresponds to one point per unit, then GMC = 16 points; this relationship correlates with the expert level of formation of GMC. If competencies are formed partially, the formula reflects the skill level of the (the GMC is equal to 12 points), experience (the GMC is equal to 8 points) or awareness (the GMC is equal to 4 points).Note that the situation in which GMC is equal to 0 is impossible, as the future specialist in the learning process must carry out certain activities, for example, to participate in conferences, etc.

It should be noted that if a portfolio is used as an educational technology for the formation of masters' competencies, it is possible to assess the acquisition of competence under the scheme. In the case of using a portfolio as a tool for assessing the level of masters' formation, evaluation is carried out only on the effective criterion and for the assessment of the motivational, activity and reflexive criterion, it is necessary to further use the methods of questioning, interviewing and observation.

3. DISCUSSION

A survey was conducted to determine the attitude of students to using the portfolio as a tool for evaluating master’s competencies. The survey was attended by 57 masters of the second year of study from two universities of Ukraine: Borys Grinchenko Kyiv University and the National University of Life and Environmental Sciences of Ukraine. These students created a portfolio in the framework of specialized training.

Research question: Does the use of portfolios influence the formation of general competencies (Table 1) and professional growth?

According to the survey, 82% of the respondents acknowledged the positive impact of portfolio use in educational practice. Detailed answers are given in Table 3.

Table 3.

Percentage distribution of answers from students from KUBG and NULES in the group of point reflecting student's attitude towards the use of portfolio in educational practice

	KUBG (31)	NULES (26)
Formation of general competencies		
I1. Ability to analyze and synthesize. Problem solving	56%	62%
I2. Skills of using digital technologies	82%	85%
I3. Information management skills. Ability to work independently	78%	75%
I4. Ability to organize and plan. Ability to design and manage projects	32%	29%
S1. Ability to learn and self-improvement	82%	79%
S2. Ability to apply knowledge in practice	54%	60%
S3. Ability to adapt to new situations. Caring for quality	78%	81%
S4. The desire to succeed in the profession	94%	92%
S5. Ability to conduct research	36%	42%
In1. Work in group	51%	46%
In2. Ability to communicate with specialists in their field	67%	78%
Educational activities and professional self-determination		
Creating a personal training trajectory	69%	76%
Motivation for self-education	71%	68%

Self-assessment of own professional competence	54%	50%
Formation of reflexive culture	56%	60%
Expert evaluation		
Self-evaluation	78%	73%
Assessment by other masters	45%	51%
Teacher evaluation	65%	68%
Assessment by employers (grantees, etc.)	88%	92%

Source: Own work

CONCLUSIONS

The emergence of the e-portfolio around the world makes radical changes in the perceptions of learning technologies. Its application makes it possible to evaluate and summarize certain achievements of the individual at different stages of study throughout his life, that is, contributes to the formation of general competencies. This advanced technology is a key element in creating a constantly learning community.

The pedagogical philosophy of the portfolio includes: put the emphasis on students' progress in educational, scientific, social activities; transfer of pedagogical accent from self-esteem evaluation. The technology of electronic portfolio helps to organize the planning of their own student's educational activities, establishing the relationship between formal and informal learning experiences, professional development and scientific intelligence, the formation of an active social position and digital citizenship. In addition, the technology of the electronic portfolio is not only an addition to the main evaluation tools for the achievements of graduate students and is characterized by an effective form of self-assessment of the results, but also contributes to strengthening the motivation to self-education, the formation of a reflective culture, directs their consciousness to the objective setting of their own professional competence.

Electronic portfolios are universal, therefore, they can be used by both students and professors and employers. Moreover, there is the possibility of using electronic portfolio systems by legal entities, such as firms, grant agencies, or international organizations.

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DEVELOPING THE SKILLS OF PRIMARY TEACHERS IN PROGRAMMING, ICT AND E-LEARNING

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Abstract: *The activation of the processes of digitization, automation and robotics in all spheres of public life determine the necessity to increase the quality and effectiveness of the training in computer science. Taking into account these trends, the Ministry of Education and Science in Bulgaria adopted a new Pre-school and School Education Law according to which from the new 2018/2019 school year computer programming and modelling will be studied as a compulsory school subject from the third grade of elementary school. The article will share the approach chosen in Bulgaria and the authors' experience to develop the knowledge and skills of primary teachers in the field of programming, computer modelling, ICT and e-learning.*

Keywords: computer programming, e-learning

INTRODUCTION

Modern trends in the development of digital technologies require ever more dynamic and adequate changes in modern education. The activation of the processes of digitization, automation and robotics in all spheres of public life determine the necessity to increase the quality and effectiveness of the training in computer science. New technologies entered the classroom at a rapid pace - on the one hand, as a means of increasing the efficiency of the learning process and, on the other, as a basis for developing a qualitatively new level of student intelligence. It has been shown that the formation of important skills related to the processing and use of information is directly or indirectly related to computer science. Achieving qualitative results in building competencies for processing and using information is related to adequate training in and out of school.

Although computer sciences are studied in elementary school for years as an optional school subject, this training is done by computer specialists and not by primary school teachers. Therefore, the problem of the preparation and training of primary school teachers, who have to teach the new subject matter, is very important. The article will share the approach chosen in Bulgaria and the authors' experience to develop the knowledge and skills of primary teachers in the field of programming, computer modelling, ICT and e-learning.

The rest of the paper is organized as follows. A short review of learning computer programming is considered in Section 1. This is followed by an overall description of the various trainings and teacher initiatives in Section 2. Section 3 demonstrates the the authors' experience in organizing and conducting training with primary school teachers.

1. REVIEW OF COMPUTER PROGRAMMING STUDIED AT SCHOOL

ICT is one of the areas with the greatest potential for future development of young people and their professional careers. Basic digital skills are needed not only in the IT sector but also in almost 90% of the professions in the modern world. Educators, parents, economists and politicians in Europe and around the world have long been convinced of the need to raise the level of digital competences among pupils from a very early age. Undoubtedly, skills related to computer programming, abstract and algorithmic thinking help to solve more of the problems in the modern information society (Tzanev, 2010).

One of the main challenges to education in Bulgaria is the continuing need for raising the qualification of educators (Kirova & al., 2012). Some of the issues related to promoting teaching and learning computer programming are:

- How to integrate computer programming in the curriculum into classroom and out-of-class work, given the case studies of the new Preschool and School Education Act?
- How to use computer programming for cross-discipline connections?
- How to connect computer programming with other ICT skills?
- How to train future and current teachers in ICT and eLearning?

The development of digital competencies is a top priority in almost all education systems. The importance of computer programming in European countries in relation to other ICT skills priorities is also reflected in the development of: consumer ICT skills; skills to develop key competences or as a learning tool. This is the reason why European countries should monitor the development of the following competencies and priorities:

1. Developing digital competence (including media literacy);
2. Developing the application of ICT as a learning tool;
3. Developing skills for using ICT;

4. Use of ICT to develop key competences;

5. Develop computer skills for computer programming, including coding.

Table 1 shows the importance of computer programming in terms of different priorities across European countries.

Table 1

Importance of computer programming for different priorities

Main priorities	**Development of digital competence (including media literacy)**	**Developing the application of ICT as a learning tool**	**Developing skills for using ICT**	**Using ICT to develop key competencies**	**Developing computer skills for computer programming**
Countries	BE (Fl), BG, CY, DK, IE, LT, NL, NO, EE, ES, Fl, FR, LU, PL, TR, UK	BE (Fl), CZ, CY, DK, EE, EL, ES, FR, IE, IT, LU,NL, NO, PL, PT, TR	BG, CZ, CY, DK, EE, EL, ES, Fl, FR, IT, LT, LU, NO, PL, TR, UK	CZ, CY, EE, ES, IE, FR, IT, LT, LU, NO, PL, PT, TR	BG,CY, EE, EL, FR, IT, LT, Fl, , IE, IT, TR, UK (England)

Source: Own work based on Computer programming and coding Priorities, school curricula and initiatives across Europe, http://www.eun.org/bg/resources/detail?publicationID=661

The data show that most countries have adopted several priorities for the development of ICT competencies. The development of pupils' digital competence is a priority in almost all countries. The use of ICT as a learning tool is one of the main priorities for most countries. Developing skills to use ICT to develop key competences also plays an important role. Computer programming and coding skills are mentioned as a top priority for only ten countries. Although this is relatively small, it illustrates the approach to integrating computer programming into the curriculum in addition to other ICT skills. Countries such as Belgium (the Province of Flanders), the Czech Republic, Ireland, Malta and Poland define computational thinking as a basic skill acquired through integrating computer programming into the curriculum.

In the conducted studies it was found that one of the reasons for slowing down the introduction of computer programming in schools is that in very few countries it is studied as a compulsory and separate subject. Quite a few students choose to study programming through facultative forms of learning. One of the reasons for this is the complete lack of classes for learning this subject in the early years of student education. In addition, some students have a misconception about what the subject "Computer Programming" is, as they have the impression that computer work in this subject is the same as in the field of ICT. Another finding is related to discovering the fundamental difference between what teachers can teach and what they are supposed to know.

The following Table 2 examines the levels of education in which computer programming is studied as a compulsory or optional subject in different EU countries, and at what levels of education this training is being implemented. Countries marked in blue are still planning to integrate computer programming. In states marked in yellow, computer programming is an optional subject for the indicated levels. In countries marked in red, computer programming is a compulsory part of the curriculum.

Table 2

Levels of education in which computer programming is studied

Country / Level of education	AUSTRIA	Belgium (NL)	BULGARIA	CZECH REPUBLIC	DENMARK	ESTONIA	FINLAND	FRANCE	HUNGARY	IRELAND	ISRAEL	LITHUANIA	MALTA	POLAND	PORTUGAL	SLOVAKIA	SPAIN	UK (England)	
Primary level		yellow	red			yellow	red	yellow			yellow					red	yellow	yellow	red
Lower secondary (general) level	yellow	yellow	yellow		red	yellow	red	red		yellow	yellow	yellow		yellow	red	red	yellow	yellow	red
Lower secondary (vocational) level		yellow	yellow			yellow					yellow					red			
Upper secondary school (general) level	yellow		red		yellow	yellow			red		yellow	yellow	yellow	yellow		red	yellow	yellow	red
Upper secondary school (vocational) level	yellow		red	red	yellow	yellow			red		yellow			yellow	red	red			

Source: Own work based on Computer programming and coding Priorities, school curricula and initiatives across Europe, http://www.eun.org/bg/resources/detail?publicationID=661

Computer programming is integrated in most European countries at lower and upper secondary level. Estonia, Israel and Slovakia integrate computer programming at all levels of education, and in Slovakia it is a compulsory element of the curriculum in all stages of school education, i.e. all students learn it in the course of their entire education. Poland also has integrated it at all school levels since 2016.

In seven countries (Bulgaria, the Czech Republic, Denmark, Portugal, Slovakia, Spain, UK (England), computer programming is mandatory for specific levels of education and is part of the general computer training course. In ten countries - Estonia, France, Israel, Spain, Slovakia, the United Kingdom (UK), Belgium, Finland, Poland and Portugal integrate computer programming from primary level of education, while in the United Kingdom (UK), Bulgaria and Slovakia it is a compulsory subject in the primary education.

All this brings up the current task of teacher training and motivation of students for studying computer programming since primary school. The first step towards this is the organization of formal and informal initiatives and trainings for teachers.

2. TRAINING COURSES AND INITIATIVES FOR TEACHERS

If computer programming is integrated into the curriculum in order to ensure that students acquire the necessary skills, this training must be complemented by training and initiatives related to methodological support for teachers in this field. Teaching a programming language can be a challenging task, especially for teachers who do not teach ICT or computer science, as well as for teachers who have not had prior training in this area. Training can best be described as a mix of centralized support coupled with additional stakeholder-oriented initiatives. In some countries, teacher training is officially provided as part of training at the workplace or as part of adapting newly recruited teachers to their upcoming duties. In most cases, however, training predominantly is provided by professional stakeholders.

2.1. The experience of the EU countries

In thirteen EU countries (Austria, Bulgaria, France, Estonia, Hungary, Ireland, Israel, Malta, Poland, Portugal, Slovakia, Spain, England), which integrate computer programming into the curriculum, a preliminary training course is applied to support teachers in teaching computer programming at different levels. Training courses Ministry of Education. In the Czech Republic, France, Finland, Hungary, Lithuania and Poland, the Ministry of Education does not provide direct training opportunities. Instead, a variety of other institutions offer such training. In many countries such as Belgium, Bulgaria, the Czech Republic, Estonia, Finland, Ireland, Israel and Lithuania, training courses are held by universities, but also by companies and non-profit organizations. In France, Finland and Poland this training is organized at a local or regional level. In the UK, Estonia and Ireland, centralized support is offered through funding of learning resources and training projects to assist teachers in implementing curricula. Portugal supports initiatives and competitions at central level. Slovakia, Hungary, Malta, Spain provide ICT training in the workplace, which includes training of teachers from all over the country in computer programming. Spain plans training in computer programming for teachers both at national level and in the autonomous regions where it is integrated. In Malta, all teachers have been trained for two weeks at their workplace. In Slovakia, the Ministry of Education assists in providing training centres in the workplace in schools and universities.

Teacher training is considered to be particularly important in countries and regions where new curricula or new disciplines are to be introduced. In these cases, it is necessary to train a large number of teachers for a relatively short period of time. Therefore, teacher training is mainly organized by universities integrating computer programming into their curricula. There are also many other initiatives and training courses for computer programming teachers through the networks of amateur programmers, non-governmental organizations, private companies, teachers' organizations, and professional associations.

Examples of popular initiatives to increase the activity and motivation of both teachers and students include computer programming clubs and the organization of summer schools and courses. Competitions are a means of attracting talented students who are interested in computer programming and prizes for outstanding achievements - for example, in Bulgaria, the Czech Republic, Estonia, Finland, France, Hungary and Poland. Many countries support computer programming teachers by providing educational resources at various national or regional portals (for example, Ireland, Belgium, Flanders, Estonia, the Netherlands). Other countries encourage teachers through specific computer programming sites and public platforms (such as Bulgaria, France, Norway, and Poland). Several countries also support pan-European initiatives such as Code Week (for example the Czech Republic, Poland, Bulgaria, Portugal and Spain).

2.2. Initiatives and training for teachers in Bulgaria

Popular initiatives in Bulgaria are clubs for computer programming and robotics, the organization of summer schools, often conducted by authoritative training organizations or scientific institutions. Over the last few years, over 100 school robotics clubs have been created with support from SAP for students in all age groups. There were free online training courses for the teachers who organized the activities in these clubs. All these initiatives motivate primary school teachers and teachers in different learning disciplines to look for a variety of computer programming training opportunities.

Historically, in Bulgaria, until 2016-2017, computer programming was studied as a compulsory subject in the 9th grade within 2 hours a week. The new Pre-school and School Education Act stipulates that from the 2017/2018 school year this school subject is to be taught to students in the 8th grade (2 hours a week or 72 hours per year) who are trained in profiled education with intensive study of a foreign language with profiles "Mathematics", "Software and Hardware Sciences", "Economic Development" or "Natural Sciences". From the new 2018/2019 school year the subject "Computer Modelling" is introduced in 3rd and 4th grade as compulsory school hours.

The introduction of new curricula and curricular changes require a continuous increase in the level of knowledge and skills of all teachers, but this process is critical, especially for primary teachers who have not yet studied ICT, computer modelling and programming. This and the fact that a large percentage of these teachers do not feel comfortable working with digital devices, determines the need to look for a variety of ways, methods and approaches to stimulate and motivate primary teachers to learn.

3. OUR EXPERIENCE IN TRAINING TEACHERS

Surveys of the world and European experience in organizing computer programming training at all levels of school education, as well as the accumulated over the years Bulgarian experience (Glushkova, 2016) give us grounds to seek opportunities to stimulate the teacher's interest in this scientific field. A few years ago in Plovdiv region, together with the regional education administration, we set up a methodological ICT council, which included leading teachers, university lecturers and experts. We have identified several stages in which teachers will consistently learn about different aspects of computer modelling and programming:

- First Stage - Learning to Use Interactive Methods, Cloud Technologies and E-Learning Environments (2014/2015)
- Second Stage - Training of Primary and Lower Secondary Teachers in Block-Based Programming (2015/2017)
- Third stage - training of primary teachers to teach the new subject "Computer Modelling" in third grade.

During the first period, we held several training seminars that examined the capabilities of ICT and cloud technologies for organizing interactive learning. In particular, the opportunities for applying e-Learning in the classroom and in the independent learning of students were discussed. A review and classification were made of the existing learning environments (Glushkova, 2014) and the different levels of interactivity that are being reached with them (Rachnev, Rahneva & Valchanov, 2007). More attention has been paid to Moodle-based learning platforms. The main types of learning resources and services in this platform were outlined. The participants were given the task of developing one lesson from a general course. After their final completion and testing the electronic educational resources were published in the MOODLE platform of one of the leading schools, the Hristo Smirnenski Secondary School in Brezovo, for use by all participants (Glushkova & Neykova, 2013). Also, in greater detail was studied the creation of different types of tests in the MOODLE platform. Each participant had the opportunity to test the various test development options. Each training seminar ended with a feedback survey, the purpose of which is to trace whether there is an increased interest in using computer technology and whether teachers are more confident in its application in the classroom. To our satisfaction, all participants have responded that the structure and organization of the seminar is good, the goals are clear, the lessons learned would serve them in their work. 89% of the participants welcomed the style of presentation and encouragement, and the same percentage have responded that the training was varied and informative and its goals were met.

The assessment of the effectiveness of the training was done using the following methods:

- A test developed and conducted in an e-learning environment.
- Practical task – Development of an electronic lesson that includes a variety of resources (teaching material, homework assignments, tests, online consultations, forums, learning games, etc.)

A quantitative and qualitative assessment was carried out by the experts and seminar presenters. The average test score of the participants is 87%. It was found that in the 2015/2016 school year, over 90% of the participants had repeatedly applied the obtained knowledge in their work with students. This gave us confidence to continue our work in this direction by planning and organizing the training in the next stage.

In the second period, we set ourselves the goal to introduce teachers to the potential of block-based programming environments. We decided to organize and conduct a three-year experiment with training of students from different cities, schools and age groups in computer programming in interest clubs. We analysed the peculiarities in the development of logical and algorithmic thinking in early stage students as well as the experience gained by computer programming and computer science education in Europe. The goal we have set is to stimulate the development of students' logical and algorithmic thinking and to increase student activity by studying block-based languages and computer programming environments. To achieve this goal:

- we organized teacher training on block-based programming;
- we set up a school curriculum for training students (Tabakova-Komsalova & Glushkova, 2016);
- we have periodically conducted support training on an online platform;
- we created sets of sample learning tasks in each of the curriculum topics;
- we traced, analysed and summarized the learning results of the students. (Tabakova-Komsalova & Glushkova, 2017).

It is difficult to learn a new language for computer programming and at the same time to learn a new way of thinking and solving problems. This hampers teachers and they fear mistakes. All participants were briefly acquainted with the most popular 2D and 3D environments for block computer programming such as: Scratch, Blockly, Snap!, Stencyl, MIT App Inventor, Alice, Kodu, etc.

(Tabakova-Komsalova & Glushkova, 2016). Since teachers were already familiar with work in the Moodle e-learning environment, training was conducted in mixed form of attendance courses and online training. Throughout the experiment, periodic online discussions, seminars, meetings and discussions took place.

As a result of the training, teachers became more confident and found that programming can be fun and entertaining. Motivated by this, they wished to apply the acquired knowledge and skills in their work with students. For the three-year period considered, programming clubs were formed that included pupils from all primary school classes. In order to get statistically correct results, we took a sample of students from different types of locations, different types of schools and different grades of primary school from Plovdiv District. These students were monitored and tested. The analysis of the results fully confirmed the expectations. The average result of the students is 4.92 or 79.8%. The interest in programming is very high, and the use of interesting interactive approaches and the opportunity to program robotic devices further enhanced student activity and the efficiency of the learning process.

The accumulated knowledge and experience of teachers during the second training period increased their confidence and motivated them to seek additional opportunities for self-improvement and realization. Some of the teachers created robotics clubs, others sought to be distinguished with their pupils at various competitions and contests. Thus, it was easier to accept the fact that, according to the new changes in education, they should teach computer programming as a compulsory subject.

The first and second stage training was not mandatory for all teachers. In the third stage, however, all primary teachers had to be trained. The Ministry of Education and Science of Bulgaria together with various training organizations and universities carry out free qualification advancement courses for primary teachers who will teach the new subject "Computer Modelling" in the 3rd grade of the 2018/2019 school year. The experience gained during the previous two stages has enabled us to organize and conduct successful training with a practical focus. The training program contains the following topics:

1. Block programming
2. Digital identity and digital identity management
3. Constructing sequential actions
4. Constructing cyclical actions
5. Visual programming environment
6. Working with text and sound
7. World of animation

Kits of learning tasks were developed, classified according to the curriculum topics (Garov, 2017). The training is practically oriented, and at the end of the course, each teacher receives a theme for developing a project in the field of Animation and/or Computer Games. Throughout the learning process, teachers can use online resources provided in the Moodle-based e-learning platform specifically created. The best practical projects were shared in the platform. Thus, after several training courses, teachers themselves created a rich collection of sample projects that they could use in their future work.

CONCLUSION

Worldwide, computer programming is becoming more and more relevant in school education. Bulgaria is one of the first countries to introduce programming in 1986 (Rahnev, 1987). Currently in our country, tendencies in computer science education, typical of the developed European countries, are maintained. The introduction of computer modelling and programming as a compulsory subject in the primary level of education from the school year 2018/2019 is forthcoming.

Training primary school teachers is an important and current task, given the introduction of new technologies from the very beginning of school education. Lifelong learning and the use of electronic and distance learning environments enable better and more effective teacher training and faster and more sustainable learning outcomes for students of the digital generation.

Acknowledgements

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THE ROLE OF THE TEACHER IN DISTANCE EDUCATION

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Abstract: *Distance learning through information and communication technologies is becoming increasingly popular. It enables long-distance education, expanding education and staff qualifications. Distance learning helps with frequent changes in requirements for new skills and competencies of workers. Experience shows that the outcomes of distance students are often worse than those of full-time students, especially at the beginning of studies. This article shows a comparison of results achieved by distance learning students and those attending traditional classes. The article describes the importance of the teacher and his influence on the quality of distance learning. A questionnaire survey was conducted among teachers. The results show the teachers' attitude to distance learning.*

Keywords: distance education, e-learning, Learning Management System, tutor, teacher.

INTRODUCTION

Distance and blended forms of teaching are increasingly required. This is due to the need to frequently increase and supplement staff qualifications. Employees usually have to improve their requirements and change their focus more than they did in the past (Bozkurt & Akgun-Ozbek, 2015) (Cavanaugh & Gillan, 2004) (Markova & Glazkova, 2017) (Roszak & Kołodziejczak, 2017). Experience with distance learning at the University of Ostrava shows that long-distance education is very complicated for a large part of its students and many students are not completing courses. The Department of Informatics and Computers has been using distance learning for 20 years. Distance education creates more significant demands on students than studying full-time. It is reflected in the results of the students. Differences can be observed between the distance learning group and the full-time group of students. The most significant differences are reported in the first semester. The success rate of full-time students is 64% in the first semester. The success of distance learners is only 39% in the first semester. It shows that it is not enough to create quality teaching materials. It is also to create the conditions for the proper management of distance teaching. The role of teachers is also essential for distance learning. This is also important for reasons that students typically do not have practical experience with distance form of study (Kołodziejczak, 2017) (Porter & Graham, 2016) (Ozturk & Eyikara, 2016).

1. COMPARING THE SUCCESS OF DISTANCE AND FULL-TIME STUDENTS

There is a regular comparison of distance students and full-time students at the University of Ostrava. A large number of distance students do not complete the courses. Many students postpone their assignments and do not even start studying. The most significant differences between distance and attendance students are in the first semesters of bachelor studies. Differences are not significant in the following bachelor and master study years (Hannay & Newvine, 2005) (Levy, 2007).

The results of both groups (distance and full-time students) were compared using the T-test: Two-Sample Assuming Equal Variances. Two sample t-test is used to compare a difference between two populations. This parametric test assumes that the variances are the same in both groups. This assumption was tested by the F-Test Two-Sample for Variances. The data variability was measured in each item and the variation coefficient was used. A t-test was performed to interpret the results of the second-degree classification. The results were processed using MS Excel and statistical software Wizard for the operating system Mac OS X and statistical software Statistics Visualizer for iPad (Chráska, 2007) (Řehák & Brom, 2015).

The following hypotheses were determined:

Zero hypothesis: The study results of the two groups studied will not differ.

Alternative hypothesis: The study results of the two groups studied will differ.

2. RESULTS

The graph in Figure 1 shows the average of successful students in some selected bachelor's degree courses in computer science. All enrolled students were included in the survey. The following results are from 2017. Each course lasts for one semester, which is 13 weeks of teaching and a subsequent examination period. Full-time students had an average of 76% success rate. Distance students had an average of 54% success rate. Successful students earned at least 51 points out of 100 and they completed the course. The curriculum of all courses was the same for both distance and full-time students. List of courses in the first semester: APZOS -

Architecture of hardware and Fundamentals of operating systems (number of full-time students = 63 / number of distance students = 57), ALDS1 – Basic of Programming (56/66). Second semester: OPSY1 – Operating Systems (43/29), ALDS2 - Algorithms and Data Structures (30/15). Third semester: PRGCC – Programming in C/C++ (28/12), UVDAT - Introduction to Databases (38/19), LZUI1 - Logic for informatics (38/17), GALPR - The Principles and the Algorithms in the Computer Graphics (32/10). Fifth semester: OOPR3 - Programming server applications (30/8), SOFCO - Basics of softcomputing (32/10), ZMATS - Basics of Mathematical Statistics (28/12). Sixth semester: KKDAT - Data coding and compression (35/14).

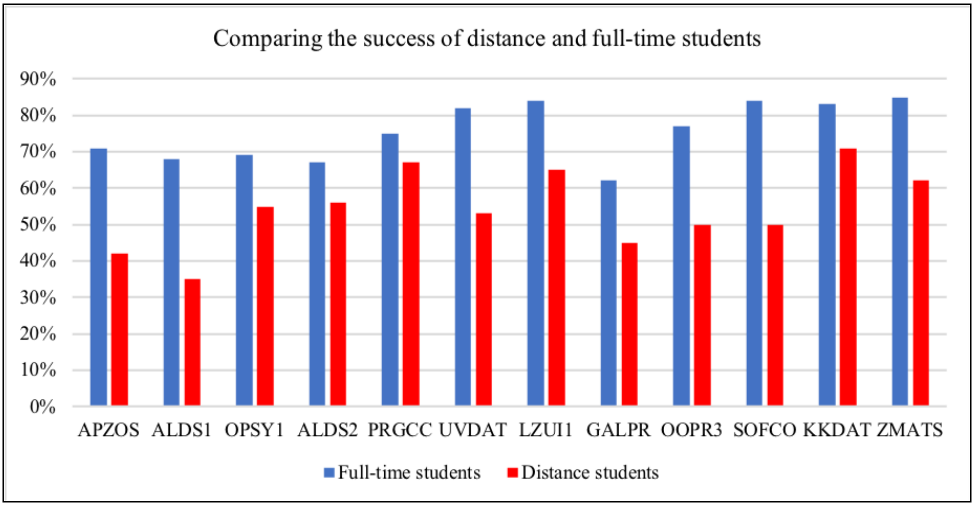

Figure 1. Comparing success in the courses

Source: Own work

The chart in Figure 2 shows the average earnings of all students who enrolled in these subjects. The graph and results of t-tests confirm the worse results of distance students. The maximum number of points for the course is 100 points. The student must obtain at least 51 points to he successfully graduated from the course. A large part of the spacer of the students does not get any point. A significant portion of students receives zero points because it does not study and homework. Students who do not do homework do not usually get to the exam. These students typically do not finish a course or study. A T-test was performed for each of the courses. Table 1 shows an example of one of the tests for the course Architecture of hardware and Fundamentals of operating systems.

Table 1.

T-Test: Two-Sample Assuming Equal Variances for course Architecture of hardware and Fundamentals of operating systems

t-Test: Two-Sample Assuming Equal Variances	Distance students	Full-time students
Mean	39,05	54,95
Variance	1643,70	1020,12
Observations (number of students)	76	94
P(T<=t) one-tail	0,00239	
t Critical one-tail	1,65397	
P(T<=t) two-tail	0,00478	
t Critical two-tail	1,97419	

Source: Own work

The results show that we must reject the null hypothesis. Distance learning students had worse results than full-time students.

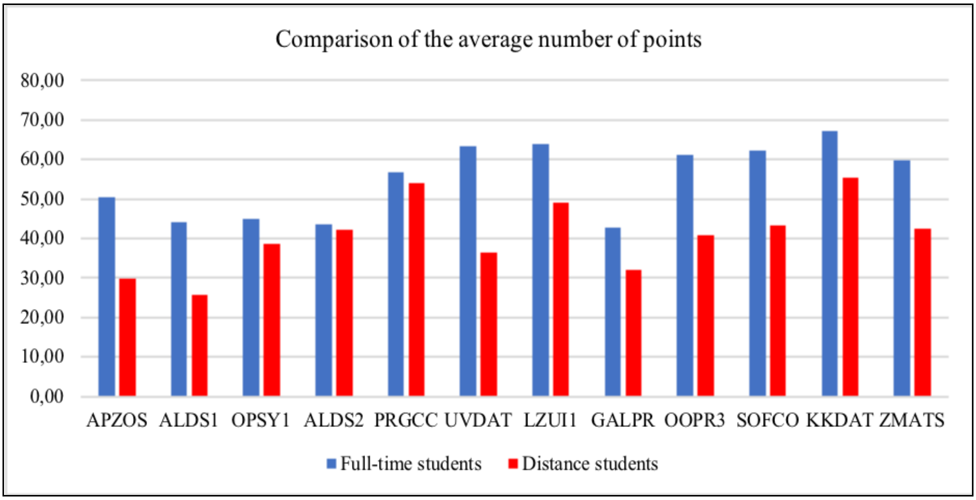

Figure 2. Comparison of the average of points (all students)

Source: Own work

Another comparison shows the results of students who have completed the courses. Figure 3 shows that the results of both groups are very similar. Distance learning students gained more points in some courses.

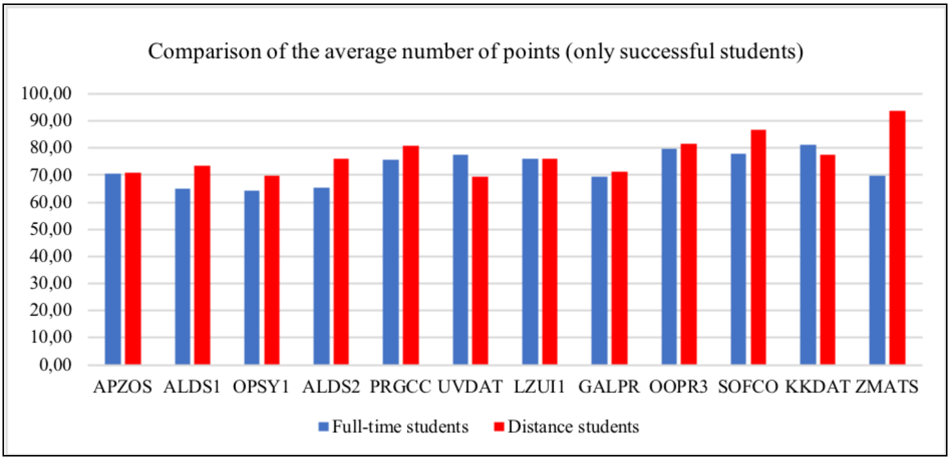

Figure 3. Comparison of the average number of points (only successful students)

Source: Own work

The results show that distance students can have more points than full-time students. A large proportion of distance students have problems with the organisation of their studies. That is why there are so many unsuccessful distance students, especially at the beginning of the bachelor study. It turns out that the teacher has a vital role in distance learning. Students typically do not have practical experience with distance learning, and therefore, it is essential that the teacher helped them (McPhee & Marks, 2012).

3. SURVEY AMONG TEACHERS OF DISTANCE LEARNING

A brief survey among teachers was conducted at the department. Twelve teachers from participated in a questionnaire survey and personal interviews on distance education. Respondents have taught in the distance education mode for an average of eleven years. Teachers must have other didactic knowledge and, in particular, skills in distance learning. Some teachers have an occasional problem with this new form. They also lack experience with this form of education.

The questionnaire looked at the attitudes and opinions of teachers on distance learning. 83% of them said they had a positive attitude toward distance learning. Many have stated that distance students are often more motivated than full-time students. Only 17% of the respondents had a neutral attitude toward distance learning. None of the respondents had a negative attitude.

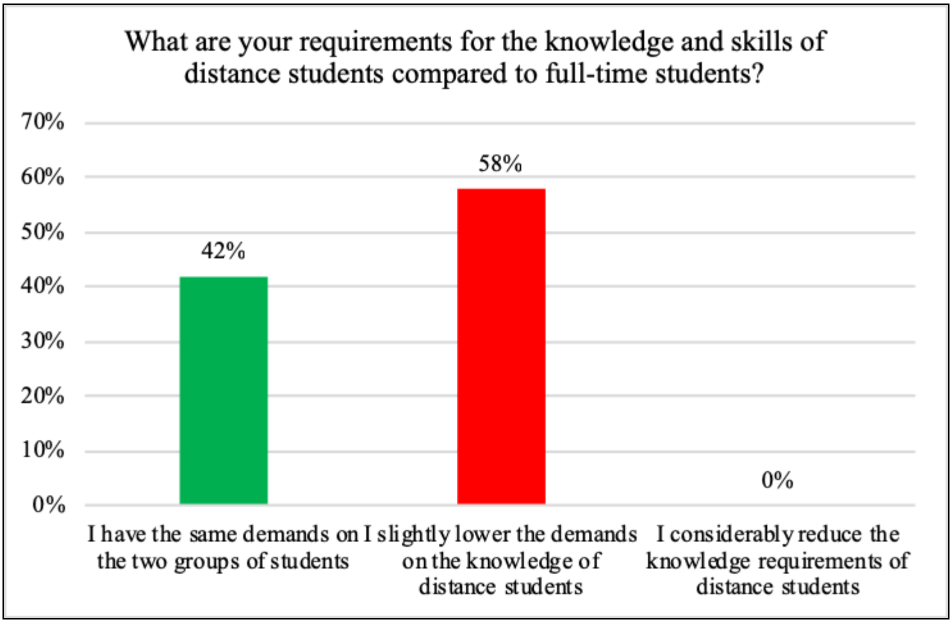

Figure 4. Teacher requirements

Source: Own work

Requirements for both distance and full-time students must be the same. However, the survey results suggest that some teachers have less demand for distance students. Figure 4 shows how respondents approach to their requirements for students.

The components of distance learning are tutorials. These usually take place on Saturdays and 2 to 3 times per course during the semester. The tutoring usually takes 2 to 4 hours. Tutorials have an essential role in teaching management and are often the only attended classes in the course. Part of the distance learning courses. It is usually held on a Saturday. Courses play a vital role in teaching and are often the only way that full-time teaching in the course. Students and some teachers often think that the tutorials are to be used for presentation of the curriculum.

Figure 5 shows what kind of tutorials teachers use. The most significant part presents and explains some of the topics in the course. The results of the interviews with the teachers show that this fact is caused by a smaller experience of teachers with distance learning. Some students have little practice in the curriculum, so they have no questions. The teacher must teach students to study the subject in front of the tutorial. Tutorials should serve mainly as a collective consultation.

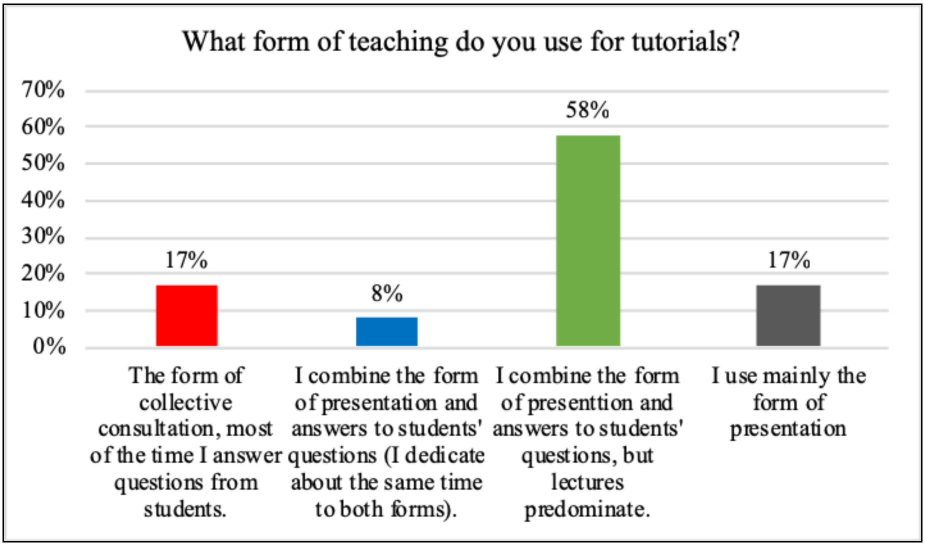

Figure 5. Forms of tutorials

Source: Own work

Communication between the participants of the course learning management is essential (Klimová Frydrychová, 2015) (Paechter & Maier, 2014). The electronic conference appears as one of the most appropriate instruments for communication among distance students and teachers. The conference is supposed to replace the discussion in the traditional classroom. If students send their questions by means of-emails, these questions and answers cannot be seen by other students. All distance students in the electronic conference see all the questions and the answers and can respond to them. Experience shows that it is advisable to support student engagement at the Moodle conference. For example, the awarding of points for activity in the conference. The results of the survey show that teachers use the Moodle conference less than is appropriate (Figure 6). Experience with distance course management shows that it is essential to motivate students to work actively on a continuous basis. Students who work continuously during the semester usually have better results. Continuous activity can be assured, for example, by assisting with regular tasks that students have to develop. For example, once every 2-3 weeks. A long timespan between correspondence tasks proved inappropriate.

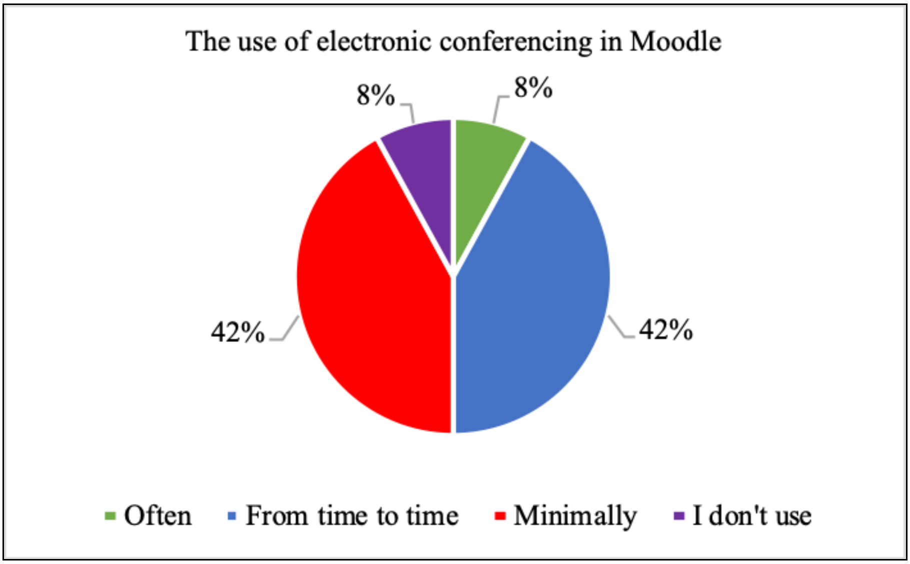

Figure 6. The use of electronic conferencing in Moodle

Source: Own work

All teachers communicate by email. Almost all of the teachers also used full-time consulting. However, this form of communication is often complicated to use due to the workload of distant students or considerable distance.

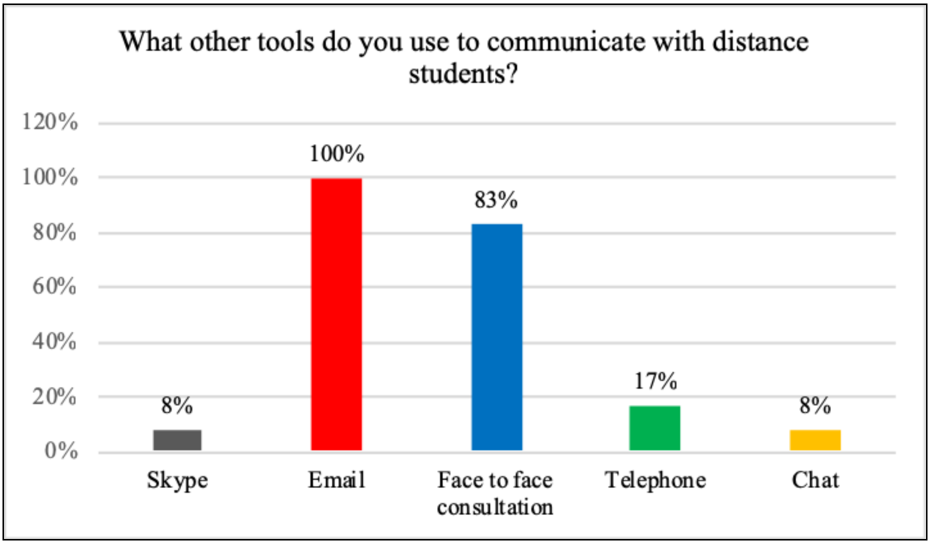

Figure 7. Other communication tools among teachers and students

Source: Own work

The respondents consider it essential to have high-quality teaching materials for distance learning. Not only texts, but also tests, multimedia materials, video lectures, and so on (Leszczyński 2018). Students need feedback. For example, results of tests and most importantly homework. Respondents answered the question of how much homework they assign. Teachers usually create four assignments as homework in one course per semester. Some teachers, however, assign only one task or vice versa to ten tasks. Setting the right amount of homework is very difficult. A small number of tasks do not activate students often enough, and students do not usually study continuously. On the contrary, a large number of tasks can be demotivating for students and can discourage them.

CONCLUSION

The results of the comparison of success rates demonstrate that distance students have on average worse results than full-time students, especially at the beginning of the bachelor study. Among them was a large group of students who could not properly organise and plan a course study. They often postpone the tasks, and then they do not get to the test, and they finish their studies.

Experience shows that it is not enough to have only good teaching material. Distance students need leadership courses. Students usually have little practical experience with distance learning. Therefore, it is necessary that the teacher helped students organise their university courses of study. The survey showed that even teachers, who teach for a relatively extended period, do not use the right method. For example, teachers make little use of electronic conferences that can, to a certain extent, replace student discussions in traditional teaching. Teachers prefer e-mail communication. Other students cannot participate in this communication. The electronic conference is beneficial for communicating with distance students. Teachers also do not use tutorials as a consultation but as a presentation of topics, which is not very appropriate due to the limited timescale. For quality distance learning, it is necessary to train teachers in the distance learning methodology. Most teachers usually have practical experience only with traditional teaching.

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METHODOLOGY OF RESEARCH INTO THE DYNAMIC FORMATION OF PROFESSIONALLY IMPORTANT COGNITIVE AND PERSONAL QUALITIES OF IT SPECIALTIES STUDENTS

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Abstract: *The article is devoted to the description of certain methods which identify the dynamic formation of the structure of intelligence and the identity of the IT training profile students. The study uses a technique that includes the colour-associative test of M. Luscher, the definition of the Myers-Briggs typology, and a modified intelligence structure test for R. Amthauer. The verification of the effectiveness of the methodology was carried out by testing students of the Faculty of Information Technologies of the Borys Grinchenko Kyiv University, the results of which are demonstrated on the basis of the obtained data. The proposed methodology allowed to reveal the peculiarities of the impact of studying at the university on the professionally important qualities of future IT industry professionals.*

Keywords: intelligence structure, IT specialists, cognitive qualities, research methodology, verbal and nonverbal intelligence.

INTRODUCTION

Changing the priorities and requirements for the quality of education and training of future workers as a result of the "movement" of the labour market into the intellectual sphere of human activity that requires new approaches to education, where not only formal but also informal and informational education can raise basic human competencies (Morze, Spivak, 2014), first of all, the ability to use electronic teaching aids in a synthetic learning environment and social networks (Lytvynova, Burov, 2017) consider the problems of cybersecurity occurring before a person and immersed in the digital world (Burov, 2016).

The need for reforming education in the direction of individualizing the trajectory and personalizing learning tools has become a global challenge of time (Morze et al., 2014). Changing the priorities of mankind from the production of material and real objects of life to the production of new knowledge and metadata, to the creation of the Internet things is accompanied by the disappearance of many professions and the emergence of new ones, based on the use of information and communication technologies (ICTs). Experts estimate that the main professions that have the highest demand in the international market today (Sharonov, 2017), and the requirements for the competences of future professionals in leading professions, focus not on the skills of specific skills, but on the social and cognitive capabilities of workers, personal skills related to solving problems, critical thinking, creativity, ability to manage an international team (Education and Training 2020 Work program).

The popularity of professions based on the design and intensive use of ICTs has exceeded all other professions over time. However, practice indicates that the shortage of IT specialists will be felt for a long time not so much because of the lack of appropriate educational institutions, but due to the lack of consideration of human abilities for these professions, which manifests itself in a particular feature of the structure of intelligence and, more broadly, the structure of the personality of IT professionals.

The purpose of this article is to develop and test the effectiveness of the method of identifying the peculiarities of the dynamics of the formation of the structure of intelligence and the identity of students of the IT training profile.

1. PROFESSIONALLY IMPORTANT QUALITIES OF IT PROFESSIONALS

It should be noted that intellect is not a static structure but one that is dynamically changing (Ushakov, 2004) not only during school years (Chalikova, 2002; Burov et al., 2012), but also during studies at university (Bodryakov et al., 2009).

At the same time, it is generally acknowledged that the world market needs labour equipped with new competences (Education and Training), which are formed on the basis of all components of intelligence (Burov et al., 2012). Special meaning this trend is due to the increasing role of technology of the Third Platform, including Internet of Things (IoT), robots and drones, complemented and virtual reality (AR / VR), 3D printers (Computer Review, 2018). In particular, in 2017 the AR/VR start dynamically develop the technological market, cognitive systems and artificial intelligence, and robotics.

Accordingly, there is a growing need for highly skilled IT workers, requirements for their professional skills and standards for the required competences are developed.

However, there is practically no clear understanding of professionally important qualities of specialists in this field and their peculiarities. And if theoretical and experimental features of the structure of the intellect of mathematicians and its formation in the profile classes of high school (Burov, 2018) are investigated theoretically and experimentally, then, in relation to the intellectual and personality characteristics of the development of senior IT students, there is an obvious lack of psychological and pedagogical research. Despite numerous publications on the psychology of programming, the fundamental work can be considered a book B. Schneidermann, but a number of questions raised in her there is still no substantiated answer (Schneiderman, 1984), in particular regarding the problem, whether there is a purely professional feature of the intelligence (its structure) and personality programmers and what they can do (Rozhnikov, 2014).

Psychological research on this issue mostly relates to the 70-80s of the last century, when the nature and trends of the programmer's work differed from today’s. Attempts to identify the structural features of the intelligence of IT specialists are usually limited to studies of the psychology of experienced programmers and do not study the specific features of senior students who study in educational institutions (classes) of the IT profile whose personal and intellectual qualities are formed in a real digital environment, and not only under the influence of learning as such.

The generalization of information on professionally important intellectual and personal qualities of IT specialists allows one to distinguish the following: analytical abilities, logical and mathematical thinking, developed memory and imagination, patience, and propensity for intellectual activity (Doyle, 2018).

2. TECHNIQUE TO STUDY IT STUDENTS’ INTELLECT AND PERSONALITY CHANGES

2.1. Research technique

The research used a methodology (Burov et al., 2012) which includes the tests:

- *M. Luscher color and associative test* (method of dual elections); purpose of use - assessment of stress, balance of psychological qualities; recorded parameters: total deviation (CO), Shiposha coefficient (VC), stress level (C), working capacity (RP), heteronomy-autonomy (GA), concentricity-eccentricity (KE), balance of personality traits (BL), the balance of the vegetative system (BV);
- *Definition of Myers-Briggs Typology* (MBTI); the purpose of use - an assessment of the ability to certain activities and individual properties of communication; Traditional indexes of an individual typology estimation according to the Myers-Briggs methodology are recorded based on the evaluation of the prevailing signs on the 4 criterion scales: extraversion E - introversion I (orientation of consciousness), intuition N - sensory S (way of orientation in a situation), thought / judgment J - perception P (method of preparation of decisions), thinking T - experience F (decision-making);
- *Modified Intellectual Structure Test for R. Amthauer* (TCI); purpose of application - definition of the level of development and structural features of intelligence, as well as attention, memory; The following subtests are used (the brackets show the corresponding structural component of the intelligence): LS (testing of language, ability to formulate judgments), GE (conceptual intuitive thinking), AN (combinatorial abilities, mobility and ability to switch thinking), RA (ability to solve practical computational problems character), ZR (logical and mathematical thinking), FS (figurative synthesis), WU (spatial thinking), ME (memory, attention). The values of the structural components of intelligence were calculated as the sum of the correct answers for each subtest, the values of verbal (VI) and nonverbal (NI) intelligence - as sum of values, respectively, LS, GE, AN, ME and RA, ZR, FS, WU. The overall IQ score was calculated as the sum of values VI and NI with a correction factor of 1.462.

The resulting primary data was entered into a spreadsheet for further analysis. Test results were not personified, but were taken into account for each course separately.

2.2. Subjects

In order to verify the effectiveness of the methodology, 65 students of 1-6 courses at Borys Grinchenko Kyiv University (University of Grinchenko) were involved in the testing, of which 51 represented the Faculty of Information Technologies.

All of the students took part in the testing as an element of the learning process. It should be noted that the 5th course was presented by only 2 students, who, moreover, showed low motivation to perform tests (first of all, subtitles of intelligence from the 4th, mathematical calculations, on the 8th, test of memory and attention) In addition, the indicator of the vegetative balance of the WB in them pointed to the mobilization of all functions and readiness for active protection, escape from the procedure. Therefore, their results can be considered conditional.

2.3. Results and discussion

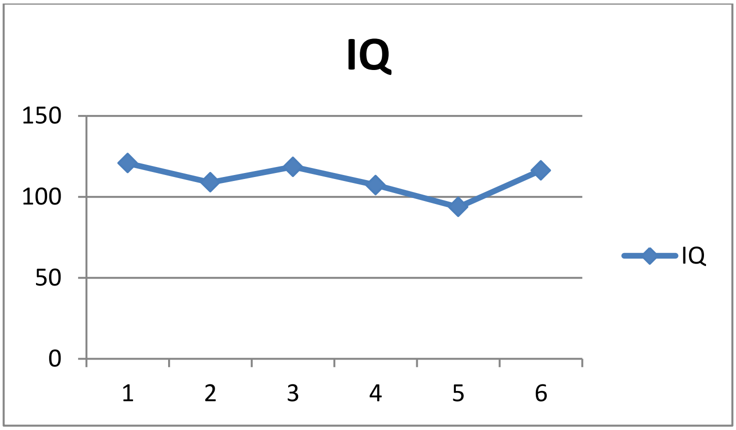


Figure. 1. Average value of general intelligence of students 1-6 courses
Source: Own work

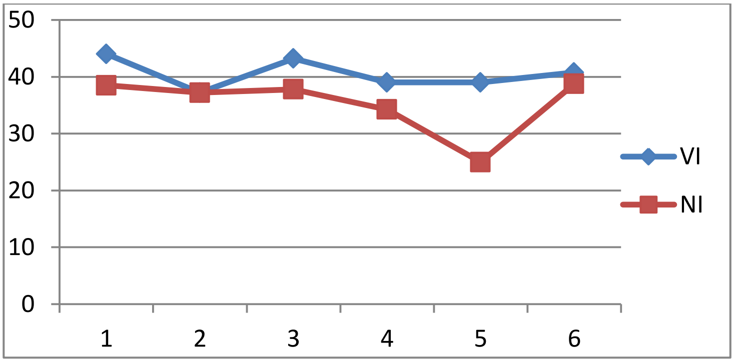


Figure 2. The mean value of the verbal (VI) and non-verbal (NI) intelligence of 1-6 year students. *Source: Own work*

Based on the data obtained, it is evident that the average level of students' intelligence is practically the same in all courses and is within the range of 110-120 points (Fig. 1). However, the comparison of verbal and nonverbal intelligence points to an unexpected tendency: in all the courses, nonverbal intelligence is lower than verbal (Fig. 2). For comparison: according to our preliminary data for assessing the level of intelligence of the 9th grade students of the profile IT lyceum, the average value of the IQ of the lyceum was 139, that is, it was significantly higher, and the nonverbal intelligence significantly differed from the average data in the schools of Ukraine towards the increase (approximately by 20%).

Higher indexes of verbal intelligence for students of all courses at the University of Grinchenko contrasted with the results of the students' survey of the IT-lyceum, but confirm the long-standing (1972) opinion of A.P. Ershov, who denied the priority of mathematical abilities in programmers. Experimentally, this idea was confirmed later (Orel, 2007), when it was shown that the work of programmers is dominated by verbal abilities, erudition and logical thinking, and also important thinking is imaginative. In our opinion, the contradictions between the results of students and students of the IT-lyceum can be explained by the current situation in Ukraine, when the motivation to study at an older school with a focus on mathematics is much lower than that of the IT specialty. Therefore, students with high mathematical abilities are oriented precisely to the IT training profile, where it will be easier to realize oneself in further work.

Comparison of the indicators of LS logical choice, RA mathematical thinking, ZR logical thinking, and figurative synthesis of FS confirms the above results, namely: higher level of development of logical thinking and figurative synthesis in comparison with mathematical thinking (Fig. 3).

Students' personal characteristics were analysed in accordance with the views of K. Jung and Myers-Briggs, namely on each of the binary criteria scales: the way of orientation in the situation NS, the way of preparing decisions JP, orientation of consciousness EI, decision-making TF (R3, respectively, a, b, c, d). The results are given in the points received by the students (on average on the course).

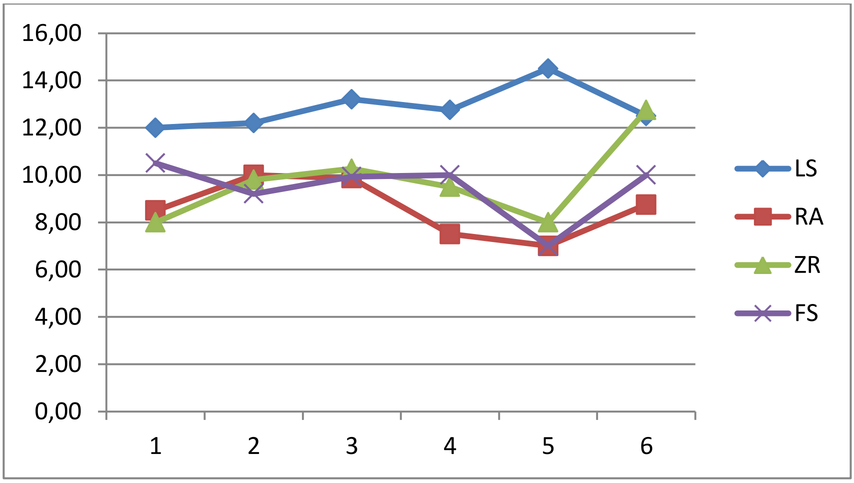
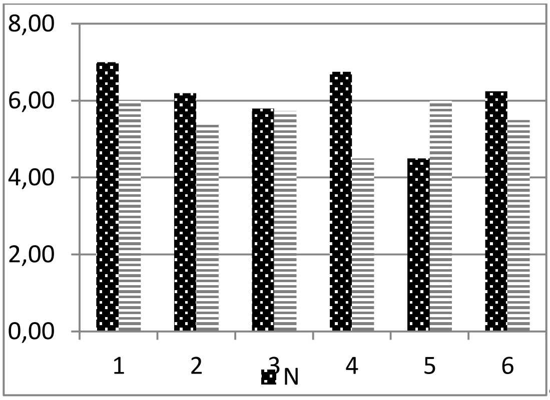


Figure 3. The level of development of individual components of the structure of intelligence. *Source: Own work*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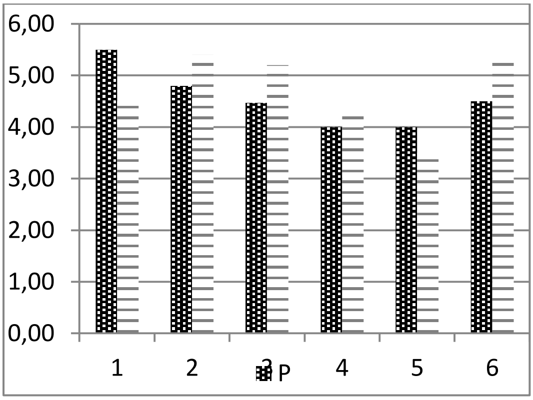
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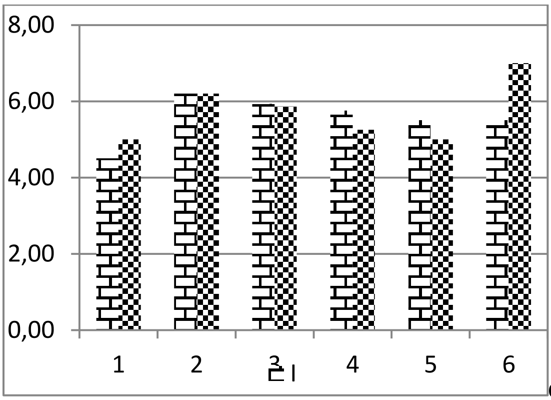
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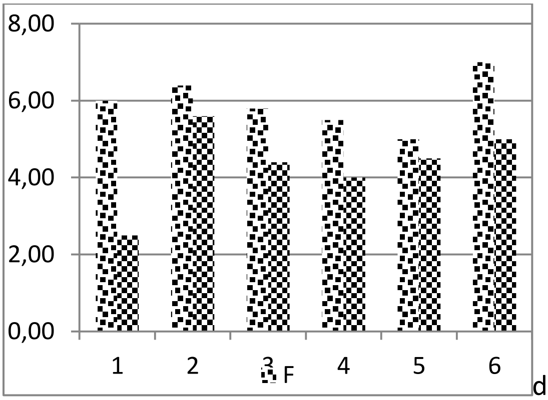

Figure 4. Manifestation of personality properties of students on criterion scales (designation see in the text) on the courses of study (abscissa axis)

Source: Own work

From the above data, it follows that the intuition of IT students is more typical than the sensor, which could be expected, taking into account the requirements of the future profession. The data of 5-course students somewhat "fall out" from the general trend, but the unreliability of their assessments we drew attention higher.

According to the criterial scale of the method of decision-making, judgment J dominates in comparison with perception P practically in all courses, except for the first one. This is logical, because the freshmen, as a rule, are young people who are just starting out of the teenage age, being guided more often by irrational criteria than rational ones.

The same reason can be explained by the predominant nature of extraversion E in freshmen. According to previous studies, in extracurricular subjects of the examined schools, extroversion is significantly dominated by introversion regardless of the school profile (Burov et al., 2012). The manifestation of the prevalence of extraversion in the 6th year students may be due to the peculiarities of the selection of masters who must not only have the necessary professional skills but also the ability to work in a team, to communicate with colleagues and users. With regard to students from the 2nd to the 4th year, the prevalence of introversion may be explained by the selection of training for individuals focused on a greater focus on the inner world and behaviour patterns.

The predominance of F's feeling of thinking T for students of all courses in the decision-making scale confirms the views of the part of psychologists who believe that for programmers, not only formal logical thinking is important, but also a sense of the image of verbal structures that are ICTs. However, this question requires a more in-depth study.

Analysis of the indicators of the balance of psychological qualities of students of IT direction (Table 1) allowed to trace the dynamics of changes in these qualities during the study at the university.

Table 1.

Students' psychological qualities balance

Course	**Г-А**	**К-Е**	**БЛ**	**ВБ**
1	1,95	0,65	1,35	2,45
2	-1,28	2,68	0,96	-0,86
3	-0,53	1,88	0,48	-0,03
4	-1,41	-0,46	0,61	0,79
5				
6	-0,30	1,75	-0,25	-0,93

Source: Own work

On the scale of heteronomy (0 ... 9.8) -autonomy (0 ... -9.8), according to which, according to M. Luscher, autonomy reflects self-determination, arbitrariness, independence, and heteronomy - complacency, compromise, obedience, avoidance, It should be noted that first-year students again differ from students of further courses in the tendency to heteronomy. However, this may be more a manifestation of the psychology of the first-year student in general than the professionally defined specifics. In the future, obviously, autonomy with a tendency to approach to "0", that is, a greater balance.

On the scale of concentricity-eccentricity K-E, students of all courses, except for the 4th, showed some tendency to concentricity, that is, orientation to their own needs and problems.

The personal balance of the BL indicates the apparent tendency of transition from an unstable and contradictory personality to the first year to a moderate balance of personal qualities during the studies at the university.

In our opinion, the scale of the vegetative balance of the WB reflects the effect of the student's impact on the student rather than professional development, since for students of the 1st and 4th courses are characterized by mobilization of all functions and preparation for active protection. At the same time, students in the

2nd, 3rd, and 6th courses have shown a tendency towards being oriented toward rest, recovery and resource conservation.

In general, it must be admitted that the dynamics and level of student balance sheet characteristics reflect not so much the professional formation of IT specialists, but how relevant is the dynamics of study at the university.

CONCLUSION

The proposed the method which identify the dynamic formation of the structure of intelligence and the identity of the IT training profile student allowed to reveal the peculiarities of the impact of studying at the university on the indicated professionally important qualities.

It has been established that the average level of students' intelligence is practically the same in all courses and is within the range of 110-120 points. Higher verbal intelligence rates for students of all courses at the University of Grinchenko are in contrast with the results of the survey of IT students, but confirm the results of other studies on the psychology of programmers, which have shown that programmers are dominated by verbal abilities and logical thinking, as well as imaginative thinking. In our study of the comparison of indicators of logical choice of LS, RA mathematical thinking, logical thinking ZR and figurative synthesis of FS confirmed students a higher level of development of logical thinking and figurative synthesis compared with mathematical thinking.

In our personality structure, our study found that intuition for IT students is more characteristic than a sensor; according to the scale of the decision-making method, judgments J prevail in comparison with perception P practically in all courses, except for the first; On the introversion-extraversion scale, the students of the first and the sixth years are dominated by extroverts, while in other courses - introverts; on the decision-making scale for students of all courses, the feeling of F prevails over the thinking of T.

The dynamics and level of students' balance sheet indicators reflect~~s~~ not so much the professional formation of IT specialists, but how relevant is the dynamics of study at the university.

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ANALYSIS OF DEVELOPMENT LEVEL OF THE CERTAIN DIGITAL COMPETENCES OF THE UKRAINIAN EDUCATORS

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Abstract: *The paper examines the analysis of development level of the digital competences of the Ukrainian educators according to the European Framework for the Digital Competence of Educators (DigCompEdu). For this purpose the authors have developed and conducted a survey of the target audience of Ukrainian educators composed of PhD students (in the field of Education), school teachers and University teachers. In accordance with the survey findings, the authors have analysed development level of the certain digital competences of the Ukrainian educators and proposed ways to improve this level.*

Keywords: Digital Competence, Educators, European Framework for the Digital Competence of Educators, DigCompEdu.

INTRODUCTION

Innovative and modernized education and training are key priorities of the Europe 2020 strategy (Joint Report of the Council and the Commission on the implementation of the strategic framework for the European cooperation in education and training (ET 2020), Official Journal C 417/25 of 15.12.2015). Progress towards full integration of digital technologies into Education and Training is still needed not only for many EU countries, but also for Ukraine.

In accordance with the EU Parliament indications on key competences for lifelong learning (Recommendation 2006/962/EC of the EU Parliament and of the Council of 18 December 2006, Official Journal L 394 of 30.12.2006), digital competence is one of 8 key competences that are fundamental for each individual in a knowledge-based society.

According to the EU Framework for the Digital Competence of Educators (JRC SCIENCE FOR POLICY REPORT, Luxembourg: Publications Office of the EU, 2017), Digital Competence can be broadly defined as confident, critical and creative use of ICTs to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society. Digital competence provides not only the ability to use digital technologies. It has also become increasingly necessary for the formation of creativity and critical thinking that is so meaningful in the 21st century.

This research presents our investigation of the European Framework for the Digital Competence of Educators (**DigCompEdu**) and development level of the certain Digital Competences of the Ukrainian educators according to **DigCompEdu**.

Research goal. This paper reviews the results of the recently completed study specifying development level of the certain Digital Competences according to the **DigCompEdu**. This attempts to address the following questions:

- analysis of the theoretical backgrounds of the research;
- analysis of the **DigCompEdu**;
- analysis of development level of the Digital Competences of the Ukrainian educators according to the survey conducted;
- consideration of the way to improve development level of the Digital Competences of the Ukrainian educators (from target group) and the future Computer Science teachers in the Dragomanov National Pedagogical University (future educators) according to **DigCompEdu**.

Research methods. The authors have used the following research methods and tools for the investigation (2017-2018):

- questionnaire;
- survey and interview of the Ukrainian educators;
- observation;
- documents and content analysis;
- meeting, conference, seminar, workshop, etc.;
- analysis of research papers.

159 Ukrainian educators have taken part in the present research. The Ukrainian educators from the target group (PhD students (in the field of Education), school teachers and University teachers from different Ukrainian regions) have been involved in this process.

The questionnaire was created during this project which purposed to gain data on development level of the Digital Competences of the Ukrainian educators according to **DigCompEdu**.

1. THE THEORETICAL BACKGROUNDS OF THE RESEARCH

In 2017 the authors have analysed the world trends of using of ICTs in education and scientific research. They include the following: (Learning and Skills for the Digital Era; Strutynska & Umryk, 2017):

- Student mobility and study abroad:
  - Institution-industry partnerships overseas are growing and diversifying;
  - International engagement is increasingly research-focused;
  - National governments increasingly seek to drive internationalization;
- Use of English as a medium of instruction;
- Increasing Use of Blended Learning;
- Increasing Use of Collaborative Learning Approaches;
- Rise of STEM, STEAM and STREAM Learning;
- Use of Open Educational Resources (OER);
- Use of Massive Open Online Courses (MOOCs).

The authors have conducted local prior-research on specifying awareness level of the Ukrainian educators regarding the abovementioned issues. The local survey was open for 6-month period between April 20, 2017 and July 20, 2017. It contained information about the modern ICT tools and trends in research, education and science (Strutynska & Umryk, 2017).

The findings of the local prior-research have shown that the level of knowledge and skills of the target group in regards to the use of the modern innovative learning technologies and ICT tools in research, education and science needs improvement (Strutynska & Umryk, 2017).

Analysis and comparing results of the similar research on the EU's scholars and educators (Kramer & Bosman, 2016) have shown that the EU community uses more innovative and traditional tools in their professional activities.

Similar research results in development of the different EU Frameworks for the Digital Competence: European Framework for the Digital Competence of Educators, Digital Competence Framework for Citizens, European Framework for Digitally-Competent Educational Organisations (https://ec.europa.eu/jrc/en/ digcompedu).

Furthermore, the teaching professions face rapidly changing demands, which require a new, broader and more sophisticated set of competences than before. The ubiquity of the digital devices and applications requires the educators to develop their digital competences (DigCompEdu, 2017).

The European Framework for the Digital Competence of Educators dated 2017 has been used in the research. **DigCompEdu** framework is just for educators at all levels of education, including general and vocational training, special needs education, and non-formal learning contexts.

According to the European Framework for the Digital Competence of Educators (DigCompEdu, 2017), the six **DigCompEdu** areas focus on different aspects of educators' professional activities:

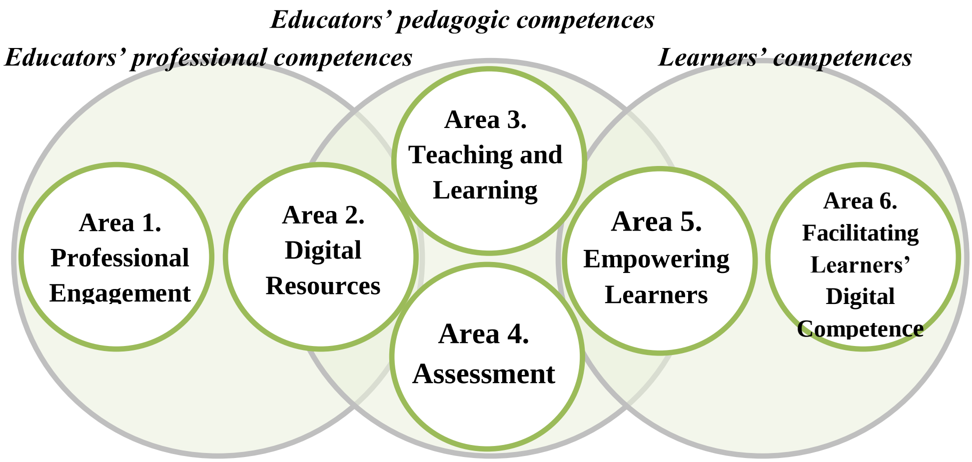

Figure 1. European Framework for the Digital Competence of Educators

Source: Own work based on DigCompEdu (2017, p. 15), https://publications.europa.eu/en/publication-detail/-/publication/fcc33b68-d581-11e7-a5b9-01aa75ed71a1/language-en (accessed on 15 August 2018)

Taking into account similar research (Kramer & Bosman, 2016; Strutynska & Umryk, 2016, 2017) and the **DigCompEdu**, authors have continued the research on specifying development level of certain Digital Competences of the Ukrainian educators.

The authors have analysed the findings of a new survey of the Ukrainian educators according to **DigCompEdu**.

2. ANALYSIS OF THE EUROPEAN FRAMEWORK FOR THE DIGITAL COMPETENCE OF EDUCATORS (DigCompEdu)

DigCompEdu includes three competence groups:

- *Educators' professional competences* (group 1);
- *Educators' pedagogic competences* (group 2);
- *Learners' competences* (group 3).

These 3 groups include six areas with focus on different aspects of the educators' professional activities (see in Fig. 1), (DigCompEdu, 2017).

Professional Engagement (area 1) consists of:

1.1. Organizational communication;

1.2. Professional collaboration;

1.3. Reflective practice;

1.4. Digital Continuous Professional Development.

Digital Resources (area 2) consist of:

2.1. Selecting digital resources;

2.2. Creating and modifying digital resources;

2.3. Managing, protecting and sharing digital resources.

Teaching and Learning (area 3) consist of:

3.1. Teaching;

3.2. Guidance;

3.3. Collaborative learning;

3.4. Self-regulated learning.

Assessment (area 4) consists of:

4.1. Assessment strategies;

4.2. Analysing evidence;

4.3. Feedback and planning.

Empowering Learners (area 5) consist of:

5.1. Accessibility and inclusion;

5.2. Differentiation and personalization;

5.3. Actively engaging learners.

Facilitating Learners' Digital Competence (area 6) consist of:

6.1. Information and media literacy;

6.2. Digital communication and collaboration;

6.3. Digital content creation;

6.4. Responsible use;

6.5. Digital problem solving.

For specifying development level of the certain digital competences of the Ukrainian educators, authors have conducted survey for certain areas according to **DigCompEdu**. It needs to be indicated that the survey has considered competences of the first two groups (group 1 and group 2), which is the part of the core of **DigCompEdu** framework. The last group 3 (*Learners' digital competence*) is captured by the European Digital Competence Framework for Citizens (DigCompEdu, 2017). Because of this, group 3 merits a dedicated area in the **DigCompEdu** framework. (DigCompEdu, 2017). Just due to this, group 3 will be considered in our further research. More details see below in Fig. 3.

The present research based on the target group who needs to improve their Digital Competences. This target group consisted of **159 Ukrainian educators**. As noted in **DigCompEdu** "... the **DigCompEdu** framework is directed towards educators at all levels of education, from early childhood to higher and adult education..." (DigCompEdu, 2017). The research target group consists of the Ukrainian educators: PhD students (in the field of Education), school teachers and University teachers.

The distribution of respondents by educational role is shown in Fig. 2. It is important to note that the largest group of respondents is belonging to Computer Sciences field (68,5% of the participants).

As we can see from Fig. 2 the largest group of respondents is school teachers (63% of the participants – 100 people). The number of University teachers is 55 people (35% of the participants). The smallest group of participants is PhD students in the field of Education (2% of the participants – 4 people).

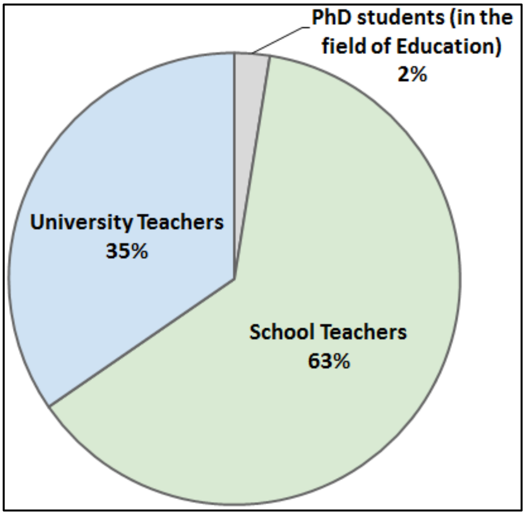

Figure 2. Distribution of respondents by educational role

Source: Own work

The online questionnaire was elaborated in the Ukrainian using Google Forms for gaining data on the Ukrainian educators' views and attitudes towards various educational processes in some areas according to **DigCompEdu**. We have guaranteed participants only anonymous data would be shared.

The questionnaire was opening for 6-month period between December 20, 2017 and June 20, 2018. It contained information about some areas according to **DigCompEdu**.

The questionnaire consisted of 24 questions related to the Digital Competences group 1 and group 2 (areas 1-4), see in Fig. 3:

- 1 on educational role;
- 8 on area 1 (organizational communication, professional collaboration, digital continuous professional development);
- 3 on area 2 (selecting; creating and modifying; managing, protecting, sharing);
- 9 on area 3 (teaching, guidance, collaborative learning);
- 3 on area 4 (assessment strategies, feedback and planning).

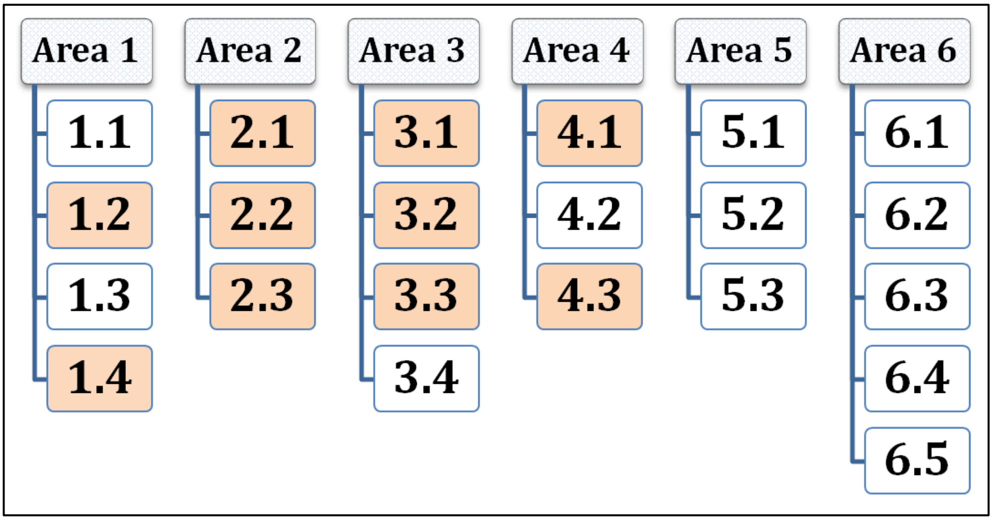

Figure 3. Digital Competences of Educators analysed in the research survey

Source: Own work based on DigCompEdu (2017, p. 16), https://publications.europa.eu/en/publication-detail/-/publication/fcc33b68-d581-11e7-a5b9-01aa75ed71a1/language-en (accessed on 15 August 2018)

3. ANALYSIS OF DEVELOPMENT LEVEL OF THE DIGITAL COMPETENCES OF THE UKRAINIAN EDUCATORS ACCORDING TO THE SURVEY CONDUCTED

We analysed development level of the Digital Competences of the Ukrainian educators according to the **DigCompEdu**. For this purpose the results of survey of certain Digital Competences groups are stated.

The data about development level of the some Digital Competences of the Ukrainian educators are presented in Tables 1-10 and Fig. 4-14 below.

Area 1. ***Professional Engagement***

Digital Competence 1.2. ***Professional collaboration***

Q.: *Which tools do you use for professional collaboration?*

Survey responses on professional collaboration tools usage are shown in Table 1 and in Fig. 4 (multiple answers are possible, that's why the total responses can be more than 100%):

Table 1

Responses distribution on professional collaboration tools usage

Professional collaboration tools	Responses
Trello	10,06%
CoSchedule	0,63%
Podio	1,89%
Virtual boards	37,11%
ICT tools for creating infographics	27,04%
ICT tools for creating mind maps	47,8%
I do not know about any of these tools	30,19%

Source: Own work

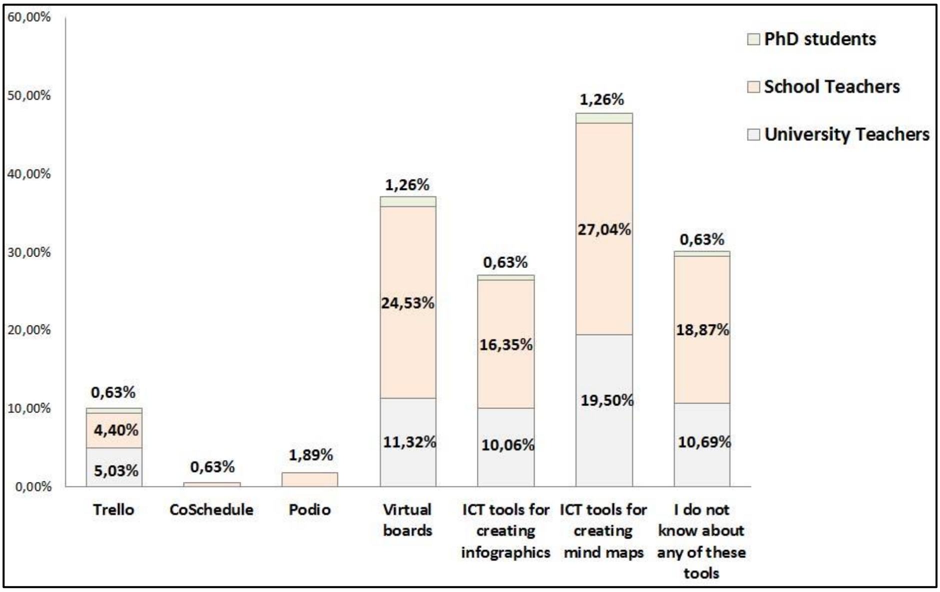

Figure 4. Survey responses on professional collaboration tools usage

Source: Own work

Digital Competence 1.4. ***Digital continuous professional development***

Q.: *Which digital sources and resources do you use to improve your own skills?*

Survey responses on usage of digital sources and resources are shown in Table 2 and in Fig. 5 (multiple answers are possible, that's why the total responses can be more than 100%):

Table 2

Responses distribution on usage of digital sources and resources

Digital sources and resources	Responses
MOOC	48,43%
Thematic channels on YouTube	82,39%
Webinars	52,2%
TED	22,01%
Thematic blogs	27,04%
Social Networks Thematic Groups	48,43%

Digital sources and resources	Responses
Other Open Educational Resources	32,08%
Educational Resources of mobile applications	52,83%

Source: Own work

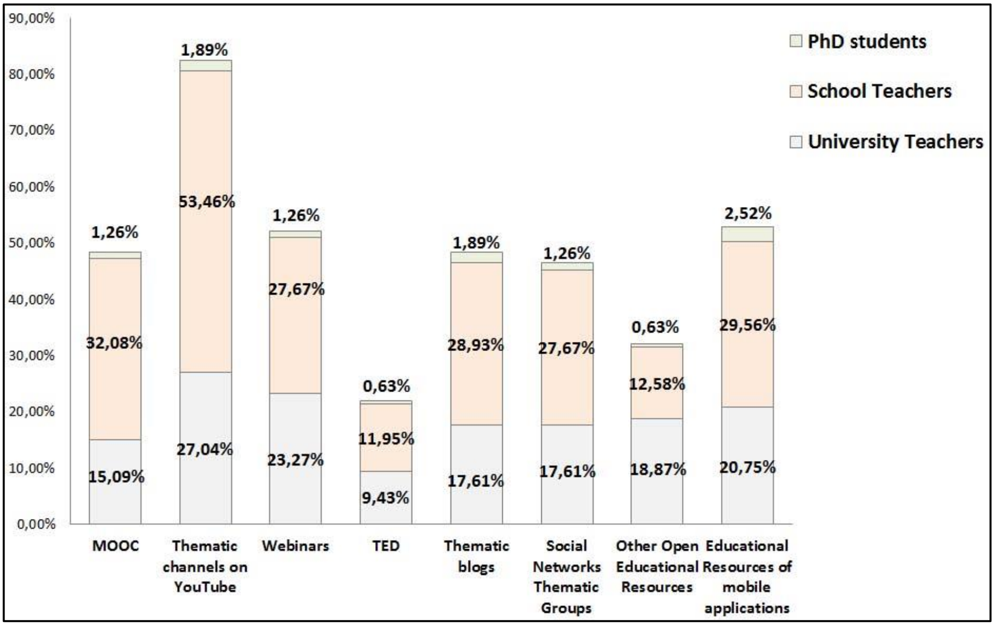

Figure 5. Survey responses on usage of digital sources and resources

Source: Own work

Q.: *Which MOOC platforms do you use for continuous professional development?*

Survey responses on MOOC platforms usage are shown in Table 3 and in Fig. 6 (multiple answers are possible, that's why the total responses can be more than 100%):

Table 3

Responses distribution on MOOC platforms usage

MOOC platforms	Responses
Coursera	35,85%
edX	17,61%

MOOC platforms	Responses
Udacity	6,29%
KhanAcademy	22,64%
CanvasNetwork	5,03%
FutureLearn	4,4%
FUN	5,66%
Prometheus	48,43%
I do not have an account on any of above mentioned platforms	27,04%

Source: Own work

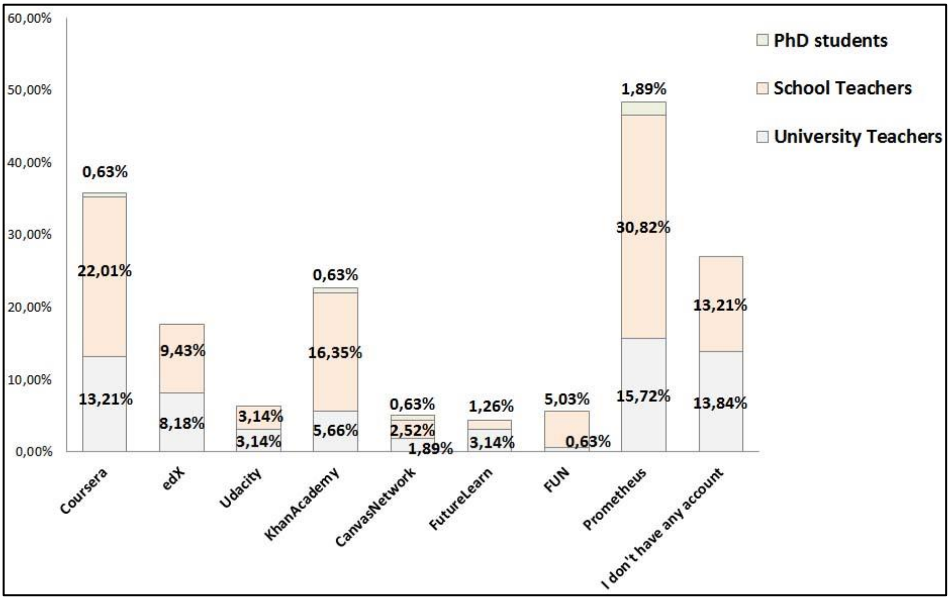

Figure 6. Survey responses on MOOC platforms usage

Source: Own work

Analysis of the MOOC platforms usage is shown that most respondents (48,43% of the participants) prefer using Prometheus (http://prometheus.org.ua). Prometheus is a Ukrainian project for developing MOOCs (Strutynska & Umryk, 2016, p. 302). One of the reasons of using this provider by Ukrainian educators is because all courses are in Ukrainian.

Area 2. ***Digital Resources***

Digital Competence 2.1. ***Selecting digital resources***

Q.: *Which scientometric databases do you use to identify, assess and select digital resources for teaching and learning?*

Survey responses on scientometric databases usage to identify, assess and select digital resources are shown in Table 4 and in Fig. 7 (multiple answers are possible, that's why the total responses can be more than 100%):

Table 4

Responses distribution on scientometric databases usage to identify, assess and select digital resources for teaching and learning

Scientometric databases	Responses
Google Scholar	67,92%
Web of Science	47,17%
Scopus	42,14%
Mendeley	5,03%
WorldCat	10,69%
Polska Bibliografia Naukowa	1,89%
Universal Impact Factor	11,32%
Research Bible	1,89%
Ukrainian scientific journals	37,11%
ERIH PLUS	1,89%
Socioindex	3,77%
Eurasian Scientific Journal Index	2,52%
Index Copernicus	27,67%
I do not know about any scientometric databases	20,13%

Source: Own work

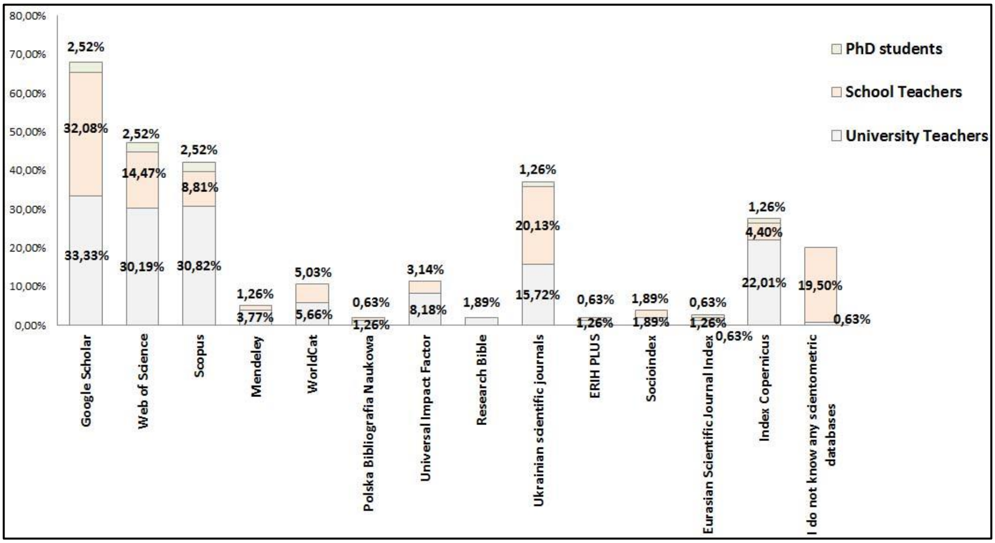

Figure 7. Survey responses on scientometric databases usage to identify, assess and select digital resources for teaching and learning

Source: Own work

Digital Competence 2.2. ***Creating and modifying digital resources***

Q.: *Which scientific portals do you use for creating and modifying digital resources?*

Survey responses on scientific portals usage for creating and modifying digital resources are shown in Table 5 and in Fig. 8 (multiple answers are possible, that's why the total responses can be more than 100%):

Table 5

Responses distribution on scientific portals usage for creating and modifying digital resources

Scientific portals	Responses
Google Scholar	69,81%
Web of Science	13,84%
Scopus	11,95%
ResearchGate	5,66%
ORCID	23,27%
Mendeley	0,63%

Scientific portals	Responses
Academia.edu	10,69%
ResearchID	6,92%
MyScienceWork	0%
ERIH PLUS	0%
I do not have an account on any portal	23,9%
I do not know about any portal	6,92%

Source: Own work

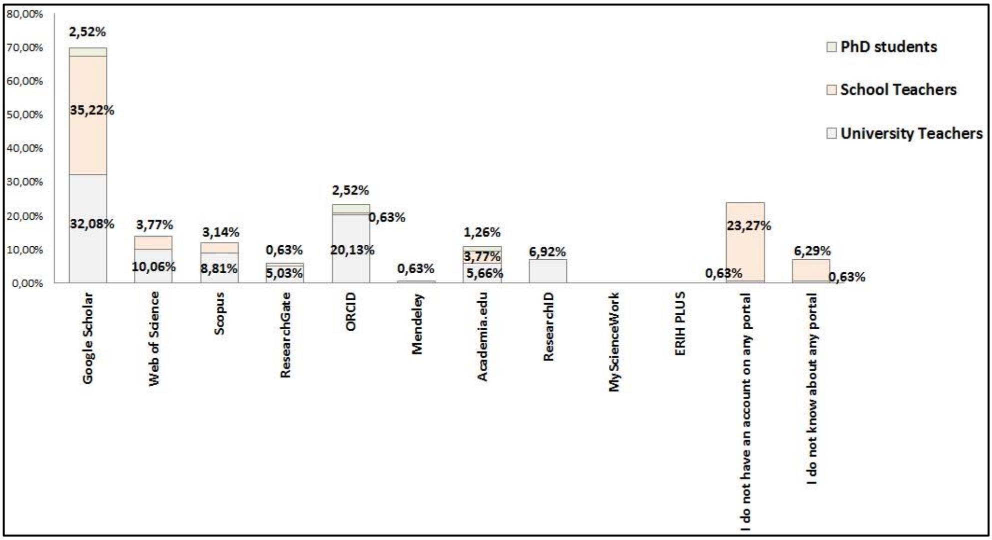

Figure 8. Survey responses on scientific portals usage for creating and modifying digital resources

Source: Own work

As we can see from Table 4-5 and Fig. 7-8 Ukrainian educators use Google Scholar to identify, assess, select, create and modify digital resources the most. This may be due to the fact that Google Scholar is the most popular scientometric databases in Ukraine.

Digital Competence 2.3. ***Managing, protecting and sharing digital resources***

Q.: *Which tools/sites do you use to share your digital resources?*

Survey responses on usage of tools/sites for sharing own digital resources are shown in Table 6 and in Fig. 9 (multiple answers are possible, that’s why the total responses can be more than 100%):

Table 6

Responses distribution on usage of tools/sites for sharing own digital resources

Tools/sites	Responses
Google Drive	78,62%
OneDrive	42,77%
Facebook	64,78%
F1000Research	0%
F1000Workspace	0%
ORCID	14,47%
ResearchGate	5,03%
ScienceOpen	2,52%
Slideshare	13,21%
Prezi	28,3%
I do not use any of these tools	4,4%

Source: Own work

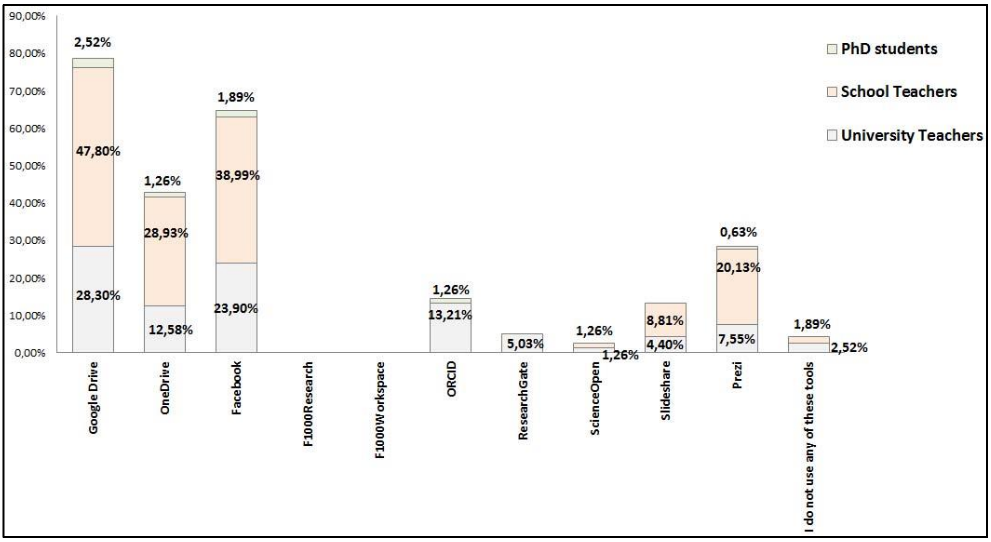

Figure 9. Survey responses on usage of tools/sites for sharing own digital resources

Source: Own work

The biggest group of respondents is University or school Computer Sciences teachers. As our Informatics curriculum at school is included of studying Google services that's why the Google Drive are used the most for sharing digital resources.

Besides the next large group of responses belongs to Facebook. This may be due to the fact that Facebook is a popular social network among students.

Area 3. ***Teaching and Learning***

Digital Competence 3.1. ***Teaching***

Q.*: Which innovative approaches do you use in your professional activity?*

Survey responses on innovative approaches usage in own professional activity are shown in Table 7 and in Fig. 10 (multiple answers are possible, that's why the total responses can be more than 100%):

Table 7

Responses distribution on innovative approaches usage in own professional activity

Innovative approaches	Responses
Distance learning or its elements	66,67%
Blended learning or its elements	53,46%
MOOC or its elements	33,96%
Mobile or its elements	32,08%
STEM / STEAM	20,75%
Gamification of learning	20,13%
Social Networks	57,86%
I do not use any of these technologies	5,66%
I do not know about any of these technologies	0,63%

Source: Own work

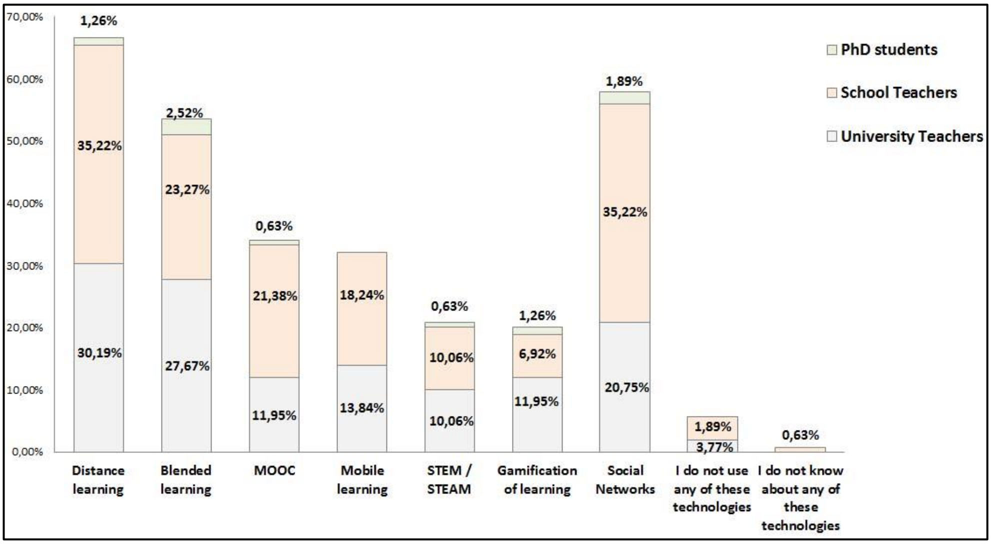

Figure 10. Survey responses on innovative approaches usage in own professional activity

Source: Own work

As we can see from Table 7 and Fig. 10 a lot of respondents use distance and blended learning or its elements. This may be due to the fact that large group of respondents relates with Computer Sciences field.

Digital Competence 3.2. ***Guidance***

Q.*: Which ICT tools, digital technologies and services do you use in your professional activity?*

Survey responses on usage of ICT tools, digital technologies and services in own professional activity are shown in Table 8 and in Fig. 11 (multiple answers are possible, that's why the total responses can be more than 100%):

Table 8

Responses distribution on usage of ICT tools, digital technologies and services in own professional activity

ICT tools, digital technologies and services	Responses
Webinars and appropriate ICT tools	37,11%
Virtual boards and appropriate ICT tools	30,82%
ICT tools for survey and testing	62,26%

ICT tools, digital technologies and services	Responses
Mind maps and appropriate ICT tools	47,8%
Infographics and appropriate ICT tools	23,27%
ICT tools for creating e-books	19,5%
Word cloud and appropriate ICT tools	12,58%
Google Classroom	25,79%
I do not use any of these ICT tools	14,47%
I do know about any of these ICT tools	3,77%

Source: Own work

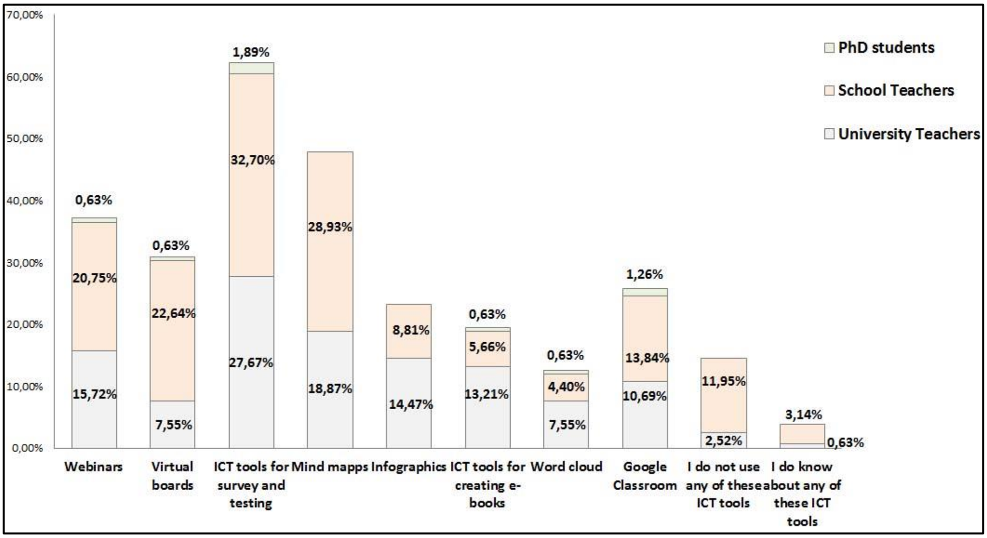

Figure 11. Survey responses on usage of ICT tools, digital technologies and services in own professional activity

Source: Own work

As we can see from Table 8 and Fig. 11 Ukrainian educators use ICT tools for survey and testing the most. That's why they need to improve present Digital Competence for further using ICT tools, digital technologies and services in their own professional activity.

Digital Competence 3.3 ***Collaborative learning***

Q.: *Do you think it is necessary to use digital technologies to foster and enhance learner collaboration?*

Survey responses on usage of the digital technologies to foster and enhance learner collaboration are shown in Fig. 12:

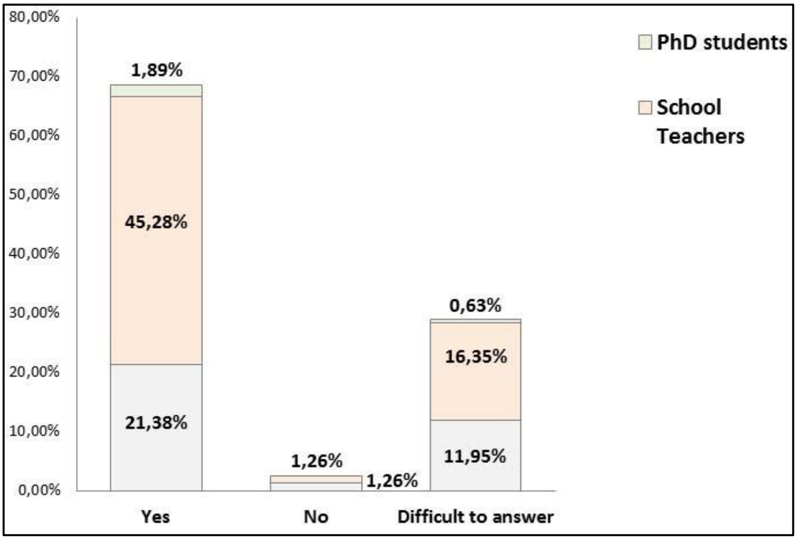

Figure 12. Survey responses on usage of ICT tools, digital technologies and services in own professional activity

Source: Own work

Large part of responses "*Difficult to answer*" may be due to the fact that respondents don't know about digital technologies to foster and enhance learner collaboration.

Area 4. ***Assessment***

Digital Competence 4.1. ***Assessment strategies***

Q.: *Which ICT tools and digital technologies do you use in your professional activity for survey and testing?*

Survey responses on usage of ICT tools, digital technologies and services for survey and testing are shown in Table 9 and in Fig. 13 (multiple answers are possible, that’s why the total responses can be more than 100%):

Table 9

Responses distribution on usage of ICT tools, digital technologies and services for survey and testing

ICT tools, digital technologies and services for survey and testing	Responses
Google Form	76,1%
Kahoot	28,3%
Socrative	1,89%
Quizworks	2,52%
Gnowledge	0%
Monkey Survey	5,03%
ICT tools built into distance learning platforms	36,48%
I do not use any ICT tools for survey and testing	13,21%
I do not know about any of these ICT tools	2,52%

Source: Own work

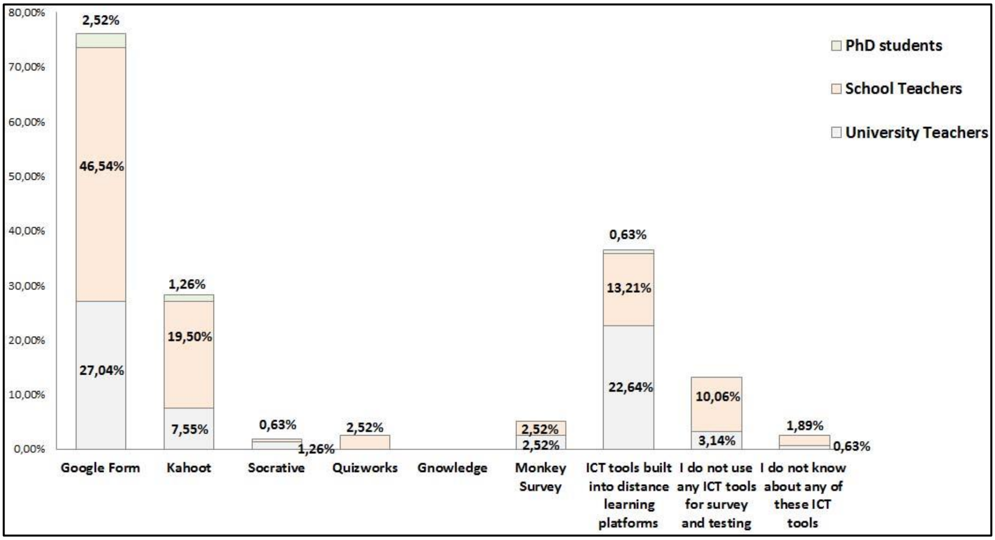

Figure 13. Survey responses on usage of ICT tools, digital technologies and services for survey and testing

Source: Own work

As we can see from Table 9 and Fig. 13 Ukrainian educators use Google Form for survey and testing the most. The reason of this fact is explained above.

Digital Competence 4.3. *Feedback and planning*

Q.: *Do you consider MOOCs as effective and needed technologies for feedback and planning?*

Survey responses on usage MOOCs as effective and needed technologies for feedback and planning are shown in Table 10 and Fig. 14 (scale from 1 – ineffective to 10 – effective and very needed):

Table 10

Responses distribution on usage MOOCs as effective and needed technologies for feedback and planning

Scale	Responses
1	1,88%
2	1,26%
3	3,14%
4	4,4%
5	15,09%
6	13,21%
7	18,24%
8	16,35%
9	15,72%
10	11,32%

Source: Own work

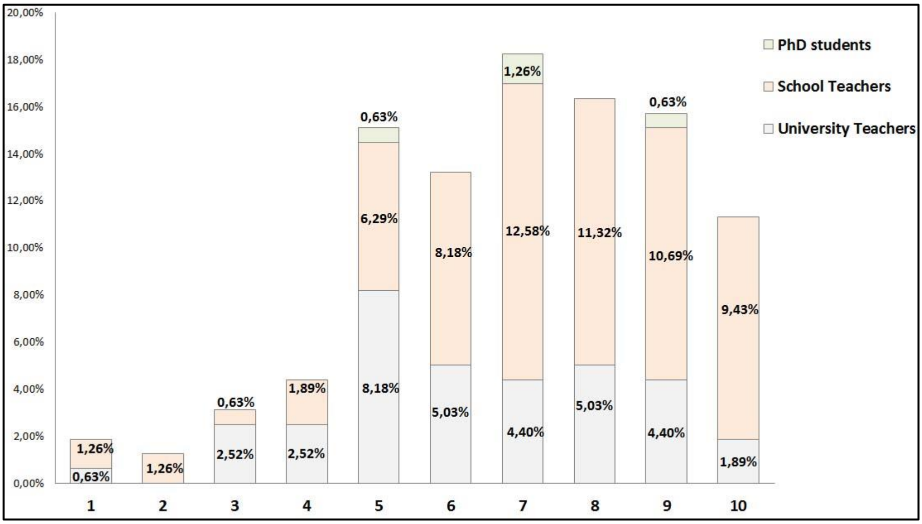

Figure 14. Survey responses on usage MOOCs as effective and needed technologies for feedback and planning *Source: Own work*

As we can see from Table 10 and Fig. 14 Ukrainian educators are ready to use technologies for feedback and planning. In our further research, we are planning to outline the ways how to improve their Digital Competences.

On the one hand, finding of the survey conducted shows that the Ukrainian educators need improvement of the development level of their Digital Competences. From the other hand, the survey's results also show that Ukrainian educators are ready to use digital resources, modern ICT tools and trends in their professional activity.

4. DISCUSSION

So, this paper addresses the following questions: analysis of development level of certain digital competences of the Ukrainian educators.

Last research question about the ways of increasing the development level of the Digital Competences according to **DigCompEdu** requires more details explanation.

Based on the research conducted, the authors could propose ways to improve development level of the digital competences according to **DigCompEdu** for different groups to the Ukrainian educators:

a. Make the Ukrainian educators aware of the EU Standards and Guidelines on Digital Competence Framework for Educators (for all the groups of the Ukrainian educators).

b. Increase of the awareness of the EU Digital Competence framework for educators:

   - for PhD students (in the field of Education) – improve level of development level of the Digital Competences by updating of curriculum.

   In 2017-2018, specially for Master students of Faculty of Informatics of the Dragomanov National Pedagogical University (future Computer Science Teachers), curriculum has been updated in accordance with the modern requirements to use of the digital resources, modern ICT tools and trends in their future professional activity. And the next update of the curriculum is planned for the bachelor students this year. Thus, the issue of the future educators concerning development of the digital competences will be resolved in accordance with **DigCompEdu**.

   - for school teachers – level of development level of the digital competences by preparing and conducting of the seminars on work with ICT tools and digital resources. The next step is to create appropriated online courses.
   - for University teachers – level of development level of the Digital Competences by encouraging them to take part in summer schools of

academic development, conference and international projects related with Digital Competences.

c. create questionnaire for target groups of the Ukrainian educators for self-assessment in the digital competence according to basic materials from **DigCompEdu**.

Also it needs more detailed examination of hypothesis of research about group 3 (Learners' digital competence) and unresearched elements of the abovementioned group 1 and group 2.

The authors plan the following activities in their further research on the development level of Digital Competences of Ukrainian educators:

- analysis of progression model "…linked to the six proficiency levels used by the Common European Framework of Reference for Languages (CEFR), ranging from A1 to C2…" (DigCompEdu, 2017, p. 28-29);
- preparation of survey for specifying development level of the certain Digital Competences according to proficiency levels of the progression model (from A1 to C2);
- development of the methods for improvement of the proficiency level of Digital Competence for each group of Ukrainian educators.

5. CONCLUSIONS

According to The European Commission's science and knowledge of service learning and skills are key contributors to the society and economy. As modern societies and economies are changing due to, amongst others, globalization and technological progress, a fundamental transformation of education and training throughout Europe is required to deliver the knowledge and skills needed for growth, employment and participation in the society. The teaching professions face rapidly changing demands, which require a new, broader and more sophisticated set of competences than before. The ubiquity of digital devices and applications, in particular, requires educators to develop their digital competence.

Improvement of development level of the Digital Competences is a new important trend in the modern education. This is the transformation of the educational process inside and outside of the educational institutions.

Findings of the conducted survey of the Ukrainian educators have shown the insufficient development level of their Digital Competences. However, the Ukrainian educators are ready to use digital resources, modern ICT tools and trends in their professional activity.

Our future work is to elaborate a new survey for the Ukrainian educators. In future experiments, we will study their proficiency level of the Digital Competences (from A1 to C2). Also it is planned to consider ways of development of the Digital Competences level for group 3 (*Learners' competences*).

Continuation of the experimental process is a key issue for improving pedagogical education in Ukraine in general.

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CONTEMPORARY IT SOLUTIONS WITH CRM KEY COMPETENCIES FOR MARKETING

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Abstract: *This paper focuses on contemporary IT solutions for better knowledge in Customer Relationship Management (CRM) systems for marketing with regard to e-learning capabilities. The positive advantage is that CRM systems offer diversity, and companies choose by preferences. However, the negative reality is in the fact that marketers need an optimal amount of CRM key competencies (skills) for marketing. Quality skills are focused on contact management, customer reports, document storage, emails, and social media integration. Effective acceptance of these skills requires the training of students in optimal CRM systems. In this paper, specified CRM systems were selected to test the level of integration of needed options for CRM key competencies. The analysis made shows the diversity in the integration of marketing options; therefore, education has to train needed skills in more (two or three) CRM systems such as vtiger CRM, Zoho CRM, Marketing 360 or eWay-CRM.*

Keywords: E-Learning, CRM, key competencies, marketing

INTRODUCTION

Marketing is one of the important areas in company as a value-creating process (Chernev & Kotler (Foreword), 2018). Markets are overestimated by commodities and services and it is difficult to search for a target audience. Changes are visible also to customers who are intelligent and have a good orientation in commodity substitutions, the level of prices and the amount of services they can provide at a fixed price. Social networks (such as Twitter, Facebook) offer great support and day-to-day search using Google to share common knowledge and existing market and retailer experience (Evans, 2010).

In all cases, optimal marketing communication (Frey, 2008) and patience for customers are indispensable for all employees in companies. It is not just a question for employers who speak directly with customers, but it is a question of all employers because they are part of the production chain to make the optimum product or service for customers, preferably from own production to billing and shipping. A special place has marketing for great responsibility for optimal communication with customers and special services that offer available commodities and services.

Marketing has great influence on patience and soft skills. It is the ability to understand the words of customers, their preferences and needs to build customer profiles (Artun & Levin, 2015). Further requirements are focused on timing, quality and knowledge about the company's ability to offer optimal commodities with events (Lattenberg, 2010). You can use default paper and pencil for the default notes on what you do. Unfortunately this is not optimal. Strong pressure from customers and competitors leads to the use of modern systems of information technology (IT). An important role is played by dedicated contacts with customers to increasing customer lifetime value (Dib, 2016). The focus is on CRM systems for marketing support and key competencies (Ghazian et al., 2016; Gupta, 2011) for the preparation of new generation specialists based on e-learning.

1. MARKETING NEEDS

Marketing activities also rely on information technology and there is a place for digital marketing and management (Hunt (Editor), 2018; Marshall & Johnston, 2018). Marketing responsibility is linked to the demand to maximize competition and minimize instability and frustration. Unfortunately, many companies do not have an optimal focus on marketing strategy. They use PPC Ads with high costs and low returns. The reason is that paid advertising is not the same as marketing strategy. Ads bring benefit in form of time to support campaigns. Otherwise, they bring a long-term risk (Volpe, 2017).

Marketing management (Kotler & Keller, 2015) requires complexity and long-term work to understand all internal and external factors that affect sales and customer interest. There are following reasons why marketers are important:

- To present a company with products and services in a better light with modern systems.
- To use optimal knowledge and good insight into proven methods and the best practice example.
- To promote humanization of products and services that customers will like.
- To ensure optimal consistency with support for social communication.
- To create marketing with ROI (Return on Investment) on realized activities.

- To build space for everyday tasks as desired by the customers.

  (White, 2017)

Marketers have to work with a unique perspective through the company. That is why they ask a lot of questions about the special affairs of the brand (Miller, 2017). A good solution is for those who known the sings of suitable systems with experience to share value-added information for customers and they talk about it (Hughes, 2006). The high impact on the brand is supported by the Internet rules. Social networks (like Facebook, Twitter, Instagram, LinkedIn, Google+) have own rules, and it is difficult to take care of the optimal presentation for customers. It must use the optimal technology that is appropriate for the adopted strategy. The world does not care about technical background, but it is important to know if systems or services address specific problems.

There are special systems, social media and different websites and everyone knows them. That is why everyone thinks he is a good marketer. However, it is difficult to be a good marketer and there are important key competencies for innovative marketing (Kotler & Trias De Bes, 2005). The solution is not to buy more and more Google AdWords PPC. This way, leads are formed, but in a limited volume. One can buy more and more. Then more revenue is expected (over and over), but it does not work. And budget is becoming more and more disadvantageous (Patalas, 2009). There is no sustainable marketing strategy and marketing model with business metrics (Kozielski (Editor), (2017).

In this situation, modern marketing communication (Prikrylova & Jahodova, 2010) is important through blogs and social media. One spends the time (money) needed to publish blogs for customers and potential customers. They start to with free Google search results. The results are based on continuous work with articles (only a few articles from last month + a few articles from actual month + others for the next month, …). The advantage is continuous blogging and the form of asset-centric marketing program.

Social media creates a marketing strategy based on activity. Facebook, LinkedIn, and Twitter help to build on what is already done. It attracts more friends and followers and company has more and more potential customers, which can increase each month. There is room for intellectual creativity with complexity. It is important to believe in success, and understand customers very well with the necessary knowledge to create a personal relationship environment with sincerity.

A heavy pressure of competitors and new technologies brings the possibility of introducing marketing innovations. Companies must consider new ways of preparing marketing plans and marketing guide for business (Johnson, 2018). It is more difficult for customers to find optimal commodities, and it is also more difficult to build their interest in available products and services. The number of new brands is higher in the market, and people change habits and test news. It creates a pragmatic reality that companies are losing market share without innovations.

For illustration of this situation see Figure 1.

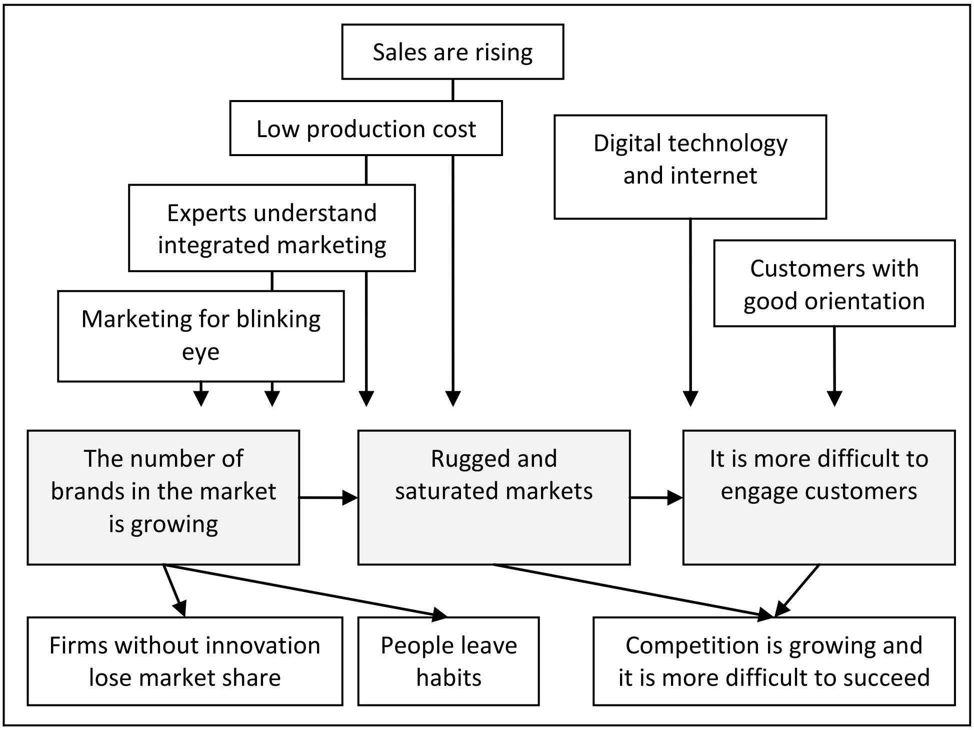

Figure 1. Marketing in new conditions

Source: Own work based on Kotler, 2005

Marketing is a sophisticated business and there are dynamic influences from customers, the market, information technology, innovation, and manufacturing (Kotler et al., 2007). An intelligent marketer needs to use different systems, applications and tools, and it is natural that information technology is an essential part of marketing success in modern society. And good marketers must have an optimal knowledge of information technology to support marketing.

2. INFORMATION TECHNOLOGY FOR MARKETING

Successful marketing management (Moutinho, 2016) needs unique communication skills and precise timing to make the right time with the right product (or services) in the right place. The tasks performed are focused on working with target customers and leads, but it is difficult to find customers interested in the products or services. Personal charisma and intuition are important, but a great role to play here has information technology.

Information technologies offer many applications and systems that support activities implemented in all areas of human life. Marketing is one of the areas where information technology has a place. It is positive that marketers choose from different solutions such as blogging, computer presentations, CRM systems, email communication, email marketing, graphic design software, social media, and websites (White, 2018):

- Blogging.

Blogging is a place to communicate with customers on a professional level to marketers who create and manage information (blog) about products, services, questions, and business advice. One can choose from many platforms as Blogger, Ghost, Joomla, Medium, Squarespace, Tumblr, Weebly, Wix, WordPress.com, and WordPress.org.

- Computer Presentations.

The computer presentation is focused on creating marketing presentations and sales based on applications such as PowerPoint.

- Customer Relationship Management (CRM) Systems.

CRM systems are one of the special IT solutions for customer care. There are comprehensive solutions and simple applications to support customer contact, complaints, presentations, purchases, sales calls, and other links to forecasting and business intelligence. CRM systems are for all employers who take care of customers and offer goods with services. The advantage is that marketers have instant access to information with database support and mobile access.

- Email Communication.

Email communication is one of the primary forms of communication with support of information technology. Positive influence is visible when sharing documents, offers, and contacts with contracts. In this form of communication, there is time to read necessary documents and to understand the context in which to work. Email communication is available with potential customers, customers, co-workers, and media and journals.

- Email Marketing.

Email marketing is still one of the major forms of marketing in companies. Easily sends offers and information about available cooperation on selected emails. This form of communication focuses on new business and customer relationships (potential, current and past). This approach uses database customer information to automatically send newsletters and email ads.

- Graphic Design Software.

Graphic design software is important software for setting the optimal design that is being sold. Marketers use this software to create advertising and collateral materials in the form of newsletters and presentations. There are applications such as Adobe Indesign, Cinema 4D, CorelDraw, Cyberlink, GIMP, Illustrator, Inkscape, PhotoShop, Sumopaint, Vector, and Xara Xtreme.

- Social Media.

Social media are web sites for sharing information with followers in various forms like tweets and posts with text, pictures and links. Marketers use media like Baidu Tieba, Facebook, Instagram, Line, Messenger, Pinterest, Sina Weibo, Reddit, Skype, Snapchat, Tumblr, Twitter, Viber, QQ, QZone, WeChat, WhatsApp, YouTube. Social media (networks) play and will play an important role in marketing. Social networks are used for promotional purposes, and marketers need to know about using popular social media technologies to attract the products and services they offer to create new business relationships and customer relationships. This is the responsibility for creating and managing Facebook and Twitter accounts for businesses, publishing videos on YouTube, and using LinkedIn profiles for a company contact.

- Websites.

Websites are once again well-known places where businesses offer forms of customer contacts and information on the products and services they offer. The primary challenge is for marketers to be responsible for web design with maintenance skills at the design, security, content, and programming level. Perhaps all companies use this technology to communicate with the world.

The lines above show one of the big marketing problems. Marketing uses many information technologies. There are enterprise information systems, CRM systems, and data warehouse based analytics. It needs large projects to support marketing, but these projects are cumbersome without the optimal relationship to time and change in society. It is hard to keep up with the fast pace of change for ever-changing marketing, campaigns and customer contacts (Saran, 2011). Many experts say that time is one of the main barriers between information technology and marketing. Time, reaction speed and mentality are different for marketing and information technology. The reason is that information technology likes to be more serious, but it leads to a great slowdown.

But information technology needs marketing and marketing needs information technology. There is a successful way of cooperation between information technology and marketing. The current challenges also lead to innovations in marketing and information technology. And innovation brings a new solution for success. Innovations are being built on a solid partnership with shared goals and metrics for deep cooperation. Innovations also require a good knowledge of marketing and information technology to bring the existing approach together with a new approach. Education and e-learning have sufficient knowledge to learn about optimal marketing skills based on information technology. The necessary changes are dynamic and it is important to look for an optimal amount of information technology knowledge (skill) for marketers as new generation specialists with respect to marketing management essentials (Publishers, 2018).

3. EXISTING PROBLEM AND METHOD FOR SOLUTION

Marketing needs are well known. The same situation is in the area of information technology. A modern approach calls for the use of information technology in all human activities. Marketing is one of them. There are many approaches and templates as an example of good practice. Internet and social networks also have a positive impact because it is a place to share ideas and work method with others. Problems cause serious press with timing, budget, and quality of customer contact with support marketers. In this unstable environment, it is not easy to choose optimal support with information technology. This reality also needs a wide range of skills for new generation marketers, and because one can not know all, then it is important to specify the optimal volume of key marketing competencies. Interest is focused on CRM systems, so this optimal volume of key competencies for marketing is oriented to CRM systems for new generation specialists (Paliouras & Siakas, 2017; Wali et al., 2016).

To address this problem effectively, the most important marketing needs and information technologies (two captions above) were specified. The next step is to specify the CRM options for more detailed evaluation. The focus is on integration:

- Contact management.
- Custom reporting.
- Document storage.
- Emails.
- Social media.

Selected CRM systems will not only be top-class, but also middle and lower hierarchies. Very interesting is the CRM systems at the top, but there are roughly 500 CRM systems and it will interested to evaluate some systems from middle and lower hierarchy as these CRM systems also have customers and companies use them for marketing. Selected CRM systems are:

- Easy Simple CRM.
- eWay-CRM.
- Hubspot CRM.
- Marketing 360.
- Maxcustomer.
- The Newspaper Manager.

- Snapforce CRM.
- SutiCRM.
- vtiger CRM.
- Zoho CRM.

The following work focuses on evaluation of selected CRM systems according to specified criteria (evaluation options). Individual CRM systems have been analyzed according to their existence, user-friendly and templates with advices to support the necessary tasks in important CRM key marketing competencies.

4. CRM KEY COMPETENCIES FOR MARKETING

It is important to know the CRM key competencies for marketing in order to set optimal e-learning based on education. Marketing is changing at high speed in relation to market and customer needs. Information technologies have great development and new approaches are here. In this situation, education needs to reflect current changes to better support marketing through information technology. Quality and time are also important. Following rows show the integration level for contacts, custom reports, document storage, email and social media as selected evaluation options for specified CRM systems.

Easy Project CRM is a system for registering leads and contacts to track communication with integration with a lead generation solution. The individual modules deal with Leads, Contract Management, Contact Management, Sales Manager Dashboard, Sales Consultant Dashboard, Marketing automation, Lead qualification, Lead generation, E-commerce solution. Contact information is stored as needed and personal contacts are available and can be synchronized with other devices. Leads are generated from forms, imported, and manually. There are advanced filters for setting up sales pipelines and opportunity lists (Easy Project, 2018).

eWay-CRM is a system that offers modules as Societies, Contacts, Opportunities, Projects, Marketing, Diary, Documents, Emails, Attendance, Tasks, Calendar, and Reports. The Societies module manages information about companies integrated with the Commercial Register (ARES) and the European VAT Payers Register. The Contacts module manages all business contacts and lets you add notes, communication history, and documents. The Opportunity module is useful for working with opportunities and activity planning. The Marketing module supports personalized emails and links to phone calls and feedback letters. The Module Diary uses store notes and meeting or phone call information. The Document module stores accessibility documents in Microsoft Outlook. Documents are different types such as Microsoft Word, Excel, PDF. The Emails module offers compatibility with Microsoft Outlook and eWay-CRM communication. The Report module has preset reports that provide help in different views of stored data as the success of a particular trader, the best source of inquiries, or a list of opportunities without a scheduled task (eWay-CRM, 2018).

Hubspot CRM has basic features that are oriented on Contact management, Contact & company insights, Company records, Gmail & Outlook integration, Deals, and Tasks. The advantage is to use special features for marketers as Lead analytics dashboard, Forms and Contact activity. Other features are for retailers who support Email scheduling, Email templates, Documents, Calling, Meetings, and Canned snippets (Hubspot CRM, 2018).

Marketing 360 is a cloud-based marketing system. There are modules oriented on Digital Marketing, Natural Listing Ads, Top Placement Ads, Retargeting Ads, Social Targeting Ads and Other Services. The Digital Marketing is based on a variety of goal-setting variables that allow you to generate views on sales and monthly performance forecast. The Natural Listing Ads serve to market content. The Top Placement Ads manage paid-to-click campaigns for Google Search and Google Shopping. The Retargeting Ads are part of support for remarketing campaigns. There are Email Marketing, SMS Marketing, and Marketing Analytics with links on Social Media Management and Social Profiling. Social media is used for campaigns and an integrated search engine is used to optimize and analyze the performance of digital marketing (Marketing 360, 2018).

MaxCustomer is one from the simpler CRM systems. This system is based on managing Sales Reps, Leads, Opportunities, Customers and Tasks, Products and Vendors. Here is a place for Quick View of Sales, Pipeline, Call History, and the Calendar. For the Sales Reps, the system displays a list of sales reps with information on the job role, manager with their activity. Leads are responsible for all leads and can turn potential customers into opportunities with support for creating tasks and log conversations with customer for reference. A bid advantage is dashboards that show a summary of important business components by statistics and tracking the level of sales trend, pipeline trend, sales rep, call history (MaxCustomer, 2018).

The Newspaper Manager servers Contact manager, Customer search, Calendar and event, Notification, My call backs, My mailing lists, Email marketing, Dashboards and reports. Contact manager shows default issues related to contacts, teamwork, and business management. Positive benefits bring Customer searching for seamless and specific search. Calendar and events synchronize with web calendar so all events are in one place. My mailing lists are focused on creating and managing email lists with campaign links and exporting data by performance. Email marketing uses a predefined email template to run campaigns. Dashboard and reports provide customizable reports and shows an overview of sales and production metrics (The Newspaper Manager, 2018).

Snapforce CRM divides work into several modules as Getting started, Sales, Marketing, Service, Communication channels, Calendar, Billing, and Analytics. All modules have a navigation bar to work in the specification area. The Sales module is used to navigate through leads with creation and conversion. There is a place for opportunities and quick adding. Marketing focuses on campaigns. An amazing skill has Communication channels that can be used to set up a phone, email configuration, activity timeline, notes, tasks, events, calls, files, e-mail, mailbox, associating e-mail messages, voicemail settings, and chat. Analytics provides regular reports, call reporting, exporting reports, dashboards, and filter operators (Snapforce CRM, 2018).

SutiCRM is a cloud-based CRM system with automation of marketing, sales, and contracts. Interest is focused on marketing, sales, service support, reports and analytics, activity management, social CRM, inventory management. Marketing helps with marketing activities to reach targeted audience based on campaigns, leads from different sources, and targeted emails. Sales offers contact management, opportunity management, lead management, reports, dashboards, territory management. Social CRM enables real-time interaction with customers through social media. It is possible to transfer communication between existing and potential customers (SutiCRM, 2018).

Vtiger CRM has a large volume of modules. Individual modules are focused on Calendar, Campaigns, Contacts, Dashboard, Documents, Leads, Mail Manager, Opportunities, Project tasks, Reports, Sales order, Tickets, Vendors, vtmessages, vttwitter, Webmail. Contacts store information about a person with links to organizations or events. The Documents module is designed to display the list of documents used in CRM system. These documents are grouped into folders by preferences. The Mail manager is designed to create contacts, leads and email tickets. The vttwitter is module provides the necessary integration with Twitter (vtiger CRM, 2018).

Zoho CRM offers default modules for contact management with customers. These modules are Leads, Accounts, Contacts, Deals, Campaigns, Cases, Solutions, Products, Price Books, Quotes, Invoices, Sales Orders, Vendors, Purchase Orders, Events, Tasks, and Calls. Interesting is marketing automation that offers Auto Response Rules and Google AdWords. There is space for multi-channel communication with Sales Signals, Zoho CRM emails, Mass Emails, Email Insights, and Live Chat with Visitor Tracking. Social networks are based on the Set up social tab, Using social tab, and Social profiles. There is no special module, but you can add lead/contact from Twitter, Facebook, or Google+ page, and Twitter, Facebook, or Google+ profile will automatically connect to the record. The Document management focuses on Document library, Manage documents, and Manage folders (Zoho CRM, 2018).

A summary of the analysis is presented in Table 1. This table shows the solution for selected key competencies in the specified CRM systems. It is clear that there are different spectral approaches and it is not always easy to work with emails or social media (networks) in individual CRM systems. The bigger difference is in supporting work with document storage. On the other hand, it is natural that all

CRM systems offer contact management and custom reporting as one of the basic things for custom relationship management.

Table 1.

Key competencies in selected CRM systems

Key competencies in selected CRM systems	**Contact management**	**Custom reporting**	**Document storage**	**Emails**	**Social media**
Easy Project CRM	X	X			
eWay-CRM	X	X	X	X	
Hubspot CRM	X	X	X	X	
Marketing 360	X	X		X	X
Maxcustomer	X	X			
The Newspaper Manager	X	X		X	
Snapforce CRM	X	X		X	
SutiCRM	X	X			X
vtiger CRM	X	X	X	X	X
Zoho CRM	X	X	X	X	X
Total	**10**	**10**	**4**	**7**	**4**

Source: Own work

The first column shows 10 selected CRM systems from Easy project CRM to Zoho CRM. CRM systems are selected from the top, but there are also middle and lower ranking systems. The other columns are dedicated to the individual key competencies that marketing needs and CRM systems must offer the easiest work in these areas. Contact management and custom reporting are available on all CRM systems (10), but sophisticated document storage is only in 4 CRM systems, comprehensive social media work offers also 4 CRM systems, and suitable email tools are available in 7 CRM systems.

For e-learning, it is important to take care of key competencies in difficult areas such as email for marketing, social networking to communicate with customers, as well as customer reporting. The reason is that CRM systems have different work support here and it is not easy to use CRM systems for marketing because experience from one CRM system is difficult to use for another CRM system.

5. RECOMMENDATION FOR E-LEARNING TO SUPPORT KEY MARKETING COMPETENCIES

The e-learning recommendation promotes various IT skills that are used in marketing. There are many educational documents on marketing and information technology, but practical skills are important. Many authors are interested in successful e-learning education for digital marketers (Google Digital Academy, 2017) focusing on the development of a marketing strategy (B r a d l e y, 2015) or for machine learning to strengthen marketing campaigns (R a j e c k, 2014). To improve the current situation, it is important to show the variability of CRM systems because marketing needs different solutions. In practice, there is not unique and the best marketing and education solutions have to respect it.

Education is responsible for preparing new-generation specialists with CRM key competencies for marketing. This is an active work with various CRM systems. One cannot rely on just one CRM system because it is not the diversity that would be accepted for marketing. However, e-learning has a limited time and capacity in one or two semesters in a given academic year. There is, therefore, a place to understand only a few CRM systems with key marketing competencies.

Based on the CRM analyses, the CRM systems like vtiger CRM or Zoho CRM have to create a basic CRM system for training in marketing tasks. These CRM systems, however, cannot offer experience with all the necessary marketing tasks and it is optional adding of another CRM system that shows a different method of working. From this perspective, CRM systems such as Marketing 360 or eWay-CRM can offer more insight into marketing tasks that are not available on other systems.

CONCLUSION

This paper focuses on the use of e-learning to prepare a new generation of marketing specialists with optimal capabilities to use CRM systems. Marketing is a highly dynamic field and is a site for information technology. The reason is that there is no optimal presentation of a company based on optimal knowledge with good overview and respecting return on investment (ROI). Information technologies offer many ways to promote marketing, but their use varies according to real needs.

CRM systems are systems that are used for marketing. The market offers over 500 CRM systems ranking from simple to complex solution. Marketers must have the optimal amount of skills to work with them. Key competencies are focused on working with contacts management, custom reporting, document storage, emails, and social media. Problems cause CRM systems have different levels of integration menu to work. Education is also difficult because it is not optimal to select only one CRM system for e-learning. It is better to choose two or three CRM systems that would show different marketing jobs to have the optimal volume of skills. One is basic (such as vtiger CRM or Zoho CRM), because it has to offer the most suitable menu for training CRM key competencies. Other CRM systems (such as Marketing 360 or eWay-CRM) have special menus that serve to marketing in their own custom reports, emails, or social networks.

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TRANSVERSAL SKILLS: A KEY ELEMENT DEVELOPED THROUGH HYBRID LEARNING

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Abstract: *To prepare students for the professional world, it is essential to develop their transversal skills at home. In our paper, these skills will be presented: information exploitation, problem solving, critical judgement, creative thinking, use of information technologies, cooperation or appropriate communication. Then an example of how an e-learning module coupled with a face-to-face programme can help develop them will be analysed. We will present the choice of the multimedia task and the elements of analysis of surveys carried out with the students who have followed this module at Warsaw University's Institute of Romance philology. We intend to show that even if the tool actually pushes the development of transversal skills, it would remain insufficient on its own.*

Keywords: blended learning, transversal skills, multimedia, foreign language teaching.

INTRODUCTION

In her speech to the OECD on November 14, 2016, during the week of education, the now former French Minister of Education Najat Vallaud-Belkacem recalled several key points that underlie the problem we are addressing in this article, that is, preparing our learners for the job market. Quoting the American prospectivist Thomas Frey who announced that "60% of the jobs of the next 10 years have not yet been invented", she called for a development of "these skills that require learning to learn, skills that allow people to learn, adapt ". The minister also reminded that all "digital natives", a term used by Prensky (2001), who are our students, this expression did not correspond to a reality to the extent that having grown up with the new technologies did not entail a true mastery of the latter. We could therefore rather call them "digital naives" (Hargittai, 2010). Finally, she stressed the importance of teaching our students to "seek, to approach the Internet with a critical and demanding spirit". These skills underlined by the minister are in fact part of a larger group, often referred as to "transversal skills".

This development of skills is at the heart of foreign language teaching following a paradigm shift that has already begun with the communicative approach, then the action-oriented approach, moving from a paradigm of knowledge and simplification, to that of the competence and complexity evoked by Claire Bourguignon (2006: 59). Thus, with CEFR, foreign language teaching is firmly in an empowering approach of the learner. Developing these skills will require an environment where the student can experiment, face by himself problems, where he can manage his time and can look for information. The classroom is too limited for that because of the resources it offers, or the timeframe required, and that is why e-learning becomes the best place to develop these skills. In the first part of this article, we will present these transversal skills, and the way e-learning can be used to develop them. In the second part, we will analyse the results of research conducted from October 2010 to June 2015 showing the use of a blended learning module to help in their development.

1. PREPARING FOR THE MODERN JOB MARKET: TRANSVERSAL SKILLS

Although for language teaching CEFR essentially puts forward so-called "general" competences, including know-how, another type of skills gradually emerges in teaching programmes and corresponds precisely to the skills mentioned by Najat Vallaud-Belkacem in her speech: transversal skills. Coming from the world of business, this type of skills prepares students for today's ever-changing world characterised by the flow of content and information (Crouzet, 2012: 10) and that is why they have been already implemented in many countries.

In the US, some of them have been grouped under the term of 4C's (Partnership for 21st century Learning) since 2002 standing for: collaboration, critical thinking, creativity and communication. Since 2007, the transversal skills have been described in the Belgian curriculum as: to be aware, to manage scholar tools, to manage time, memorise, comply with a statement, sum up, auto evaluate, use tools for work. Since January 2017 they have been grouped under the name "soft skills" (Becquet & Etienne, 2016) and taught in Australian institutions, regrouping: ICT, creative and critical thinking, personal and social aptitudes (group working and working in diversity), ethical aptitudes (understanding values and identifying them at others) as well as the intercultural competence. However, the notion of transversal skills has already been present since the 1990s in Quebec (where they are now referred to as "certain skills"), and the definition given by the Canadian MELS seems to us the most complete. It groups transversal skills into four categories.

The first category includes four intellectual skills to be gained by the learner:

- Exploiting information: this is the competence that enables the quest for information to be systematised, the appropriation of information, and to know how to profit from it,
- Solving problems: and thus know how to analyse the elements of a given situation, to test possible solutions and to know how to adopt a flexible functioning (with a return on the stages crossed and the recovery of some of them if necessary),
- Exercising his critical judgement: this transversal competence is that allowing the construction of an opinion, the expression of the latter as well as its relativisation,
- implementing his creative thinking: the learner must know how to immerse himself in the elements of a situation, engage in exploration and adopt a flexible functioning.

The second category, methodological, has two cross-curricular competencies:

- Acquiring efficient working methods: this includes the ability to visualise the task as a whole, regulate the process and analyse it,
- exploiting information and communication technologies: this transversal competence, which is fundamental here, includes the use of appropriate technologies, the ability to benefit from the use of technology and the ability to evaluate the effectiveness of this use. On that aspect, the use of an e-learning environment makes totally sense.

The third category also has two skills and is at the personal and social level for the learner:

- to actualise his potential: the learner must know how to recognise his personal characteristics, take his place among others and use his personal resources,
- to cooperate: this competence is that through which the learner contributes to the collective work, benefits from it and interacts with open-mindedness in different contexts.

The last skill is communicative:

- the ability to communicate appropriately: the learner must know how to appropriately use various languages, use various modes of communication and manage his communication.

We see it here, the development of these skills is closely related to the development of the learner and concerns all spheres of evolution that can determine a proximal area of development: intellectual, personal, methodological and communicative. These skills are crucial in modern life in order to adapt to the always-changing world and be able to mobilise all resources available around in an efficient way.

In foreign language learning, transversal skills might be mistaken for what is called "key competencies". The latter are global competencies required for the general development of the learner. Transversal skills are indeed a huge plus in this development but are not necessarily required.

2. HYBRID LEARNING: AN ENVIRONMENT AND A TOOL TO DEVELOP TRANSVERSAL SKILLS

In a foreign language curriculum, the place available for transversal skills is there. However, the classic frame of a language class is often not suitable. Indeed, working on these skills requires a lot of time, individual and collaborative work, personalisation, equipment: elements which put together might suffer from the limits of the classroom. That is why another frame for work is required: e-learning coupled to the classroom. Inside a Learning Management System, students are put in a semi-controlled environment, where the limits can be looser than in a class.

Three limitations of the classroom can be erased by using an e-learning module: time, content as well as the degree of autonomy and personalisation. All these three elements are totally linked. More time allows more complex tasks and bigger or more complex content. More time also allows more autonomy on working on the complex content and in the choice of tools to solve the problems.

Working on most of the transversal skills will take a lot of time, which then cannot be used for elements of language learning. If we take the example of "exploiting information", depending on the difficulty, at the beginning this can take a long time if the students are lacking techniques. The interest of having time is to leave them in autonomy and let them experiment different ways to look for the information and use it in an efficient way. The student does less feel the time limit for his search. Having more time also allows to confront students to more complex problems and make these more interesting. Another consequence is that "acquisition of efficient working methods" is also pushed. As previously underlined, when we talk about the transversal skill "exploiting information and communication technologies", the use of e-learning seems an obvious solution. Using a LMS pushes the students in using ICT at a maximum. It also allows the students to use both "classical" solutions such as books and technological solutions. If autonomy is enhanced, collaborative work is too: during the timeframe given, nothing stops the student to ask for help around and to share methods and information.

3. AN EXAMPLE OF ENVIRONMENT TO WORK ON TRANSVERSAL SKILLS

In 2010, the Institute of Romance philology started to recruit students having no knowledge of French. Therefore, a specific program had to be created in order that these students could reach the level required for the licence exam which is common for all groups. Within three years it is impossible to give students all the required elements, which is why autonomy in learning, techniques and skills in general will have a key influence on the studies. Thus, the student must acquire the skills to look by himself for the elements he needs. Doing so, he must be critical toward what he finds, and then combine the information he found with what he already knows in order to solve his problem. This has precisely been the goal of the e-learning module: not something about grammar, not about vocabulary, nor about the culture as a goal. These three components of the language are, of course, present but were mainly a pretext to show how transversal skills can help students in solving problems in language learning.

The module was composed of 14 groups of activities for the first year and of 5 tasks for the second year. Students were given around two weeks to complete each group of activities or task. They could modify their answers up to the deadline and use whatever means to reach the goals. The content was with a progressive level of difficulty but was not at all coordinated with the lessons they had in class: the module was fully independent.

The period of activity observed about which we will present here some results and comments was from April 2013 to February 2015.

The main transversal skills we targeted were: how to structure a text with what the student knows, his critical judgement; techniques to look for information and time management. The use of ICT was again obvious as the student was on a LMS. To this we also included cultural elements for the cultural competence.

4. RESULTS

4.1. Researchers` evaluation of transversal skills use during e learning course

The table 1 below presents our own appreciation of the requirements by skill for the first year. At first text structuration was low as the students were full beginners. Of course, these figures are quite subjective, but they are to show what importance was given to each skill. Focus was less also put on time management at the beginning as the activities proposed were at first requiring less time to be completed. In the first year, 10 to 15 activities were grouped around a topic or a point of grammar. Some of the activities were gaps to be filled with vocabulary, some were requiring short written answers and others were multiple choice items. The type of documents on which the activities were based were various: pictures, videos, texts, internet links to sites. This was done in order different searching techniques were needed to answer. To train the critical judgement, some traps for various tools were set, purposely to mislead the student. For instance, in an activity about sport the word “raquette” for tennis was to be translated and the Polish word “rakieta” was given. Students not critical to what they found would translate it by “roquette” or “fusée” both meaning “rocket” in English. Another activity presented the picture of some musketeers and the question was “what sport did the four musketeers practice?” The right answer was “tennis”, and the ones not critical would answer “fencing”.

Table 1.

Presence of work on transversal skills and cultural competence in the group of activities for the first year of studies (scale from 1- never to 4 very often)

	Transversal skills and cultural competence				
Name of the group of activities	*Text structuration*	Critical judgement	Information seeking	Time management	Cultural elements
1.1- Pays et nationalités	1	3	3	2	1
1.2- Chiffres	1	2	3	2	2
1.3- Articles 1	1	3	4	2	1
1.4- Articles 2	1	4	4	2	4
1.5- Verbes	1	4	4	3	3
1.6- A table!	1	4	4	3	4
1.7- Logements	2	3	4	3	3
1.8- Le corps	3	4	4	3	4
1.9- Positions et directions	3	3	4	3	2
2.1- Le sport	3	3	4	3	4
2.2- Les loisirs	3	3	4	3	3
2.3- Le cinéma	4	3	4	3	4
2.4- La France ailleurs	4	4	4	4	4
2.5- La métropole	4	4	4	4	4
average	**2,3**	**3,4**	**3,9**	**2,9**	**3,1**

Source: Own work

During the second year, students were able to make more complex written answers, which is why the requirement for text structuration was increased. Work on critical judgement was considered being already mainly done during the first year, but they were still traps set. More information seeking was needed, and the information was more complex to find in order to increase the efficiency of the techniques used. There were no more groups of activities but tasks: a goal had to be achieved thanks to different activities in the task, which were the steps to help reach the goal. Time management remained crucial as the tasks were requiring between 3 to 4 hours of work according to most of the students. Content used included more videos in original language but also with different accents and were longer than in the activities for the first year. Original texts and pictures were used as well as audio recordings (Table 2).

Table 2.

Presence of work on transversal skills and cultural competence in the tasks for the second year of studies (scale from 1- never to 4 very often).

	Transversal skills and cultural competence				
Name of the tasks	*Text structuration*	Critical judgement	Information seeking	Time management	Cultural elements
Task 1 - Ma cabane au Canada	4	2	4	4	4
Task 2 - J'ai la frite!	4	4	4	4	4
Task 3- Afriqu'art	4	2	4	4	4
Task 4- Assistant en Suisse	3	2	4	4	4
Task 5- On recrute	4	3	4	4	4
average	3,8	2,6	4,0	4,0	4,0

Source: Own work

4.2. Students evaluations of transversal skills use during e-course

At the end of each year, an anonymous survey questionnaire was sent to students. Among the questions was one on a Likert scale about their feeling about transversal skills. The tables 3 and 4 below gathers the results on the covered period (April 2013 to February 2015). Again, this is based on impressions and these results are subjective, but they do reflect the feeling students had. That is why we will here make only careful suppositions but not draw conclusions.

For the first year (Table 3), we can notice that about how the module helped them on text structuration, students felt it did not help much. This result is more than logical as we explained that this skill was barely touched as they are beginners. However, it seems that students did not feel the work on critical judgement. This might be because they did not see the traps or did simply not feel they were critical when choosing the information. At this point we can only suppose as no questions were asked on the details. The help for information seeking techniques was the most felt by students.

Table 3.

How important was the help for the development of skills thanks to the module according to the 1st year students (scale from 1=not at all to 4=a lot, n=73).

Skill	1	2	3	4	avevage
Text structuration	8	12	40	13	2,8
Information seeking	3	6	18	46	3,5
Critical judgement	8	19	30	16	2,7
Cultural elements	2	9	24	38	3,3

Source: Own work

On the second year (Table 4), although there was quite a strong requirement for longer and structured written answers, students did not feel a big help on this skill. Students even felt more help for critical judgement skill than text structuration. Feeling on how it helped for information seeking is similar to the first year, we must, however, remember that students already gained some techniques during the first year and might then have acquired new or strengthened the ones they possessed. The feeling on cultural content is stronger because all the tasks were heavily culturally oriented: A student exchange in Quebec, a presentation to do on Belgium, a Francophone African art contest, a job in Switzerland and a job interview to work in France.

Table 4.

How important was the help for the development of skills thanks to the module according to the 2nd year students (scale from 1=not at all to 4=a lot, n=58).

Skill	1	2	3	4	avevage
Text structuration	5	17	21	15	2,8
Information seeking	3	5	14	36	3,4
Critical judgement	4	10	25	19	3
Cultural elements	0	2	10	46	3,8

Source: Own work

As for time management for both years, we only asked the students how long the realisation of the elements took them. In the first year, answers were mainly “between one and two hours” (58%, 42 persons out of n=73). For the second year it took more time as the tasks were more complex: 52% (30 out of n=58) answered “between two to three hours” and 33% (19 out of n=58) “over three hours”. When we analysed the activity of each group of activities and tasks, the result was almost always the same: a pike of activity just the day before and on the day of the deadline. Meaning most students did the work at the last minute.

The last question of the questionnaire which was “the work on the platform contributed to the development of your skills in French language”, gave quite positive answers: in the first year 52% answered “I rather agree” (38 persons out of n=73) and 31% “I fully agree” (23 persons out of n=73). For the second year, 57% (33 persons out of n=58) answered “I rather agree” and 17% (10 persons out of n=58) “I fully agree”.

CONCLUSIONS

These results are encouraging us to think that the module was useful and did indeed help the students to increase their transversal skills, except maybe time management where some better ideas are to be found. This last element shows that this tool is not enough by itself. These skills will be used later not only for language learning but for all kinds of professional occupation that might appear. In our opinion, it is critical to prepare our students for the economic and social world, and working on transversal skills is of crucial importance. To this end, the help of an LMS seemed to us the best way to help to achieve this goal.

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