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Editorial

The IJREL Editorial Board is pleased to release the seventh number of the Journal. The present volume contains ten articles gathered in four chapters. Chapter I is entitled Research on Distance, Online and Blended Learning in COVID-19 time.

The texts focus on solutions introduced in online learning used in the conditions of the COVID-19 pandemic. In the issue, the reader will also find articles devoted to the methodology of teacher preparation to use ICT tools in the classroom and students use of learning strategies during remote knowledge and skills acquisition.

Preparation of teachers to use new technologies in online learning during the COVID-19 pandemic is the topic of the article by Ukrainian researchers – **Oksana Strutynska and Mariia Umryk**. The authors gathered data on the technologies used in higher education in their country. They referred their results to distance, online, and blended learning solutions. The data indicate that the teachers are aware of the possibilities to use numerous tools in online learning and want to increase their skills in this area. However, they see the need to gain more competence in using various tools. The results also show the necessity to improve work management and to decrease teachers' workload. The survey indicated the need for psychological support for teachers and motivational incentives.

Cloud computing and its use in education is the theme of the article by Portuguese Authors **Nuno Silva and Isabel Alvarez**. The text presents technical, pedagogical, as well as ethical and social aspects of using a Cloud to create, store, and retrieve knowledge. Data analysis was conducted in the context of the Luisiada University, which has its locations in Portugal and former Portuguese colonies in Africa. The results revealed difficulties with working with Cloud which stem from differences in culture, legal solutions, and students' competences. The authors to drew valuable conclusions on the importance of these difficulties with generating and sharing knowledge worldwide.

The usage of learning strategies by students participating in distance learning is the topic of the article by **Lucie Zormanová**. The article is a state-of-the-art re-

view of literature findings. On the basis of existing literature, the author extracted information on which learning strategies are preferred by the students learning online, which factors influence the use of strategies enhancing knowledge acquisition in online learning, and what kind of research methods has been used to explore the topic of learning strategies use among online learners.

Ukrainian researchers: **Nadia Balyk, Inna Grod, Yaroslav Vasylenko, Galyna Shmyger, and Vasyl Oleksiuk** devote their article to augmented reality and its role in training future teachers of computer science. The authors present the project in which students created an augmented technology application on the Unity Platform. The text contains valuable methodological insights from the project and the data presented support the effectiveness of using augmented reality in the classroom.

Chapter II "Innovative Methods and Technology in Education" includes three articles. **Svitlana Skvortsova and Tetiana Britskan** – in their article "Organization of Mathematical Distance Learning in Primary Schools" – provide data on the use of online services for creating virtual classrooms and interactive exercises, as well as organizing and conducting distance lessons in Ukrainian elementary education during the first months of the COVID-19 pandemic. The data obtained provide evidence that knowledge of various services and applications should be supported by encouragement to use them extensively, which is especially important in the case of Google Classroom and tools for creating interactive videos. The authors of the article provide valuable recommendations and solutions concerning services which are designed to conduct online learning.

Juan Arias Masa, Rafael Martín Espada, and Juan Arias Abelaira present the article "Teaching in the subject 'Systems Interconnection' of Extremadura University". The authors describe the contents of the "System Interconnection" course, basic competences to be acquired by students, teaching methodology, including expository classes, practical tasks, autonomous and virtual learning, as well as course evaluation results. The authors present evidence for gradual increase in students marks as the course is perfected and especially as summative evaluation was introduced in 2017.

The review of the data concerning the usage of new technologies in the Czech Republic is contained in the article titled: "Czech Population Sociability Online in the European Context" by **Hanne-Lore Bobáková and Martina Chylková**. The text shows the usage of various online learning tools in the Chech Republic and other European countries. The authors focused on online learning participation and Internet usage skills.

Chapter III "Theoretical, Methodological and Practical Aspects of ICT and E-Learning In Education. E-Learning In Development Of Key Competences And Skills In Education" contains two papers.

In the article "Measuring Student Involvement When Taking Tests in E-learning Courses", **Krzysztof Dziedzic** from Poland presents the study on the effectiveness of using the Quizzer e-learning platform. The text presents the platform which provides data on the correctness of answers, number of attempts, hint usage, and time of users' reactions. The data provided illustrate the utility of the platform and show the most effective modes to its usage in online education.

In the article "Visual Literacy as a Dimension of the Young generation's Cultural Capital – Comparative Research" by **Małgorzata Wieczorek-Tomaszewska,** the results presented focus on opinions on visual communication and visual literacy of Polish and Italian students. The results of the extensive study, which uses both qualitative and quantitative approach, showed, among others, that traditional visual artwork is present in the lives of young generation and young people are able to recognize authors of various paintings, as well as characters and symbols which they contain. Evidence is given for the great importance attached to visual forms of communication by the young generation, especially in shaping attitudes and providing information. The data presented in the text show that the young generation is well prepared for taking advantage of modern technologies in which presentation of information in the visual form is prevalent.

Chapter IV "Reports" includes one article. "A Report from the 12th Annual International Scientific Conference 'Theoretical and Practical Aspects of Distance learning' DLCC2020 (www.dlcc.us.edu.pl) entitled 'Innovative Educational Technologies, Tools and Methods for E-learning', held online at the Uiversity of Silesia, Poland, October 12th and 13th, 2020 DLCC2020", prepared by **Eugenia Smyrnova-Trybulska,** describes proceedings from 12th Annual International Scientific Conference 'Theoretical and Practical Aspects of Distance learning': ogranisers, programme, lectures and presentation, keynote speakers, events, some conclusions, and photoreportage.

We hope that studies and solutions included in the present IJREL volume will be inspiring and encourage reflection on how to manage the increasing demand for online education.

Eugenia Smyrnova-Trybulska
https://orcid.org/0000-0003-1227-014X
Anna Studenska
https://orcid.org/0000-0002-6699-9510

I. Research on Distance, Online and Blended Learning in COVID-19 time

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Oksana Strutynska
National Pedagogical Dragomanov University, Kyiv, Ukraine
http://orcid.org/0000-0003-3555-070X

Mariia Umryk
National Pedagogical Dragomanov University, Kyiv, Ukraine
https://orcid.org/0000-0002-0396-0045

Distance, Online and Blended Learning as Main Educational Trends During Pandemic 2020 Conditions

Abstract

Distance learning and self-education have been an actual trend for many years but during the pandemic, it became critically relevant and important. The closure of schools and higher education institutions around the world had a negative impact on the educational sector in many countries in general and has affected almost every student and educator. This paper examines Ukrainian educators' level of knowledge and skills in using modern distance learning tools and trends and the way of improving the teaching-learning process during the conditions of the 2020 pandemic. The authors present their review of educational trends under the conditions of distance, online and blended learning. They also examine the Ukrainian educators' level of knowledge and skills in using modern distance learning tools and trends. For this purpose, the authors have elaborated and implemented a local survey for a Ukrainian university teaching staff (target group) who need to use distance learning tools in their research and professional activity during the quarantine. The authors also present the ways of improving the learning process via distance learning tools.

K e y w o r d s: distance learning tools, distance learning trends, COVID-l9, digital transformation, learning tools, educational trends

The trend towards distance learning and self-education has been unchanged for many years but during the pandemic, it became critically relevant and important. The closure of schools and higher education institutions around the world has had a negative impact on the educational sector in many countries in general and has affected almost every student and educator.

The statistics (on the official UNESCO portal) indicate that more than 60% of pupils and students worldwide have faced the problem of full or partial closure of schools (Education: From disruption to recovery. UNESCO, 2020). Data as of August 3, 2020 show that 1,058,547,236 pupils and students around the world have suffered from full or partial closure of educational institutions. This is 60.5% of the total number of pupils and students in the world. It is also stated that as of August 3, 2020, 105 countries have closed educational institutions (Education: From disruption to recovery. UNESCO, 2020).

Therefore, many schools and universities use every opportunity to keep the learning process going. For this purpose, all educational technologies for distance learning are widely used: the Internet, television, mobile communication, etc. Educators of all countries are faced with the issue of implementation of the distance learning process without losing the quality of such training compared to the classical pre-quarantine training. Thus, considering the 2020 pandemic, distance learning tools are very important tools of modern education at all levels.

Problem of Research. This paper examines the level of knowledge and skills of selected Ukrainian educators in using modern distance learning tools and trends and the way of improving the teaching-learning process during the conditions of the 2020 pandemic.

Research Focus. Taking into account the rapid development of digital technologies, the authors believe that the efficiency of education in general will be increased by improving the teaching-learning process during the 2020 pandemic conditions and in the future, after the pandemic conditions have loosened.

Methodology of Research

The goal of the research is to address the following issues:

- analysis of the modern trends in education;
- analysis of the readiness level of Ukrainian educators (from target group) in the use of distance learning tools, according to the conducted survey;
- consideration of the ways of improving the teaching-learning process via distance tools and during the 2020 pandemic conditions.

Research methods. The authors have used the following research methods and tools for the investigation (2020):

- survey;
- interview with selected Ukrainian educators;
- documents and content analysis;
- analysis of research papers.

194 Ukrainian educators have taken part in the present research. The Ukrainian educators from the target group (university teaching staff from the Dragomanov National Pedagogical University, Kyiv, Ukraine), have been involved in this process.

The survey was created to collect data on the readiness level of the university teachers to use distance learning tools.

The Results of the Research

1. Educational Trends Under the Conditions of Distance, Online and Blended Learning

Huawei presented to the world the latest Global Industry Vision (GIV) report, which outlined the impact of technology in the coming years and identified various technological trends (techno-trends) of the future until 2025 (Huawei Predicts 10 Megatrends for 2025), (Economic Strategy of Ukraine 2030. Ukrainian Institute of the Future), (Morze, Kucherovska, & Smyrnova-Trybulska, 2020). They include:

- the use of bots (penetration of bot technology into social life is expected to be 14%);
- virtual and augmented reality technologies (the percentage of industries that use VR/AR will increase to 10%);
- no-search service (the trend of equipping daily-used devices with special sensors which allows the device to anticipate human needs and meet them without human influence. GIV predicts that 90% of owners of smart devices will use intelligent personal assistants);
- robotization;
- enhanced creativity (access to cloud services will reduce barriers to scientific experimentation, innovation and art, opening horizons for creativity. GIV predicts that 97% of large companies will use such technologies);
- communication without borders;
- cloud technologies expansion (up to 85% of applications are projected to be cloud-based).

Under such conditions, society and education should evolve and focus on the future, train professionals who will turn innovations into inventions, and, consequently, produce a transformation within the educational environment, which, in turn, will provide comprehensive competency and modern approach to education (Morze, Kucherovska, & Smyrnova-Trybulska, 2020, p. 75).

Existing research (Sánchez Begines, et al., 2017), (NMC Horizon Report Preview, 2018), (Morze, Vember, & Hladun, 2019), (Morze, Kucherovska, & Smyrnova-Trybulska, 2020), (Hrynevych, 2020) examines current educational trends and their impact on the formation of educational policy in the field of the digitalization of educational institutions. Based on their analysis, the authors identify the following educational trends:

- lifelong learning;
- ***distance learning, online learning;***
- ***blended learning;***
- informal learning (also MOOCs);
- STEAM education;
- gamification;
- multidisciplinary environments;
- mobile technology in education;
- cloud technology in education;
- VR, AR, MR;
- 3D printing and robotics in education;
- coding for children/young adults.

Thus, an important issue for quality education under the quarantine conditions is proficiency in modern ICT in education, which primarily includes distance learning, online and blended learning technologies.

Distance, online and blended learning are interrelated. Blended learning uses distance and online learning technologies. Distance learning uses online learning, but it can also be done in an asynchronous mode.

The concept of blended learning appeared in the 1990s, as opposed to online learning, Blended learning was implemented in some forms in the university system of North Carolina in the mid-1990s as a pilot project. In general, people started to study and implement it only after the beginning of the 2000s. The term «*blended learning*» has different definitions in the literature and means a combination of online learning, traditional (full-time) and independent learning and in different proportions. Other names include: «*hybrid learning*» and «*flexible learning*».

Blended learning is not the same as distance (or online) learning. Online learning does not involve personal communication between students in the classroom (or between students and teachers). It is also its main advantage and dis-

advantage compared to blended learning, as students who study online do not have the opportunity to communicate personally and develop teamwork skills (Blended learning: essence and advantages in the modern world , 2019). Blended learning means group learning, self-study that can be done both in classrooms and online.

In 2007, experts from the Sloan Consortium classified several models of the learning process, depending on the use of distance learning technologies (Rashevska, 2010), (Allen & Seaman, 2011), (Buhaichuk, 2016):

- traditional / classroom learning (0%);
- full-time / face-to-face learning, enhanced by distance technologies (the use of distance technologies up to 30%);
- blended learning (the use of distance technologies up to 80%);
- online learning (the use of distance learning technologies – more than 80%).

The classification of the learning process models based on the use of distance learning technologies is presented in Table 1 (Rashevska, 2010), (Allen & Seaman, 2011), (Buhaichuk, 2016):

Table 1
Classification of the learning process models based on the use of distance learning technologies (according to Sloan Consortium's findings)

Percentage of use of distance learning technologies	Model of learning process	Brief description
0%	Traditional (classroom) learning	Information is delivered orally or in writing (digital technologies are not used), asynchronous interaction is not carried out
1–29%	Use of distance learning technologies	Network technologies are used, but mostly for the delivery of educational material and organizational issues within the traditional learning of a specific discipline
30–79%	Blended learning	Network technologies are used not only for the delivery of educational material, but also for task performance, cooperation and other educational interactions. Face-to-face meetings are kept to a minimum
80+%	Online learning	All educational activities and delivery of educational material are carried out using network technologies. No face-to-face meetings are scheduled

S o u r c e: Own work based on Buhachuk (20l6)

The Clayton Christensen Institute (USA), which has been studying blended learning for many years, notes that it is a form of learning within which a student receives a formal educational program (Clayton Christensen Institute for Disruptive Innovation. Blended Learning). The student:

1. ***Partially*** learns ***online*** using materials located on the Internet (with elements of self-control, at an individual pace, anywhere, at a convenient time, etc.).
2. ***Partially*** learns ***in the classroom*** under the supervision of a teacher (students physically attend the institution for face-to-face classes; at the same time, they should complete at least part of the curriculum not at home but at school, according to the schedule).
3. Gains a ***comprehensive (complex) learning experience*** (this is due to a combination of full-time and online learning).

2. Examination of Ukrainian Educators' Knowledge of Current Trends in Virtual Education and Their Skills in the Use of Modern Distance Learning Tools

Areas of digital technology are the basis for digital transformations in Ukraine. The analysis of these trends makes it possible to predict the development of specific economic, technological, and even social phenomena in the future (Project "Digital agenda of Ukraine 2020", 2016, p. 12).

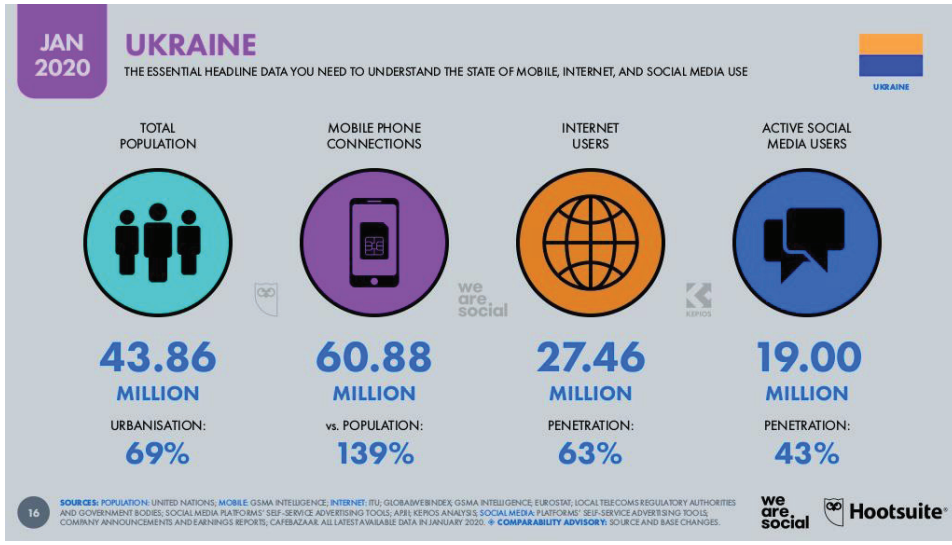

Figure 1. Statistics on the use of digital technologies in Ukraine.

S o u r c e: Kemp S. (2020) «*Digital 2020 Ukraine*» Hootsuite & We Are Social, retrieved from https://datareportal.com/reports/digital-2020-ukraine (accessed on 27.08.2020)

The statistical data of the ***Data reportal*** (supported by the agency *We Are Social* and the social media management platform *HootSuite*) also acknowledges that digital technology is now an integral part of human life. These trends are also present in Ukraine. At the beginning of 2020, it has been determined that more than half of the population in Ukraine are Internet users (63%). 43% are already active users of social networks (Hootsuite & We Are Social, 2020). It is noted that Ukrainians use almost 61 million mobile devices; in general, one person has more than one mobile device (Fig. 1).

The dynamics of changes in the use of digital technologies in Ukraine is presented in Fig. 2:

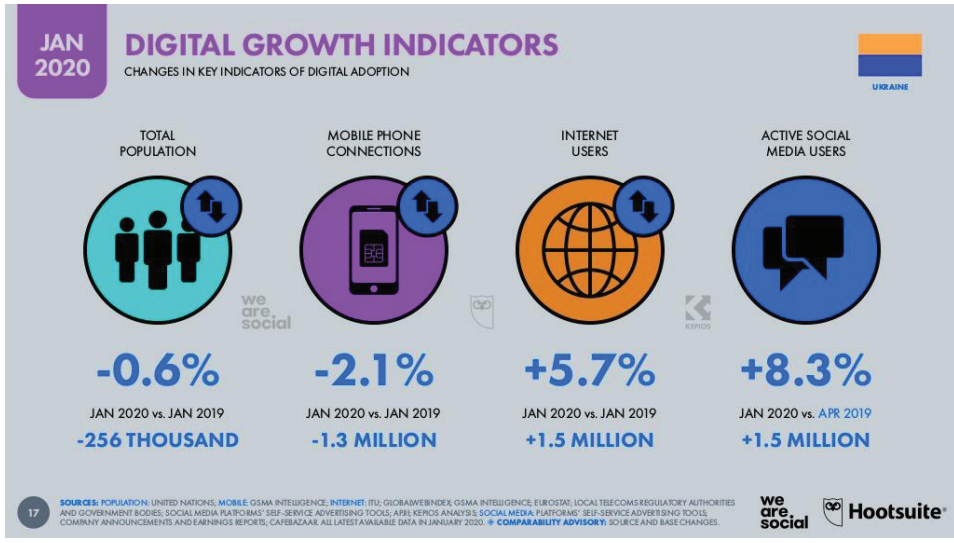

Figure 2. Dynamics of changes of the use of digital technologies in Ukraine.
S o u r c e: Kemp S. (2020) «*Digital 2020 Ukraine*,» Hootsuite & We Are Social, retrieved from https://datareportal.com/reports/digital-2020-ukraine (accessed on 27.08.2020)

As we can see from Fig. 2, the number of Ukrainian Internet users increased from January 2019 to January 2020 (by 5.7% – about 1.5 million people). The number of active social media users had also increased (by 8.3% – about 1.5 million people).

This shows that digital technology is an integral part of human life. Digital transformation is becoming the basis of global economic development, which provides benefits to both consumers and businesses that adapt to the technological changes.

Among many other countries, Ukraine is also developing a digital transformation strategy aimed at supporting sustainable economic growth and increasing the

productivity of the economy. In recent years, several important steps have been taken in this direction, namely the adoption of such documents as:

- EU4Digital initiative between the EU and the EU's Eastern Neighborhood (2016);
- project «Digital Agenda of Ukraine - 2020» (2016);
- The Concept for development of the digital economy and society for 2018-2020 in Ukraine (2018);
- Creation of the Ministry of Digital Transformation of Ukraine (2019).

Citizens are the key resource of the digital society. They are able to use digital technologies for their own needs effectively and productively (self-realization, work, study, and leisure), as well as to achieve common economic, social and civilian goals. In this regard, the development of digital skills and competencies of Ukrainians acquires special significance, which cannot be realized without the transformation of education.

The directions of the modernization of education largely depend on the needs of the labor market, which, recently, has been very dynamic. In the conditions of the rapid development of high technologies, higher education institutions, first of all pedagogical ones, need to make adjustments in various aspects of their activity, in particular, to update the content of their training.

The digital transformation of education opens wide prospects for improving the efficiency of the educational process, deepening the professionalism of educators. The requirements of teachers and lecturers are being constantly updated. New and more sophisticated sets of competencies are required to meet the rapid changes in the digital society. The rapid spread of digital devices, their diversity, and popularity among students leads to the need to develop the digital competence of educators (Strutynska & Umryk, 2018), (Morze, Vember, & Hladun, 2019).

The situation in the world, which has arisen due to the pandemic of 2020, is leading to fundamental changes in the educational systems of many countries, including Ukraine. Due to quarantine measures, blended and distance learning technologies come to the fore. Now, skills in the use of distance learning tools are necessary for all educators in Ukraine. So, it is important to examine the Ukrainian educators' level of knowledge and skills in using modern distance learning tools.

The present research is based on a target group that needs to use distance learning tools in their professional activity. This target group consisted of 194 Ukrainian university educators from the Dragomanov National Pedagogical University (Kyiv, Ukraine).

The online survey was elaborated in Ukrainian using Google Forms to collect responses concerning the Ukrainian educators' readiness level to use ICT in their professional activity, especially distance learning tools. We guaranteed participants that only anonymized data would be shared.

The survey was open for a 3-month period between March and June 2020 (the time of the quarantine). It contained information about modern distance learning tools.

The survey included 26 questions divided into three groups:

- general information (about the educational role, discipline, age, sex, etc.);
- questions related to the educators' professional activities with the use of distance learning tools under the conditions of the quarantine;
- questions determining the general distance learning readiness of the university educators under the quarantine (problems, readiness for training, etc.).

The distribution of respondents by educational role is shown in Fig. 3.

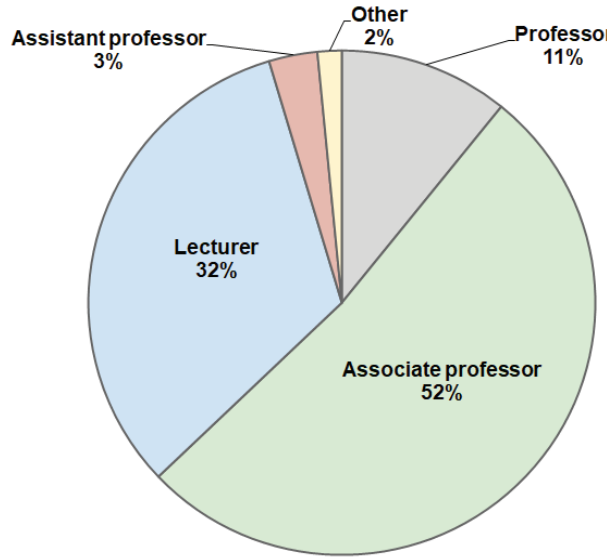

Figure 3. Distribution of respondents by educational role.
S o u r c e: Own work

As we can see from Fig. 3, the largest group of respondents is *associate professor* (52% of the participants – 101 people). The number of *lecturers* is 63 people (32% of the participants) and the number of *professors* is 21 people (11% of the respondents). The smallest group of participants is *assistant professor* (3% of the participants – 6 people). The ***«other»*** group includes moderators and department assistants who are not teachers. They are the support staff of the university.

It is drastically important to analyze and describe the readiness level of the educators from the Dragomanov National Pedagogical University (Kyiv, Ukraine)

to use distance learning tools and online learning tools under the quarantine conditions. They are training and preparing the future teachers of the country. Their future professional activity depends on how effectively university teachers will teach their students – the future teachers – with the use of distance learning tools and online learning tools. Namely, the more effectively the university teachers will teach future teachers to use distance learning tools and online learning tools, the more effectively the latter will use them in teaching at school.

2.1. The readiness level of the selected group of Ukrainian educators to use distance learning and online learning tools

The data on the readiness level of the Ukrainian educators from the target group to use distance learning and online learning tools are presented in Tables 2–3 and Fig. 4–5 below.

Q1*: Do you use distance learning activities during the quarantine?*

All respondents answered «***yes***», but the next questions and answers will show the tools used.

Q2*: What distance learning platforms do you use?*

Survey responses on distance learning platforms' usage are shown in Table 2 (multiple answers are possible, which is why the total responses may be more than 100%):

Table 2
Responses' distribution on distance learning platforms usage

Distance learning platforms	Responses
Google Classroom	30.41%
Moodle	68.56%
Microsoft Teams	1.03%
Tebo	0.52%
Schoology	0.52%
Other tools	4.64%
I don't use any platforms	0.52%

S o u r c e: Own work

As we can see from Table 2, almost all university educators have used distance learning platforms, especially *Moodle* (68.56%) and *Google Classroom* (30.41%). The Dragomanov National Pedagogical University has its own educational envi-

ronment based on *Moodle* (moodle.npu.edu.ua). That is why the common answer to this question was «***Moodle***». In addition, educators have used *Google Classroom* because it is a freeware and friendly-interface distance-learning platform. Among the answers «***Other tools***», respondents sometimes wrote «***e-mail***», «***Zoom***», «***Telegram***», «***Viber***», «***Skype***», etc. It shows that educators do not know that these tools are not distance learning platforms.

Q3*: What tools for video conferencing meeting do you use in your professional activity?*

Survey responses on video conferencing meeting tools' usage are shown in Table 3 (multiple answers are possible, which is why the total responses may be more than 100%):

Table 3
Distribution of responses on video conferencing meeting tools usage

Video conferencing meeting tools	Responses
Google Hangouts Meet	11.34%
Zoom	50%
Microsoft Teams	2.06%
Skype	53.09%
Viber	6.19%
Telegram	2.06%
YouTube Live	8.76%
Other tools	3.61%
I don't use any tools	14.95%

S o u r c e: Own work

Survey responses on video conferencing meeting tools' usage distributed by educational role are shown in Fig. 4 (multiple answers are possible, which is why the total responses may be more than 100%).

As we can see from Fig. 4, the largest group of respondents (53.09%) used *Skype* as a video conferencing meeting tool. The popularity of this tool can be explained by the fact that teachers have previously used it for personal communication. As for *Zoom*, it is used by half of the respondents (50%), which can be explained by its simple interface and the availability of browser and free versions of this software. At the same time, about 15% of educators from the target group did not use any tools.

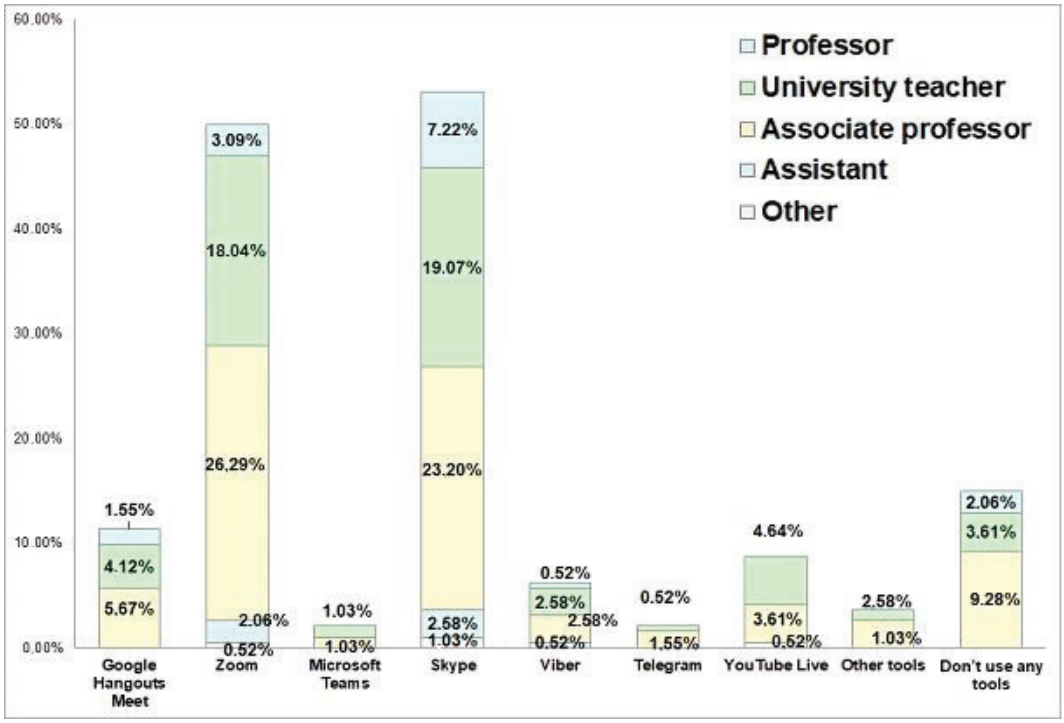

Figure 4. Survey responses on video conferencing tools' usage distributed by educational role

Source: Own work

***Q4**: What tools do you use for designing and creating electronic teaching materials (tasks, exercises, practices, tests, etc.) in your professional activity?*

Survey responses on using tools for designing and creating electronic teaching materials are shown in Fig. 5 (multiple answers are possible, which is why the total responses may be more than 100%).

Fig. 5 shows that the most popular tools for designing and creating electronic teaching materials are *Moodle* (73.71%), *Google Forms* (31.44%) and *H5P* (29.38%). In this case, materials developed using *H5P* can be embedded in *Moodle*.

The group ***«other»*** includes the following tools: *Quizizz*, *Testmoz*, *Socrative*, *Liveworksheets*, *Actionbound*, *Edpuzzle*, *Wordwall*, *Baamboozle*, *Classtime*, *Hot potatoes*, *Crosswordlabs*, *Easy generator*, *Idoceo*, and *Google Classroom*. But their use is not very popular (8,76%) among the tools used by the university teachers. This means that the teachers try to use *Moodle* (as a tool of education and within the informational environment of the university). At the same time, some respondents do not use any tools (about 8%).

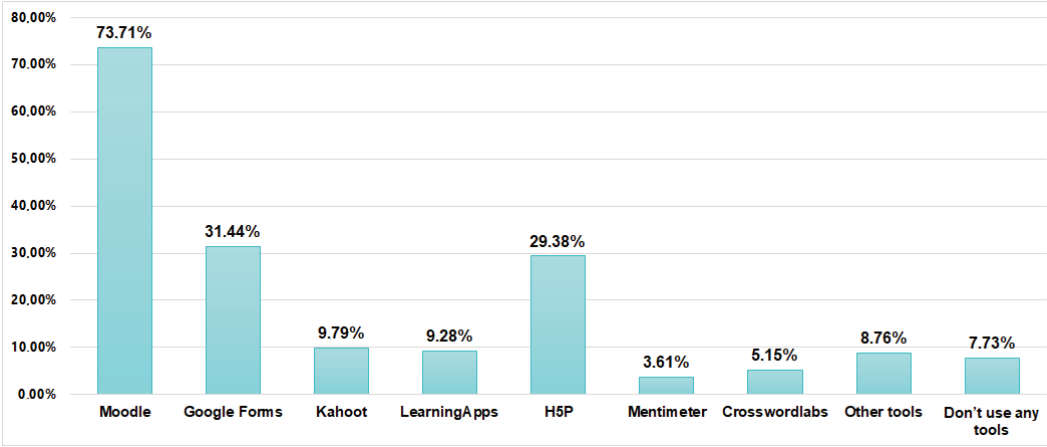

Figure 5. Survey responses on using tools for designing and creating electronic teaching materials

S o u r c e: Own work

2.2. The readiness of the Ukrainian university educators to improve their skills in using distance learning tools and online learning tools

The data about the readiness of the Ukrainian educators from the target group to improve their skills in using distance learning tools and online learning tools is presented in Figs. 6–9 below.

Q5*: What barriers/obstacles did you face during distance learning classes under the quarantine conditions?*

Survey responses on existing barriers/obstacles during the conduction of distance learning classes under the quarantine conditions are shown in Fig. 6 (multiple answers are possible, which is why the total responses may be more than 100%).

The analysis of answers (given by educators from the target group) to questions about the obstacles to distance learning shows (Fig. 6) that most respondents (almost half of respondents – 48.97%) have no experience in using distance learning tools and online learning tools. In addition, a significant proportion of respondents had limited technical capacity (27.32% of respondents) to implement distance learning under the quarantine conditions due to the 2020 pandemic. At the same time, 22.16% of teachers believe that the management instructions concerning the organization of distance learning were not clear enough. 17.53% of respondents mentioned psychological problems regarding readiness to work under the conditions of distance and online learning.

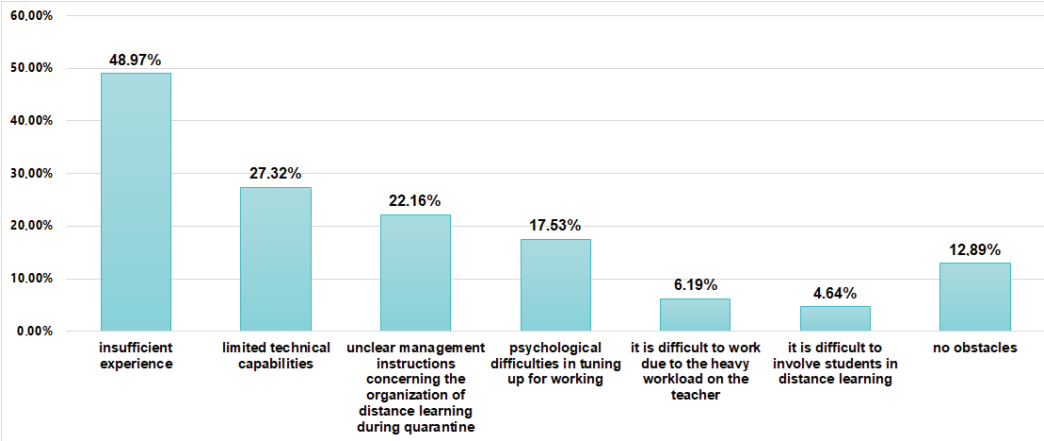

Figure 6. Survey responses on existing barriers/obstacles during distance learning classes under the quarantine conditions

S o u r c e: Own work

The Digital Educational Technology Center was established at the Dragomanov National Pedagogical University to effectively organize the educational process under the conditions of distance, online and blended learning. Further actions of the Digital Educational Technology Center are aimed at solving these problems.

The idea that the workload of teachers under the conditions of distance and online learning is expanding (due to the need to develop qualitative electronic teaching materials, detailed instructions for organizing the learning process, different learning paths of students, checking and evaluating tasks, etc.) is also confirmed by the answers to the next question.

***Q6**: How much time (during the day) do you spend on preparing distance learning classes and online classes?*

Survey responses on the preparation time (during the day) for distance classes and online classes are shown in Fig. 7.

Most of the interviewed teachers believe that their workload has increased significantly during distance and online learning. Fig. 8 shows that university teaching staff from the target group spend a lot of time every day to prepare for distance and online classes online (on average, at least 5 hours, taking into account pre-designed training courses for full-time study).

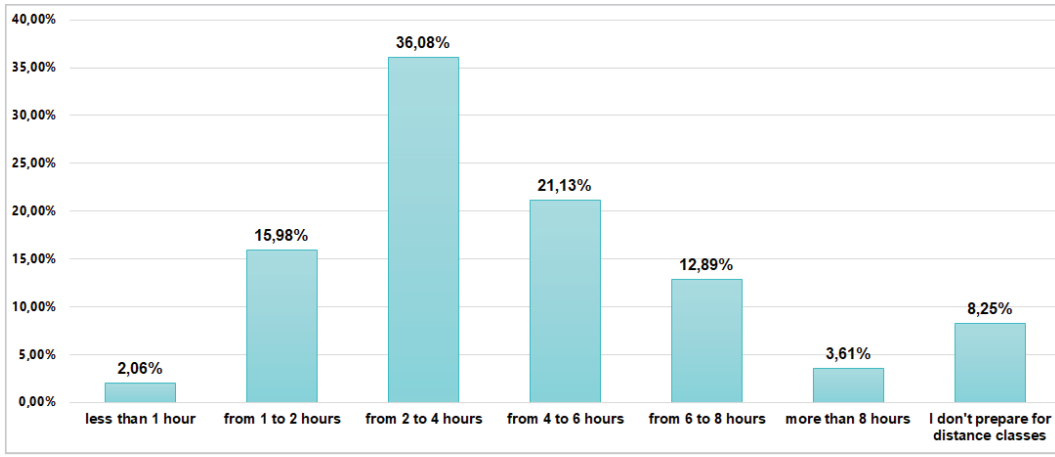

Figure 7. Survey responses on the preparation time (during the day) for distance classes and online classes
S o u r c e: Own work

Q7*: Do you use MOOC platforms for self-education?*

Survey responses on the use of MOOC platforms for self-education are shown in Fig. 8 (multiple answers are possible, which is why the total responses may exceed 100%):

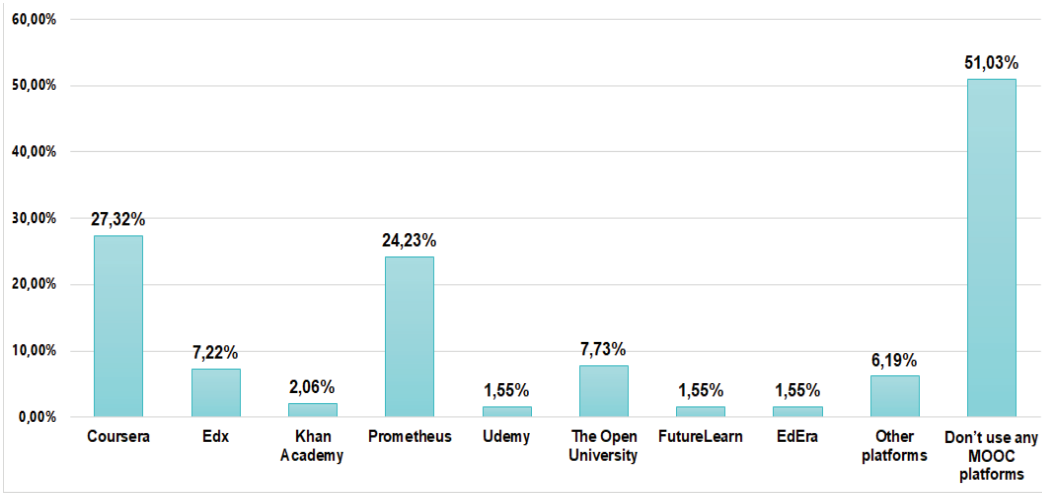

Figure 8. Survey responses on the use of MOOC platforms for self-education
S o u r c e: Own work

As we can see from Fig. 8, the Ukrainian educators from the target group mostly use *Prometheus* (24.23% responses) and *Coursera* for self-education (27.32% responses). The reason for this fact is explained above. Another reason for using *Coursera* and *EdX* by educators from the target group is the fact that the part of MOOC from these platforms was opened for University teaching staff and students (with the support of the Digital Educational Technology Center of the Dragomanov National Pedagogical University). Unfortunately, most of the respondents (51.03%) do not use any MOOCs for self-education.

***Q8**: Would you agree to advanced training (retraining, second higher education, self-study) in order to implement distance and online learning technologies in the educational process?*

Survey responses on the readiness of educators from the target group to advance training in the use of distance and online learning technologies in their own professional activity are shown in Fig. 9:

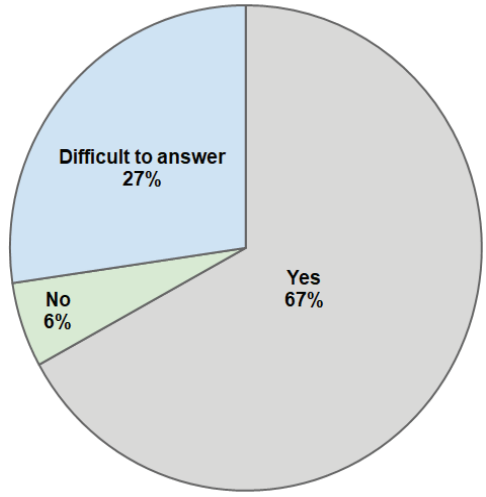

Figure 9. Survey responses on the readiness of educators from the target group to advance training in the use of distance and online learning technologies in their own professional activity

S o u r c e: Own work

As we can see from Fig. 9, most of the Ukrainian educators from the target group (67% of the respondents) are ready to receive advanced training in the use of distance and online learning technologies in their own professional activity. We are planning to outline the ways to improve their Digital Competences in this field in our further research.

3. The Ways of Improving the Learning Process via Distance Learning Tools

Modern educational institutions have faced new requirements even before the quarantine period (Morze, Smyrnova-Trybulska, & Glazunova, 2017), (Kuzminska, Mazorchuk, Morze, & Kobylin, 2019), (Kuzminska, Mazorchuk, Morze, & Kobylin, 2020). On the one hand, according to the theory of generations, pupils and students have changed; on the other, the introduction of modern educational trends is one of the key conditions for the successful functioning of an educational institution. Some of the priority areas for educational institutions are (Strutynska & Umryk, 2018), (Strutynska, Torbin, Umryk, & Vernydub, 2020):

- digitalization and innovation;
- globalization (establishing an intercultural environment);
- mobility of students, pupils, teachers, and lecturers;
- distance and online learning;
- informal learning and MOOC technologies.

The conditions of the pandemic put the leaders of educational institutions up to reconsidering and changing approaches to the educational process. Accordingly, the digital environments of educational institutions were changed and adapted to form the digital analogue of physical institutions. Specialists with different success rates try to model the digital environment of all structural and learning components of educational institutions. Virtual classes, remote personal accounts, distance lectures, etc. have appeared. The problem of placement and full functioning of all the elements of the educational process in the distance and blended learning modes has also become extremely acute.

An example of such an adaptation is the following model of distance learning, which describes the features of the educational process' organization during the quarantine in the Dragomanov National Pedagogical University (Fig. 10).

This model of distance university work has arisen by force and, for the greater part, it was a quick response to the quarantine conditions in which the whole world found itself. In addition, the university management designed possible models of organization of the educational process in the Dragomanov National Pedagogical University in terms of full or partial distance learning:

1. Blended model.
2. Distance model.
3. Classical (face-to-face) post-quarantine learning model.

I. **Blended learning model**. The advantages of this learning model are recognized by many scholars and are widely used in universities. The model contains two components, such as distance and full-time (face-to-face) classical learning. The Dragomanov National Pedagogical University has implemented a blended learning model before the pandemic because this pedagogical technology could be very important for the formation of quality education.

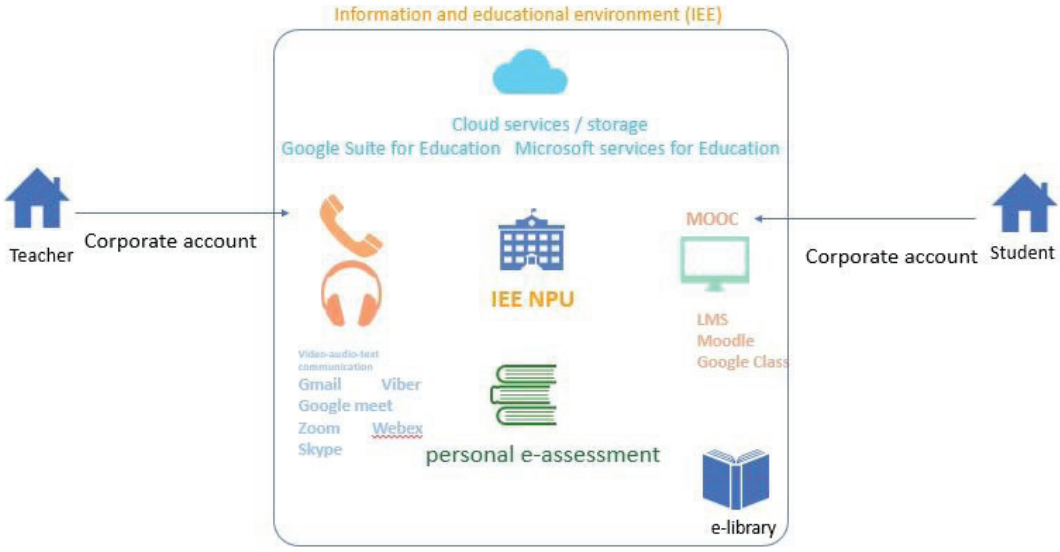

Figure 10. Educational process in the Dragomanov National Pedagogical University during the quarantine

S o u r c e: Own work

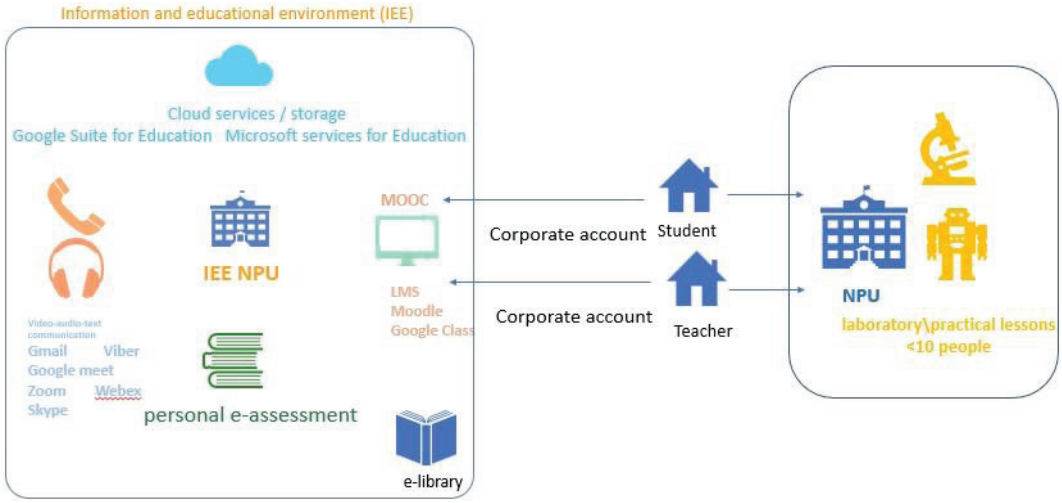

Figure 11. Blended learning model during the quarantine in the Dragomanov National Pedagogical University

S o u r c e: Own work

Blended learning provides flexibility in relation to traditional learning. It also allows teachers to offer training in different variations of the presentation of

educational material, containing the format of training courses, which is a harmonious combination of traditional and distance learning. Blended learning was implemented at the university as part of the use of the Moodle platform and elements of MOOC (massive open online courses) in full-time education. During the quarantine, the blended learning model was adapted and became more commonly used. The blended model is implemented through online classes with support for various distance learning technologies and through face-to-face classes in small groups of up to 10 people, taking into account the quarantine conditions (Fig. 11).

II. **Distance learning model**. The distance learning model was forced to be implemented during the quarantine. It includes solely online classes with support of various distance-learning technologies without the inclusion of face-to-face classes. This model is described above and shown in Fig. 10.

III. **Classical model of face-to-face learning** (post-quarantine). It is planned that all learning tools involved in and implemented during the quarantine should continue to work and improve the efficiency and quality of education. The post-quarantine learning model includes traditional learning with distance support of all elements of the educational process (Fig. 12). Besides, there is a module of international activities of the university with international mobility for faculty and students.

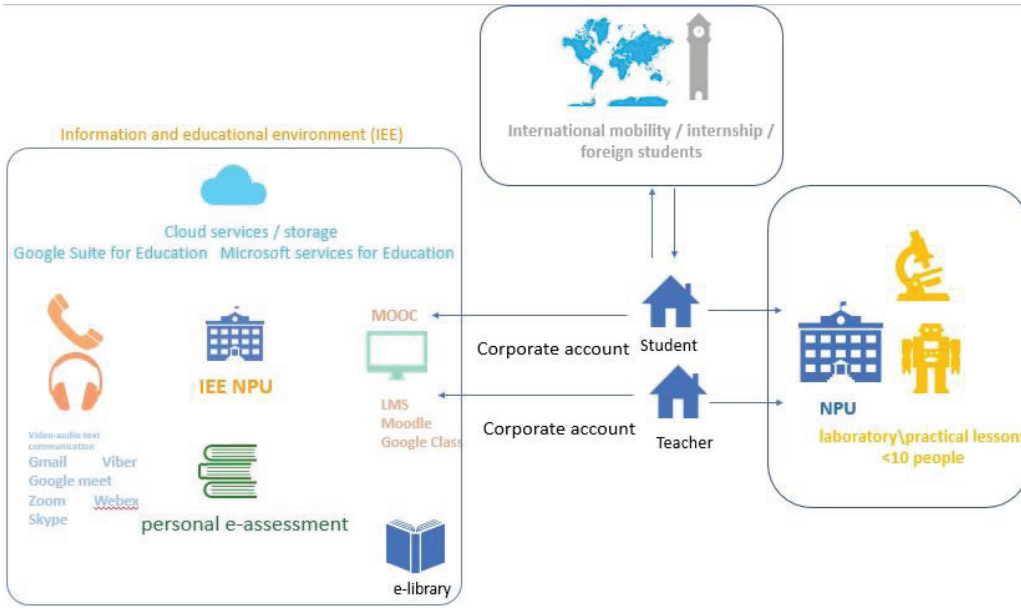

Figure 12. Classical (face-to-face) post-quarantine learning model in the Dragomanov National Pedagogical University

S o u r c e: Own work

Practical implementation of distance and blended learning models (that took place under the quarantine conditions due to the pandemic 2020) has shown their effectiveness. The survey results have shown the need to improve the skills of the Ukrainian educators from the target group in order to allow them to use the existing information and education environment of the Dragomanov National Pedagogical University effectively and ensure a high-quality educational process. It is obvious that the classical post-quarantine learning model will be specified by an increase in the share of distance learning tools and online learning tools in general.

Discussion

The survey results show that the level of knowledge and skills of the target group as regards the use of distance learning tools need to be improved. The possibilities of development should take the following issues under consideration:

1. Survey responses on video conferencing tools' usage have shown that about 15% of educators from the target group did not use any tools. Also, more than half of the respondents use Zoom and Skype without verification and authentication (Fig. 4).

It means that there is a need to improve their skills in the use of distance learning tools and online learning tools, i.e., video conferencing tools. The paths to development are provided through the training and retraining of future teachers.

2. Survey responses on the use of tools for designing and creating electronic teaching materials (Fig. 5) indicate a lack of technical means for the development of electronic teaching materials and/or the need to improve skills in the development of relevant digital competencies. The last issue needs further research.
3. Survey responses on existing barriers/obstacles during distance learning classes under the quarantine conditions have shown that university teachers need psychological support, which can be organized in the form of training conducted by psychologists who deal with similar problems (Fig. 6). The Faculty of Psychology of the Dragomanov National Pedagogical University provides special training for educators.
4. Survey responses on using MOOC platforms for self-education have shown that the university must implement a motivation system (a system of incentives) in order to change this situation (Fig. 8). One of the possible solutions is considering certified MOOCs as advanced training of teaching staff.

Recommendations:

- Retraining of the University teaching staff to improve their skills in the use of distance learning tools and online learning tools have started in the current academic year (2020-2021), supported by the Digital Educational Technology Center of the Dragomanov National Pedagogical University.
- The involvement of university teacher staff in the psychological training to support them under quarantine conditions.
- Proposed models need to be improved to account for the rapid development of digital technologies and the appearance of new learning tools.

Acknowledgements

The present research was organized and supported by the Digital Educational Technology Center of the Dragomanov National Pedagogical University.

Conclusions

Under the conditions of the 2020 pandemic, such models of study as distance, online and blended learning now are educational trends. The task of every educator is to be skilled in using distance, online and blended learning tools for the effectiveness of professional activity. Therefore, the analysis of the educators' level of skills and awareness in this matter is the starting point for decisive changes in improving the competence of educators and organizing the educational process in general.

The authors also propose to improve the teaching-learning process in the field of digital competencies' development through the training of future teachers in the Dragomanov National Pedagogical University to prevent the gaps in their future professional activity.

Based on the experience gained in this research and on the feedback received from the target group, the authors are planning a scenario for the next steps in improving the Ukrainian educator's level of knowledge and skills in the use of distance learning tools and trends in their professional activity, especially under quarantine conditions:

- the analysis and adaptation of the best European practices in the use of the distance learning tools in the professional activity for the training of Ukrainian educators;
- design of the curriculum for the retraining of Ukrainian educators and implementing it in the Dragomanov National Pedagogical University for the development of Educators' Digital Competences in using distance, online and blended learning tools;
- update of the informational and educational environment for improving the teaching-learning process of the Dragomanov National Pedagogical University;
- design of the possible models of the teaching-learning process of the Dragomanov National Pedagogical University (supported by the Digital Educational Technology Center) under the quarantine.

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Oksana Strutynska, Mariia Umryk

Nauczanie na odległość, online i mieszane jako główne trendy edukacyjne w warunkach pandemii 2020

Streszczenie

Tendencja do uczenia się na odległość i samokształcenia nie zmieniła się od wielu lat, ale podczas pandemii stała się niezwykle istotna i ważna. Zamknięcie szkół i instytucji szkolnictwa wyż-

szego na całym świecie miało negatywny wpływ na sektor edukacji w wielu krajach i dotknęło prawie każdego studenta i nauczyciela. W artykule przeanalizowano poziom wiedzy i umiejętności ukraińskich edukatorów w zakresie korzystania z nowoczesnych narzędzi i trendów w nauczaniu na odległość oraz sposób doskonalenia procesu nauczania-uczenia się w warunkach pandemii 2020. Autorzy przedstawiają przegląd trendów edukacyjnych w warunkach nauczania na odległość, online i blended learning. Zbadano również poziom wiedzy i umiejętności ukraińskich nauczycieli dotyczący korzystania z nowoczesnych narzędzi i trendów w nauczaniu na odległość. W tym celu autorzy opracowali i wdrożyli lokalną ankietę dla kadry dydaktycznej ukraińskiego uniwersytetu (grupa docelowa), która musi korzystać z narzędzi uczenia się na odległość w swoich badaniach i działalności zawodowej podczas kwarantanny. Autorzy przedstawiają również sposoby usprawnienia procesu uczenia się za pomocą narzędzi nauczania na odległość.

S ł o w a k l u c z o w e: narzędzia uczenia się na odległość, trendy uczenia się na odległość, COVID-19, transformacja cyfrowa, narzędzia edukacyjne, trendy edukacyjne

Оксана Струтинская, Мария Умрык

Дистанционное, онлайн и смешанное обучение как основные образовательные тренды в условиях пандемии 2020

А н н о т а ц и я

Тенденции последних лет показывают актуальность дистанционного обучения и самообразования, но во время пандемии они стали критически важными. Закрытие школ и высших учебных заведений по всему миру оказало негативное влияние на сектор образования во многих странах в целом и затронуло почти каждого учащегося и преподавателя. В данной статье исследуется уровень знаний и навыков украинских педагогов в контексте умений использования ими современных инструментов дистанционного обучения. Рассмотрены возможности улучшения учебно-педагогического процесса в условиях пандемии 2020 года. Авторы приводят обзор образовательных тенденций в условиях дистанционного, онлайн и смешанного обучения. Также исследуется уровень знаний и навыков украинских педагогов в использовании современных инструментов дистанционного обучения. С этой целью авторы разработали и провели опрос украинских преподавателей педагогического университета (из целевой группы), которым необходимо использовать инструменты дистанционного обучения в своей исследовательской и профессиональной деятельности во время карантина. Авторы также рассматривают способы улучшения процесса обучения с помощью средств дистанционного обучения.

К л ю ч е в ы е с л о в а: инструменты дистанционного обучения, тренды дистанционного обучения, COVID-19, цифровая трансформация, инструменты для обучения, образовательные тренды

Oksana Strutynska, Mariia Umryk

El aprendizaje a distancia, en línea y mixto como principales tendencias educativas durante las condiciones de la pandemia de 2020

Resumen

La tendencia hacia el aprendizaje a distancia y la autoeducación no ha cambiado durante muchos años, pero durante la pandemia, adquirió una relevancia e importancia fundamentales. El cierre de escuelas e instituciones de educación superior en todo el mundo tuvo un impacto negativo en el sector educativo en muchos países en general y ha afectado a casi todos los estudiantes y educadores. Este documento examinó el nivel de conocimientos y habilidades de un grupo seleccionado de educadores ucranianos en el uso de herramientas y tendencias modernas de aprendizaje a distancia y la forma de mejorar el proceso de enseñanza-aprendizaje durante las condiciones de la pandemia de 2020. Los autores presentan su revisión de las tendencias educativas en las condiciones de aprendizaje a distancia, en línea y mixto. También examinó el nivel de conocimientos y habilidades de los educadores ucranianos en el uso de herramientas y tendencias modernas de aprendizaje a distancia. Para ello, los autores han elaborado e implementado una encuesta local del personal docente universitario ucraniano (grupo objetivo) que necesitan utilizar herramientas de aprendizaje a distancia en su investigación y actividad profesional durante la cuarentena de 2020. Los autores también presentan formas de mejorar el proceso de aprendizaje a través de herramientas de aprendizaje a distancia.

Palabras clave: Herramientas de aprendizaje a distancia, Tendencias de aprendizaje a distancia, COVID-19, Transformación digital, Herramientas de aprendizaje, Tendencias educativas

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Nuno Silva
Universidade Lusíada de Lisboa, Portugal
http://orcid.org/0000-0003-0157-0710

Isabel Alvarez
Universidade Lusíada de Lisboa, Portugal
http://orcid.org/0000-0003-4381-6328

Cloud-Based Knowledge and Glocal Dilemmas in Higher Education

Abstract

The potential of cloud computing systems as a support tool for novel and meaningful knowledge creation, storage, and distribution within the context of higher education is recognised and so is the impact to which the global dimension imposes inherent ethical issues and social impacts within local contexts (glocality). Hitherto, mainstream literature debates on ethical issues like equity or cultural sensitivity, disregarding existent social dilemmas related to organizational innovation. This paper aims to promote a philosophical and empirical argument within contextual determinants; therefore, it reflects upon the key ethical issues and social dilemmas that cloud-based systems pose to distributed knowledge systems in the dialectic process of higher education diversity (global versus local). In this regard, an e-University strategic implementation framework interacting with ethics and culture (developed by the first co-author) will help two research objectives: to understand current e-learning practices in higher education and to suggest potential future guidelines for the dialectical process between the global and local.

K e y w o r d s: cloud, knowledge, glocal, higher education

Despite considering "ICT, education and development as separate pillars required to support knowledge society" (GeSCI, 2011, p. 7), the truth is that overlaps exist between those pillars. Therefore, higher education does not merely promote technological innovation, but also exploits it. However, the emphasis must be on knowledge production, management, and distribution through cloud platforms. But knowledge is specific to time, place, sequence, timing, position, and relationships within communities' contextualization. Furthermore, it follows that knowledge cannot be abstracted from context (physical or social), which includes a trade-off between global and local knowledge.

Education is inevitably expressed within local dimensions and the global region (European Bologna Process). The main educational issues in any region are: cultural diversity, ethics and values, mobility, intercultural communication, organisational cooperation, economical value, and government's education policy (Silva, Alvarez, & Rogerson, 2011). However, it is interesting that characteristic dialog concerning global and local dimensions in higher education focuses primarily on learner's diversity in various educational settings.

The globalised higher educational contexts threaten diversity, and the emergent technology of cloud computing will likely emphasise glocal dilemmas in educational knowledge. This novel infrastructure speeds up the adoption of various innovations adoption in academia (Ercan, 2010; Praveena & Betsy, 2009; Aymerich, Fenu, & Surcis, 2008). Collaborative learning, and e-learning, as much are enhanced by a knowledge grid (Liao et al., 2014), independent of time, space, and location (Laeep & Shaikh, 2016). For each of these dimensions, organisational dilemmas (localisation, collaboration, etc.) should be considered associated with strategy and policy, namely, to ensure equity and access to education. Consequently, several dilemmas 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 for knowledge creation and management.

In addition, for the e-University, as a self-container of global e-learning programmes in higher education, knowledge is accessible from any location with (traditional university) or without a single physical campus (virtual university), representing not only a technical (interoperable learning or managerial functionalities), but also strategic decision (flexible and competitive), the focus of which is quality (excellence) and culture change (collaboration and sharing in an equitable virtual community).

The empirical evidence emerged within Lusíada universities' context since the e-university project was implemented. Despite the organisational strategic interest, its development outlines remarkably diverse intermediate results which this research project grasps through a comparative cross-national environment. Those empirical results seem to prove that a purely technological perception of educa-

tion condemns any cloud-based knowledge paradigm because "glocality" imposes several dilemmas that require analysis of the implementation process.

Knowledge in Education

Knowledge structure in academic organisations has changed over time, reflecting normative perceptions concerning its significance or educational conception (Silva, Alvarez, & Rogerson, 2011).

It is interesting to acknowledge that the literature on this subject suggests the concept of pedagogic content knowledge (Koppelman, 2008). A further perspective needs to recognise potential knowledge lockers (barriers to knowledge management) in their inherent phases of capturing, sharing and application (Okah, Teye, & Shoniregun, 2011). In order to identify, capture, store, preserve, and disseminate knowledge, higher educational organisations have incorporated technological systems to promote continuous feedback and adjustment to their knowledge strategy (Handzic & Hasan, 2003). Nonetheless, e-learning is converted into distributed learning, or in cloud-based knowledge (Chikhi & Abed, 2017), meaning that course components are distributed across multiple media, as well as exhibits a tendency for a student-centred learning approach and evokes a collective contribution (Mason & Rennie, 2008). Summing up, the e-learning paradigm allows the flourishing of knowledge communities, as well as providing free and unfettered access to information. This process denotes novel bottom-up structures of knowledge since traditional learning relationships (lecturers talking in classrooms) are replaced by knowledge projects structured as "content management environments" (Singh & Sandhu, 2006, p. 74).

According to Silva, Alvarez, and Rogerson (2011), knowledge engages on two different platforms:

- Learning Knowledge Management Systems (LKMS) – LMS evolution due to social interaction, which entails Personal Learning Environments (PLEs) and Social Software (SS);
- Learning Oriented KM Systems (LOKMS) – LMS evolution at an instructional level.

These systems characterise a range of strategies and practices used within institutions to identify, create, represent, distribute, and enable adoption of perceptions and experiences (i.e. Knowledge Management), whereas the novel technology of cloud computing refers to online services, applications, and data storage (Rawtani, 2012).

To Siddiqui et al. (2019), e-learning attracts more and more users and can improve the knowledge of learners anywhere anytime. The advent of cloud-based authoring tools is a relatively effective emerging trend that enables course editing and proofreading with a context-aware help engine. Therefore, a collaborative learning cloud cannot function smoothly without the support of knowledge modelling, knowledge discovery, and reasoning techniques (Liao et al., 2014).

Glocality

According to Meyrowitz (2005), glocality acknowledges a convergence between two concepts: *global* and *local*. Gordon (2009) claims that local information access is no longer restricted to geographic location due to the network configuration or distributed fluxes of information, in spite of the undefeatable cultural barriers that glocality imposes. Therefore, "glocal morality" is a fusion between global and local identities, where diversity shapes the relationship between local and global (Poster, 2005). World culture does not present itself as uniform, but can be rather described as "organised diversity", i.e., a web of various local cultures "glocalities" (which are not necessarily anchored in any geographical territory) (Silva, Alvarez, & Rogerson, 2011).

Special attention should be directed towards systems and services through personalised web-based interfaces, which facilitate and encourage collaboration, team participation, and consensus, knowledge sharing, and thus the promotion of academic excellence. In clouds, personalization of e-learning systems is enhanced (Ghallabi et al., 2020).

The existing and essential role that universities have in the social context (Altbach, 2008) is reinforced by glocality in order to promote sustainability and intercultural dialogue. The ICT for expanding cross-cultural experiences enables proactive communication between universities and stakeholders, namely students. These parties need to know more about global, societal, and local structures that create or prevent equity and justice among students of various cultures to reduce stereotypes and detriments (Räsänen, 2000).

Thus, a primary goal in global education is to guarantee respectful interactions among people from different nationalities and cultures in order to reinforce the transnational, economic, political, and social forces that have effectively enforced a glocal culture (respect for national boundaries) (Landorf, Roco, & Nevin, 2007).

Furthermore, other technological factors can affect the global use of e-learning. Particular importance of this assumption assumes management systems, namely

because the e-learning evolution involves four general categories of technological systems: Learning Management Systems (support administrative tasks) (Lassila & Poyry, 2007); Managed Learning Environment (including the whole range of information systems and processes which contribute directly or indirectly to learning and learning management) (Winter, 2006); Learning Content Management Systems (allowing developers to store, manage, and provide access to content used in e-learning) (Abazi-Bexheti, 2008); and Virtual Learning Environments (the components in which students and tutors participate in several online interactions, including online learning) (Weller, 2007). In addition, several dilemmas as to the application of a global open-source e-learning solution can emerge (like Moodle), or when it comes to the analysis of concurrent vendor proposals (global services and protocols, or local suppliers). In other words, Star and Ruhleder (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, according to Dinevski and Pšunder (2007), e-learning includes not only a technological platform, but also content and interactivity (communications processes). It embraces learning models and pedagogy to be attended out of the "bottom layer" (see next sections), which usually involves the collaboration of specialists (instructional designers, content creators, knowledge management practitioners, tutors, etc.), as well as standard authoring tools.

Taking the above into consideration, it is not possible to provide a unique definition or understand what consensual components involve e-learning, and whether any change in one of these impacts on the implementation of the whole system. Therefore, it is important to shed some light on the main issues and acknowledge the dimensions of e-learning: technological infrastructure and services (bandwidth, networks, computers, and other electronic tools), knowledge and content management (knowledge distributed, content development, copyright, curriculum, pedagogy, etc.). To ensure the successful use of ICT in educational systems, UNESCO usually acknowledges several policy frameworks about: the 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:

- the 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;
- complexity: this is the most important feature of our society, as e-learning, culture, and ethics as "human constructs" are complex.

Cloud Computing

Concept

Cloud computing is one of the leading forces of digital communications, which refers to web collaboration, document sharing, content creation, data syncing, etc. It describes a variety of computing concepts due to massive computational interactions in real-time through a communications network (e.g., Internet). Cloud computing tools include, among others, Facebook, Google services or apps, Dropbox, iCloud, etc. that enable data sharing, collaborative work, cooperation, editable and publishable content anywhere, anytime, through any device, and by any person (Carroll, Kotzé, & Merwe, 2012; Limbu, 2012). In addition, cloud computing is independent from the space or location in which the computational resources needed matter (Floridi, 2009).

Cloud computing, as an emerging distributed technology, requires urgent research since its inherent development activities are expected to change the applications with socio-political consequences (Hall & Stahl, 2012). However, cloud computing may lead to a multinational worldview of data management in which local laws may be a barrier for this concept to take hold (Thibodeau, 2010). This dangerous assumption of Thibodeau is a manifesto of globalisation, which Ammirabile (2012) recognises. It is a form of globalisation frequently based on specialisation and cost reduction. Its gradual emersion in the global networked communities can lead to the reasoning that cloud-based pedagogy is insurmountable (Limbu, 2012). Therefore, this invisible web (cloud-based) comprises all the databases relevant to the dominant academia environment but, on the other hand, without the possibility of being searched by general internet search engines (including learners) (Lewandowski & Mayr, 2006).

Cloud-Based Knowledge

Users of cloud computing are offered a variety of services through pay per use and fee-based infrastructure with value added infrastructure (Arora & Sharma, 2013) because this innovative technology promises to deliver computing resources to different locations through globalised circulation networks (Hall & Stahl, 2012).

Cloud computing, web 2.0, and enterprise 2.0 have raised some novel challenges to Knowledge Management Systems (KMS) which overcome institutional boundaries, i.e., access to the newest and most relevant knowledge; however, hitherto, lacking of integration among KMS functions and the Internet (Antonova, Gourova, & Roumen, 2009). These novel dimensions for cooperation must be emphasised to knowledge workers since KMS future developments (architecture)

are expected to be more effective, user-oriented, and sharable (i.e., the removal of physical barriers) (Floridi, 2009). Thus, the foreseen benefits of cloud-based computing are: user key information and software that can be easily accessed (virtually anywhere through his/her computer, smartphone or tablet); and higher levels of productivity because individuals can instantly access the knowledge stored within the cloud. Furthermore, redundancy is another benefit from cloud computing (Rawtani, 2012).

The Bond with E-Learning

The introduction of cloud computing in educational systems acknowledges the purpose of increasing scalability, flexibility, and availability at the application level (Popel & Shyshkina, 2019), which should be faster, cost-effective, and efficient (Siddiqui et al., 2019). Therefore, the traditional e-learning networking model assessment denoted a possible cutting-edge solution regarding the infrastructure itself and potentially costs; that is, to migrate e-learning systems (corporate and non-corporate) to the cloud. In addition, it ensures resolution in time to execute developments, support, updates, and fixes (Bitar, 2017). This option allows educational organisations to be charged according to students' access to servers (Masud & Huang, 2012).

Two keen and free-of-charge cloud computing applications for education are: (i) Google Workspace for Education (Google Apps), a free online suite of tools that includes Gmail and Google Docs. While Gmail is suitable for checking personal e-mails, Google Docs serves to open documents, spreadsheets, or presentations; (ii) Microsoft's 365 cloud service (replaced Live@edu), which includes SkyDrive. Thanks to the use of the cloud computing approach, collaborative work on a document or dynamic improvements are possible through different contributions (Thomas, 2011). Likewise, enhancement of objectives such as availability, cost reduction, on demand, and self-service are also possible (Goyal & Krishnamurthi, 2019). However, cloud computing usage in higher education changes universities' structural organisation, as well as how the design and delivery of lectures and lessons occur (Hall & Stahl, 2012). In fact, cloud computing will likely influence education because it intensifies participatory and creative practices (distributed knowledge contributions versus a single local contribution) (Greenhow, Robelia, & Hughes, 2009; Katz, 2008).

Issues Raised by Educational Change

Technical.

The evidence for a novel generation of e-learning systems supported by a cloud-based environment is real. These systems operate through a wide range of devices,

while storing data in the cloud recognises a novel educational paradigm (Masud & Huang, 2012). Cloud computing is widely recommended as an excellent alternative for educational institutions with lower financial resources to operate their core systems; it makes it possible to avoid expenditures on computers, network devices, and excessive licenses, as well as provides full access to global platforms (simplified scalability) (Ercan, 2010). The proposed e-learning cloud architecture can be divided into five different layers (Arora & Sharma, 2013): infrastructure, software resource, resource management, service, and application. A LMS based on cloud architecture generally presupposes a rental basis (financial gain), with the advantage to be a worldwide and ubiquitous accessible system hosted on servers (data centre) from a third party (e.g., a vendor) (Aleckson, 2012).

In spite of the potential (mostly unresolved) critical issues involving the deployment of cloud computing, it is considered a turbulent business driver. Besides, some other typical usages of cloud computing to academics are: personal workplaces, opportunities for ubiquitous computing, no need to pack up everything into a thumb drive or copy all content between computers, and high processing power (Thomas, 2011).

Pedagogical.

Cloud computing, as a global and cross-cultural communication medium, enables learners' cultural knowledge since these are required to develop novel multicultural understandings (Limbu, 2012). The lecturers' roles will not be replaced by e-learning; in fact, cloud computing reshapes and updates old methods through an array of novel concepts, technologies, and tools which provide new strategic directions for education. Lecturers will continue to play leading roles and participate in developing and making use of the e-learning cloud (Masud & Huang, 2012). The underlying reason for this assumption is that the cloud computing infrastructure accelerates and fosters the adoption of innovations within the academia (Aymerich, Fenu, & Surcis, 2008).

Cutting edge, Cloud Learning Environment systems (CLEs) extend Personal Learning Environments (PLEs) because all educational organisations truly own it (the cloud serves as a large, autonomous system). CLEs users are academics or learners who share similar privileges, including control, choice, and the sharing of content (Mikroyannidis, 2012; Malik, 2009). Clearly, academics are most interested in cloud potential for storage and sharing their intellectual work as digital content with other academic community members. Hence, a truly open, collaborative, and scholarly intellectual environment will be possible (research, dissemination, peer-review, critique, publish, and, further, the ability to build upon it) (Thomas, 2011).

Ethical and social.

In spite of the significant short- and long-term benefits that cloud computing will produce in a scholarly environment, some serious perils and ethical challenges exist to account for in this emerging technology (Brady, 2010). The increasing interest of policymakers and regulatory authorities in cloud computing is due to implications for security, privacy, and trust (Rand Europe, 2011) (for the opposing views see EDRI (2021) or Salter (2019)). It seems necessary to quote the following key remark: "The governance of emerging technologies, whose menace can merely be lessened, is critical to undertake advanced measures to protect the most security-sensitive information stored" (Rawtani, 2012, p. 361).

From an educational point of view, and acknowledging that cloud computing might provide unlimited resources for storage capacity and data process, universities will become a key element in future security systems (Nagenborg & Capuro, 2011). Also, in policy-driven interactions across clouds, the infrastructure will require adequate design in order to address several risks bounded to the perspectives of security and privacy (Winans & Brown, 2009). To Laeep and Shaikh (2016), privacy is improved in clouds.

Personal information will be available nowhere and everywhere; though the majority of privacy laws assume that data resides in one place (Deal Architect, 2008). So, a responsible management of personal data is a key issue to ensure trust in the adoption of cloud-based services and, thereby, to encourage users to explore them (Pearson, 2013).

Beyond information privacy, the cloud computing debate focuses on authentication and authorisation. Insofar, the literature acknowledges several types of identity federation and claims-based authentication to make transactions easier between service end points, as well as between intermediaries in the cloud (Chou, 2008). As Antonova, Gourova, and Roumen (2009) point out, the referred benefits of cloud computing, namely agility, adaptability, flexibility, cost saving, and interoperability face some important barriers (e.g., security, privacy) that can prevent their widespread implementation.

Lastly, cloud computing communities – known as Culture Clouds – are enabling tools for users' description and connection to different or 'foreign' cultural resources, which is a significant social dilemma. This aspect is important to consider, as it is very difficult to improve multicultural knowledge and mutual understanding in the trans-geographical knowledge of workers, academics, and learners (Pawlowski, 2008). Nevertheless, the geographical location of cloud computing service providers in developed countries and owned by large multinational groups may undermine this process due to information ownership (cultural and economic dominance). A trustworthy relationship is associated with the control

of user data and, probably, with establishing personal social interaction which the digital divide may also constrain (Wakunuma, Stahl, & Ikonen, 2011).

Concluding, global information and computing ethics is urgent (shared norms, values, and practices) to minimise these and other ethical and social quandaries.

Research Methodology

Selecting a methodology is a process worth taking time over, as it is vital to any research project since it determines the nature of findings. Mayan (2009) beautifully describes this process through the "armchair walkthrough", namely, in qualitative research: "qualitative researchers aim not to limit a phenomenon – make it neat, tidy, and comfortable – but to break it (...) so that a description of the phenomenon, in all of its contradictions, messiness, and depth, is (re)presented" (p. 11).

In consonance with the above, this research assumes a qualitative analysis to grasp and describe the social phenomena and cultural milieus in which people live. Through interpretive and critical tradition, the researchers understand socially constructed realities, as well as attempts to create conditions for emancipation.

Keeping the above in mind, and keeping in mind the research environment, four assumptions arise:

1. multiple case studies – Lusíada Universities intercontinental context and different organisations managing multiple campuses which enable a feasible comparison.
2. longitudinal approach – summarises a continuous correspondence between the researchers and participants (informal conversations and semi-structured interviews with focus groups), along with participant observation behaviour (lecturing and IT management – organisational roles). These data collection procedures have generated much empirical data (interviews, documents, jottings, etc.)
3. a holistic solution – the interaction between e-learning, global, and local knowledge exhibits a lot of complexity.
4. anonymity – taking care of the description of identity and relationship with participants to avoid easy confidentiality disclosures; care should be taken to avoid these where possible.

It is feasible to claim that the dominant aspect of the researchers' role moved from that of a participant-observer to a one which is more action-oriented. While critical reflexivity is crucial in empowering others to implement change, researchers aimed not only to improve their practice, but also to increase their understanding in the context of that practice. In this scenario, the researchers desired to use the

e-learning platforms to justify the innovative practices with which they engaged, and to reflect on their educational practice, as well as to improve the rationality of knowledge in the Lusíada University educational environment.

Empirical Evidence

Lusíada Universities are a unique organisational context since these encompass multiple universities in national and transnational locations through personal and cultural connections engaged in the responsibility of internationalising higher education. These universities share communalities like its trademark, the pedagogic project, and, more importantly, the e-learning project, while, diverging in topics such as location, organisational structure taxonomy, and the educational management process.

The trademark recognises an international cooperation agreement as a result of the privileged relationships between Portugal and its former African colonies, as well as a way to promote organisational innovation. The last milestone encompasses the development of technological solutions and shared curriculum (Silva, 2012). Lusíada contextual differences are: (i) campuses' location in Portugal (Lisbon, Oporto, and Famalicão), Angola (Luanda, Benguela, and Cabinda), Cape Verde (Praia), São Tome and Prince (São Tomé); (ii) while the university in Portugal acknowledges a non-profit private organisation (Minerva Foundation) founded in 1986, in Angola – as a profitable private organisation (Saber Angola Ltd.), which started in 2001. In Cape Verde, there is a non-formal foundation (Ramiro Alves Figueira) established in 2011 and São Tomé has an organisational model similar to Portugal (foundation – Atena) since 2008; (iii) a unified management model with an autonomous pedagogical model on each campus (Portugal and São Tomé), in contrast to an integrated model for management and education (Angola) (Silva, 2012). Note that, in Cape Verde, there is an ambiguous organisational structure that has prevented any curriculum actions.

These contextual differences are easily perceived in field work, as the following examples of cloud computing technologies demonstrate: (i) in Portugal, the old and existent agreement with Microsoft allowed the implementation of the Live@edu platform (later renamed Office 365). However, this strategic adoption was limited to Lisbon and Famalicão, while Oporto preferred to explore Google Apps, and Moodle platforms. The access to both options is always available as a result of infrastructure liability in Portugal, while in Angola, the continuous existing problems with internet connection and bandwidth led to autonomous solutions

like Dropbox; (ii) however, access problems refer not only to bandwidth liability, but also to speed. Unfortunately, this is a common problem in African countries; so, it is typical to report problems for instance in SSO (Single-Sign-On) synchronisation, content synchronisation, trust of passwords (external security), and unexpected software updates; (iii) some novel functionalities of cloud computing distract and frustrate users due to the lack of usability. For example, problems were reported for multiple accesses through SkyDrive and/or Office365. If a person accesses the FAQ (Frequently Asked Questions) on Microsoft's website, problems like the obligation for two accounts – one on Office 365 and a personal account on Microsoft, used to access SkyDrive content, Messenger, and Xbox/Zune configurations – an error occurs. Users must first access https://skydrive.live.com using the Microsoft personal account to access it upon the update of Live@edu; it is, however, possible, through http://office.microsoft.com/pt-pt/ to access *My Office* (documents location). Webmail access is another nightmare for users (http://mail.office365.com), as the first author's personal experiences denote. It is quite common to receive the message *working on it* when access time is extreme; sometimes sent e-mails appear in the draft folder; (iv) market pressure (cloud option compulsory) enables cost opportunity dilemmas since it cancels old contracts. The Adobe cloud plans are an evidence of this scenario.

Other than the dilemmas observed, there was a distinction between knowledge and content, with emphasis on the necessity of global content and local knowledge, for example on the labour market. On the other hand, in libraries, there is a sense of global knowledge and local repositories which respect local regulations on copyright. Most teachers try to comply with the programmes but sometimes, in the middle of classes, there is other content that is relevant for the students to know even if it is not part of the programme. There are authors recognized at a global level, but how do you connect this globalization to local needs of knowledge? It also happens that each teacher is hampered by national educational culture; for example, Angola has not yet established native authors for several different subjects. However, since students are familiarized with local core knowledge, some aspects of the educational process are unique to their own culture. Some international facets, however, stay universal. From the educational point of view, language is the main problem in knowledge transfer, both because of local dialects in Angola and the influence of Portuguese language variations in Angola (the Brazilian variation in particular). There are authors recognized worldwide and, therefore, the problem is how a teacher adapts this facet of globalization to local needs. There is insufficient clarification of the relationship between practical knowledge and scientific knowledge.

These dilemmas are even enhanced if e-learning is borderless, or if the emerging services of cloud computing technologies involve the renegotiation of conces-

sion contracts. Furthermore, diversity implies a continuous intercultural communication which globalisation has enhanced; this glocal dialogue produced "glocal moralities" (Silva, Alvarez, & Rogerson, 2011). But, unfortunately, many political and business leaders have based their decisions on international statistics for justifying global education on the nationalistic criterion (Heilman, 2009). Heilman also criticises the underlying claim that students cannot compete in the new world economy and asks whether "this appeal to national and personal self-interest [is] causing us to miss the opportunity to connect with people's hopes and values?" (p. 25).

Finally, as regards global platforms, recognized and used in the educational environment worldwide (e.g. Moodle and Microsoft Teams), they have different approaches to issues concerning user's privacy (Ślósarz, 2020), or do not always give opportunities for ubiquitous computing (e.g. countries with limited access to the Internet or where some services were blocked). The time of the pandemic has shown that e-learning is associated with the weakening of human ties (ELearning Inside, 2021) and collaborative edition of documents is considered a myth and advertising slogan (Zhao & Watterston, 2021).

Conclusion

The potential of cloud computing systems is being recognised as supportive to a new meaningful knowledge creation, storage, and distribution system within higher educational contexts (Ercan, 2010). These distributed knowledge networks indeed facilitate knowledge sharing; however, its globality imposes serious dilemmas for global challenges in education related to inequality and social justice. While it is important to contextualise differences between and within global cultures, local cultures can have ineliminable differences. There are educational authors that are recognized worldwide but the problem is how this globalization fits into local needs. There is insufficient clarification of the relationship between practical knowledge and scientific knowledge. Thus, higher educational institutions have a social responsibility to promote "glocal knowledge"; therefore, the authors believe that, ultimately, a deeper understanding of "glocal morality" is required. It is the authors' opinion that "glocal morality" implies a fusion of competences that permit ethical decisions within different cultural diasporas (glocal) (Silva, Alvarez, & Rogerson, 2011).

However, because of knowledge-sharing through various e-learning platforms, the use of collaborative and interactive tools (synchronous or asynchronous) allows

debate about the presentations, which entails a process of knowledge creation and transference. Knowledge and learning are usually collective activities; therefore, team participation and consensus should be valued just as much as, if not more than individual achievement. This scenario is further enhanced due to the tightening of copyright and other ownership restrictions through international treaties and regulations, which limit access to information sources. Yet, chronological data as regards the transfer of knowledge in higher educational institutions exhibits a wide array of mixed results.

As regards cloud-based knowledge, it is necessary to incorporate tools for knowledge creators to attend to linguistic and liability problems, as well as local students' skills. Finally, all knowledge creators have a moral responsibility to be ethical and culturally sensitive, even though dissimilar higher educational institutions may produce diverse yet inclusive and equitable learning environments.

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Nuno Silva, Isabel Alvarez

Wiedza oparta na technologiach w chmurze i glokalne dylematy w szkolnictwie wyższym

S t r e s z c z e n i e

We współczesnych czasach dostrzega się potencjał systemów przetwarzania w chmurze jako narzędzi wspierających tworzenie, przechowywanie i udostępnianie wiedzy w kontekście szkolnictwa wyższego, podobnie jak uwarunkowania oddziaływania wymiaru globalnego na nieodłączne kwestie etyczne i skutki społeczne w kontekście lokalnym (glokalność). Dotychczasowa literatura przedmiotu porusza kwestie etyczne, takie jak równość czy wrażliwość kulturowa, pomijając istniejące dylematy społeczne związane z innowacjami organizacyjnymi. Niniejszy artykuł ma na celu promowanie argumentacji filozoficznej i empirycznej w ramach uwarunkowań kontekstowych; odzwierciedla zatem kluczowe kwestie etyczne i społeczne, jakie systemy oparte na chmurze stawiają rozproszonym systemom wiedzy w dialektycznym procesie różnorodności szkolnictwa wyższego (perspektywa globalna kontra lokalna). Strategiczne ramy wdrażania e-uniwersytetu, postrzegane przez pryzmat interakcji z etyką i kulturą (opracowany przez pierwszego współautora), pomogą zatem zrealizować dwa cele badawcze: zrozumienie obecnej praktyki e-learningu w szkolnictwie wyższym oraz wskazanie możliwych przyszłych wytycznych co do dialektycznego procesu zachodzącego pomiędzy tym co globalne a tym co lokalne.

S ł o w a k l u c z o w e: chmura, wiedza, glokalność, szkolnictwo wyższe

Нуно Силва, Изабель Альварес

Знания, основанные на облачных технологиях и глокальные дилеммы в высшем образовании

А н н о т а ц и я

Авторы утверждают, что можно признать потенциал систем облачных технологий в качестве вспомогательного инструмента для создания, хранения и распространения новых и значимых знаний в контексте высшего образования, и этот глобальный аспект обуславливает неотъемлемые этические вопросы и социальные последствия в локальных контекстах (глокальность). До сих пор в основной литературе обсуждались этические вопросы, такие как равенство или культурная чувствительность, и игнорировались существующие социальные дилеммы (связанные с организационными инновациями). Эта статья направлена на продвижение философских и эмпирических аргументов в контексте контекстуальных детерминант, обусловленных ключевыми этическими проблемами и социальными дилеммами, которые облачные системы ставят перед распределенными системами знаний в рамках диалектического процесса разнообразия высшего образования (глобального или местного). В этом отношении структура стратегической реализации электронного университета в контесте взаимодействия с этикой и культурой (разработанная первым соавтором), поможет про-

анализировать и понять текущую практику электронного обучения в высшем образовании, так и предложить потенциальные будущие основные принципы диалектического процесса между глобальным и локальным.

К л ю ч е в ы е с л о в а: облако, знания, глокальный, высшее образование

Nuno Silva, Isabel Alvarez

Conocimiento basado en la nube y dilemas glocales en la educación superior

R e s u m e n

Se reconoce el potencial de los sistemas de computación en la nube como herramienta de apoyo a la creación, almacenamiento y distribución de conocimientos novedosos y significativos en el contexto de la educación superior donde la dimensión global impone cuestiones éticas inherentes e impactos sociales dentro de los contextos locales (glocalidad). Hasta ahora, la literatura principal debate cuestiones éticas como la equidad o la sensibilidad cultural, e ignora los dilemas sociales existentes (relacionados con la innovación organizacional). Este artículo tiene como objetivo promover un argumento filosófico y empírico dentro de los determinantes contextuales; por lo tanto, reflexiona sobre las cuestiones éticas clave y los dilemas sociales que los sistemas basados en la nube plantean a los sistemas de conocimiento distribuidos dentro del proceso dialéctico de la diversidad de la educación superior (global versus local). A este respecto, un marco estratégico de implementación de la Universidad Electrónica que interactúe con la ética y la cultura (desarrollado por el primer coautor) ayudará tanto a analizar como a comprender las prácticas actuales de e-learning en la educación superior como a sugerir posibles directrices futuras para el proceso dialéctico entre global y local.

P a l a b r a s c l a v e: nube, conocimiento, glocal, educación superior

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Lucie Zormanová
University of Silesia in Katowice, Poland
https://orcid.org/0000-0002-8004-8674

Learning Strategies Applied by University Students in Distance Learning

Abstract

This review study aims to provide an overview of previous research on learning strategies used by students studying in a distance-learning form. The basic sources for research were the Web of Science, Research, Gate and Google Scholar databases. We also proceeded with a subsequent search based on frequent citations, using the Internet search engine Google.

In accordance with the aim of this study, we sought answers to the following research questions in the analysis:

1. Which learning strategies are most frequently used by students studying in a distance-learning form?
2. In connection with which factors influencing distance-learning outcomes are learning strategies examined?
3. Which research methods are used to study distance-learning strategies?

We came to the following conclusions: In distance learning, it is necessary to help students develop their autonomous learning competence, knowledge of diverse learning strategies and reflective use of learning strategies, and increase the repertoire of reading strategies used by students. For some distance-learning students, however, the use of diverse learning strategies poses an issue; adult distance-learning students use only a fairly limited repertoire of learning strategies. Adult students use only those learning strategies which have worked for them in the past and are therefore convinced of their effectiveness. The most frequently

used learning strategies for distance-learning students are retelling the text in their own words, with which students check whether they have understood the text sufficiently, compilation of an overview of information based on the read text, and the use of mnemonics.

In connection with the factors influencing distance-learning outcomes, research has shown that there is a relationship between the degree of cognitive development and the use of a broader repertoire of learning strategies. It was found that the effectiveness of learning in self-directed learning and the use of a wider repertoire of learning strategies are closely related to students' mood, self-confidence, self-assurance, and perseverance. In this study of learning strategies, quantitative and qualitative research methods are applied. However, mixed method research design is the most commonly used approach.

K e y w o r d s: learning strategies, distance learning, tools supporting collaboration, metacognitive strategies, student's motivation

We date the beginnings of scientific research into learning strategies back to the 1960s, when, along with the development of cognitive psychology, researchers' attention focused more on the student and the learning processes, whereas previously, research was primarily teacher-oriented. The first research study on learning strategies was Carton's *The Method of Inference in Foreign Language Study* (Carton, 1966). First research studies (Stern, 1975; Naiman, Frohlich, Stern, & Todesco, 1978; Rubin & Wenden, 1987) focused on discovering which learning strategies were used by successful students. The results of these first research studies found that the success of students in school was more significantly influenced by the learning strategies they used rather than their intelligence. These results are in agreement with the results of later research (e.g., Czerniawska, 1993, 1998), which showed that successful students use more diverse learning strategies than unsuccessful students (e.g., Zimmerman & Pons, 1986; Vlčková, 2005), and that successful students use different learning strategies from those used by unsuccessful students (e.g., O'Malley, Chamot, & Küpper, 1989; Mangubhai, 1991; Wen & Johnson, 1997; Lind & Sandmann, 2003; Vlčková, 2005). Recently, however, research has emerged that refutes this thesis and demonstrates that there is little or no relationship between the learning strategies used and learning outcomes (Artelt, 2000; Baumert, 1993; Baumert & Köller, 1996; Baumert, Heyn, & Köller, 1992; Pintrich & de Groot, 1990; Pokay & Blumenfeld, 1990; Schiefele, Streblow, Ermgassen, & Moschner, 2003; Sinkavich, 1994; Souvignier & Gold, 2004).

Research Method

This review study aims to provide an overview of previous research on the topic of learning strategies used by students studying in a distance-learning form. Since it is a presentation of the issue, an overview study method was selected, the so-called literary review, i.e., according to Mareš (2013, p. 430), "an overview of existing knowledge about the selected topic in a certain period of time [which] is based on discovered research studies on the topic, on the analysis and generalization of their results". The basic sources for the research were the Web of Science, Research Gate, and Google Scholar databases. We also proceeded with a subsequent search based on frequent citations, using the Internet search engine Google.

In accordance with the aim of this study, in the analysis, we sought answers to the following research questions:

1. Which learning strategies are most frequently used by students studying in a distance-learning form?
2. In connection with which factors influencing distance-learning outcomes are learning strategies examined?
3. Which research methods are used to study distance-learning strategies?

Terminology

The term *learning strategy* was first used in 1956 by Bruner, Goodnow, and Austin (1956) in the psychology of thinking; they defined learning strategies as a sequence of decision-making in the receiving, storing, and utilising of information, which leads to predetermined goals. Even today, this concept is the basis of most definitions, as learning strategies are usually conceived as a set of procedures, methods, techniques, and activities that students consciously or unconsciously use in the learning process and that lead to learning effectiveness; learning strategies are used to remember more information faster, recall memorized information, and apply it (Vlčková, 2007, pp. 82–91). We encounter this concept, for example, in the definition of learning strategies by Vlčková and Lojová (2011), who understand learning strategies as conscious or potentially conscious and intentional procedures that the individual uses during the learning process to facilitate the acquisition, processing, memorization, recall, and application of information (Lojová & Vlčková, 2011). Janíková et al. (2011) define learning strategies as complex problem-solving

operations in which the process of creating hypotheses and verifying them is of particular importance.

Contrary to this notion, Czerniawska and Ledzińska (1994) define learning strategies as the conscious use of a particular procedure, specific activities and techniques in order to memorize and recall instilled information in a particular situation. According to Czerniawska and Ledzińska, the conscious use of a certain learning strategy increases the efficiency of the learning process, leads to faster memorization of a larger amount of information, which the student is then able to systematically classify, and it generally helps with in-depth learning. Czerniawska (1999) sees learning strategies as any way of organizing learning activities in order to acquire new information. Riding and Cheema (1991) perceive them as a tool or technique for managing a learning situation. While Weinstein (1989) understands learning strategies as ways of behaving and thinking that enable learning, Weinstein and Mayer (2016) and Richards and Platt (1992, p. 209) have a similar understanding of learning strategies. Weinstein (1989), Hnilica (1992), Somuncuoglu and Yildirim (1999) understand learning strategies as a repertoire of activities that start from simple study skills to complex thought processes. The connection between learning strategies and metacognitive processes is also emphasized by Ledzińska (2000), Arends (2012), and Janík (2013), who emphasize the connection between metacognitive processes and learning effectiveness.

A learning strategy that is appropriately chosen with regard to the goal of education leads to greater learning efficiency, positively affects the student's ability to discover, acquire, systematize, and master new information (Weinstein & Mayer, 2016). Seel (2011) also emphasizes the connection between learning style and learning strategies, understanding learning strategies as a set of learning techniques (Seel, 2011) based on the individual's learning styles.

Results of the Study

Which Learning Strategies are Most Frequently Used by Students Studying in a Distance-Learning Form?

Research by Dutch researchers Neroni, Meijs, Gijselaers, Kirschner, and Groot (2019), which included 758 distance education students, pointed out the connection between learning effectiveness and the choice of an appropriate learning strategy, and notes that motivation, the ability to plan and reflect on one's own learning strategies, and the use of diverse learning strategies, including metacognitive

strategies, helps with study success. For some distance-learning students, however, the use of diverse learning strategies poses an issue; as was found in the research study by Morgan, Dingsdag, and Saenger (1998), adult distance-learning students only use a fairly limited repertoire of learning strategies. Peacock (2001) also states that adult students use only those learning strategies which have worked for them in the past and are therefore convinced of their effectiveness.

According to Najvarová (2005), the most frequently used learning strategy for distance-learning students is retelling the text in their own words, with which students check whether they have understood the text sufficiently (this strategy was used by 54.3% of respondents). 15.7% of students compile an overview of information based on the read text and 17.1% of students use mnemonics. According to an Australian longitudinal research study (Lyall, 2005), the following learning strategies are crucial for distance-learning students. Before beginning the acquisition of learning materials from textual study materials, students use a preliminary reading in which they "scan the text", which is followed by an in-depth reading, in which students read the text carefully in order to memorize as much information as possible. In the in-depth reading phase, students approach the text interactively and critically, graphically highlight key information in the text, write notes in the text that help them navigate through it, categorize information, and create their own notes. Students also consider retelling the read text in their own words to be an effective learning strategy. Research by Žlábková and Krnínský (2014) carried out at the Faculty of Education of the University of South Bohemia found that students prepare for exams most frequently by developing answers to questions and memorizing and repeating them. Most students prepare answers because they need to create their own system that helps them navigate through information and makes it easier to memorize key information and repeat curriculum. A smaller percentage of students prepare for their exams only by reading the recommended sources, understanding the read material and memorizing key information (Žlábková & Krninský, 2014, p. 22).

Rehearsal strategies are very popular among adult students (Filcher & Miller, 2000). Specific rehearsal tactics include "repeating the material aloud, copying the material, taking selective verbatim notes and underlining the most important parts of the material" (Weinstein & Mayer, 2016, pp. 315–327). In a study conducted on adult learners in distance education, Bemt and Bugbee (1990) examined specific tactics, such as underlining/highlighting, memorizing the material, and mentally rehearsing important ideas. In a study conducted on adult learners in distance education, McKeachie et al. (1986) and Weinstein and Mayer (1986) examined specific tactics, such as paraphrasing, summarizing, creating analogies, generative note-taking, and answering questions.

In Connection with which Factors Influencing Distance-Learning Outcomes are Learning Strategies Examined?

Although research has shown that there is a relationship between the degree of cognitive development and the use of a broader repertoire of learning strategies (Neuner-Anfindsen 2005), many adult students are unable to study fully independently, as they lack self-management and autonomous learning competencies, and are dependent on the teacher (Pryck et al., 2005, p. 44).

A research study conducted at the Faculty of Agriculture at the Iowa State University (Filcher & Miller, 2000, pp. 60–68) found that the effectiveness of learning in self-directed learning and the use of a wider repertoire of learning strategies is closely related to student's mood, self-confidence, self-assurance, and perseverance; it is also related to volitional and character traits, such as ambition, diligence, and self-motivation. Similar results were obtained by McKeachie et al. (1986) and Pavelková (2002). According to McCombs (1988) and Moore (1989), higher learning efficiency for distance-learning students is mainly related to motivation, both internal and external. Similar results were obtained by Sinkavich (1994), Oxford, Park-Oho, Ita, and Sumrall (1993). According to Vlčková (2003) and Vandergriff (2005), motivated students use a wider repertoire of learning and metacognitive strategies. According to Miller and Carr (1997), the e-learning environment itself is motivating and supportive for students in developing learning and metacognitive strategies, as Miller and Carr found that students in the e-learning environment show more interest in using effective learning strategies; they think more about their own learning process, they plan their study activities, and monitor and evaluate the results of their learning.

Zlámalová (2008) perceives the lack of motivation of students to study as the biggest problem on the part of students, which leads to a loss of interest in the progress of education and poor study results. It was found that insufficiently motivated students feel lonely when studying, so it is important to enable and develop communication and collaboration in the online environment. Insufficient motivation of students can also be caused by bad study habits. According to Miller and Carr (1997), the level of students' motivation is influenced by their cooperation with classmates within the online environment. They found that contact with other classmates and tutors was very important for students. Their research found that nearly all students studying in distance education maintain contact with their classmates, with whom they motivate, support and help each other; only 18.9% studied only on the basis of tutorials. Rashid and Rana (2019, pp. 57–66) also confirmed this finding in their research and further discovered that cooperation and mutual learning is an important factor that positively influences learning outcomes and motivation to learn. A similar conclusion was reached by a team of researchers that included Tran, Nguyen, Van De, Soryaly, and Doan (2019, pp. 79–88). Coopera-

tion and mutual learning also significantly influence students' motivation to learn (Mahmood & Igbal, 2018); students motivate each other to study, which reduces the risk of procrastination (Zormanová, 2017). Students in distance learning were found to have a subjective feeling of a higher rate of procrastination related to the lack of strong will to self-study and inability to organize their time effectively (Zormanová, 2017). The learning group plays an important role in distance education (Roszak & Kołodziejczak, 2017; Alonso-Díaz, Gutierrez-Esteban, Delicado-Puerto, Yuste-Tosina, Delgado, & Arias-Masa, 2017). Learning in groups is a way to overcome the isolation of a distance student (Ryazantseva, 2016; Liu, Xue & Li, 2020; Karim et al., 2018).

Tools that support collaboration include video and audio conferences, online meetings, forums, instant messaging, chats, blogs, wiki-resources, electronic mailing lists, "white boards", social networks, shared documents (Morze, Vember & Varchenko-Trotsenko, 2017), online collaborative projects (Moskwa-Tarnowska, 2017), telecollaboration projects (Marczak, Krajka, 2016), broadcasting networks (Shelomowska, Sorokina, Romaniukha, & Bohomaz, 2017), and gamification (Morańska, 2016; Azoui, Ayachi Ghannouchi, & Brahmi, 2020). It can be claimed that the more communication options available for the teacher within the course, the easier and more efficient it is for the teacher to organize the learning process (Noskova, Pavlova, & Yakovleva, 2017). Other important tools include tests, quizzes, and simulations which offer students a chance to test their knowledge without taking any risks. Online communication not only helps to increase student motivation, but also mediates the exchange of information within the virtual environment (Šnýdrová, Ježková, & Petrů, 2020).

Frequent communication and cooperation with the tutor are also very important. Miller (1997) found that students who frequently seek the effective help of the tutor were more likely to receive an "A" on the exam. According to Barešová (2011), collaboration in the form of student's interaction with the tutor enables the monitoring of a student's progress, increases the student's motivation to study, and also reduces the risk of procrastination. According to Pryck et al. (2005), intensive communication and cooperation between the student and the tutor is highly important. It was found that distance students regularly feel uncertain about whether they are going in the right direction and whether they have understood the subject well because they lack immediate feedback from the teacher. Distance students also feel social isolation (Zormanová, 2017). This problem can be partially eliminated by creating various self-evaluation tests (Voronova, Hotler, & Romanukha, 2017) and through intensive communication between the tutor and students through various communication channels (Černý, Chytková, Mazačová, & Šimková, 2015).

Pryck et al. (2005) state that distance learning can also be implemented for non-independent students who possess insufficiently developed autonomous learning competencies. Their shortcomings can be eliminated by controlled constructive interaction between the tutor and students and the use of structured study materials with predefined goals and set learning tasks that evoke an indirect virtual dialogue in which the student communicates with the text (Kapoun, 2016). The text is complemented by questions leading to the student's self-reflection and other self-assessment activities which allow the student to control the effectiveness of their own learning. The content of the course consists of, for example, reading materials, assignments, case studies, simulations with instructions for students, or tests. Course activities should develop students' critical thinking and a repertoire of learning strategies, and require the application and analysis of memorized information (Pryck et al., 2005). Other tools used in the virtual environment also contribute to the effectiveness of distance learning and to the remarkable success of students in their studies. For example, in a research study by Miller (1997), it was established that successful students were more likely to use self-testing, utilising tests and quizzes during an e-learning course. Noskova et al. (2017) created a classification of digital educational resources. They are divided into these groups: news, instructional, evaluative, instrumental, experiences, conversational, and collaboration.

Table 1
Pedagogical ICT tools

Classification of digital educational resources	Pedagogical ICT tools
News	Reference books and documents
Instructional	Exercise activities Interactive tutorials E-learning courses Self-assessment questionnaires
Evaluative	Training tests Summative assessment Opinions surveys Search engine virtual atlas
Instrumental	Calculators Translators WebQuest modalities
Experiences	Scientific simulations Virtual Worlds Mailing lists

Conversational	Forums Chats Instant messages Comments Blogs Audio and videoconferences Telamatics projects
Collaboration	Wiki environments and management within a network oriented to the applications of knowledge

S o u r c e: Own work

Which Research Methods are Used to Study Distance-Learning Strategies?

Quantitative and qualitative research methods are applied in the study of learning strategies. However, it can be said that the qualitative approach was more prominently used at the beginning of the study of this topic. Currently, a mixed design is the most commonly used approach.

Quantitatively oriented research studies focus on the influence of individual characteristics on the learning strategies used, the influence of culture on the learning strategies used. Furthermore, they deal with the relationship between learning strategies and learning outcomes, the transfer of strategies to new situations and tasks, and the models of strategy training; they also create classifications of learning strategies and terminology. Descriptive and descriptive-relational research predominate among quantitatively oriented research surveys. Both basic and applied research is widespread among quantitatively oriented research surveys (Vlčková, 2010). Basic research, which is less frequent, deals mainly with the identification of learning strategies, with defining learning strategies, creating classifications of learning strategies, exploring the characteristics of learning strategies, and researching the influence of variables on the use of learning strategies (main variables examined are age, gender, and motivation). The influence of specific variables on the use of learning strategies is addressed by, for example, Chamot and El Dinary (1999), Green and Oxford (1995), Oxford (1990), Burry-Stock (1995), and Vlčková (2005).

Applied research, quantitatively oriented, is focused on the issues of teaching and training learning strategies. Its aim is to map the possibilities of supporting effective learning for learners (Vlčková, 2010). Among the best-known research studies of applied research dealing with the topic of learning strategies is research on successful students (e.g., Rubin, 1975; Stern, 1975).

As regards quantitative methods, the method of a questionnaire survey is applied most, while the questionnaires used are based on already created classifications of learning strategies. The aim of research conducted with the re-

search method of a questionnaire survey is to supplement the already created and used classifications of learning strategies with new findings (e.g., Oxford, 1990; O'Malley et al., 1985; Weinstein & Mayer, 2016, etc.).

Qualitatively oriented research surveys focus on teaching learning strategies, expanding the repertoire of learning strategies used by students, the development of learning strategies, and the development and changes in their use in relation to the age of students. Action research predominates among qualitatively oriented research surveys (Vlčková, 2010). In terms of qualitative methods, the following research methods are most frequently used: ethnographic observation and individual unstructured interviews, which serve mainly to create theoretical concepts (e.g., research study by Wong-Fillmore (1976, 1979) and Rubin (1981)).

Table 2
Topics of research studies focusing on learning strategies

Topic of research	Author/s
Identification, description, and classification of strategies, terminology of the field	Wong-Fillmore, 1976, 1979; Rubin, 1981; Naiman et al., 1978
Development of learning strategies	Chipman & Segal, 1985; Brown et al., 1983; Adams, 1989
Creating a standardized research technique	Oxford, 1990; Weinstein, Palmer, & Schulte, 2002;
Effectiveness of learning strategies	Cohen & Aphek, 1981; Bialystok, 1981; Politzer & McGroarty, 1985; Zimmerman & Pons, 1986; Huang & Narsen, 1987; Artelt, 1999; Bremer, 1999; Lind & Sandman, 2003; Vlčková, 2004, 2007; Escribe & Huet 2005
Learning strategies in the context of student characteristics	Reiss, 1981; Politzer & McGoarty, 1985; Oxford & Ehrman, 1987; Skehan, 1990; Stern, 1992; Lind & Sandmann, 2003; Vandergriff, 2005; Vlčková, 2003, 2007
Learning strategies in the context of environmental characteristics	Wong-Fillmore, 1976, 1979; Naiman et al., 1978; Rubin, 1981; Davies & Kaplan, 1998; Vlčková, 2003, 2007
Learning strategies in the context of teaching characteristics, Models of teaching learning strategies	Oxford, 1990, 1994; O'Malley, 1990; Brown, Campione, & Day, 1981; Brown et al., 1983; Dansereau, 1985; Brown & Palincsar, 1984; Friedrich, 1992
Transfer of strategies to new situations and tasks	Palincsar & Brown, 1984; Borkowski, Weyhing, & Carr, 1988
Learning strategies in the context of language skills	Oxford, 1990; Najvarová, 2008

Learning strategies in the context of a language task	Weaver & Cohen, 1997; Chamot & El-Dinary, 1999; Fan, 2003; Vandergrift, Goh, Mareshcal, & Hassantaghodtari, 2005
Teaching learning strategies	Brown & Palincsar, 1989; Mandl & Friedrich, 1992

S o u r c e: Own work

Table 3
Researcher describing/analysing learning strategies

Method used	Researchers using the method
Observation	Rubin, 1975
Interview	Chamot, 1999, 1996
Retrospective interview	Rubin, 1975; Naiman et al., 1978; O'Malley & Chamot, 1990
Stimulated recall interview	Robbins, 1996
Thinking-out-loud interview	Flavell, 1992; Bialystock, 2001; Chamot & Keatley, 2003; Cohen et al., 1998, O'Malley, Chamot, & Küpper, 1989
Questionnaires, inventories	Chamot & El-Dinary, 1999; Fan, 2003; Najvarová 2006; Vandergrift, Goh, Mareshcal, & Hassantaghodtari, 2005; Weaver & Cohen, 1997
Questionnaires of learning strategies (general)	FLA questionnaire (Hug, 1976); AVI (Thiel et al., 1979); STEB (Fritsch & Küffner, 1980); IGT (Schumann-Hengsteler et al., 1993); SRST-K (Kuhl & Christ, 1993); LPS (Neber, 1994); LIST (Wild & Schiefele, 1994); LSF (Lingl, 1997) and LASSI (Weinstein, Palmer, & Schulte, 2002)
Questionnaires of learning strategies for foreign language learning	SILL questionnaire (Oxford, 1990) used by Cohen, Weaver, & Li, 1998; Nyikos & Oxford, 1993; Olivares-Cuhat, 2002; Oxford, 1990, 1996; Oxford & Burry-Stock, 1995; Wharton, 2000; Vlčková, 2003, 2005; Bedell & Oxford, 1996; Bruen, 2001; Green & Oxford, 1995; Nyikos & Oxford, 1993; Oxford & Burry-Stock, 1995; Wharton, 2000; Miller, 2000; Vlčková, 2003, 2006
Questionnaires focused on strategies on specific language skills	MARSI questionnaire (Mokhari, 2000); MALO (Vandergrift, Goh, Mareschal, & Hassantafaghodtari, 2005); ITEF and CTEF (Finkbeiner, 2005)
Diary	Rubin, 1975; Nunan, 1995; Paige, Cohen, & Shively, 2004
Experiments	Cohen, 1996; Nunan, 1997
Tests	Cohen & Aphek, 1981

S o u r c e: Own work

Conclusions

In accordance with the aim of this study, we have answered to the following research questions in the analysis:

1. Which learning strategies are most frequently used in the studies by students studying in a distance-learning form?

We came to the following conclusions: The most frequently used learning strategies for distance-learning students are paraphrasing, summarizing, underlining/highlighting key information in the text, categorizing information to remember the text better, writing notes, creating analogies, as well as generative note-taking, question answering, retelling of the text in their own words, and preparation of answers to memorize key information better.

2. In connection with which factors influencing distance-learning outcomes are the learning strategies examined?

It was found that there is a relationship between the degree of cognitive development and self-directed learning, the use of a broader repertoire of learning strategies and self-confidence, self-assurance, perseverance, ambition, diligence, and motivation, both internal and external. It was established that students in the e-learning environment pay more attention to using effective learning strategies; they concentrate on their own learning process: they plan their study activities, monitor and evaluate the results of their learning.

3. Which research methods are used to research distance-learning strategies?

Both quantitative and qualitative research methods are used in the research study of learning strategies. Nevertheless, mixed design was used the most widely.

Quantitatively oriented research studies deal with relationship between learning strategies and learning outcomes, models of strategy training, the identification of learning strategies, defining learning strategies, creation of classifications of learning strategies, exploration of the characteristics of learning strategies, and researching the influence of variables on the use of learning strategies (main variables examined are age, gender, and motivation). Quantitative-oriented research studies focus in particular on the method of questionnaire survey. The questionnaires used are based on the already created classifications of learning strategies. Qualitatively oriented research surveys mainly deal with the development of learning strategies. Qualitatively oriented research studies, on the other hand, focus in particular on the method of ethnographic observation and individual unstructured interviews are applied the most often.

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Lucie Zormanová

Strategie uczenia się stosowane przez studentów studiujących na odległość

Streszczenie

Niniejsze badanie przeglądowe ma na celu przedstawienie wcześniejszych badań na temat strategii uczenia się stosowanych przez studentów studiujących na odległość. Podstawowym źródłem badań były bazy danych Web of Science, Research Gate i Google Scholar. Przystąpiliśmy również do kolejnego wyszukiwania w oparciu o częste cytowania z wykorzystaniem wyszukiwarki internetowej Google.

Zgodnie z celem niniejszego badania, w analizie poszukiwaliśmy odpowiedzi na następujące pytania badawcze:

1. Jakie strategie uczenia się najczęściej stosują na studiach studenci studiujący na odległość?

2. W związku z którymi czynnikami wpływającymi na efekty uczenia się na odległość są najczęściej badane strategie uczenia się?

3. Jakie metody badawcze są wykorzystywane do badania strategii uczenia się na odległość?

Doszliśmy do następujących wniosków: W przypadku nauczania na odległość jest ważna pomoc studentom w rozwijaniu ich kompetencji w zakresie samodzielnego uczenia się, znajomość różnorodnych strategii uczenia się i refleksyjnego wykorzystania strategii uczenia się, a także

rozwijanie repertuaru strategii czytania stosowanych przez studentów. Jednak dla niektórych studentów uczących się na odległość stosowanie różnych strategii uczenia się może stanowić pewien problem, ponieważ korzystają jedynie z dość ograniczonego repertuaru strategii uczenia się. Dorośli studenci używają tylko tych strategii uczenia się, które sprawdziły się w przeszłości i dlatego są przekonani o ich skuteczności. Najczęściej stosowaną strategią uczenia się w przypadku uczenia się na odległość jest powtarzanie tekstu własnymi słowami. Dzięki niemu studenci sprawdzają, czy dobrze zrozumieli tekst, tworzą zestawienie przeglądu informacji na podstawie przeczytanego tekstu i wykorzystują mnemotechniki.

Badania wykazały, że istnieje związek między stopniem rozwoju poznawczego a stosowaniem szerszego repertuaru strategii uczenia się. Stwierdzono, że skuteczność uczenia się i stosowanie szerszego repertuaru strategii uczenia się jest ściśle związana z nastrojem ucznia, pewnością siebie i wytrwałością.

W badaniach strategii uczenia się są stosowane ilościowe i jakościowe metody badawcze, jednak najczęściej stosowane są metody mieszane.

S ł o w a k l u c z o w e: strategie uczenia się, kształcenie na odległość, narzędzia wspierające współpracę, strategie metapoznawcze, motywacja

Люси Зорманова

Стратегии обучения, используемые студентами обучающимися дистанционно

А н н о т а ц и я

Это обзорное исследование направлено на представление обзора предыдущих исследований стратегий обучения, используемых студентами обучающимися дистанционно. Основным источником исследований были базы данных Web of Science, Researchgate и Google Scholar. Мы также использовали другой инструмент поиска, основанный на частых цитированиях с использованием поисковой системы Google.

В соответствии с целью данного исследования, в ходе анализа мы искали ответы на следующие вопросы исследования:

1. Каковы наиболее распространенные стратегии обучения, используемые студентами во время учебы дистанционно?

2. В отношении каких факторов, влияющих на результаты дистанционного обучения, наиболее изученные стратегии обучения?

3. Какие методы исследования используются для изучения стратегий дистанционного обучения?

Мы пришли к следующим выводам: для дистанционного обучения важно помочь студентам развить их независимые учебные компетенции, ознакомиться с различными стратегиями обучения и рефлексивным использованием стратегий обучения, а также разработать систему стратегий чтения используемых стедентами. Однако для некоторых студентов дистанционного обучения может быть проблемой использование различных стратегий обучения, и эти студенты используют только довольно ограниченный набор стратегий обучения. Взрослые студенты используют только те стратегии обучения, которые работали в прошлом, и поэтому уверены в их эффективности. Наиболее распространенные страте-

гии обучения в случае дистанционного обучения - это повторение текста своими словами, студенты проверяют, правильно ли они поняли текст, составление обзора информации на основе прочитанного текста и использование мнемоники.

Исследования показали, что существует взаимосвязь между степенью когнитивного развития и использованием более широкого набора стратегий обучения. Было обнаружено, что эффективность обучения и использование более широкого набора стратегий обучения тесно связаны с настроением, уверенностью и настойчивостью учащегося;

При изучении стратегий обучения используются количественные и качественные методы исследования. Однако чаще всего используются смешанные методы исследования.

К л ю ч е в ы е с л о в а: стратегии обучения, дистанционное обучение, инструменты поддержки сотрудничества, метакогнитивные стратегии, мотивация.

Lucie Zormanová

Estrategias de aprendizaje utilizadas por estudiantes a distancia

R e s u m e n

Este estudio de revisión tiene como objetivo proporcionar una descripción general de la investigación previa sobre las estrategias de aprendizaje utilizadas por los estudiantes a distancia. La principal fuente de investigación fueron las bases de datos Web of Science, Research Gate y Google Scholar. También procedimos a otra búsqueda basada en citas frecuentes utilizando el motor de búsqueda de Google.

En línea con el objetivo de este estudio, en el análisis se buscaron respuestas a las siguientes preguntas de investigación:

1. ¿Cuáles son las estrategias de aprendizaje más comunes utilizadas por los estudiantes a distancia durante sus estudios?

2. ¿En relación con qué factores que influyen en los resultados del aprendizaje a distancia son las estrategias de aprendizaje más estudiadas?

3. ¿Qué métodos de investigación se utilizan para estudiar las estrategias de aprendizaje a distancia?

Llegamos a las siguientes conclusiones: Para el aprendizaje a distancia, es importante ayudar a los estudiantes a desarrollar sus competencias de aprendizaje independiente, familiarizarse con una variedad de estrategias de aprendizaje y el uso reflexivo de las estrategias de aprendizaje, y desarrollar un repertorio de estrategias de lectura para los estudiantes. Sin embargo, para algunos estudiantes de educación a distancia puede ser un problema utilizar diferentes estrategias de aprendizaje y estos estudiantes de educación a distancia solo usan un repertorio bastante limitado de estrategias de aprendizaje. Los estudiantes adultos solo utilizan estrategias de aprendizaje que han funcionado en el pasado y, por lo tanto, confían en su eficacia. Las estrategias de aprendizaje más habituales en el caso del aprendizaje a distancia son la repetición de un texto con sus propias palabras, el alumno comprueba si ha entendido correctamente el texto, la recopilación de una revisión de información basada en el texto leído y el uso de mnemotécnicos.

La investigación ha demostrado que existe una relación entre el grado de desarrollo cognitivo y el uso de un repertorio más amplio de estrategias de aprendizaje. Se ha descubierto que la

eficacia del aprendizaje y el uso de un repertorio más amplio de estrategias de aprendizaje están estrechamente relacionados con el estado de ánimo, la confianza y la perseverancia del alumno;

Los métodos de investigación cuantitativos y cualitativos se utilizan en el estudio de las estrategias de aprendizaje. Sin embargo, los métodos de investigación mixtos se utilizan con mayor frecuencia.

P a l a b r a s c l a v e: estrategias de aprendizaje, aprendizaje a distancia, herramientas de apoyo a la cooperación, estrategias metacognitivas, motivación.

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Nadiia Balyk
Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine
https://orcid.org/0000-0002-3121-7005

Inna Grod
Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine
https://orcid.org/0000-0002-0785-2711

Yaroslav Vasylenko
Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine
https://orcid.org/0000-0002-2520-4515

Galyna Shmyger
Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine
https://orcid.org/0000-0003-1578-0700

Vasyl Oleksiuk
Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine
https://orcid.org/0000-0003-2206-8447

The Methodology of Using Augmented Reality Technology in the Training of Future Computer Science Teachers

Abstract

The paper describes the concept of augmented reality. Based on literature analysis, the authors claim that augmented reality technology enriches human experiences with digital data. The introduction of augmented reality applications and services provides an opportunity to increase the realism of research, while also offering an enhanced emotional and cognitive experience. Therefore, it can be an effective tool for the organization of learning in schools, colleges and universities.

Augmented reality technologies can be interesting as an object of study as well. To do this, scientists need to design, develop and test appropriate methodologies.

This paper explores one of the components of such techniques. The authors analysed several platforms for creating augmented reality applications. Unity, Vuforia and 3d-Studio were chosen for the purpose of analysis. Using them, the authors developed a fragment of the content of education. It contains instructions for creating an augmented reality application. The paper contains the author's account of the process of training future teachers of computer science at Ternopil Volodymyr Hnatiuk National Pedagogical University (Ukraine). Based on the conducted study, the authors claim that students showed considerable interest in augmented reality technologies and the content of their training.

Keywords: augmented reality, virtual reality, augmented reality software developer toolkit, software development kit, integrated development environment

The introduction of digital technologies into the educational process is provided by a number of strategic documents, including the concept of the "New Ukrainian School"1 as well as the strategy "Education 2030"2, which were approved by UNESCO and UNICEF together with other organizations, and the development strategy "Europe 2030"3 adopted by the European Commission.

One of the phenomena of digital technologies in the last 10 years is the technology of virtual and augmented reality (VR and AR). Today, it has an ever-expanding business, entertainment and educational application. First of all, the companies involved in augmented reality are making a digital transformation of education (Morze, Smyrnova-Trybulska & Boiko, 2019). Therefore, scientists (Lukashenko & Lutsenko, 2016; Selivanov & Selivanova, 2015) see the significant educational potential of these technologies. Basic studies on the impact of VR on humans' focus on the study of the impact of computers and working with them, the Internet, social networking resources, and computer games on the feelings, thoughts and actions of an individual (Lukashenko & Lutsenko, 2016; Selivanov & Selivanova, 2015).

In her study, Heather (2018) says that AR affects the brain in new and exciting ways. There are three ways in which AR affects the brain:

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[1] https://mon.gov.ua/storage/app/media/zagalna%20serednya/nova-ukrainska-shkola-compressed.pdf

[2] http://uis.unesco.org/sites/default/files/documents/education-2030-incheon-framework-for-action-implementation-of-sdg4-2016-en_2.pdf

[3] https://ec.europa.eu/commission/sites/beta-political/files/rp_sustainable_europe_30-01_en_web.pdf

- AR drives high levels of visual attention in the brain (almost double that of non-AR tasks).
- Right now, AR elicits a 'surprise' response in the brain.
- What is stored or encoded into memory is 70% higher for AR experiences.

AR is a technology that enriches human experiences with digital data and thus mixes the real and virtual environment. It uses virtual information as an additional useful tool. As a result, a new, more informative and stimulating environment is created (Hruntova, Yechkalo, Striuk, & Pikilnyak, 2018). In the article by Podkosova, Varlamova, Ostroukh, and Krasnyansky (2011), the following advantages of such an environment are distinguished:

- micro and macro universe;
- creating models of phenomena or processes that cannot be directly and clearly registered by human senses;
- visualization of abstract models (producing objects that have no form in the real world).

AR apps can help a person focus their attention on certain elements of the camera image; improve the understanding of the objects of the surrounding world by providing necessary information overlapping the image in the form of a text message or visual image. Today, AR is used in the following fields: education, medicine, military affairs, aviation, marketing, tourism, design, and games. In education, AR helps children learn about the world, as they can point the camera at the subject of interest and see detailed information about it.

The reader should not confuse VR with AR. The fundamental difference is that VR constructs a new artificial world and AR only adds individual artificial elements to the perception of the real world. A combination of these realities is called Mixed Reality. VR can be filled with people, weather conditions, events, and more (Smyrnova-Trybulska, 2019). For now, AR-technology is one of the main components of modern educational concepts such as STEM and STEAM (Balyk, Shmyger, Vasylenko, Oleksiuk & Skaskiv, 2019).

In our study, the understanding of the essence of VR is used to a greater extent in the traditionally cybernetic (programmatic) sense and is in tune with the thought of S. Karelov (2000). His theory boils down to the following basic characteristics: 1) creation by means of programming of three-dimensional images of the objects, as close as possible to reality, models of real objects, similar to holographic ones; 2) the possibility of animation (the subject in a virtual space can move, look at the object from different directions, "fly" in the universe, "move" inside the biological cell, etc.) (Selivanov & Selivanova, 2014).

AR is an environment with a direct or indirect complement to the physical world of digital data. The addition of AR objects takes place in real time, with the use of digital devices such as tablets, smartphones, smart glasses or accessories

with special software. The device recognizes objects, special labels on them, or the user's location through a camera or other interface (such as Bluetooth or GPS). The marker can be both a special beacon with a built-in chip and a regular QR code (Korenova, 2018). In order for the add-on to occur, the user needs to be within the scope of this beacon or read a QR code.

Augmented Reality Platforms for Programming and Coding

AR technologies can be used not only as a means of learning. Experience shows that AR applications and services can be interesting and effective as an object of study.

For example, such tools as CoSpaces Edu, Vuforia AR, Unity, ARCore, SketchUp, and others are popular in the process of studying programming in secondary schools, colleges and universities.

CoSpaces Edu is a service for creating an AR application. It enables students to learn through practice, using various tools available within the range of VR and AR technologies. The platform uses a visual (Scratch-like) programming language. With its fun, Lego-like coloured blocks, CoBlocks, it is the ideal solution for junior pupils. CoSpaces Edu provides access to scripting languages for more advanced coding too. Therefore, more advanced coders can create scripts to add interactions and events or even create games. Teachers can create 3D scenes and virtual models for their subjects at Cospaces Edu. They can also encourage students to be creative and create their own 3D scenes and learning models of objects, phenomena and processes (Levina & Konyukhov, 2019).

One of the first Software Development Kits (SDK) for developing AR applications was Vuforia AR. Vuforia uses computer vision technologies, as well as tracking flat images and simple three-dimensional real objects in real time. The latest versions of Vuforia can recognize text and cylindrical markers. The image rendering capability allows developers to position and orient virtual objects such as 3D models and media content. They blend with the real scene when displayed on mobile devices. Unity recently partnered with Vuforia to integrate this AR platform into the Unity game engine (online: https://developer.vuforia.com/). The great possibilities of the integrated successful implementation of these platforms occur in the least amount of time. For example, the Unity and Vuforia platform was successful in the course "3D design for Mobile Augmented reality" at The Norwegian School of IT. In the course, students learned to make efficient,

optimized and visually coherent content for Augmented Reality apps for mobile devices (Kjellmo, 2013).

The present research of the authors was devoted to designing an AR spatial visualization training system. The system consists of a manual controller and a visualization-training task. In the process of manual controller design, there was a necessity to think of an experiment to generate intuitive manipulation. In the process of preparing the training task, by analysing spatial training factors, a new visualization-training task was designed. In the process of AR integration, the system was implemented by Qualcomm AR in Unity3D with Vuforia portal and the final AR-based spatial visualization ability training system is completed (Chang & Chen, 2015).

Unity provides for multiple options SDKs which can be used for AR development. Vuforia and ARCore are the two most popular SDKs. ARCore provides better plane detection, pose tracking, motion tracking, and image recognition than Vuforia. The only downside of ARCore is that it runs only on certain older mobile phones, but all phones released in the past 3 years have ARCore enabled in them. ARCore is an SDK provided by Google, which allows for smooth computer vision, plane detection and motion tracking in certain Android mobile phones. ARCore allows for better AR experiences since it can detect planes (in proper lighting conditions) in 2 seconds approximately. ARCore does not require a specific kind of hardware since most of the latest processors are capable enough to provide computing power required by ARCore. Because of Unity's popularity, ARCore development comes built in with Unity (Kapoor & Naik, 2020).

Vuforia SDK supports different types of targets, both 2D and 3D, including multi-target configurations, cylinder targets to track images on a cylindrical surface, image targets without markers, frame markers, and cloud recognition targets to track 1 million targets simultaneously. The SDK provides features like localized occlusion detections using virtual buttons and image target selection in real time, and has the capability to reconfigure and create target sets depending on the scenario. It also supports text target acquisition to recognize and track words. Below are some features of this platform (Amin & Govilkar, 2015):

- Provide faster local detection of targets with the capacity of tracking 5 targets simultaneously.
- Efficient tracking in low light conditions, even if the target is partially covered.
- Extended tracking capabilities, which enable the app to keep tracking targets and helps maintain a consistent reference for augmentations of objects even when the targets are no longer visible in real time camera view.

The Vuforia SDK Architecture has components such as (Tran, online: https://www.academia.edu/7028565/AR_with_Vuforia):

- Camera. It ensures that every preview frame is captured and passed efficiently to the tracker.
- Image Converter. The pixel-format converter converts from the camera format to a format suitable for OpenGL ES rendering and for tracking internally.
- The tracker component contains computer vision algorithms that detect and track real-world objects in camera video frames. The results are stored in a state object that is used by the video background renderer and can be accessed from the application code.
- Video Background Renderer. Rendering the camera image stored in the state object.
- Application Code. Query the state object for newly detected targets, markers or uploaded states of these elements.
- Rendering of augmented graphics overlay.
- Device Database. It is created using the online Target Manager.
- Cloud Database. It can be created using the Target Manager or the Vuforia Web Services API.
- User-Defined Targets. This feature allows for creating targets on the fly from the current camera image.
- Word targets. The Vuforia SDK can recognize words and track them similarly to other type of targets, with two available recognitions, “Words” and “Characters”.

An Example of the Authors’ Implementation of Methodology

To illustrate our approach to the study of AR development platforms, we will show an example of one task. It will be created as a project in an integrated development environment. The students’ task is to create a real-time label for activating virtually animated objects which form an AR.

We based our work on the integrated approach of S. Semerikov and his colleagues. According to their approach, ideas are developed using standard objects and implemented in a visual design environment. Assigning new properties to standard objects and creating new ones is performed in the associated object-oriented programming environment (Syrovatskyi, Semerikov, Modlo, Yechkalo & Zelinska, 2018).

Students implemented this project in three stages: creation of tags; working with the scene; compilation of the project for mobile platforms.

The Unity Platform was chosen for the project. It has a free version compatible with Windows. To create the project, students used such components as: Unity

2019.4.5f1, Android Build Support, iOS Build Support, Vuforia Augmented Reality Support, WebGL Build Support, and Windows Build Support.

At the first stage, students created a project. To use Vuforia in the Unity-project, students registered on its official website (online: https://developer.vuforia.com/) and received a license. This is required to create the Vuforia plugin. Our students created ARTag. A tag (ARTag) is a marker to the appearance of a virtually animated object within the real world. To create it, students deploy a tags database. In general, everyone could choose any image as a tag. For example, in one of the student projects, such an image was the Hryvnia – the Ukrainian national currency.

In the second stage, students worked with the scene. They had to add a plug-in camera and a database to the project. To test the effectiveness of the marker, developers had to turn on the camera on the laptop, expand the project and show the hryvnia banknote or its image.

Next, students worked with models from the Asset Store. The model is an animated virtual object. In addition to the store, advanced students had the opportunity to create it themselves, for example in 3D Max Studio. For example, a condor bird was developed as an object.

To check the correctness of the import of the model into the project, developers check the ability to control its parameters such as: position, image size, and rotation.

Later, using ImageTarger, students linked the label to the model. This is a father-daughter relationship. As a result, the condor became a subsidiary of the hryvnia. Now, if a student photographs a hryvnia with a smartphone and points the camera at the condor image, the bird will fly away. This will happen because it is downloaded with the finished animation.

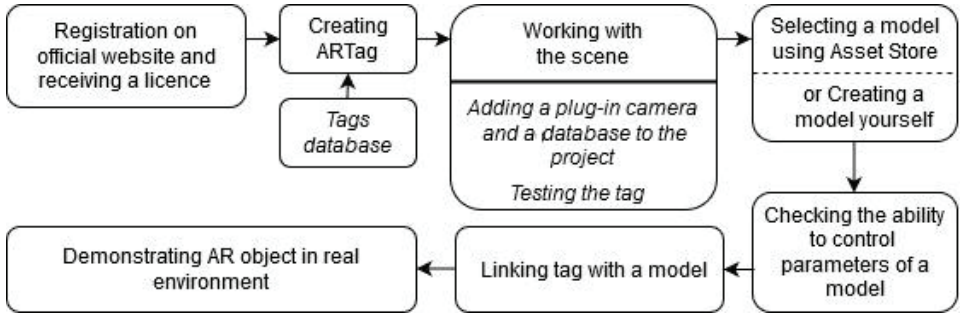

Figure 1. Technological chain of creation of AR objects in physical space.

S o u r c e: *Own work.*

Figure 1 shows the sequential steps in the technological chain of construction of AR objects in the physical space.

In the third stage, students compile the project for mobile platforms. In the first stage, students needed to download the .apk file to their smartphones and install the application.

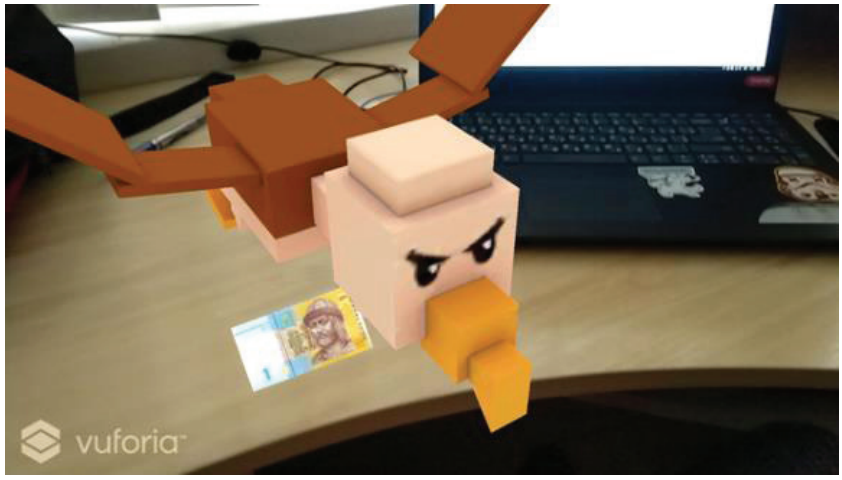

Figure 2. What we see on a smartphone.
Source: *Own work.*

The next step is to download the library of objects needed to compile the application to the phone. To compile the whole project, we also need to download the library system (which depended on the OS version of the mobile phone). Then, the scenes that are being worked on need to be transferred. The object is compiled together with the libraries and must now be copied to the phone in a folder within the internal storage of the phone.

The most interesting part is the demonstration of a created virtual object through a smartphone, whose camera we direct on the hryvnia (or the corresponding QR code); we will see a flying condor (Figure 2).

Creation of AR Objects with Unity

The behaviour of objects is controlled by the Components are attached to them. Unity's built-in components can be very versatile but we need to go beyond their capabilities to meet our own needs. Unity l allows you to create your own components using scripts that allow you to activate objects and change their settings. The program supports two programming languages: C# and UnityScript, a language specifically designed for use with Unity (similar to JavaScript) (Indraprastha & Shinozaki, 2009).

The script interacts with Unity's internal mechanisms by creating a class derived from the built-in MonoBehaviour class. The class name is taken from the name you provided when creating the file. The class name and filename must be the same so that the script component can be attached to the object. No code will be activated unless the script instance is attached to the object.

The first step is to get a link to the component you want to work with. This is done using the GetComponent () function. The object components are stored as variables. Here is an example in C#:

```
void Start() {
      Rigidbody rb = GetComponent<Rigidbody>();
}
```

As soon as the link to the component instance appears, students must set its properties in the Inspector window:

```
void Start() {
      Rigidbody rb = GetComponent<Rigidbody>();
      // Change the mass of the object's Rigidbody,
      rb.mass = 10f;
}
```

Consider the case of linking objects through variables. The easiest way to find the object we need is to add a GameObject type variable with a public access level to the script:

```
public class Enemy : MonoBehaviour {
      public GameObject player;
      // Other variables and functions...
}
```

The variable can be seen in the Inspector window. Finding objects is possible when there is some information through which they can be identified.

Unity's script is not like a traditional program where the code runs all the time until it completes its task. Instead, Unity periodically delegates script management when calling certain declared functions. As soon as the function completes its execution, control returns to Unity. These functions are known as event functions because they are activated by Unity in response to events that occur. Unity uses a naming scheme to determine which function to call for an event. Unity has many features of events.

The key concept in programming is to change the position, state and behaviour of objects right before drawing a frame. Such a code in Unity is usually placed in the Update function. Update is called before the frame is drawn and before the animations are calculated:

```
void Update() {
    float distance=speed*Time.deltaTime*Input.
```

```
GetAxis(“Horizontal”);
    transform.Translate(Vector3.right * distance);
}
```

Sometimes it is advisable to be able to make additional changes at a time when the object of the scene worked with the functions Update and FixedUpdate and calculated all the animations. An example is when a script code has to override an animation effect (say, make the character’s head return to the target in the scene). In such situations, students can use the LateUpdate function:

```
void LateUpdate() {
      Camera.main.transform.LookAt(target.transform);
}
```

```
private void FixedUpdate() {
transform.Rotate(1, 2, 3);
 //1 - angle for the X axis, 2 - angle for the Y axis,
 //3 - angle for the Z axis
}
```

A more specific version of the FixedUpdate function:

```
 void FixedUpdate() {
             if (Input.GetKey(KeyCode.RightArrow))
 transform.Rotate(0, 0, 2);
     if (Input.GetKey(KeyCode.LeftArrow)) transform.
 Rotate(0, 0, -2);
     if (Input.GetKey(KeyCode.UpArrow)) transform.
 Rotate(2, 0, 0);
     if (Input.GetKey(KeyCode.DownArrow)) transform.
 Rotate(-2, 0, 0);
 }
```

It is useful to be able to call on the initialization function before any updates occur. The Start function is called before the first frame or physics of the object is updated. The Awake function is called for each object when the scene is loaded. For different objects, the Start and Awake functions are called in a different order, all Awake will be executed before the first Start is called. This means that the code in the Start function can use everything that was done in the Awake phase.

Using the UnityGUI to Create Augmented Reality Objects

By creating augmented reality objects, students can immediately work with a graphical user interface (GUI). This will concern programming controls (objects of the Controls class) using UnityGUI.

UnityGUI controls the use of a special OnGUI() function that calls each frame as long as the script in which it resides runs.

Here is an example of a GUI control structure:

```
//JavaScript
function OnGUI() {
    // Make a background box
    GUI.Box (Rect (10,10, 100, 90), “Loader Menu”);
    // Make the first button.
    // If it is pressed, Application.Loadlevel(1) will be
executed
    if (GUI.Button (Rect (20,40,80,20), “Level 1”)) {
        Application.LoadLevel(1);
    }
    // Make the second button.
    if (GUI.Button (Rect (20, 70, 80, 20), “Level 2”)) {
        Application.LoadLevel(2);
    }
}
```

The GUI.Box(Rect(10,10,100,90), “Loader Menu”) string is a typical schema declaration for controls. Since the code in the OnGUI () method is called upon when drawing each frame, we do not need to explicitly create or delete GUI controls. The line declaring control essentially creates it. If we want to display the controls at a certain point in time, we can use any kind of programming logic to do this.

The following GUI.Button() code is called only every second, so the button will appear and disappear. The user can only click on the button when it is visible:

```
/* Flashing button example */
// JavaScript
Function OnGUI() {
 if (Time.time % 2 < 1) {
 if (GUI.Button(Rect(10, 10, 200, 20), “Meet the flashing
button”)) {
             print (“You clicked me!”);
 }
 }
}
```

As a conclusion, students can use any desired logic to control the display and functionality of GUI controls. Three key pieces of information are required to determine GUI control: Type, Position, and Content. Note that this is a structure, a function with two arguments. The types of control are determined by calling the Unity GUI class or GUILayout class function. All other types of controls are described on the developer’s site, in the Controls section.

The second argument for GUI controls is the content that will be displayed in the control. To display text, you must pass a string as an argument, for example, as follows:

```
/*String Content example */
// JavaScript
function OnGUI() {
 GUI.Label(Rect(0,0,100,50), “This is the text string for a
Label Control”);
}
```

To display a picture, students must declare a variable of type Texture2D and pass its name as an argument, for instance:

```
/*Texture2D Content example */
// JavaScript
var controlTexture : Texture2D;
function OnGUI() {
      GUI.Label(Rect(0, 0, 100, 50), controlTexture);
}
```

There is also a third option in the GUI control that allows you to display both text and pictures together. You can pass a GUIContent object as a “content” argument and define a picture line to display in GUIContent.

```
/* Using GUIContent to display an image and a string */
// JavaScript
var icon : Texture2D;
function OnGUI() {
    GUI.Box(Rect(10, 10, 100, 50), GUIContent(“This is
text”, icon));
}
```

Finally, we will talk about the creation and implementation of augmented reality work. It is impossible not to mention the call-backs which are used when it comes to the appearance and disappearance of objects in the display of any camera. Instead of waiting for answers to continue running the program, JavaScript keeps executing while waiting for other events.

The MonoBehaviour class, which is the parent of each script created by students in Unity, has methods that are called when an object becomes visible / invisible to any of the existing cameras. A message is sent to all scripts attached to the renderer. This is useful for avoiding computations which are only needed when the object is visible. OnBecameVisible() is called when an object is visible to any camera, whereas OnBecameInvisible() is called when the object is not visible.

To zoom in or out on an object when it is displayed on the screen, follow these steps:

- add the object to the Vuforia database;
- create an ObjectTransform script and connect it to an object whose scale will be resized;
- implement the script:

```
bool bVisible = false;
void OnBecameVisible() {
   bVisible = true;
}
void OnBecameInvisible() {
   bVisible = false;
}
void Update() {
   if (!bVisible)
              return;
   if (Input.mouseScrollDelta.x < 0 || Input.
mouseScrollDelta.y < 0) {
              Vector3 scale = transform.LocalScale;
              scale.x -=0.1f; scale.y -=0.1f; scale.z -=
      0.1f;
              transform.LocalScale = scale;
   }
   if (Input.mouseScrollDelta.x > 0 || Input.
mouseScrollDelta.y > 0) {
              Vector3 scale = transform.LocalScale;
              scale.x +=0.1f; scale.y +=0.1f; scale.z +=
      0.1f;
              ransform.LocalScale = scale;
   }
}
```

- run and check the result.
- To be able to rotate the object along the Z axis, it is necessary to:
- add the following code to the ObjectTransform script:

```
if (!Input.GetMouseButton(0))
      return;
float rotX = Input.GetAxis(“Mouse X”) * 5;
transform.Rotate(0, rotX, 0);
```

- run and check the result.

The Pedagogical Aspects and Conditions of the Introduction of AR Technologies in the Educational Process

The processes of implementation of VR and AR technologies are quite active and have a wide range of uses. In the near future, augmented reality will become a popular method for learning at schools, universities, colleges, and even for children in home schooling. The effectiveness of the use of AR in education is due to three features:

- contextuality,
- interactivity,
- spaciousness.

Contextuality is the natural introduction of virtual objects into the surrounding space so that they do not seem something superfluous and alien. The actual environment and virtual objects, which are essentially just pieces of code, are shown together and in a complex way – and thus create a single holistic picture.

The second advantage of using AR in education is interactivity. This means that you can interact with virtual objects as if they were real: move, relocate, and even destroy them; only the physical aspects, such as touch, smell, feel, etc. are absent. This level is still unattainable using present technologies.

The third feature is spaciousness. Educational AR applications offer interaction with three-dimensional virtual objects which have their own coordinates in space. The user can move freely in space to view the augmented reality object from different angles.

The visual representation of the object of study and its visualization arouses interest. Live animations with which you can fully interact are much more interesting than static pictures and schematic images.

In education, AR-applications are effective because they allow you to visually study and work with devices or objects, access to which is extremely difficult to obtain in real life.

In today's realities in education, the use of AR and VR technologies has a number of limitations. The introduction of such technologies is associated with many financial and material difficulties: the high cost of equipment, lack of a large number of quality programs and, consequently, the need to develop them, and, most importantly, little experience in using this technology from teachers who need additional training.

The total number and variety of existing applications using AR and VR technologies specifically designed for education is quite modest. To change the situation, of course, requires state support for such projects and the presence of initia-

tives by the educational community. Creating even a small VR application, for example, in the field of history, requires the involvement of many specialists: historians, artists, programmers, cultural specialists, etc., as well as appropriate technical support. This requires support from the state and major corporations which are interested in training professionals with competencies in modern areas of information technology.

It is clear that the use of AR technologies in education will have a significant effect but the standard time limits for school lessons and classes in universities and colleges will significantly disrupt existing programs because the time spent using these technologies will change the curriculum. This will increase the time spent by teachers and lecturers on the preparation of relevant educational material. Therefore, for the introduction of AR technology in the educational process, there is a need to adjust educational programs and curricula in order to include new disciplines specializing in AR technologies or the inclusion of relevant modules or topics in existing disciplines. In addition, it is necessary to make changes in the evaluation of labour for teachers.

The use of technologies such as AR and VR reality not only make educational programs innovative, but also significantly strengthen the position of educational institutions on the market of educational services. The use of AR- and VR-reality technologies by educational institutions contributes to their perception as modern, advanced and high-tech educational institutions.

Although VR and AR technologies have a great potential for improving student achievement, they can be a significant distraction. Examples of the use of technology show an increase in interest in the learning process. However, in the case of excessive fascination with the form to the detriment of the content, the effect may be reversed.

In order to determine the prospects for the introduction of AR technologies in the educational process, as well as to identify the attitude of the teaching staff and student audience to new learning technologies, we conducted a survey in the form of an expert interview. It was attended by 16 respondents from the teaching staff and 48 university students of various specialties.

The opinions and assessments of the experts involved regarding the use of specialized AR applications are extremely positive. Teachers are ready to use AR applications in their professional activities, provided they are adapted to the conditions of teaching disciplines. In addition, respondents spoke in favour of a positive outlook for the overall use of AR applications in the educational process, emphasizing the special relevance of such technologies in practice-oriented specialties such as biology, medicine, physics, and chemistry.

Due to the unprecedented speed of development and introduction of digital technologies in all spheres of human activity, educational institutions are actively

implementing the latest learning forms that not only improve the quality of education, but also increase competitiveness of educational institutions on the global educational market.

Conclusions

The augmented reality technology has a great educational potential. It creates opportunities for the transfer of elements from the virtual world into the real one. Augmented reality can complement the things that we are able to see, hear, or feel with virtual, sometimes non-existent or ideal objects.

The conducted survey allows researchers to speak about the high degree of relevance and demand in the fields of higher and secondary education for the use of the latest AR and VR technologies, as well as to remark upon the very active process of implementing virtual education technologies in Ukrainian and foreign educational institutions.

Therefore, the problem of developing a methodology for teaching students to create such applications and services is in demand. In particular, this problem is relevant in the case of training future teachers of computer science. After all, they will teach future generations these and newer technologies. The possibilities of augmented reality in combination with 3D modelling and interactivity are of particular importance for students of natural and technical specialties. In this work, based on the analysis of different platforms for creating applications with augmented reality, we have developed our methodology based on an integrated example of creating an AR-project in Unity, which is implemented at Ternopil National Pedagogical University.

Our students implemented it during the following stages: creating tags; work with the scene; and, compilation of the project for mobile platforms. In the process of learning, we observed students' interest in the objects of study. It can be argued that the technologies of AR and VR reality, which are actively updating every day, have a great potential for development and future prospects in education.

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Nadiia Balyk, Inna Grod, Yaroslav Vasylenko, Galyna Shmyger, Vasyl Oleksiuk

Metodologia wykorzystania technologii rozszerzonej rzeczywistości w szkoleniu przyszłych nauczycieli informatyki

Streszczenie

Artykuł zawiera przegląd koncepcji rozszerzonej rzeczywistości. Na podstawie analizy literatury autorzy twierdzą, że technologia rzeczywistości rozszerzonej wzbogaca ludzkie doznania o dane cyfrowe. Wprowadzenie aplikacji i usług rzeczywistości rozszerzonej daje szansę na zwiększenie realizmu badań; dostarcza wrażeń emocjonalnych i poznawczych. Może więc być skutecznym narzędziem do organizacji nauki w szkołach i na uczelniach.

Technologie rzeczywistości rozszerzonej mogą być również interesujące jako przedmiot badań. Dlatego naukowcy muszą zaprojektować, opracować i przetestować odpowiednie metodologie.

Autorzy artykułu przeanalizowali kilka platform do tworzenia aplikacji rozszerzonej rzeczywistości. Wśród nich wybrano Unity, Vuforia i 3d-Studio. Korzystając z nich, autorzy opracowali fragment treści kształcenia zawierający instrukcje tworzenia aplikacji rozszerzonej rzeczywistości. Artykuł zawiera relację autora z procesu kształcenia przyszłych nauczycieli informatyki na Narodowym Uniwersytecie Pedagogicznym im. Włodzimierza Hnatiuka w Tarnopolu (Ukraina). Na podstawie badania autorzy twierdzą, że studenci wykazywali duże zainteresowanie technologiami rozszerzonej rzeczywistości i treścią ich szkoleń.

S ł o w a k l u c z o w e: rzeczywistość rozszerzona, rzeczywistość wirtualna, zestaw narzędzi dla programistów do rzeczywistości rozszerzonej, zestaw do tworzenia oprogramowania, zintegrowane środowisko programistyczne

Надежда Балык, Инна Грод, Ярослав Василенко, Галина Шмигер, Василий Олексюк

Методика использования технологии дополненной реальности в подготовке будущих учителей информатики

А н н о т а ц и я

Статья содержит обзор концепции дополненной реальности. Основываясь на анализе литературы, авторы утверждают, что технология дополненной реальности обогащает человеческие ощущения цифровыми данными. Внедрение приложений и сервисов дополненной реальности дает возможность повысить реалистичность исследований; обеспечивает эмоциональный и познавательный опыт. Так что это может быть эффективным инструментом для организации обучения в школах, колледжах и университетах.

Технологии дополненной реальности также могут быть интересны как объект изучения. Для этого ученым необходимо спроектировать, разработать и опробовать соответствующие методологии.

Эта статья содержит один из компонентов таких методов. Авторы проанализировали несколько платформ для создания приложений дополненной реальности. Unity, Vuforia и 3d-Studio были выбраны среди них. Используя их, авторы разработали фрагмент содержания образования. Он содержит инструкции по созданию приложения дополненной реальности. Статья содержит авторский отчет о процессе подготовки будущих учителей информатики в Тернопольском национальном педагогическом университете им. В. Гнатюка (Украина). На основе проведенного исследования авторы утверждают, что студенты проявляли значительный интерес к технологиям дополненной реальности и содержания их обучения.

К л ю ч е в ы е с л о в а: дополненная реальность, виртуальная реальность, инструментарий разработчика программного обеспечения дополненной реальности, комплект разработки программного обеспечения, интегрированная среда разработки

Nadiia Balyk, Inna Grod, Yaroslav Vasylenko, Galyna Shmyger, Vasyl Oleksiuk

La metodología de uso de la tecnología de realidad aumentada en la formación de futuros docentes de informática

R e s u m e n

El documento contiene la revisión del concepto de realidad aumentada. Según el análisis de la literatura, los autores afirman que la tecnología de realidad aumentada enriquece las sensaciones humanas con datos digitales. La introducción de aplicaciones y servicios de realidad aumentada brinda la oportunidad de aumentar el realismo de la investigación; Proporciona experiencia emocional y cognitiva. Por lo tanto, puede ser una herramienta eficaz para la organización del aprendizaje en escuelas, colegios y universidades.

Las tecnologías de realidad aumentada también pueden ser interesantes como objeto de estudio. Para hacer esto, los científicos necesitan diseñar, desarrollar y probar metodologías apropiadas.

Este documento contiene uno de los componentes de tales técnicas. Los autores analizaron varias plataformas para crear aplicaciones de realidad aumentada. Unity, Vuforia y 3d-Studio fueron elegidos entre ellos. Utilizándolos, los autores desarrollaron una parte del contenido de la educación. Contiene instrucciones para crear una aplicación de realidad aumentada. El documento contiene el relato de los autores sobre el proceso de formación de futuros profesores de informática en la Universidad Pedagógica Nacional Ternopil Volodymyr Hnatiuk (Ucrania). Según el estudio, los autores afirman que los estudiantes mostraron un interés significativo en las tecnologías de realidad aumentada y el contenido de su formación.

P a l a b r a s c l a v e: realidad aumentada, realidad virtual, kit de herramientas para desarrolladores de software de realidad aumentada, kit de desarrollo de software, entorno de desarrollo integrado

II. Innovative Methods and Technology in Education

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Svitlana Skvortsova
South Ukrainian National Pedagogical University named after K. Ushynsky, Odesa, Ukraine
https://orcid.org/0000-0003-4047-1301

Tetiana Britskan
Izmail State University of Humanities, Izmail, Ukraine
https://orcid.org/0000-0001-7277-4169

Organization of Mathematical Distance Learning in Primary School

Abstract

The article is devoted to researching the problem of using ICT by primary school teachers in teaching mathematics, in particular during distance learning caused by the COVID-19 pandemic. The results of comparative analysis of the most common online services are presented in three categories: 1) services for creating a virtual classroom and interactive exercises and other educational content (LearningApps, Google Classroom, Classtime, and Classdojo); 2) services for organizing a distance lesson (Padlet); 3) services for conducting a distance lesson in the form of a conference (Zoom, Skype, Microsoft Teams). The generalized results of the online survey of Ukrainian primary school teachers on the use of these online services in mathematics lessons are presented. Furthermore, methodological recommendations for the use of selected online services are reflected in the developed e-course "Internet resources for creating mathematical learning and game content for primary schoolchildren".

K e y w o r d s: ICT, distance learning, online services, primary schoolchildren

1. Using Online Services as a Means of Improving Learning Efficiency

Based on the needs of modern students in a virtual environment, given the question of improving the effectiveness of learning, including mathematics in primary school, various scientists have researched the field of online services for teachers (Zegzula & Smyrnova-Trybulska, 2017; Morze, Smyrnova-Trybulska, & Boiko, 2019; Horvathova, 2019; Sagan, Los, Kazannikova, & Raievska, 2019; Gocheva, Somova, Angelova, & Kasakliev, 2020; Palaigeorgiou, Papadopoulou, & Kazanidis, 2018; Razis, et. al., 2018; Afify, 2020; Kornytska, 2018; Stechkevych, 2020).

The use of various online services, in particular the online board Padlet, which allow for collaboration between students and the teacher have been explored by I. Kornytska (2018), while O. Stechkevich explores the possibilities of Google Classroom for the organization of the educational environment (Stechkevich, 2020).

Many researchers claim that interactive video has a positive impact on learning: (Palaigeorgiou, Papadopoulou, & Kazanidis, 2018) and the learning environment created through interactive video has helped students achieve a high level of self-control, self-discipline, and self-learning, in addition to allowing them to manage their learning progress successfully. The results of Razis' study indicate that the use of interactive video improves the preservation of educational material in schoolchildren (Razis et. al., 2018). The results of Afify's study, on the other hand, showed that the performance of students who studied with the help of short videos achieved better results in both direct cognitive achievement and post-cognitive achievement, which is the preservation of learning outcomes in the long term (Afify, 2020). Finally, several researchers, such as Gocheva, Somova, Angelova, and Kasakliev emphasize that the game content created with the help of ICT is used both for cognitive activity and for motivating primary schoolchildren to learn mathematics and support understanding educational content (Gocheva, Somova, Angelova, & Kasakliev, 2020).

It is also possible to increase the efficiency of teaching mathematics in primary school by using online services for teachers. Our research (Skvortsova & Britskan, 2018, p. 59; Skvortsova, Onopriienko, & Britskan, 2019, p. 277; Skvortsova, Britskan, Bastinec, & Hruby, 2019, p. 74; Britskan & Kovalchuk, 2019, p. 42; Britskan & Fedii, Onopriienko, 2020, p. 9; Skvortsova, Ishchenko, & Britskan, 2020, p. 124) focuses on preparing teachers to use Web 2.0 services: LearningApps, H5P, Plickers, GIMKIT, and Google Forms. Thus, LearningApps allows the teacher to create a virtual classroom, filling it with interactive tasks and recording the results of students' performance in a virtual journal. H5P does not give the teacher an

opportunity to create a virtual classroom but, in this service, the instructor can develop a pre-prepared interactive educational video, providing pauses for students to perform interactive exercises created in the templates of this service. In Plickers, the teacher also does not have the opportunity to create a virtual classroom but it can be used to create test tasks with four possible answers and "true/false" quizzes. These quizzes are performed by students without the use of gadgets; they choose the correct answer to a particular task and raise printed cards with the appropriate side up. The teacher opens his own profile of this service in the gadget and scans all the cards at once. Plickers allows the teacher to create a series of different types of tasks, including tests and open-ended tasks, tasks using Google Forms, and send them to students for completion using a link. The advantage of creating tasks in this Google application is that the teacher can view the intermediate and final results of students performing the tasks. On the other hand, GIMKIT is a service for designing and instantly evaluating tests and quizzes. It should be noted that this service contains both a free version with a limited number of designs for creating quizzes and a paid one, which provides more opportunities for teachers. The GIMKIT service evaluates the performance of tests in the form of a game – by answering the questions correctly, the student "earns" money. The service contains three types of competition: 1) Game by game, where students compete individually for leadership; 2) Against their classmates, where students compete for leadership in the season, saving up "money" over a series of games; 3) Against other classes, where students compete collectively against other classes.

Mainly, our work contains practical recommendations for teachers on the use of these services, in particular in the process of teaching mathematics. We organized and conducted experimental training of teachers to work in these services and obtained results that prove the effectiveness of these Web 2.0 services in teaching primary schoolchildren (Skvortsova & Britskan, 2018, p. 59; Skvortsova, Onopriienko, & Britskan, 2019, p. 277; Skvortsova, Britskan, Bastinec, & Hruby, 2019, p. 74; Britskan & Kovalchuk, 2019, p. 42; Britskan, Fedii, & Onopriienko, 2020, p. 9).

At the same time, the research study considered provides only general information on the use of a separate online service in the educational process. However, the issue of selecting online services for integrated use, including mathematics lessons in primary school, has escaped the attention of scientists. This prompted us to conduct research in this direction.

Based on the need for organizing distance learning caused by the COVID-19 pandemic and the inability of students around the world to attend school, we set the ***goal***, thusly, to determine a set of online services for distance learning for use in math lessons and to explore which of these services are used by Ukrainian primary school teachers in math lessons.

2. Analysis of the Possibilities of Online Services for the Organization of Distance Learning

To achieve the purpose of the study, at the stage of preparatory work, we explored the possibilities of free online services or services that provide a free version (Figure 1): LearningApps, Google Classroom, Classtime, Padlet, Zoom, Classdojo, Liveworksheets, Wizer.me, H5P, Lino it, etc.

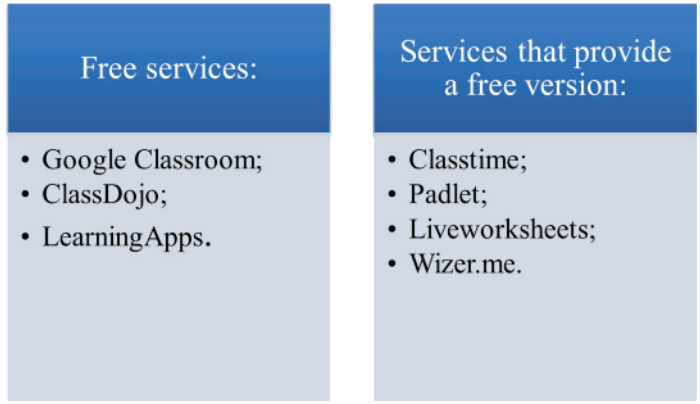

Figure 1. Paid and free online services.
Source: own work

For the organization of distance learning, the teacher needs to create a virtual classroom and invite students, fill this classroom with learning materials and tasks for students, preferably those that will be checked by the service automatically – making it interactive. It is important that the test results are recorded in the electronic journal in the form of a certain number of points; furthermore, it is also desirable that it stores the work of the students. When checking non-interactive tasks, the teacher needs the service to provide the teacher with feedback from students and parents, in the form of comments. The teacher is also interested in presenting all stages of the distance lesson in the online service. Therefore, an analysis of online services was carried out according to the following criteria: 1) availability of a virtual class and an electronic journal; 2) the ability to create materials and tasks, and export tasks from other services; 3) the possibility for the teacher to create interactive exercises on the basis of the tasks from the printed textbook or notebook; 4) service capabilities for organizing a distance lesson.

2.1 Organizing a Virtual Classroom and E-Journal

When choosing services, we took into account the needs of teachers as regards digital tools for online teaching. To organize distance learning, the teacher needs a service that involves the creation of a virtual classroom where they can place tasks for students. We took into account the ease of connecting schoolchildren to the virtual classroom; the need or lack of registration on the site; the opportunity to create interactive exercises and tasks with open-ended questions; the ability to create tasks with links to other services; the opportunity for schoolchildren to send completed tasks; the opportunity to save schoolchildren's work and evaluate the results of their learning activities, both with points and verbally; and the opportunity to record test results in a virtual journal. After comparing online services that allow the teacher to create a virtual class and generate a virtual journal for inclusion in the e-course, we chose LearningApps, Google Classroom, Classtime, and Classdojo (Figure 2).

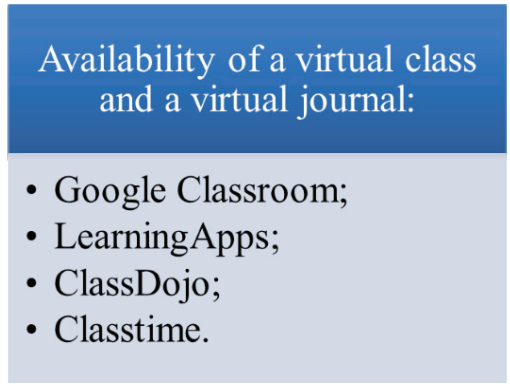

Figure 2. Services that provide the ability to create a virtual classroom and e-journal.
Source: own work

The ways of involving schoolchildren in a virtual classroom are shown in Figure 3 and the preferred ways to check completed tasks are shown in Figure 4.

In order to join students to the virtual class in LearningApps, the teacher fills in the profiles of all schoolchildren: indicates their names and surnames, and the service generates logins and passwords for them. Schoolchildren do not register on their own but attend the virtual classroom by following the link and typing in the login and password given to them by the teacher. After coming into the virtual classroom, the student views the pictures with the tasks to be completed and completes them in random order. But the student has only one attempt to perform a certain interactive task. Completed tasks are evaluated by the service

automatically as completed/not completed. The students can review their results immediately after completion of the interactive exercise. The service allows the teacher to comment on the results of the task finished by a particular student. To do this, they need to go to the virtual class and select the option "Write a message" next to the appropriate name of the student.

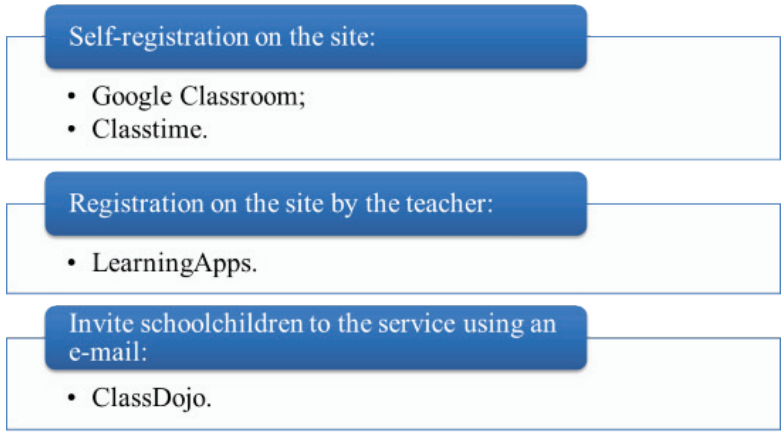

Figure 3. Ways of involving schoolchildren in a virtual classroom.
S o u r c e: own work

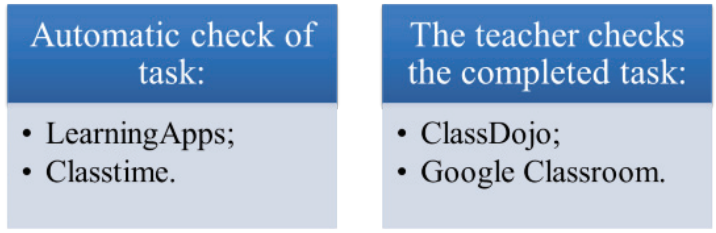

Figure 4. Ways to check tasks in selected services.
S o u r c e: own work

The e-journal LearningApps contains a list of schoolchildren in the virtual classroom and a list of tasks that have been assigned. The results of the tasks performance are displayed in the following form: opposite the tasks that the student performed correctly, the service generates a mark with the word 'completed' in green, indicating the date and duration of time for this task. Tasks that are performed incorrectly are displayed in red. If a student has just opened an interactive exercise but has not completed it, this task is indicated with a yellow question mark. The pages of the e-journal can be printed out by the teacher immediately.

Schoolchildren can only join a virtual classroom in the Google Classroom using their Gmail account and only with parental consent. Once in the created course, schoolchildren get acquainted with the learning material and complete tasks. The student's account displays a list of tasks, herewith the tasks downloaded by the teacher last, are located at the top of the list. The student can perform the tasks in any order. After completing the tasks, the student sends the work to the teacher in various formats – in the form of text, photos, Google images, audio, or video. The students can download the file from their own computer or give a link. Unlike LearningApps, the teacher checks the completed tasks (except for the test tasks created in Google Forms) and gives the appropriate grade awarding a certain number of points. Checking the task, the teacher can write a comment on the work or return the work for revision.

The Google Classroom e-journal, as well as the LearningApps e-journal, displays a list of students in the virtual classroom and a list of assignments given to students in the order they were uploaded by the teacher. The e-journal contains information about the tasks that students have submitted for review. By clicking on a specific task in front of a specific student, the teacher can view it, score according to his own criteria, and write a comment. Immediately, the number of points awarded by the teacher for the completed task and the maximum number of points are displayed in the electronic journal. The student, through e-mail box, is informed about the results of the teacher's check of his work. The teacher can view all assessment results in the journal and copy them to Google Spreadsheets or download them as a file (csv).

In the Classtime service, it is possible to create a virtual class with an electronic log of session results. In order to get students to the tasks, the teacher sends them a link and a session code. No special registration is required on the service. Once on the main page of the service, the student goes to the students' line and enters the code in the text box. Next, a window appears on the student's page where the student should write their last and first name. Then, the student gets to their own page, which displays the tasks they need to perform. According to the settings set by the teacher when creating tasks, the student has either only one attempt to complete the task or several. Unlike Google Classroom, where the teacher sets the maximum number of points for each task, in the Classtime service, like in LearningApps, the teacher cannot evaluate the completed task with points according to their own criteria. In the free version, the instructor has only two options – either 1 point or 0 points. Test tasks are evaluated by the service automatically and 1 point is awarded for the correct answer and 0 for the incorrect answer. There are tasks (Text template) which the teacher checks independently and awards with 1 point.

The Classtime e-journal looks similar to the LearningApps e-journal. Opposite the task that the student has completed correctly, the mark is displayed in green, incorrectly completed tasks – in red. Unlike LearningApps and Google Classroom, the Classtime service calculates the total score for all tasks completed by the student. In the free version of the service, the instructor can download the analysis of results only in a pdf document and in the paid version – in Excel.

In Classdojo, teachers invite students to a created class, similar to the Google Classroom, by adding their e-mail boxes to the list. The service sends them invitations by mail. Similar to Classtime and LearningApps, students can also join their class by typing in their class's entry code. There is also an opportunity for students to enter into the virtual classroom by scanning the QR code. Once in the classroom, students choose an avatar in the form of a monster that will represent their profile. Tasks for the student are performed in the Portfolio tab and information materials – in the Class Story tab. Tasks are presented in the form of a list and the student must complete them in the order they were prepared by the teacher; at the bottom of the list, there are the tasks that were created by the teacher last. The format of the student's answer, whether it is text, drawing, audio or video, is indicated by the teacher in advance when creating the task. It is not possible to submit a response in another format, or in multiple formats, unlike in Google Classroom. So, if the teacher, during the development of the task, stated that the answer should be sent in the form of a video, then, starting the task, the student will immediately turn on the camera on their device.

The teacher checks completed tasks independently. For each task, the teacher does not give points but skills. Moreover, skills are designed by the teacher themselves, giving them a name and scoring from 1 to 5 points. Parents of all students can be invited to the service and the results of their children's learning activity can be shared with them so parents can monitor the success of their children's academic performance and communicate with the teacher.

There is no e-journal in the Classdojo service like in LearningApps, Google Classroom, and Classtime. After the students have completed the tasks, the teacher can view each student's portfolio with the completed tasks, which is evaluated with skills (from 0 to 5 points) and download the results to their own computer in the form of a journal in Microsoft Excel (.csv) file or in Google Spreadsheets. Thus, there is no e-journal in this service; it is only possible to download the results of students' work on the tasks to the teacher's computer, which will allow them to view the results of students in the usual format.

Based on this, the authors have selected online services LearningApps, Google Classroom, Classtime, and Classdojo for the e-course which allowed for the creation a virtual class, filling it with tasks for students; these were services that automatically generate a virtual journal or allow the teacher to download it to their

computer. But, to organize distance learning, the authors are interested in the Padlet virtual board, which does not involve the creation of a virtual classroom and a virtual journal but only groups the users of the virtual board. This board is interesting due to the variety of board templates, the ability to present all elements of the lesson on a virtual board, the variety of forms of presenting lesson tasks – its images, photos, videos, audio, text, and embedding links to other online services and other Internet content. Although it groups users on a virtual board, an analogue of the virtual classroom, it does not allow students to send completed tasks; students can only comment on the tasks presented on the virtual board and these comments can be read by all users of the virtual board. The format of students' comments is either text, audio, video, images, and/or photos.

2.2 Organizing Distance Learning

As a result of the analysis of LearningApps', Classtime's, Google Classroom's, Classdojo's, and Padlet's opportunities, the conclusion has been reached that, to organize distance learning, it is expedient to choose Google Classroom as a basic service. This service allows the teacher to create a virtual class and has a convenient virtual journal. Google Classroom involves filling the lesson not only with tasks, but also materials that are not subject to evaluation. In the materials section, the teacher can give students a link to the Padlet virtual board that will present the lesson in the form of a scheme with arrows (virtual board canvas), according to which all stages of the lesson are organized – greeting the teacher, updating basic knowledge and methods of action, the formation of new knowledge and methods of action, as well as skills' consolidation and formation, and, finally, the result of the lesson and reflection on it. The choice of the Padlet virtual board for presenting a lesson is also explained by a variety of forms of task presenting – video and audio, drawings, interactive tasks created in LearningApps service, the link to Classtime, Classdojo, and other services. The only inconvenience is that students cannot send their answers to this service – they have to send them in Google Classroom. Therefore, in the virtual classroom, the tasks for students presented on the Padlet virtual board are duplicated, and the tasks are filled in the same order as they are offered in the lesson in Padlet. We would like to note that Google Classroom practically does not allow the teacher to create interactive tasks so, in Google Classroom, students will send either photos or screenshots of interactive tasks performed in other services, such as LearningApps or Classtime. The teacher checks the student's work himself: according to the screenshot of interactive tasks uploaded to Google Classroom, they are awarded a certain number of points and open-ended tasks are checked on their own. Moreover, a very useful function is that the teacher can comment on the tasks performed by students in order to draw students' attention to mistakes.

Presenting a lesson on the Padlet virtual board with duplicated interactive exercises in the Google Classroom task list creates the conditions for distance learning at a time convenient for the students. But, if it is possible to organize distance learning at a certain time, according to the schedule, then, in this case, the teacher is more interested in services that allow them to organize conferences. These can be Skype, Zoom, or Teams.

To begin with, Skype is a free program to download. To create an online lesson, the teacher generates a link and students use it to join the lesson. The teacher must also share the link by inviting all students, even if they are not Skype subscribers. A student can join an online lesson in a browser window if they do not have the program installed. A maximum of 50 people can be invited to one lesson and there is no limit to the duration of the call. In this program, there is an opportunity to show the screen to the moderator and conference participants. The teacher can also make a video of the conference, which is stored up to 30 days. An additional feature in this service is that background blur can be enabled so that nothing extra gets into the frame.

In contrast, Microsoft Teams combines meeting chat, file sharing, and corporative applications in a common desktop environment. There are paid and free versions; this application can be used by the whole educational institution, which expands the possibilities of its use. The duration of the broadcast of Microsoft Teams is 24 hours. In this program, there is an opportunity to show the screen to the moderator and conference participants.

Lastly, Zoom offers communication software that combines video conferencing, online meetings, chat, and mobile collaboration. There are paid and free versions. Prior to quarantine, the free one allowed for short 40-minute video conferences. For the duration of the pandemic, this restriction has been removed.

Thus, as a result of the analysis of online services on the criteria of free version's availability, the ability to create virtual classrooms, filling it with tasks, and the availability of a virtual journal, the ability to submit all elements of the lesson, and online conferencing organization, for the organization of distance learning, we selected online services: LearningApps, Google Classroom, Classtime, Padlet, Classdojo, and Zoom. Therefore, we were interested in the issue of awareness of primary school teachers about the existence of these services and their use in teaching mathematics to pupils.

3. Experimental Study of the Use of Online Services by Primary School Teachers in Ukraine

3.1 Purpose, Tasks, and Tools of the Study

The aim of the study was to determine the set of online services that primary school teachers worked with during the quarantine caused by the COVID-19 pandemic in March-May 2020. In the process of experimental research, the following tasks were solved: 1) the creation of the list of online services of which teachers are aware is determined; 2) naming online services that teachers have worked with; 3) the identification of online services that teachers used to organize a virtual classroom; 4) the identification of online services that teachers used to create interactive exercises in mathematics and other electronic materials; 5) the identification of online services that teachers used to organize and conduct an online lesson; 6) determination of what services teachers used when creating an educational video; 7) analysis of the obtained experimental data and identification of online services which were the most popular among teachers; 8) the comparison of the results of experimental research with the results of the preparatory one – the theoretical part of the study is used to determine a set of online services for the organization of distance learning of mathematics for primary school students.

3.2 The Results of a Survey of Ukrainian Primary School Teachers on the Use of Online Services

The main method of the experimental part of the study was a survey of Ukrainian primary school teachers. To study the problem of primary school teachers' use of the online services discussed above, we organized an online survey of Ukrainian teachers. This survey is posted in the closed group on Facebook called "Mathematics 'Ranok'. Pilot" (Figure 5), which was created for the professional communication of primary school teachers.

This group has 9,277 participants – mostly primary school teachers, as well as teachers of pedagogical universities of Ukraine and students majoring in "Primary Education". The settings of the group make it possible to create a survey, the results of which are immediately analyzed by Facebook and presented in the form of a diagram, which shows even the avatars of teachers who gave particular answers. Unfortunately, this survey format does not make it possible to determine the exact number of teachers who took part in the survey, as one and the same teacher could choose several answers. In addition, each question was presented in a separate publication so we have a different number of answers to different questions. In summary, it can be stated that at least 119 teachers answered at least one question

of the survey (this is the largest number of teachers who chose one of the options to answer at least one of the survey questions).

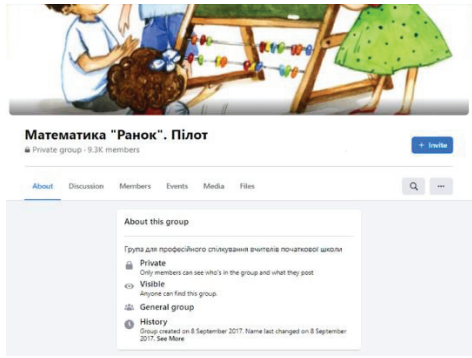

Figure 5. Page of the group "Mathematics 'Ranok'. Pilot".
S o u r c e: Facebook, https://www.facebook.com/groups/114415665917818

The group members were asked to answer six multiple-choice test questions. Each question was offered answer options but survey participants had the opportunity to add their own answers.

The questions were preceded by a brief explanation of the purpose of the survey: "Dear colleagues! We investigate the problem of the use of ICT by primary school teachers in teaching mathematics to pupils. We ask you to answer the following questions. Choose one or more answers to the question, and, if necessary, add your own answer. Thank you for your cooperation!".

The first question was: "Which of the online services for distance learning do you know?". In answering this question, teachers had to name the services they were aware of, whether their colleagues were working with or whether they had heard about these services from colleagues or on the Internet. The distribution of teachers' answers is presented in Figure 6.

As can be seen, the most popular is Viber/Messenger; this answer was chosen by 23% of teachers. Slightly fewer teachers are aware of Google Classroom – 21% of teachers, and LearningApps – 18% of teachers. Less popular among teachers are the following services: Padlet – 11% of teachers, Classdojo – 9% of teachers, Classtime – 5% of teachers, Liveworksheets – 4% of teachers, Wizer.me – 2% of teachers, Learnis – 2% of teachers, H5P – 1% of teachers, and Lino.it – 1% of teachers. Survey participants also had the opportunity to add their answer options. Yes, the teachers added Plickers to the first question and 2% of respondents indicated that they also worked with this service; Google Meet was indicated by 1% of teachers.

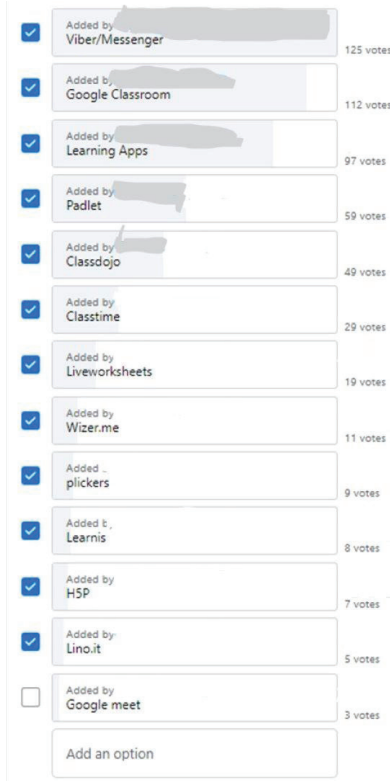

Figure 6. The results for the question "What services do you know?"…
Source: Facebook survey. https://www.facebook.com/groups/1144156659178l8/permalink/613591862666860

Thus, primary school teachers in Ukraine are generally aware of online services that can be used in the organization of mathematics' distance learning.

The next question was to discover which services the teachers worked with or continue to work with (Figure 7).

Here, fewer answers were received but the pattern of the greatest popularity of Viber/Messenger remained – 24% of votes. Zoom and Google Classroom are about equally popular with teachers; they received 18% of votes and 16% of votes, respectively. The ranking of online services that teachers have worked with or continue to work with is distributed as follows: LearningApps – 10% of votes, Padlet – 7% of votes, Classdojo – 4% of votes, Classtime – 2% of votes, Learnis – 2% of votes, Liveworksheets – 2% of votes, Lino.it – 1% of votes, Wizer.me – 1% of votes, and H5P – 1% of votes. If the answers are compared between question 1 and question 2, we can see that 112 teachers know about the existence of Google Classroom but only 40 teachers work with it; 97 teachers know about LearningApps but only 25

use it; 59 teachers know about the Padlet virtual board but 19 teachers are used; 49 teachers know about the Classdojo service but only 11 teachers used it; 29 people know about the Classtime service but only 5 teachers used this service; 19 teachers know about Liveworksheets service but only 5 used this program; 11 people know about the Wizer.me service and only 1 teacher used it; 8 teachers knew about Learnis and 4 teachers used it; 7 teachers know about the H5P service and only 1 teacher uses it; 5 people know about Lino.it service but only 2 teachers use it. This state of affairs can be explained by the fact that the first and second questions were answered by different numbers of teachers; perhaps there were those who answered only the first question.

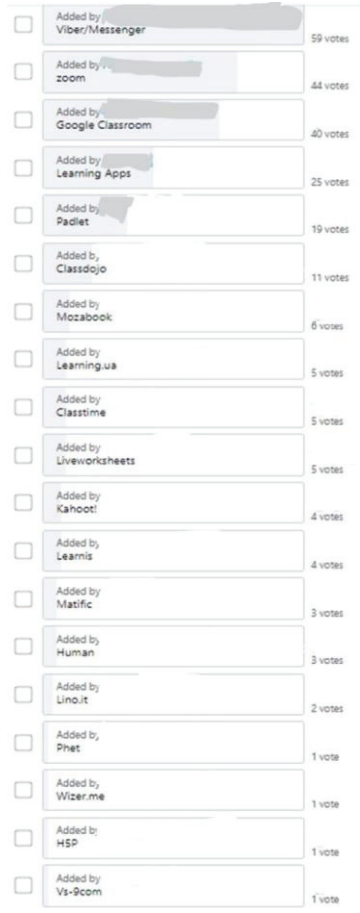

Figure 7. The results for the question “What services have you worked with or continue to work with?”.

Source: Facebook survey. https://www.facebook.com/groups/1144156659178l8/permalink/613594019333311

Note that teachers added other services in the answer to the second question. And these are Mozabook – 2% of votes, Learning.ua – 2% of votes, Kahoot! – 2% of votes, Matific – 2% of votes, Human – 2% of votes, Phet – 1% of votes, and Vs-9com – 1% of votes. We can conclude that each teacher chooses the service that meets most of their needs.

Thus, primary school teachers in Ukraine mostly use Viber/Messenger, Zoom, Google Classroom, and LearningApps in teaching mathematics.

The third question involved choosing an online service to conduct an online lesson (Figure 8). Most teachers cast their votes for Zoom (82% of votes). Google Meet received 12% of votes, Skype 5% of votes, and Microsoft Teams 1% of votes. The results are predictable, as most teachers preferred the service which has a free version despite some time constraints on conducting an online lesson.

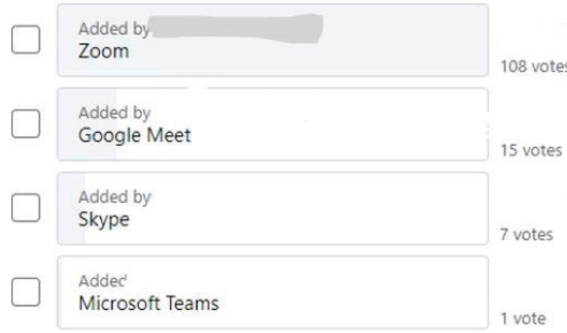

Figure 8. The results for the question "What services do you use to conduct an online lesson?".

Source: Facebook survey. https://www.facebook.com/groups/1144156659178l8/permalink/613595495999830

In answering the fourth question, teachers chose the services they use to create interactive exercises and teaching materials and tasks (Figure 9). The most popular service is LearningApps; 44% of teachers mentioned it in their answers. 21% of teachers marked Google Classroom, 15% of teachers – virtual board Padlet, 6% of teachers – Classtime, 6% of teachers – Classdojo, 1% of teachers – H5P, and 1% of teachers – Lino.it. In addition, teachers added the following answer options: Kahoot! and 6% of respondents indicated that they, among others, also use this service. Liveworksheets, Wizer.me, and Learnis received no votes. It means that teachers do not have knowledge about the capabilities of these services and they have unformed skills to work with them. Although these services have quite a lot of features – they allow an instructor to make almost any task that can be made in a notebook – it additionally features an interactive printer base, as well as a possibility to create a training video with pauses to complete tasks. Thus,

we can conclude that the surveyed teachers have no experience with interactive emails, interactive videos, and web quests. And this raises some concerns about the readiness of Ukrainian primary school teachers to organize distance learning for a possible extended quarantine period.

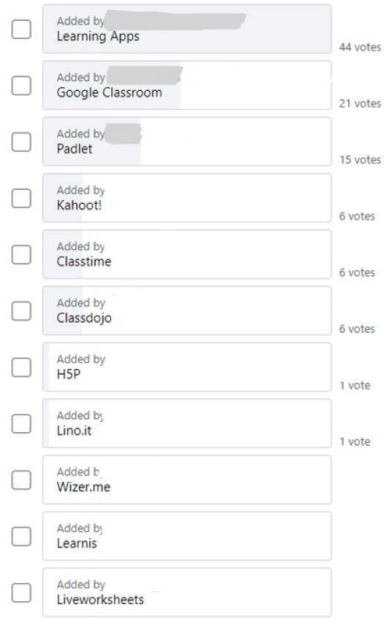

Figure 9. The results for the question "What services do you use to create interactive exercises, fill the course with educational materials and tasks?".
Source: Facebook survey. https://www.facebook.com/groups/1144156659178l8/permalink/613598155999564

Because instructional videos with teacher explanations play a role in distance learning, teachers were asked the fifth question. In answering this question, teachers had to indicate whether they have experience in creating educational videos and if so, what services they use for this purpose (Figure 10). 84% of teachers indicated that they have experience in creating educational videos: 51% use Microsoft PowerPoint, 29% record videos in Zoom, and 3% of teachers in Learnis. Teacher R. Boyko also pointed out that she uses a set of services to create an educational video: Zoom + Freecam (1%). 16% of teachers indicated that they had no experience creating educational videos.

In order to answer the sixth question, teachers had to choose the services they use to organize a virtual classroom and an e-journal (Figure 11). 54% of teachers chose Google Classroom, 18% of teachers – LearningApps, 16% teachers – vir-

tual board Padlet, 6% teachers – Classdojo, 2% of teachers – Classtime, and 1% of teachers – vs-9com. Moreover, teachers added the Human service to this question and 2% of respondents indicated that they also worked with it. Also, 1% of respondents indicated that they organize a virtual classroom and e-journal using their own school platform at school.academy.com.ua.

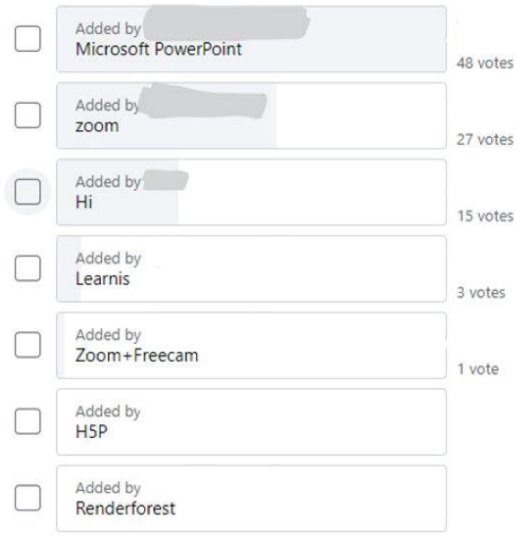

Figure 10. The results for the question "Do you have experience in creating an educational video? If so, what services do you use?"

S o u r c e: Facebook survey. https://www.facebook.com/groups/1144156659178l8/permalink/613600509332662

Thus, primary school teachers in Ukraine are familiar with most online services that can be used to organize distance learning. But, for now, they are limited to creating a virtual class and have appreciated the benefits of a virtual journal in Google Classroom. At the same time, not many teachers create interactive math exercises and only 3 teachers use the Learnis service to create interactive videos. It is in these areas, in the direction of learning to create interactive tasks, "live" sheets, and interactive educational videos, that it would be advisable to work with Ukrainian primary school teachers.

The results of the survey confirm our opinion that, for the organization of distance learning, it is advisable to choose Google Classroom as a basic service. This service is the most common among teachers and they have experience working with it. One of the many advantages of this program, among others, is that an instructor can organize a distance lesson in this service by following the link to the virtual Padlet board, which presents all stages of the lesson, with

materials and tasks created in the services LearningApps, Classtime, Classdojo, and others.

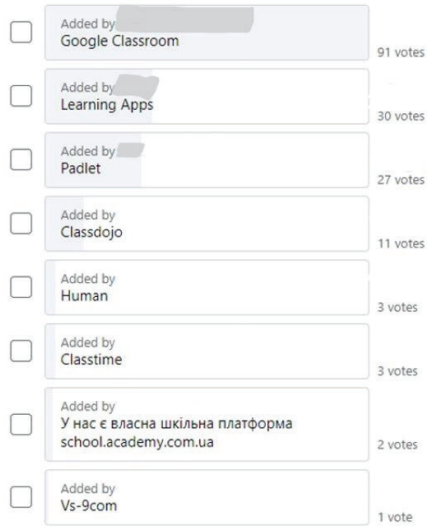

Figure 11. The results for the question "What services do you use to organize a virtual classroom and e-journal?".

Source: Facebook survey. https://www.facebook.com/groups/114415665917818/permalink/613596325999747

Conclusions

We should state that there are a lot of various services on the Internet that can be used to teach primary schoolchildren. But each service has its own peculiarities in terms of functioning and involves both advantages and disadvantages of its use in the educational process, in particular for the organization of distance learning. It should also be noted that there is no single service that can completely satisfy the teacher – the one used to create a virtual classroom and organize various tasks students are assigned, and to evaluate and store schoolchildren's work and track the dynamics of their success in the virtual journal. Therefore, to organize the learning process, the teacher must use a set of online services.

The authors studied the possibilities of free online services or services that provide a free version: LearningApps, Google Classroom, Classtime, Padlet, Zoom, Classdojo, Liveworksheets, Wizer.me, H5P, Lino it, etc.; both the advantages and

disadvantages of their use in teaching mathematics to primary schoolchildren were outlined. The peculiarities of presenting mathematical problems with the help of various templates of these services were analyzed. The aspect of combining these services was considered and the question which services can complement or replace each other was discussed.

Based on the criteria set forth earlier for the analysis of online services, namely: 1) the availability of a virtual classroom and 2) organization and functionality of the e-journal, along with an analysis of survey data of Ukrainian primary school teachers, we consider it appropriate to conduct special work to familiarize them with or improve their skills in working with the following online services: LearningApps, Google Classroom, Classtime, Padlet, Classdojo, and Zoom. These services allow the teacher to organize distance learning of mathematics for primary schoolchildren taking into account the aspects outlined above.

For the organizational structure, the authors advise an instructor to choose the most popular service among teachers, namely Google Classroom, which is easy for schoolchildren to access through a Google account. This service offers a convenient format of the virtual class in the form of a list of tasks with the specified deadline of their performance and the maximum score. Google Classroom is a very informative e-journal, where the teacher can award points for the task, and all student works are stored in it. The only inconvenience of the Google Classroom service is the rather limited possibilities of creating interactive exercises, but there is a possibility to embed links to other online services. In addition to the tasks assessed by the teacher, teaching materials for the lesson can also be created, which will not be recorded in the electronic journal.

As training material, the authors recommend that the teacher provide a link to the lesson presented on the Padlet virtual board. The Padlet virtual board allows the teacher to display all stages of the lesson, presenting each element in a variety of formats (text, picture, audio, video, links to other content). It is not possible to create interactive tasks in this service, but interactive exercises from other services, such as LearningApps can be embeded. Schoolchildren complete the LearningApps task and send a screenshot in response to the virtual Google Classroom. Therefore, all the tasks presented on the virtual board should be duplicated in the list of tasks in the virtual classroom. Students' works are reviewed by the teacher in Google Classroom, and their results are instantly displayed in an e-journal.

These services are included in the program of e-course "Internet resources for creating mathematical learning and game content for primary schoolchildren". The authors see prospects for further research in continuing to study the peculiarities of other online services, which can also be used to create educational and game content in mathematics for primary schoolchildren and develop the next course for primary school teachers of Ukraine.

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Svitlana Skvortsova, Tetiana Britskan

Organizacja nauki na odległość z matematyki w szkole podstawowej

Streszczenie

Artykuł poświęcony jest badaniu problemu wykorzystania technologii informacyjno-komunikacyjnych przez nauczycieli szkół podstawowych w nauczaniu matematyki uczniów szkół podstawowych, w szczególności w nauczaniu na odległość spowodowanym pandemią COVID-19. Przedstawiono wyniki analizy porównawczej najpopularniejszych usług internetowych w trzech kategoriach: 1) usługi tworzenia wirtualnej klasy i wypełniania jej interaktywnymi ćwiczeniami oraz innymi treściami edukacyjnymi (LearningApps, Google Classroom, Classtime, Classdojo), 2) usługi związane z organizacją lekcji na odległość (Padlet); 3) usługi prowadzenia lekcji na odległość w formie konferencji (Zoom, Skype, Microsoft Teams). Przedstawiono uogólnione wyniki ankiety internetowej przeprowadzonej wśród nauczycieli szkół podstawowych na Ukrainie na temat korzystania z określonych usług online na lekcjach matematyki. Zalecenia metodyczne dotyczące korzystania z wybranych serwisów online znajdują odzwierciedlenie w opracowanym kur-

sie elektronicznym „Zasoby internetowe do tworzenia treści edukacyjnych i gier z matematyki dla młodzieży szkolnej”.

S ł o w a k l u c z o w e: TIK, kształcenie na odległość, usługi online, młodzież szkolna

Светлана Скворцова, Татьяна Брицкан

Организация дистанционного обучения математики в начальной школе

А н н о т а ц и я

Статья посвящена исследованию проблемы использования учителями начальных классов ИКТ в обучении младших школьников математике, в частности при дистанционном обучении, вызванного пандемией COVID-19. Представлены результаты сравнительного анализа наиболее распространенных онлайн сервисов по трем категориям: 1) сервисы для создания виртуального класса, и его наполнения интерактивными упражнениями и другим учебным контентом (LearningApps, Google Classroom, Classtime, Classdojo), 2) сервисы для организации дистанционного урока (Padlet); 3) сервисы для проведения дистанционного урока в виде конференции (Zoom, Skype, Microsoft Teams). Представленные обобщенные результаты онлайн опроса учителей начальной школы Украины относительно использования указанных онлайн сервисов на уроках математики. Методические рекомендации по использованию избранными онлайн сервисами отражены в разработанном электронном курсе «Интернет ресурсы для создания учебного и игрового контента по математике для младших школьников».

К л ю ч е в ы е с л о в а: ИКТ, дистанционное обучение, онлайн сервисы, младшие школьники

Svitlana Skvortsova, Tetiana Britskan

Organización del aprendizaje matemático a distancia en la escuela primaria

R e s u m e n

El artículo está dedicado a investigar el problema del uso de las TIC por parte de los profesores de primaria en la enseñanza de las matemáticas, en particular durante el aprendizaje a distancia provocado por la pandemia de COVID-19. Los resultados del análisis comparativo de los servicios en línea más comunes se presentan en tres categorías: 1) servicios para la creación de un aula virtual y ejercicios interactivos, y otros contenidos educativos (LearningApps, Google Classroom, Classtime y Classdojo); 2) servicios para organizar una clase a distancia (Padlet); 3) servicios para la realización de una clase a distancia en forma de conferencia (Zoom, Skype, Microsoft Teams). Se presentan los resultados generalizados de la encuesta en línea a profesores de escuelas prima-

rias de Ucrania sobre el uso de estos servicios en línea en las lecciones de matemáticas. Además, las recomendaciones metodológicas para el uso de determinados servicios en línea se reflejan en el curso en línea desarrollado «Recursos de Internet para crear contenido de aprendizaje y juegos matemáticos para niños de primaria».

P a l a b r a s c l a v e: TIC, educación a distancia, servicios en línea, escolares de primaria

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Juan Arias Masa
University of Extremadura, Spain
https://orcid.org/0000-0003-2605-3736

Rafael Martín Espada
University of Extremadura, Spain
https://orcid.org/0000-0002-9710-4097

Juan Arias Abelaira
Alcala University, Spain
https://orcid.org/0000-0002-5387-8584

Teaching in the Subject 'Systems Interconnection' at Extremadura University

Abstract

This work describes the teaching of the subject "Systems Interconnection" taught in the Higher School of Telecommunications Engineering of the University of Extremadura, Spain. As soon as students finish the course, they will acquire all the theoretical and practical contents that are taught in the subject, which are detailed in different sections of the subject. In addition, a summary is made of the teaching methodology used and learning results. Finally, the article concludes by detailing the evaluation methodology and, above all, the academic results of the previous courses, where an improvement in results is observed, especially in the percentage of students that have passed all the exams of the subject (approved students onwards), namely by reducing the sum of percentages of those that have not changed their results or have failed the subject's exams. This improvement has been achieved based on the introduction of continuous assessment in the theoretical section of the subject. In short, it is a descriptive study of the current situation of the subject of "Systems Interconnection."

K e y w o r d s: teaching, telematics, engineers, higher education

The teaching-learning process in the subject "Systems Interconnection" is complex, because it is important to have a comprehensive abstract knowledge to understand the convenience of level communication according to the OSI model (Open systems interconnection (OSI), n.d.) of the ISO (ISO – International Organization for Standardization, n.d.) and its practical implementation. Consequently, as teachers, we must make it easy by relying on available resources and, among them, the use of New Technologies (Arias Masa et al., 2004) that provide substantial advantages for the acquisition of new knowledge. This subject is compulsory in the degree of Telematics Engineering in Telecommunications and is taught at the University Center of Merida (CUM, n.d.) at the University of Extremadura, Spain (UEx, n.d.). It is taught in the fourth semester of the degree, has 6 credits, and is divided into 3 theoretical credits and 3 practical credits (Arias Masa, 2018). Consequently, the weekly timetable encompasses two hours for the mostly theoretical content and another two hours dedicated to the development of purely practical content.

The topic belongs to the matter of "Communications", which also contains the subjects of "Communications Electronics", "Data Transmission", "Transmission Media", and "Network Fundamentals". On the other hand, this subject, together with the subjects of "Software and Programming Engineer", "Architecture", and "Physical Electronics", form the module called "Common" in the Telecommunications area, which are a total of 60 ECTS credits (European Credit Transfer and Accumulation System).

The objective of this work is to show what the current situation of this subject in the teaching-learning process is. For this, each of the essential sections which contextualize the subject are described and listed. Therefore, we begin with a review of the existing literature, where this subject is contextualized and the scientific field to which it belongs is indicated. Next, the competences pertinent to the subject are listed from the basic, through the general ones, to specific. Later, the theoretical and practical contents to be taught are listed; these should be assimilated by the students in order to successfully pass the subject before they continue on with their studies. The teaching methodology used to teach the theoretical and practical contents by the teaching team is described below. The learning outcomes list the pieces of knowledge that students should end up having once they pass the course. In the evaluation section, in addition to reflecting the weighting of each section that students examine, we have described how the evaluation method has evolved over time and showed how this improvement is reflected in the final section on academic results.

Literature Review

According to Pallisera et al. (2010), in 2007, Spain decided that its Higher Education should have 240 ECTS credits, just like other countries such as Scotland, Turkey, and several others in Eastern Europe, while the majority of countries in Europe opted for 180 credits, which is known as the short cycle. Thus, in 2009, the teaching of the Degree in Telematic Engineering began and in the academic year 2010–2011, the "Systems Interconnection" course was taught for the first time. All this was built based upon the legislation of the Royal Decree 1393/207 of October 29 (Ministerio de educación y Ciencia, 2007).

For the design of the subject, whose detailed description is provided in the following sections, appropriate consultations were made with different sources and references:

- Internal sources from our own university. With these consultations, a contrast could be made with the rest of the subjects taught as part of the degree so that there was neither duplication of content, nor possible "gaps" in the lack of information. Finally, the first publication of the title was made in State Official Newsletter (BOE 4/2010, 2015).
- External sources from other Spanish universities. In Spain, where the Degree in Telematic Engineering from the University of Extremadura was designed, the same title had already been awarded in other universities such as the Carlos III University (BOE 71/2009, 2009), Universidad Politecnica de Madrid (Universidad Politecnica de Madrid, n.d.), etc.
- External sources of companies in the ICT sector. In this case, the publications of Curricula (2005) were consulted and included in the report entitled "The Overview Report 2005" where the profile called "Computer Engineering" is clearly identified.

For the structuring of the contents of "Systems Interconnection", similar subjects taught at other universities (for example at the Open University of Catalonia) and whose contents coincide were analyzed (Lara et al., 2011).

On the other hand, in Arias Masa et al. (2006), the full descriptive content had already been displayed in all its sections of the "Computer Networks" subject, which is the previous version of the current "Systems Interconnection". In this publication, the didactic and learning objectives, the contents of the subject, its structure and presentation, the teaching-learning model in "Computer Networks", the class methodology, and the generation of theoretical content are described, as well as the generation of practical content, the evaluation model, and, finally, a study of student data and evaluations by academic year. This scheme is very similar to the one followed in this theoretical work on the description of "Systems

Interconnection". For this, an adaptation has been made to the model that the University of Extremadura has implemented and in each of the following sections, there are theoretical justification and bibliographical references on which these sections are based.

Competences Pertinent to the Subject

This subject assumes the development of basic, general, specific, and transversal competences, like all the subjects of the degree. Basic competences are common to all university degrees; they are the ones that enable the student to integrate successfully into work and social life. These are the guidelines set by the current European Higher Education Area (EHEA) on training in basic skills and are the ones that point the way to educators for the implementation of active teaching modalities, which is necessary for the development of lifelong learning (Redalyc et al., 2003). In our case, they include the following areas:

- CBl – That students have demonstrated to possess and understand knowledge in an area of study which starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks; it also includes some aspects which imply knowledge coming from the forefront of their field of study.
- CB2 – The students know how to apply their knowledge in practice in a professional way and possess necessary skills, which are usually demonstrated by the elaboration and defense of arguments and the resolution of problems within their area of study.
- CB3 – The students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant social, scientific or ethical issues.
- CB4 – The students are able to communicate information, ideas, problems, and their solution to a specialized and non-specialized public.
- CB5 – The students have developed learning skills necessary to take up further studies with a high degree of autonomy.

General competences refer to the set of knowledge, attitudes, values, and abilities which are related to each other and, together, they allow satisfactory performances of the person who aspires to reach goals higher than the basic ones. These skills are also used as attributes, characteristics, and qualities, since they are capable of being developed in everyday learning. In the case of the "Systems Interconnection" course, these are:

- CG3 – Knowledge of basic subjects and technologies, which enables you to learn new methods and technologies, as well as cultivates versatility to adapt to new situations.
- CG4 – The ability to solve problems with initiative, decision making, and creativity, and to communicate and transmit knowledge, skills, and abilities while understanding the ethical and professional responsibilities of the Telecommunications Technical Engineer’s activity.

Specific skills are those of the degree, specialization, and work profile for which the student is prepared. These are acquired by the student thanks to the transmission and assimilation of a series of contents related to the basic areas of knowledge. Therefore, they encompass knowledge that every graduate must have for the purpose of correct performance of the professional profile, in our case, Telecommunications Telematics Engineers. Accordingly, we put forward specific competences which belongs to the subject of Communications:

- **CE6** – The ability to learn new knowledge and techniques suitable for the conception, development or exploitation of telecommunication systems and services for yourself.
- **CE8** – The ability to use computer tools to search for bibliographic resources or information related to telecommunications and electronics.
- CE9 – The ability to analyze and specify the fundamental parameters of a communications system.
- CEl0 – The ability to evaluate the advantages and disadvantages of different technological alternatives for the deployment or implementation of communications systems, from the point of view of signal spaces, disturbances and noise, and analog and digital modulation systems.
- CEl3 – The ability to understand the mechanisms of propagation and transmission of electromagnetic and acoustic waves, and their emitting and receiving devices.
- **CE17** – Knowledge and use of the concepts of network architecture, protocols, and communication interfaces.
- CEl8 – The ability to differentiate between differing concepts of access and transport networks, circuit and packet switching networks, fixed and mobile networks, as well as distributed network systems and applications, voice, data, audio, video, and interactive and multimedia services.
- CE20 – Knowledge of the telecommunication regulations and rules in national, European, and international scopes.
- **CE24** – The ability to describe, program, validate, and optimize protocols and communication interfaces at different levels of a network architecture.

In the previous list, we have highlighted in bold the competences CE6, CE8, CE17, and CE24, which are those acquired in the “Systems Interconnection”

subject and are also taught in other subjects. Thus, CE6 is shared with "Fundamentals of Networks, Data Transmission and Transmission Media". CE8 is shared with "Data Transmission and Communications Electronics". CE17 is shared with "Fundamentals of Networks".

CE24 competence is assigned exclusively to the "Systems Interconnection" subject. This makes the practical part of the subject where different protocols of different levels of network architecture will be very important. As described later in this paper, it is essentially developed in practice III and IV.

Contents of the Subject

When the curriculum of the Degree in Telematics Engineering was produced in 2009, the description of contents published in the ANECA's report (ANECA, n.d.) was: "Link level. Link layer services. Programming and study of the protocols and functions of link control. General and theoretical aspects of the network level".

Based on this short description of the contents and competences, especially the specific ones which the students should have acquired once they finish the subject, the theoretical and practical contents are proposed in the following subsections.

Theoretical Contents

This section outlines the theoretical development to achieve the expected competences, as well as a brief description of the contents which are planned; the following topics have to be taught:

- Unit 1. Introduction to the link layer.
    - Simple review of the OSI Model.
    - Basic functions of the link level.
- Unit 2. Sublayer of Access control to the medium.
    - Ethernet.
    - IEEE 802.
    - Packet driver.
- Unit 3. Elementary Link Protocols.
    - Simplex protocol without restrictions.
    - Simplex stop and wait protocol.
    - Simplex protocol for noisy channel.
- Unit 4. Flow control.
    - Sliding window protocol concept.
    - Simple rejection sliding window protocol.

    - Selective rejection sliding window protocol.
- Unit 5. Detection and correction of errors.
    - Types of errors.
    - Detection.
    - Redundancy.
    - Redundancy verification.
    - Checksum.
    - Bug fixes.
- Unit 6. Character oriented protocol.
    - Introduction.
    - Framing and synchronization.
    - Character oriented protocols.
    - BSC protocol
- Unit 7. Bit-oriented protocols.
    - Introduction.
    - Introduction to X.25.
    - Basic HDLC features.
    - Frame structure.
    - Operation of the LAPB protocol.
- Unit 8. The data link on the Internet.
    - PPP and SLIP protocols.
    - Levels of the PPP protocol.
    - LCP link control protocol.
- Unit 9. ARP protocol.
    - Introduction.
    - ARP tables or caches.
    - Structure of ARP packages.
    - ARP proxies.
    - Coding in JAVA for packet driver.
- Unit 10. Introduction to the network level.
    - Description of network level functions.
    - Datagram versus virtual circuit.

Most of these contents are described in Tanenbaum and Wetherall (2012) and in Stalling (2004). Of course, these contents are included in many more books but these are the basic and most important for our students, and especially for these specific topics of the link level and the introduction to the network level.

Practical Contents

The practical contents are developed around four sequential practices which are developed throughout the semester, namely:

- Practice I. Presentation of practices in the programming environment.
- Practice II. Packet driver specification.
- Practice III. Implementation of one of these protocols.
- Practice IV. Simulation of error control in practice protocol III.

As students of the 4th semester of the degree, they have already taken basic programming subjects which are needed to be able to practice the above skills because they are done in the JAVA language. The practices are based on the use of the laboratory's Ethernet network, with Internet Access and IP addresses.

```
run:
------------------------------------------------------
Programa Practica 1  modulo 1.1
Autor: Juan Arias Masa
Fecha: 29 enero 2020
Descripcion:
     ***Determina las tarjetas de red que tiene la maquina
Por favor ten paciencia y espera un momento
------------------------------------------------------

Buscando las tarjetas....
----------------Tarjeta: 0----------------------
 +Nombre: \Device\NPF_{514E3FAF-800D-4100-A027-F97D39823AC7}
   -descripcion: Intel(R) 82574L Gigabit Network Connection
 +Nombre del Enlace: EN10MB
   -descripcion del enlance: Ethernet
Bucle loopback desactivado
Dirección MAC: 0:1c:42:39:ae:ab:
Dirección 1:
        dirección: /fe80:0:0:0:8999:ced0:e810:b94e
          máscara: null
         difusion: null
      destino P2P: null
Dirección 2:
        dirección: /192.168.1.101
          máscara: /255.255.255.0
         difusion: /255.
--------------Fin tarjeta: 0----------------------

En total esta máquina tiene: 1 tarjetas de red
Pulsa INTRO para terminar
```

Figure 1. Example of Ethernet Card Information.
Source: Own work.

Practice I serves as an introduction to the programming environment that will be used throughout the course. Specifically, JAVA and packet drivers with access from the Windows environment are used. The general use of the packet driver is learned in practice II, where it is studied, step by step, how to access the internal core of the Ethernet cards, that is, its basic configuration data set, as its own

Ethernet address comes from the factory, and different IP addresses assigned, both version 4 and version 6. In Figure 1, we can see an example of what information the program developed by students in the first module shows.

Once the card information is located using the “see interfaces” module, the next module to be carried out is a package reception module, where the final program to be developed will be limited to showing all the packages that arrive at the Workstation. In Figure 2, we can see an example of how the information of an Ethernet packet or frame that has just arrived at the station is shown.

The third module of this second practice is to form Ethernet frames and insert them into the network. For this, it is necessary to define the destination address that will be used; in this case, it will be a broadcast address (0xffffffffffff) and, also, the source address having the Factory card. The type/longitude field will be used as the length field and the size or number of bytes (always less than 1500) of the information string will be entered in the data field of the ethernet frame. Finally, data or information will go in the data field. Once the ethernet frame is formed, it will be put on the network.

```
Iniciamos la recepcion para la tarjeta: 0 Dirección MAC: 0:1c:42:4:b4:76
Mi mac es: 0:1c:42:4:b4:76
 ============================================================
Mac Destino: 1:0:5e:0:0:fb    Mac Origen: 0:1c:42:0:0:9
Paquete con campo tipo 2048
caplen:227
len:227
sec:1594186581
longitud header:42 contenido Cabecera:1 0 94 0 0 -5 0 28 66 0 0 9 8 0 69 0 0 -43 -65 -39 0 0 -1 17 -113 27 10 37 -127 2 -32 0 0 -5 20
-23 20 -23 0 -63 -102 -71
datos IP:(14)69 (15)0 (16)0 (17)-43 (18)-65 (19)-39 (20)0 (21)0 (22)-1 (23)17 (24)-113 (25)27 (26)10 (27)37 (28)-127 (29)2 (30)-32
(31)0 (32)0 (33)-5 (34)20 (35)-23 (36)20 (37)-23 (38)0 (39)-63 (40)-102 (41)-71
longitud  data:185 contenido Datos:0 0 -124 0 0 0 0 10 0 0 0 0 13 108 111 99 97 108 104 111 115 116 95 112 114 108 0 0 1 0 1 0 0 0 0
0 4 127 0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127 0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127 0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127 0 0 1 -64 12 0
1 0 1 0 0 0 0 0 4 127 0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127 0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127 0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127
0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127 0 0 1 -64 12 0 1 0 1 0 0 0 0 0 4 127 0 0 1
::::::::::::::Datos Ethernet: Dir Destino: 01:00:5e:00:00:fb Dir Fuente: 00:1c:42:00:00:09 Tipo/Longitud: 2048
 paquete IP
version 4
version 4
Version: 4
Dir Ip origen con toString: /10.37.129.2
Dir Ip destino con toString: /224.0.0.251
Dir Ip origen con getHostAddress: 10.37.129.2
Dir Ip destino con getHostAddress: 224.0.0.251
Protocolo que transporta: numero: 17 nombre null
Caplen: 227
long cabecera213
lon 227
Version: 4
Dir Ip origen con toString: /10.37.129.2
Dir Ip destino con toString: /224.0.0.251
Dir Ip origen con getHostAddress: 10.37.129.2
Dir Ip destino con getHostAddress: 224.0.0.251
Protocolo que transporta: numero: 17 nombre null
Caplen: 227
long cabecera213
lon 227
 ============================================================
```

Figure 2. Example of receiving Ethernet packets.
S o u r c e: Own work.

The fourth and final module of this second practice consists of recovering the frames that we insert into the network in module 3. That is, we will be able to review what we have sent. Having reached this last objective, we are ready

to start refining the important aspects of the subject because we already have the transmission vehicle of our packages for the protocol to be developed in practice III.

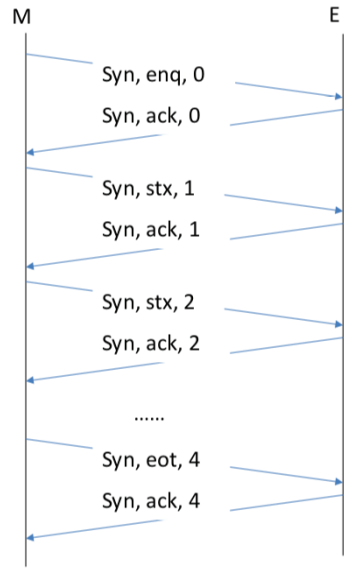

Figure 3. Basic scheme of the operation of the IS protocol.
Source: Own work.

Practice III consists of the complete implementation of a stop and wait protocol, which is called the IS protocol. In practice IV, error detection is added to this protocol by means of a cyclic redundancy code added to the frames of the IS protocol. The basic scheme of the IS protocol is a connection-oriented protocol based on the BSC (Binary Synchronous Communication) protocol developed by IBM (International Business Machine Corporation) in 1962 but it has a basic structure for easy learning by students. As we have seen in our years of teaching experience, it allows them to establish the theoretical and practical foundations of the current communication protocols, since all that is learned for the OSI model link level is transferable to the transport level, i.e., the level that the future Telecommunications Engineers whom we teach will work with. In *Figure 3* you can see an example of the operation of the protocol oriented towards connection with the three phases of establishment (sending the "enq" frame and its confirmation), transfer ("stx" frames, where the Exchange of information), and release ("eot" frame and its corresponding confirmation). The master entity of communication is represented in the left column and the slave entity in the right column. It is a one-way transmission of information from the master to the slave. Finally, we must point out that

all the frames must be positively agreed with the “ack” commanPractice IV errors control is a bit parity control, as shown in *Figure 4*. This errors control applies to all bytes of the IS frame. The above figure shows only one example for four bytes. In the real protocol, it will be applied to all the bytes of the frame. The operation performed for parity control is an XOR, the result of which is 1 if the number of ones is odd and is 0 if the number of ones is even.

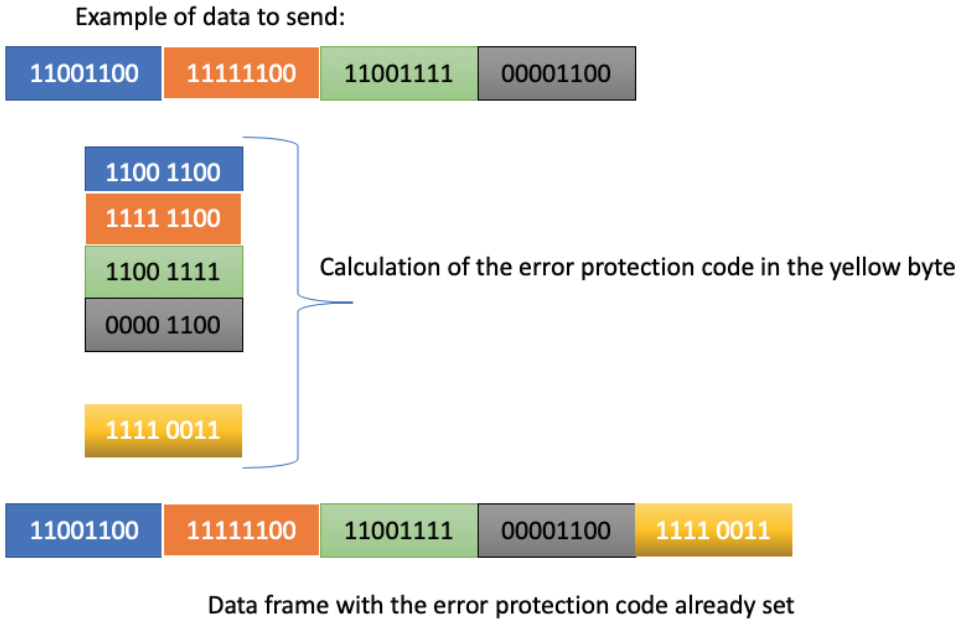

Figure 4. Example of error handling with even parity checking.
S o u r c e: Own work.

Coherence of Theoretical and Practical Content

These contents (theoretical and practical) try to respond to the specific competences C17 and C24, especially to the latter, which we have described in the previous section. The contents focus on the link level during most of the course which ends with the introduction of the network level to prepare students for the next subject – “Computer Networks”. There is a great connection between the theoretical and practical section of the subjects; in fact, both progress in parallel. While in topic 2, Ethernet is basically explained in practice II, access is made through the packet drivers to all the Ethernet frames that arrive at the work station where the student programs.

Practice III is the practical application of everything explained in topics 3, 4, and 6; where, on the one hand, the operation of the protocols is explained

in topic 3 and 4 and, on the other, in topic 6, it is detailed how it is carried out with a character-oriented protocol implemented in practice III using real Ethernet.

Finally, practice IV uses one of the error control methods explained in topic 5. This topic explains various error control methods from parity control, through cyclic redundancy codes with divisor polynomials, as used by Ethernet, for example up to frame verification sequences, as used by the IP protocol or TCP (Transmission Control Protocol). The last part of topic 5 is dedicated to correcting errors with Hamming codes.

Teaching Methodologies

Academic discourse (oral and written) is necessary to establish which teaching methodology is to be used. At present, according to Gómez Trigueros and Ruiz Bañuls (2018), the incorporation of Information and Communication Technologies (ICT) into classrooms as a mechanism for innovation is absolutely necessary. Therefore, this subject is structured in the use of the following teaching methodologies:

- Expository classes of theory and problems: Presentation of the subject's contents and planning of the participation of all students in different tasks. Discussion of theoretical aspects.
- Participatory education: Practical work in medium or small groups.
- Tutoring: A follow-up activity for the supervision of directed work, queries, and doubts; advice (individual or in small groups).
- Autonomous learning through the analysis of written documents; preparation of reports; the study of the subject taught and the development of practical skills.
- Virtual learning. The use of virtual communication tools between teacher and student, and even between students.

Learning Results

According to Adam (2004), learning outcomes are one of the main components for higher education systems and transparent qualifications. In fact, Gosling and Moon

(2001) pointed out that this focus, based on results, is becoming better known in international education.

But, to be able to design the learning process, the key point of departure is set by the learning outcomes which are intended to be achieved in the subject and as part of the degree. By **learning outcomes**, we understand what a student is expected to know, understand, and be able to demonstrate. It refers to the changes that have occurred in the knowledge, understanding, and competence level of the student as a result of the learning process. These are:

- to know the level of link and its basic protocols well.
- to know how to program communication protocols at the link level.
- to increase knowledge of the network level.
- to show an ability to detect and correct errors in frame transmission.
- to know the flow control for the transmission of information well.

Evaluation

For Kennedy (2007), evaluation can be defined as the ability to judge the value of the elements for specific purposes. Likewise, Guerra-López (2007) believes that

> The concept that the most important purpose of the evaluation is no to prove but to improve, must be the basis of all future efforts in the field of evaluation. Each and every one of the components of the evaluation must be aligned with those objectives and expectations that organizations value, and with the decisions that must be taken from the results of the information obtained from that evaluation. These decisions are essentially focused on how to improve and measure performance, at all organizational levels (p. 11).

The evaluation of the subject is structured in different percentages, depending on the regulations of the subject. These, however, are adjustable by the teaching staff and, in this case, the structure is shown in *Figure 5*. All these sections are the division of the total of the subject and, in each of them, there is a part which corresponds to the theoretical contents and the one which corresponds to the practical contents.

Both in the practical and in the theoretical part, a continuous evaluation system is employed throughout the course, which is followed by the vast majority of stu-

dents in this subject. This continuous evaluation is made up of different sections which determine the student's final grade. For the practical part, control will be carried out by means of questionnaires at the end of the teaching of each subject, where there will be questions not only of the subject that has just been studied; it will also include all the previous ones. Thanks to this teaching method, we get the students to acquire all the competences which are taught and put them to use despite the passage time.

The weight of the theoretical part is 50% of the final grade. That of the practice on the other hand, is further divided. 10% of the practical test, which is made of each practice that is carried out, is devoted to the task during which the student has to demonstrate their authorship of a modification of a part of the program developed. In addition, the practical part has 20% assigned to the evaluation of the documents delivered in the task associated with each of the practices. The remaining 20% of the total is divided into three subsections. On the one hand, there is 10% allocated for the active participation of the student in class – attendance, solving problems, raising problems, generating information for those concepts which are present in both the theoretical and practical classes that have been taught. In other words, it is the one connected to "participatory teaching", which we have exposed in the "Teaching Methodology". On the other hand, there is 5% allocated for the oral presentation of the works delivered, where transversal competencies are evaluated, such as communication and oral expression, which are of utmost necessity for the professional development of the future engineer.

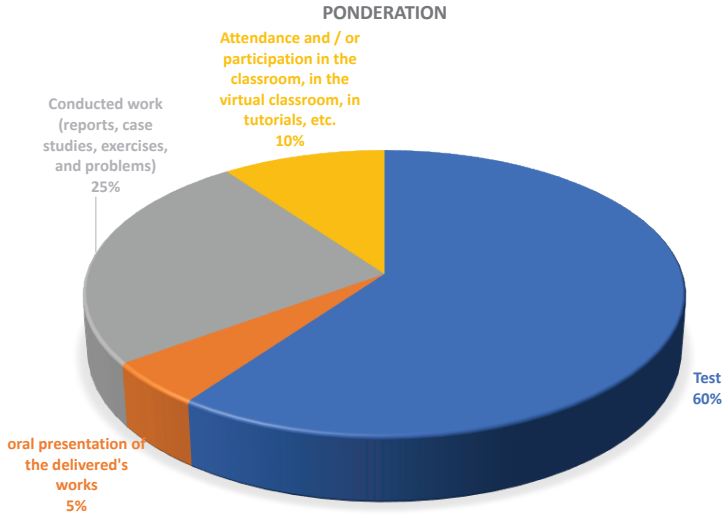

Figure 5. Specification of the "Systems Interconnection" evaluation regulations.
S o u r c e: Own work.

And, finally, the remaining 5% is used to evaluate the "format" (not the content – this is evaluated in the section where applicable), namely, the reports which are delivered in all the works that are elaborated upon in the subject, both in terms of conducted practices and theory. With this last percentage we intend to validate and help achieve the transversal competences of written communication, synthesis, etc.

This section of Evaluation is where its modification or adaptation has been added for its inclusion in the continuous evaluation. It has been introduced little by little throughout the previous academic years, the positive results of which can be seen in the following section on academic results.

Continuous evaluation has been introduced from the academic year 2017–18 in the theoretical part of the subject, since the practical part has a continuous and independent evaluation of each practice. The continuous evaluation of "Systems Interconnection" is not only a continuous, but also a summative evaluation. Summative assessment is based on the levels or grades and involves periodic evaluations which assess what students know and do not know. Such an assessment provides teachers and students with information about the level of achievement in a specific learning context.

Our summative assessment aims to assess student's learning at the end of the teaching unit by comparing its results with a standard or group measure; in our case, it is compared with the standard for each topic that the teaching team prepared in the academic year 2017–18 when it was first introduced. However, in the following academic year, 2018–19, it was already possible to compare not only with the teaching team standard, but also with the results of the academic year 2017–18.

Academic Results

Based on all the data reflected in the previous sections, in which we have shown how the subject is structured, in this section, we will show the academic results our students have obtained in the previous courses where they applied everything that they were exposed to before, as can be seen in the following figures.

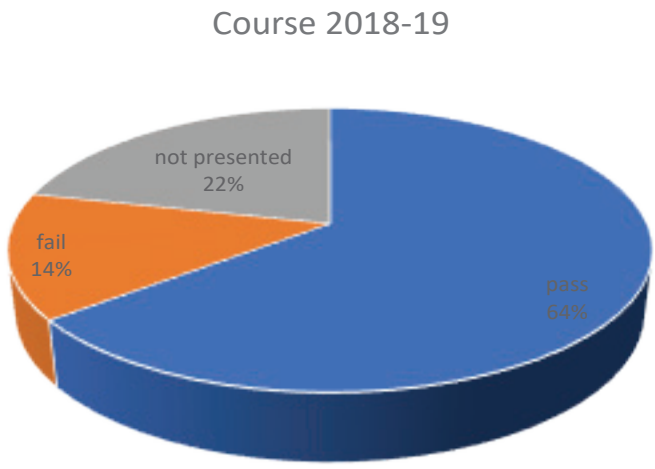

Figure 6. Academic results of the academic year 2018–19 in the first call (June 2019).
S o u r c e: Own work.

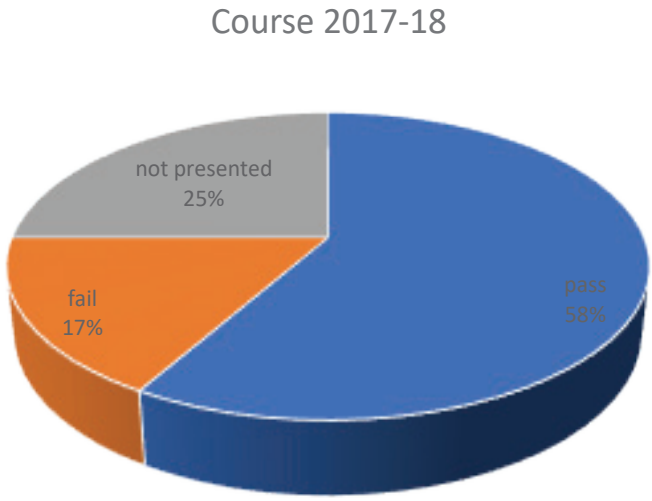

Figure 7. Academic results of the academic year 2017–18 in the first call (June 2018).
S o u r c e: Own work.

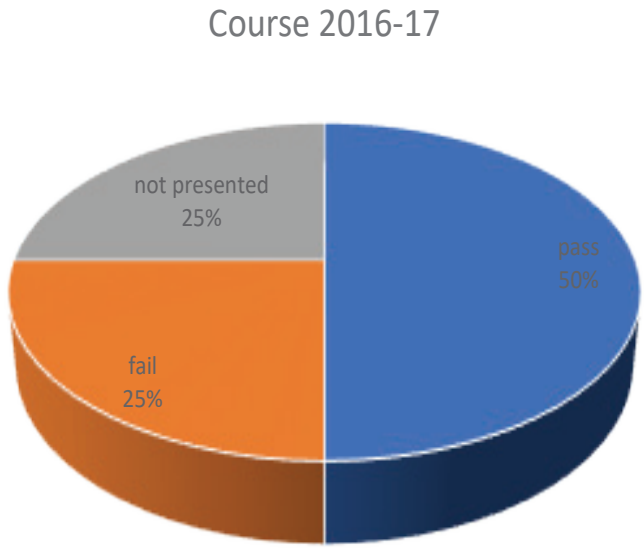

Figure 8. Academic results of the academic year 2016–17 in the first call (June 2017).

S o u r c e: Own work.

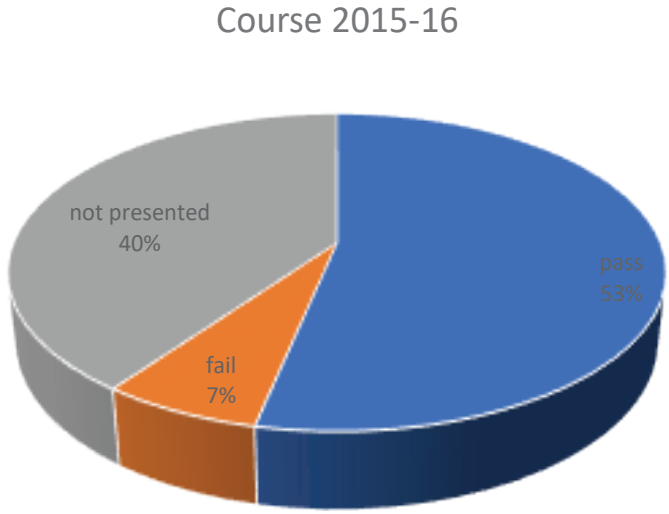

Figure 9. Academic results of the academic year 2015–16 in the first call (June 2016).

S o u r c e: Own work.

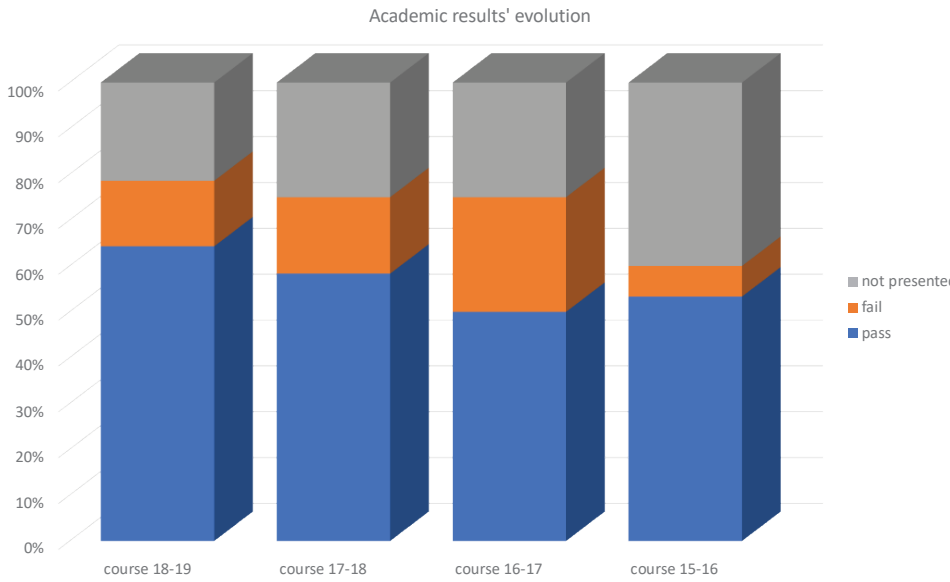

Figure 10. Academic results' evolution.
S o u r c e: Own work.

In *Figure 10*, we show the evolution of academic results. If we look only at that image, it may not provide us with enough information, of course, not much more than knowing that the subject has a high % of passing marks. But, above all, what can be seen is the increase in this percentage if we compare it to the sum of failing marks and not presented, which, in the end, are formed by students who did not pass the subject. Therefore, the subject evolves favorably towards the goal of students: pass all the exams; which, among other goals or objectives, is one of the most important ones to achieve and, of course, it is a training course for engineers.

The introduction of the summative assessment that took place in the academic year 2017–18 has led to the increase in the positive results in terms of passing marks and the general decrease in the percentage of students who did not pass the course, either because they did not appear or because they failed.

Conclusions

Throughout this work, we have described how the subject "Systems Interconnection", which is a fundamental subject for Telecommunications Engineers at

the University of Extremadura, Spain, is organized. We have started from the competences developed as part of the subject: basic, general, and specific competences. Then, the contents of the subject have been described and segmented into theoretical and practical. The practical contents have been detailed, explaining how they should be put into practice (see Practice I–IV). Teaching methodologies used have been described, as well as the learning outcomes and the evaluation of the subject. At the end of the article, academic results were presented.

In the analysis of academic results, we have highlighted how the increase in the number of students approved in the June exam has evolved positively, compared to the number of suspended and not present, which tends to decrease. However, this should not lower the alarms and should heighten the awareness of all methodological changes and innovative processes that can be implemented to refine the teaching-learning process.

The most important modification of the teaching-learning process that has been introduced was in the academic year 2017–18. It consisted in the inclusion of the summative evaluation whose positive results have been shown in the academic results section. We can see how in the academic year 2018–19, when the summative evaluation is applied not only against the standard benchmark of the teaching team, but also against the group of the previous course, it improves as compared to the results from 2017–18.

Although there are only two academic courses within this teaching modification, we believe that this modification has been very beneficial, based on the academic results. Therefore, we think that it is the horizon that we must follow in this subject and it is the intention of the teaching team to introduce the aforementioned summative assessment in other subjects for which this team is responsible.

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Juan Arias Masa, Rafael Martín Espada, Juan Arias Abelaira

Nauczanie przedmiotu „Połączenie systemów” na Uniwersytecie Estremadura

S t r e s z c z e n i e

Niniejsza praca opisuje proces nauczania przedmiotu „Połączenie systemów” w Wyższej Szkole Inżynierii Telekomunikacyjnej Uniwersytetu w Estremadurze w Hiszpanii. Wnikliwie opisuje każdą z części składowych przedmiotu i obejmuje zarówno kompetencje uzyskane przez studentów po ukończeniu kursu, jak i nauczane w ramach kursu treści teoretyczne i praktyczne. Ponadto dokonano podsumowania zastosowanej metodologii nauczania oraz wyników uczenia się. Artykuł zamyka szczegółowa metodologia oceny i wyniki akademickie ostatnich kursów, na podstawie których zaobserwowano poprawę wyników studentów, zwłaszcza w zakresie procentowej liczby studentów niezdających przedmiotu. Poprawę odnotowano dzięki wprowadzeniu oceny ciągłej części teoretycznej przedmiotu. W skrócie, artykuł stanowi opis obecnej koncepcji przedmiotu „Połączenie systemów”.

S ł o w a k l u c z o w e: nauczanie, telematyka, inżynierowie, szkolnictwo wyższe

Хуан Ариас Маса, Рафаэль Мартин Эспада, Хуан Ариас Абелаира

Преподавание предмета «Взаимосвязь систем» в Университете Эстремадуры

А н н о т а ц и я

В данной работе описывается преподавание предмета «Взаимосвязь систем», который преподается в Высшей школе телекоммуникационной инженерии Университета Эстремадуры, Испания. Каждый из разделов, составляющих предмет, подробно описан и охватывает как компетенции, приобретенные студентами после завершения курса, так и теоретическое и практическое содержание, преподаваемое в ходе курса. Кроме того, были обобщены использованная методика преподавания и результаты обучения. Статья завершается подробным описанием методологии оценки и успеваемости последних курсов, на основании которых наблюдалось улучшение успеваемости студентов, особенно с точки зрения процента студентов, не сдавших предмет. Улучшение отмечено благодаря введению непрерывной оценки теоретической части предмета. В статье описывается актуальная концепция преподавания предмета «Взаимосвязь систем».

К л ю ч е в ы е с л о в а: педагогика, телематика, инженеры, высшее образование

Juan Arias Masa, Rafael Martín Espada, Juan Arias Abelaira

Docencia en la asignatura “Interconexión de Sistemas” de la Universidad de Extremadura

R e s u m e n

Este trabajo describe la enseñanza que se utiliza en la asignatura de „Interconexión de Sistemas” que se imparte en la Ingeniería Superior de Telecomunicaciones de la Universidad de Extremadura. Una vez finalizado el curso, el alumno adquirirá todos los contenidos teóricos y prácticos que se imparten en la asignatura, los cuales se detallan en diferentes apartados de la asignatura. Además, se hace un resumen de la metodología de enseñanza utilizada y los resultados del aprendizaje. Finalmente, el artículo concluye detallando la metodología de evaluación y, sobre todo, los resultados académicos de los cursos anteriores, donde se observa una mejora en los resultados, especialmente en el porcentaje de alumnos que han superado todos los exámenes de la asignatura (alumnos aprobados en adelante), es decir, reduciendo la suma de los porcentajes de los que no han modificado sus resultados o han reprobado los exámenes de la asignatura. Esta mejora se ha conseguido a partir de la introducción de la evaluación continua en el apartado teórico de la asignatura. En definitiva, se trata de un estudio descriptivo de la situación actual de la asignatura de “Interconexión de Sistemas”.

P a l a b r a s C l a v e: enseñanza, telemática, ingenieros, educación superior

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Hanne-Lore Bobáková
School of Business Administration, Silesian University in Opava, Czech Republic
https://orcid.org/0000-0003-3875-3596

Martina Chylková
School of Business Administration, Silesian University in Opava, Czech Republic
https://orcid.org/0000-0003-4954-4263

The Use of Online Education by the Czech Population in the European Context

Abstract

The article deals with online educational courses in the Czech Republic. The subject of the investigation is the participation of individuals between 16–74 years of age in online education in the Czech Republic and its development. The investigation also focuses on the computer skills of individuals and their development between 2005–2014, and also in 2017, depending on data availability. All the above-mentioned indicators were analysed and compared to the situation in the neighbouring countries and in the European context. The methods of analysis, synthesis and comparison were applied. The research showed that the number of individuals participating in courses in the Czech Republic was relatively low in comparison to other neighbouring countries, even though the advancement of computer skills in the Czech Republic was constantly increasing from 2005 to 2014.

K e y w o r d s: competence, computer skill, internet skill, online education, sociability

Our society is in the middle of the times of the rapid development of information technology. Computer Assisted Learning (CAL) belongs to fast developing activities. It has been used in both formal and informal education in the form of eLearning. It reflects a certain ability to become a part of an online society. A prerequisite for joining this society is the knowledge of relevant competencies and computer skills and, as van Deursen and van Dijk (2010) stated, internet skills should be considered vital assets. According to Zlatuška (1999), the transition to this information society might create uncertainty and social tensions. Therefore strengthening the information society also means considering educational and educational-political aspects.

Currently, the global society has found itself in a situation which has affected countries in various sectors due to the coronavirus pandemic. The effects of the pandemic were also seen in the educational sphere, when educational institutions were looking for the ways not to interrupt the educational process via the various types of information telecommunication technology. In this situation, it is appropriate to investigate the state of competencies and computer skills in the Czech Republic.

Research Literature on the Subject

Foreign literature in this field comprises a variety of topics. This article tackles e.g. the issue of digitization that affects our thinking and communication with the world (Baecker, 2017; Castells, 2004), and didactic works focusing on media didactics enabling the development of online education (Kerres, 2018a). Kerres (2018b) and Zavera (2019) draw attention to the new educational needs in the digital environment. The following table provides an overview of the development of media pedagogy in the 20th and 21st centuries (Table 1).

The research literature on the topic is quite extensive and the research topics are diverse. Pastore (2002) discusses the challenges of eLearning and the role of eLearning in education. O'Neill, Singh and O'Donoghue (2004) examine infrastructural and pedagogical aspects of eLearning with reflections on the usefulness of technology to improve the learning experience. Singh, O'Donoghue and Worton (2005) address the issue of the implementation of eLearning into university education, including the structure and delivery of university education. They observe a variety of implications for students and teachers from a global perspective. Regarding the Czech milieu, web courses are dealt with by e.g. Zounek and Sudický (2012), Černý (2017, 2018a) and others.

Table 1
Media pedagogy in 20th and 21st centuries

Media pedagogy	20th century	21st century
Challenge	Mass media (press, radio, television) are used passively in leisure time	Digitization penetrates society
Educational process	Influenced by a book	Influenced by digitization
Approach	Active media work, extracurricular youth work	Interactive media concepts in formal and non-formal education, strengthening of non-formal education
Goals	Media competence development: • media criticism, • specialization media, • media use, • creation of media.	Education in the digital world • knowledge of digital technology, • creating an attitude to knowledge about culture, • identity development, • coping with professional requirements, • participation in social conversation
Political conflicts	National press Media concerns influence opinion on education	Multinational technology and Internet corporations are influencing the private sphere. Technology is becoming an actor.

S o u r c e: Own work, based on Kerres (2018a).

For example, Černý (2018a) describes and analyzes the use of Google Analytics and Smartlook to examine the educational environment of online courses. The monograph by Černý (2017) is a contextual description of the information and learning society with its pros and cons. Zounek and Sudický (2012) provide an overview of online education in their book *eLearning – learning with online technologies*, which also summarizes the importance of learning in life, the significance of learning and eLearning theories, and the position of technology in education, its advantages and disadvantages in connection with didactic questions of online course preparation.

From the latest literature, Conrad (2020), who examines the supportive effects of learning in the use of modern technologies only if there is a match between the individual assumptions of students, media characteristics and methodological use, could be mentioned. Balkan (2020) addresses the question of how new media can influence foreign language teaching. Hamdi (2020) also deals with the issue of new media in foreign language teaching from the viewpoint of didactics. Neugebauer (2020) pays attention to the future of teachers at a time of new media develop-

ment. The completion of an academic degree via modern technologies is also the subject of scientific research (cf., e.g. Rohs & Weber (2020)). The latest monograph in this area provides an overview of the new trending technologies (Opfermann et al., 2020). We would also like to point out a monograph that examines the role of digital education in improving digital competencies with both teachers and students (Abrah et al., 2020).

Terminology

Černý defines sociability as the ability and competence to enter into relationships in a society. He distinguishes five areas of digital competencies:

- information and data literacy,
- cooperation and communication,
- creation of digital objects,
- security,
- the ability to solve problems.

In the article, we understand the term sociability in the same way as Černý (2018b, p. 149), namely, as the ability of a society to behave in an online environment based on the availability of special skills that enable the production of communication within this environment. However, we are focused here on the part of digital competencies referred to by Černý as 'information and data literacy'.

Online learning and eLearning are concepts which are differentiated from each other. Online learning is referred to as Internet learning, while eLearning is meaningfully linked to institutional education (Černý, 2018a, p. 148). The definitions of eLearning are heterogeneous (Zounek, Staudková, Juhaňák, & Poláček, 2016). Černý (2018a, p. 148) prefers the term "online learning", justifying it with the important philosophical, pedagogical, social and technical changes that have accompanied education in the last decade. For Černý, the distinction between online learning and eLearning is also important because they distinguish between institutional and non-institutional education. As Fojtík (2001) states, eLearning, in the broader sense, is classical teaching supported by computer technology. In a narrower sense, it is presented by a virtual school. According to Marešová (2009, p. 39), modern educational systems (Learning management systems – LMS) are becoming a personalized virtual learning environment in which a student can discover courses taught by instructors or professors, tests, instructions on how to study, but, also, he/she can participate in discussion forums with teachers and other students as well.

From a specific perspective, this article tackles the sociability of the Czech population in the online environment and it is compared with the general concept of online sociability in the European context. The term sociability, in accordance with Černý (2018a, p. 150), is understood as a skill or ability to engage in society,

cooperate and communicate. It is quite evident that the ability to engage in society today also involves engaging in cyberspace.

Sociability in the online environment is a topical issue and it is defined from different points of view. Hence, the article will investigate the topic of sociability in online education and computer skills in the online space.

Research Subject, Goal and Methods

The subject of this research is the participation of individuals aged 16–74 in online education in the Czech Republic and its development between 2007–2017. Furthermore, the research focuses on the computer skills of individuals in the Czech Republic in 2005, 2007 and 2014. The article is based on the data obtained from the Czech Statistical Office. The sample is made up of the following files:

1. Data set of individuals aged 17–74 who attended an online training course between 2007 and 2017 in %.
2. Data set of individuals with 1 or 2 computer skills in 2005, 2006 and 2014.
3. Data set of individuals with 3 or 4 computer skills in 2005, 2006 and 2014.
4. Data set of individuals with 5 or 6 computer skills in 2005, 2006 and 2014.

All four files are based on the data from the Czech Statistical Office, which was available.

The studied individuals are people who attended an online course in the last three months prior to the research.

The aim of the research is to find out:

- How the participation of individuals in online training courses changed between 2007–2017,
- How computer skills management developed in the online environment in 2005, 2007 and 2014.

The level of internet skills was judged based on the respondents' self-evaluation, without testing or examining the knowledge. The respondents were asked about their specific activities on the Internet, namely:

- the use of a search engine for information searching,
- sending and receiving electronic mail,
- chatting,
- posting messages to information forums,
- internet telephony,
- the use of peer-to-peer networks to exchange movies, music or video,
- creating a personal website,
- copying, moving files/folders,
- copying/inserting data within a document,
- basic spreadsheet calculations,

- compressing/zipping files,
- connecting new devices,
- using the programming language to create programs.

The methods of analysis, synthesis and comparison were applied in the research.

Results of Research

The participation of individuals aged 16–74 in online education courses expressed in percentages were the focus of this study.

In 2007, only 1 percent of individuals in the Czech Republic attended online education courses. Comparing with our neighbours, only Slovakia and Austria had the same percentage; other countries, such as Hungary and Germany, showed participation in online learning activities by 1 percentage point higher. Participation did not increase in the following years, 2009 and 2010 but it went up in 2011. Between 2011 and 2017, participation in online training courses increased threefold and amounted to 3%.

The numbers of participants in online education are higher in Poland, Hungary, Slovakia, Germany, and Austria in comparison to the Czech Republic. From these countries, Germany, with 6%, achieved the highest participation rate of individuals in training courses, followed by Austria, with 5%. The following table summarizes the data:

Table 2
The participation of individuals aged 16–74 in online education courses in %[1]

Country	2007	2008	2009	2010	2011	2013	2015	2016	2017
Czechia	1	2	1	1	3	3	3	3	3
Poland	–[2]	2	1	2	2	–[2]	3	4	4
Hungary	2	2	2	3	5	4	3	4	4
Slovakia	1	1	1	1	1	4	3	3	4
Germany	2	2	3	3	4	4	4	5	6
Austria	1	u[3]	1	2	3	3	4	4	5

S o u r c e: Own work

Note: **1** – Individuals who attended an online course in the last three months prior to the research, **2** – not available, **3** – unreliable or uncertain data.

Individuals with 1 or 2 Internet skills

The level of Internet skills was judged based on the respondents' self-evaluation, without testing or examining the knowledge. The respondents were asked about their specific activities on the Internet, namely:

- the use of a search engine for information searching,
- sending and receiving electronic mail,
- chatting,
- posting messages to information forums,
- internet telephony,
- the use of peer-to-peer networks to exchange movies, music or video,
- creating their own website.

The overview below shows the individuals who reported one or two activities. Data for the Czech Republic in 2005 is not available. In 2006, 16% of individuals said they had 1 to 2 internet skills. In 2014, this figure was 18%. It can be seen that the highest increase in acquired Internet skills was in Hungary. From 7% in 2005, the number of individuals reached 18% in 2014.

A decline in acquired internet skills can be seen in Poland, from 19% in 2005 to 16% in 2006 and 14% in 2014. There was a drop in these skills in Germany as well, with 23% in 2005 and 17% in 2006; in 2014, this number went up slightly to 18%. Slovakia, with 20% of individuals with 1 or 2 internet skills in 2014, had the highest result. The following table summarizes the data:

Table 3
Individuals with 1 or 2 Internet skills in %

Country	2005	2006	2014
Czechia	–[1]	16	18
Poland	19	16	14
Hungary	7	9	18
Slovakia	17	18	20
Germany	23	17	18
Austria	12	12	15

S o u r c e: Own work based on the Czech Statistical Office
Note: **1** – Not available.

Individuals with 3 or 4 Internet skills

The level of internet skills focused on the same skills as mentioned in the previous part.

Data on individuals who had mastered 3 or 4 Internet skills in 2005 is not available for the Czech Republic. There was an increase in skills from 22% in 2006 to

23% in 2014. The fewest individuals who mastered 3 or 4 skills were detected in Hungary. In 2005, the majority of individuals who had mastered 3 or 4 internet skills was identified in Slovakia (35%) and Germany (34%). In 2014, the number decreased to 32% in Slovakia and to 31% in Germany. The following table illustrates this development:

Table 4
Individuals with 3 or 4 Internet skills in %

Country	2005	2006	2014
Czechia	–[1]	22	23
Poland	22	18	23
Hungary	16	21	26
Slovakia	35	30	32
Germany	34	31	31
Austria	26	24	29

S o u r c e: Own work based on the Czech Statistical Office
Note: **1** – Not available.

Individuals with 5 or 6 Internet skills

The level of internet skills is judged based on the respondents' self-evaluation, without testing or examining the knowledge. The respondents were asked about their specific activities on the Internet, namely:

- copying, moving files/folders,
- copying/inserting data within a document,
- basic spreadsheet calculations,
- compressing/zipping files,
- connecting new devices,
- using the programming language to create programs.

In 2005, Austria showed the highest number of individuals who had mastered 5 or 6 internet skills, with 31%. The data was not available in the Czech Republic. In the Czech Republic, there was an increase in the number of individuals who had mastered 5 to 6 internet skills from 14% in 2006 to 27% in 2014. Only Germany, with 30%, and Austria, with 34%, achieved better results than the Czech Republic. The lowest result, 21%, was noted in Poland in 2014.

Table 5
Individuals with 5 or 6 Internet skills in %

Country	2005	2006	2014
Czechia	–[1]	14	27
Poland	13	11	21
Hungary	20	25	24
Slovakia	19	17	25
Germany	22	27	30
Austria	31	31	34

S o u r c e: Own work based on the Czech Statistical Office
Note: **1** – Not available.

Discussion

According to the obtained data, the Czech Republic is one of the countries whose population participates in very few online educational courses. Other countries, such as Bulgaria, Croatia, Cyprus, Austria, Portugal, Romania, and Slovakia, also achieved the same results expressed in percentages in 2007. The highest percentages of people who took online courses were in Finland (13%), Iceland (9%), Estonia (7%), and Latvia (6%) in the same year.

In 2017, Finland did not maintain its lead in the number of individuals who had attended online courses in the last three months. Iceland came in first that year (20%). It was followed by Sweden (18%) and Norway (14%). The Czech Republic did not achieve a significant increase that year. With 3 percent, it represented almost the lowest position in this indicator. Only Bulgaria (2%) and Croatia (2%) noted worse results. Romania had the same percentage as the Czech Republic.

In the Czech Republic, the number of individuals who had mastered 1 or 2 internet skills increased slightly from 16% to 18% between 2006 and 2017. With this result, Czechia reached the same position as Germany and Hungary, with this percentage increasing in Hungary and falling from 23% in 2006 to 18% in 2017 in Germany. The results in Poland (14%) and Austria (15%) were worse than in the Czech Republic. Conversely, the results in Slovakia were higher, with 20%.

In 2014, the Czech Republic performed worse than the neighbouring countries in terms of mastering 3 or 4 internet skills, which was similar to the situation in Poland. Germany, on the other hand, achieved the highest results among the neighbouring countries (31%).

Comparing the criterion of mastering 5 to 6 internet skills, the Czech Republic was in the third place (with 27%), after Germany (with 30%) and Austria (with 34%) in 2014. Compared to other European countries, the Czech Republic lagged behind Finland (46%), Norway (42%), Luxembourg (42%), Denmark (39%), and Sweden (38%) in mastering these internet skills. It is gratifying for the Czech Republic that the number of individuals mastering 5 to 6 internet skills is rising.

Conclusions

Technological development affects many sectors and has a huge potential for education, as it makes it possible to change society in a global environment and give its members access to education. There has been some development in education as regards information technology. It concerns both participation of individuals in online training courses and the level of skills of those individuals. It turned out that literacy in this area was growing and the number of individuals who had mastered 5 to 6 skills was increasing in the Czech Republic, namely copying, moving files/folders, copying/inserting data within a document, basic spreadsheet calculations, compressing/zipping files, connecting new devices, and using a programming language to create programmes.

The Internet has unprecedented potential, especially in ways of making education accessible. This aspect represents a huge potential for development in the competencies of the population in individual countries, which will have a distinct impact on the education and economic development of a given country.

The question is how behavioural contexts can affect the inclusion of individuals in online learning activities. Age, gender, education, income, social status, etc., as determinants, can bridge the digital divide and lead to the development of lifelong learning for individuals. The state of online education in the Czech Republic shows that online educational activities thus have a relatively great potential for further growth.

Digital media may play a major role in the educational system in the future due to their multimedia nature. The combination of text, graphics, video and audio is a tool for creating methodological and didactic concepts in their use in teaching. However, it should be realized that the learning outcome depends on many other factors in the individual processing in the learning process, which are especially motivational and emotional in nature.

The authors teach business English and German, and communication at the Department of Tourism and Leisure Activities at Silesian University in Opava, School of Business Administration in Karvina.

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Hanne-Lore Bobáková, Martina Chylková

Korzystanie ze zdalnego nauczania w czeskiej populacji w kontekście europejskim

S t r e s z c z e n i e

Artykuł poświęcony jest zdalnym kursom edukacyjnym w Republice Czeskiej. Przedmiotem dociekań jest udział osób w wieku 16–74 lat w zdalnym kształceniu w Czechach oraz jego rozwój w latach 2007–2017. Badanie skupia się również na umiejętnościach komputerowych poszczególnych osób i ich rozwoju w roku 2005, 2007 i 2014. Wszystkie wyżej wymienione wskaźniki są analizowane i porównywane z sytuacją w krajach sąsiadujących oraz w kontekście europejskim. Zastosowano metody analizy, syntezy i porównania. Badania wykazały, że liczba osób uczestniczących w zdalnych kursach w Republice Czeskiej jest stosunkowo niska w porównaniu z innymi krajami sąsiadującymi, pomimo że w latach 2005–2014 stale rosła kontrola nad umiejętnościami komputerowymi w Republice Czeskiej.

S ł o w a k l u c z o w e: kompetencja, umiejętności komputerowe, umiejętności internetowe, edukacja online, komunikatywność

The Use of Online Education by the Czech Population in the European Context

Ханне-Лоре Бобакова, Мартина Чилкова

Использование интернета в образовательных целях в Чехии и в европейском контексте

Аннотация

В статье рассматриваются образовательные онлайн-курсы в Чехии. Предметом исследования является онлайн-образование для людей в возрасте 16–74 лет в Чешской Республике и его развитие в 2007–2017 годах. В фокусе исследования – компьютерные навыки людей и их развитие в 2005, 2007 и 2014 годах. Все вышеперечисленные показатели анализируются и сравниваются с ситуацией в соседних странах и в европейском контексте. Применялись методы анализа, синтеза и сравнения. Исследование показало, что количество обучающихся на курсах в Чешской Республике относительно невелико по сравнению с соседними странами, не смотря на то, что уровень контроля за компьютерными навыками в Чехии постоянно усиливался с 2005 по 2014 год.

Ключевые слова: компетенция, компьютерные навыки, Интернет-навыки, онлайн образование, коммуникативность

Hanne-Lore Bobáková, Martina Chylková

El Uso de Enseñanza Online en la Población Checa y en el Marco del Contexto Europeo

Resumen

El artículo trata sobre los cursos de educación online en la República Checa. El tema de la investigación es la participación de personas en la educación en línea a la edad de 16 a 74 años en la República Checa y su desarrollo entre 2007–2017. La investigación también se centra en las competencias informáticas de las personas y su desarrollo en 2005, 2007 y 2014. Todos los indicadores mencionados anteriormente están siendo analizados y comparados con la situación en los países vecinos y en el contexto europeo. Se aplicaron los métodos de análisis, síntesis y comparación. La investigación mostró que el número de personas que participan en cursos en la República Checa es relativamente bajo en comparación con otros países vecinos, a pesar de que el control de las habilidades informáticas en la República Checa aumentó constantemente entre 2005 y 2014.

Palabras clave: competencia, habilidad en computación, habilidad en internet, educación en línea, sociabilidad

III. Theoretical, Methodological and Practical Aspects of ICT and E-learning in Education E-Learning in Development of Key Competences and Skills in Education

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Krzysztof Dziedzic
Lublin University of Technology, Poland
http://orcid.org/0000-0003-4909-9980

Measuring Student Involvement When Taking Tests in E-learning Courses

Abstract

The ongoing SARS-CoV-2 pandemic has significantly affected the education process of young people in primary, secondary, and tertiary education, as well as those who improve their competences through various courses and trainings. The practically incessant lockdown in education has resulted in a situation in which distance learning, which most often plays a supplementary role, now constitutes the basic form of education. This situation has forced the selection and adaptation of the available e-learning tools to the types of classes and levels of education. Despite great progress in the development of e-learning technologies, constant stimulation and maintenance of students' interest in the content presented and monitoring their activity still pose a problem, which also concerns the education of computer science students in issues related to computer graphics. Currently, the preferred model of distance learning is based on various technologies and IT tools that enable the implementation of synchronous and asynchronous work. Prompt acquisition of data on students' activity allows trainers to adjust the form and content of the presented material to their expectations. It also makes it possible to identify issues that pose great difficulties to students. This paper discusses modern solutions and trends in designing e-learning courses based on the new interactive e-learning platform Quizer. The aim of the research is to determine the course effectiveness using the user activity-monitoring module designed and implemented for the Quizer e-learning platform. The correctness of the answers correlates with

the number of attempts to answer it (−0.65). The time devoted to a given question was usually high for questions with low correctness of answers.

K e y w o r d s: e-learning, e-learning platform, e-learning course, activity monitoring

The current challenging situation related to the spread of SARS-CoV-2 virus worldwide has significantly limited interpersonal contacts. This also applies to the education system, where education at schools and universities has been replaced by distance learning, often becoming its basic form (Barszcz, Montusiewicz, Nowicki, & Kayumow, 2021). The recurring lockdown makes it far more difficult for students to return to school and university. Most Polish universities (62.4%) declare that they have implemented e-learning in recent years, but only 49% (of all universities) have confirmed the targeted selection to satisfy specific needs (Maleńczyk & Gładysz, 2019), which may hamper the adaptation of their resources to the transition to remote learning.

The concept of distance learning is the broadest concept because it includes correspondence learning, television and radio forms, and e-learning (Szulc, 2020). At schools and universities, e-learning is mainly used for distance learning. The use of information technology has made it possible to replace real contact with a virtual one. In literature, e-learning is understood as a process that enables the relationship between the learner and the teacher through achievable technical means (usually digital ones) (Duda, Korga, & Gnapowski, 2014). In practice, e-learning involves teaching via the Internet with the use of personal computers or portable wireless devices – smartphones, tablets, or laptops. The use of dedicated e-learning applications and platforms enabling communication and teacher-student data exchange has become a necessary requirement in distance learning. Over the last years, their rapid development has been observed. E-learning applications and platforms have become very extensive, offering a number of various functionalities in line with the development of technology and teaching methods (Sierra & Sarasa-Cabezuelo, 2014).

The positive aspects of using e-learning in the process of educating pupils and students are discussed in numerous scientific papers. Improvement of ‘hard skills’, such as the use of new technologies and IT tools, as well as ‘soft skills’, such as communication and presentation skills, is observed (Csikosova, Senova, & Culkova, 2012). In the literature, e-learning platforms are mainly referred to as LMS (Learning Management System) or LCMS (Learning Content Management System) platforms (Caputi & Garrido, 2015). Currently, SCORM and xAPI are

the most commonly used formats for teaching content and quizzes available on e-learning platforms.

Nonetheless, new technical and functional solutions are still being sought in e-learning. Even commercial solutions frequently have the option of installing dedicated extensions that add new functionalities. One such example is the MoodleRec plug-in for content search. This plug-in can sort a set of supported standard repositories of educational objects and suggest an ordered list of these. For this purpose, it uses queries based on defined keywords (De Medio, Limongelli, Sciarrone, & Temperin, 2020).

Intelligent e-learning systems are an innovative approach. They enable trainers to provide education in an adaptive way, which makes it possible to take into account learners' specific needs when transmitting content. The ability to independently make decisions concerning what teaching content is to be provided to the learner in response to the identified needs is implemented with the use of the so-called teaching strategies and the IT module implemented in the LMS system, the so-called ITS agent. The key function of the ITS agent is to confront the teacher's expectations with the learner's actual progress and to make decisions as to the content provided (Marciniak, 2016). The platform used at Kajaani University of Applied Sciences is a good example of a personalised e-learning platform which uses adaptive mechanisms for customising courses for students (Deepak, 2017).

Currently, there is a trend to exploit the popularity of computer games and 3D visualization in e-learning. Children and teenagers devote a large part of their spare time to this kind of entertainment. Gamification is an approach applied in the educational process, which is now gaining in popularity. The introduction of gameplay elements into the learning process boosts the user's interest, creativity, and motivation as regards the content presented. Elements of strategy and gameplay are combined with educational content in educational games. During the game, players often have to show prompt reactions and knowledge connected with the questions asked (Montusiewicz et al., 2017). Their activity and the correctness of responses are measured and recorded for further analysis of the final effects.

Simulation games are another type of games used in teaching. They are mainly applied in higher education, in particular in the process of educating students of engineering, medical and military majors, as well as pilots (Haugea & Riedel, 2012). Modern solutions such as virtual and augmented reality, as well as artificial intelligence are increasingly used in simulation games (Marciniak, 2016). They allow for high realism of the presented content, thus increasing its understanding (Bauman, 2016). The implementation of gamification in e-learning requires a multidisciplinary approach, combining the ability to design games and knowledge of information technology with psychology and pedagogy (Urha, Vukovic, Jereb, & Pintar, 2015).

The positive effects of using a programming course with elements of gamification via an e-learning platform are presented in Pankiewicz's paper. Students who were provided with the elements of gamification achieved a better final result (than the control group), assessed the difficulty of the material as easier, and more often assessed the obtained grades as fair (Pankiewicz, 2016). Presenting content with the use of 3D computer visualisations is particularly useful in teaching technical subjects related to the design of machine parts (Dziedzic, Włodarczyk, & Paśnikowska-Łukaszuk, 2014).

To sum up, it may be stated that e-learning software continues to be dynamically developed, which will certainly be further accelerated by the global SARS-CoV-2 pandemic.

Methodology of Research

General Background. Modern Technologies and Solutions Supporting Distance Learning

Currently, in the time of the SARS-CoV-2 pandemic, the most commonly used model at universities is the distance learning model which uses various technologies and IT tools that allow for synchronous and asynchronous work with students. The most commonly used commercial solutions include Moodle e-learning platform, Microsoft Teams application, and Zoom conference software.

The Moodle learning platform is one of the most popular tools used to implement distance learning. It is an open-source learning management system (LMS) written in PHP and distributed under the GNU (General Public License) license, which can be installed on university-owned, purchased or leased server infrastructure. Functionalities of the platform can be extended with the use of plug-ins, created by the developers' community around the world. The Moodle platform is most frequently used as an information board that makes it possible to place any information, e.g., information regarding the courses taught, a list of recommended literature, and as a repository of files, e.g., for posting materials for classes, homework, or reports. In addition, the application enables the use of functionalities such as discussion forums, quizzes, surveys, or checking attendance. It is very important to be able to import the created courses in SCORM (Sharable Content Object Reference Model) format, which is a modern standard that defines the method of preparing an e-learning course in the IT layer (specification of files, extensions, file headers, blocks in which data should be placed, and embedded objects). Importantly, the SCORM package is independent of the LMS

system used. Such packages are usually zipped files which contain the necessary content of the course.

Microsoft Teams is a virtual, cloud-based environment with tools for multi-level and multi-threaded collaboration between team members. It is part of the Microsoft 365 platform distributed under a closed software license. It is impossible to copy, modify, and distribute the source code. In the process of education, it is most often used in the following areas: planning meetings, basic voice and text communication, videoconferencing with students, sharing a remote desktop during classes, and recording student attendance. Combined with other platform tools such as Forms, Whiteboard, OneDrive, or Outlook, it is an integrated environment which enables synchronous and asynchronous distance learning.

Zoom is another very popular solution. It is a software mainly designed for planning and conducting videoconferences with students, which operates in a browser or in an installed application. At universities, this tool is especially useful for conducting lectures and seminars. Other, less popular solutions used in Poland include Skype, Discord, Google Docs, Google Hangouts, and Slack. Most distance learning software works on both computers and mobile devices, regardless of the operating system installed.

The Quizer e-learning platform is an interesting, alternative, and modern solution, designed to create interactive multimedia courses. The platform has been developed by Euro-Forum as a result of research and development work carried out as part of the project: "Creating an innovative interactive Quizer platform as a result of R&D works". Euro-Forum draws upon it to create courses and makes it available for commercial sale for schools, universities, and institution.

It is characterised by the functionality of a multimedia course creator that enables the introduction of elements of gamification and a module that monitors user activity during quiz solving. The platform is a new solution targeted at companies and institutions, at schools and universities implementing remote learning, as well as companies and institutions that would like to improve the qualifications of their employees through training and online courses. It enables the preparation of training materials, presentations, as well as final tests with extensive statistics of final results.

Designing e-learning platforms that can operate in the cloud is becoming a standard nowadays. This solution allows for the elimination of the need to have one's own server infrastructure. The cloud infrastructure used in the case of the Quizer platform is Oktawave. It ensures its uniform operation on various devices such as PCs, notebooks, tablets, and smartphones. Scalability is a key feature for cloud infrastructure. Cloud computing makes it possible to allocate the right amount of resources depending on the situation during the platform operation. Such a solution for the e-learning platform increases its smooth operation, reliability, data security, and, concurrent, reduces the costs of infrastructure maintenance.

At the same time, it is vital to use an operating system that enables stable operation of the application. In the case of the Quizer platform, the virtual application server runs on the Linux-Debian operating system. Bootstrap, PHP Laravel, and MySQL have been used to build the application itself. Bootstrap is an open source CSS (Cascading Style Sheets) library. It is one of the solutions that allows for the construction of responsive websites. A responsive website (Responsive Web Design) is a type of page that adjusts the layout of elements and its width to the screen resolution of the device on which it is displayed.

A framework is another essential tool for designing an e-learning platform, the example of which is the one used to build the Laravel platform, written in PHP and based on the Model-View-Controller architectural pattern, thanks to which developers have at their disposal a number of additional built-in functions and may develop applications at various levels of advancement.

The MySQL relational database management system was used to manage the database. Such a set of the most important modern IT tools allows for the design and implementation of e-learning platforms. A general diagram of the Quizer e-learning platform structure is presented in Fig. 1. Users can set up their individual accounts and gain access to the resources available on the platform.

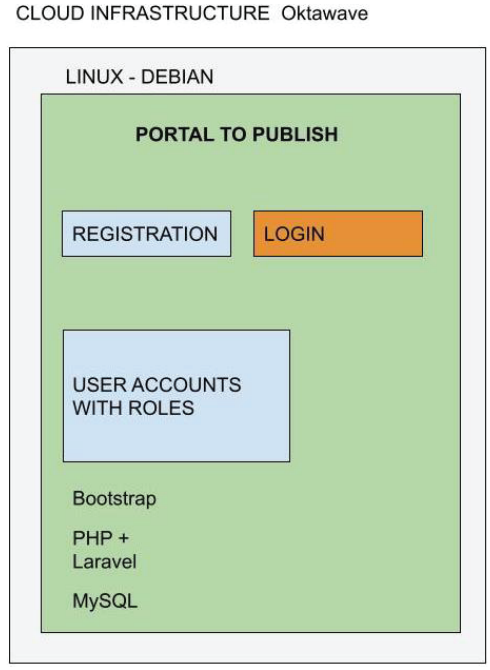

Figure 1. The diagram of Quizer platform's structure.
S o u r c e s: Author's own work

The introduction of mechanisms supporting user engagement and motivation for e-learning can be achieved by introducing gamification. The interactive exercise wizard is one of the elements of the Quizer platform and makes it possible to create quizzes. On the Quizer platform, two solutions have been used: quizzes can be created in single-player (a single player) and multiplayer (many players) formats. This allows for the creation of educational games, an alternative to other types of games which children, in particular the youngest, most often do not benefit from. The games may be played against the computer or other users.

The single-player wizard makes it possible to create multimedia educational courses and presentations using interactions, including: single choice, multiple choice, drag-and-drop, type, crossword, puzzle, connect with lines, and more. The wizard also gives the possibility to design conditional interactions based on previous user actions, using built-in or user-defined variables. By using variables, one may also monitor and examine user activity in a given course. The quizzes prepared in the wizard can be exported to SCORM or HTML formats, which enables cross-platform exchange. In addition, it is possible to publish the quiz directly to the Presenter, thanks to which it is automatically placed on the presentation platform, which constitutes a separate component of the Quizer platform (Dziedzic, Gudków &, Wiśniewski, 2020).

User activity monitoring is an optional functionality of the platform designed to observe behaviour and to measure the level of students' involvement. One may

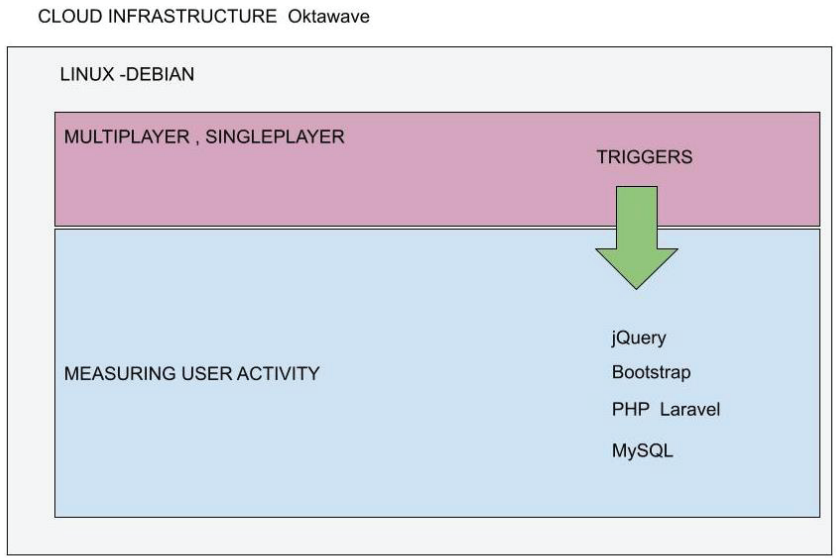

Figure 2. Outline of the structure of the application for user activity monitoring.
S o u r c e s: Author's own work

register numerous time parameters and the number of clicks on individual elements of the course. The most popular solutions available on the Moodle platform (Quiz) and in Google documents (Form) focus mainly on analysing the achieved results without analysing user activity when taking tests. The Quizer platform offers the functionality of measuring user activity in its basic form. The functionalities of Moodle can be extended with plug-ins. The aim of such solutions is to ultimately increase the effectiveness of the designed courses. Access to the user activity monitoring panel is provided by a web browser and access to the Internet. The tools used to create the application include jQuery programming library, Bootstrap, PHP Laravel, and MySQL. The general outline of the structure of the application for user activity monitoring is presented in Fig. 2. Triggers are procedures performed automatically as reactions to events in a database table. This enables the measurement of user activity and the creation of statistics on the answers given. All data is collected automatically.

Sample of Research, Procedures, and Data Analysis

The basic research problem is to determine the involvement of computer science students in completing an e-course in computer graphics, which is implemented in their education process. Computer science students usually prefer to use new IT solutions in education due to the nature of their future work. However, it very frequently occurs that when filling in various questionnaires or e-tests, students do it carelessly and quickly, which distorts the obtained results. The research hypothesis is as follows "Measurement of student activity while completing an e-course should facilitate the determination of their involvement in this process".

The following research questions have been formulated:

- How to measure student involvement during the e-course completion?
- Is it possible to indicate a correlation between the presented content and the time to respond and the use of elements facilitating the choice of the correct response, such as instructions and hints?
- Does the way the content is presented and the colours are used affect the process of completing the e-course?

The aims of the research consist in:

- characteristics of the new Quizer platform module for measuring user activity,
- measurement of user activity while taking tests,
- indication of relationships and correlations between recorded data,
- determination of the course effectiveness using the user activity monitoring module designed and implemented for the Quizer e-learning platform.

The research was conducted on computer science students during the course of computer graphics. The subject of "Fundamentals of Computer Graphics" is introduced in the second year of studies. The first and the second group amounted

to 12 people each, while the third one comprised 13 people. The study groups consisted of both men (31) and women (6).

Before starting the test, each person was assigned a unique user number, which was used to set up an individual anonymous account on the Quizer platform. The same test was performed in all groups with assumptions as in Table 1. The closed test was the type of test used.

Table 1
The type of questions and their arrangement on the screen

Group 1	Group 2	Group 3
PICK ONE, vertically arranged answers	PICK ONE, horizontally arranged answers	PICK ONE, mixed arrangement, answers on slides

Figure 3 presents an example of a test question used during the research.

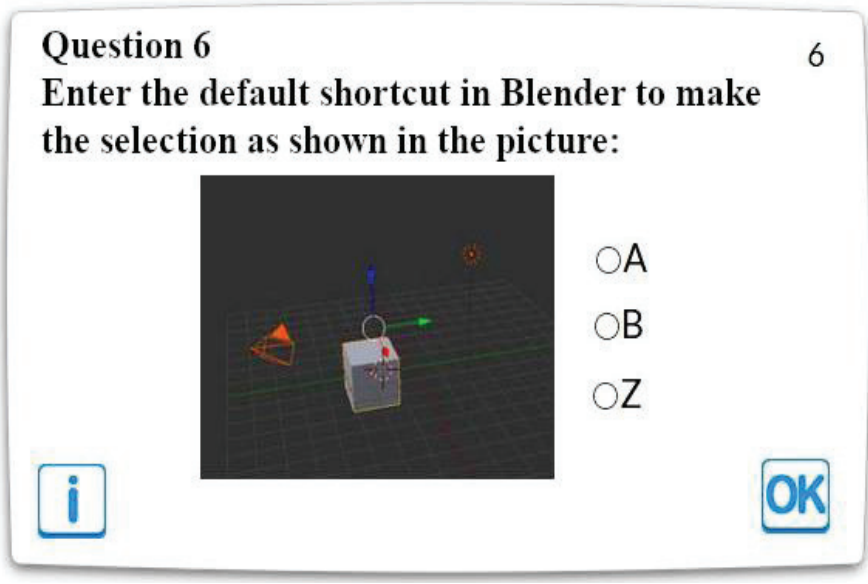

Figure 3. A sample question used during the research.
S o u r c e s: Author's own work

It was assumed that, for adults, the time needed to complete one test should not exceed 5 minutes (300 s). Upon test completion, users answered survey questions regarding the arrangement of questions and the colour scheme. After entering

the test performed by users, it was possible to collectively analyse the time and results for the entire study group. The presentation of results in the form of graphs facilitated and accelerated their interpretation.

The application also allows a detailed analysis of activity for each user. Subsequently, the results obtained were exported to a spreadsheet for further processing. Pearson linear correlation coefficient was calculated for the data.

Results and discussion

While taking the test, each user's efficiency of work was measured with the use of the user activity monitoring tool and the survey method. Among other things, the test execution time, viewing the instructions and hints, the time of displaying the questions on the screen, the number of attempts to answer, and the correctness of the answers were recorded for all target groups.

The number of attempts provides information on whether the user changed his/her decision while selecting the correct answer. Measurement started on the title page where the test was initiated. Instructions on how to do the test have been displayed on the title page. Upon test completion, the users answered survey questions regarding the question's arrangement on the page, the graphic design used, and the validity of instructions and hints.

The recorded average time of performing the test by all participants was 157.6 seconds. The maximum time of taking the test that was registered was 239 seconds. The minimum time was 89 seconds. No person exceeded the assumed maximum time for performing the test.

The list of basic parameters recorded during the test execution for users from the first group is presented in Table 2. Data for the remaining groups were recorded in a similar way. While analysing the data in the table, one may observe that, in the first group, none of the students used the hints, relying solely on their own knowledge. This was probably due to the fact that students did not receive grades for completing the test. Four people clicked on the instruction regarding how to complete the test. The time spent on the title page was generally the highest for those who used the instruction, which suggests that those persons have, in fact, read it. Similar relationships were observed for other groups. Five people used the instruction in the second group and four in the third group. The instruction display time was a maximum of 11 seconds.

The correctness of the answers given by users is shown as an average for each group for individual questions in Figure 4. For groups 1 and 2, question 5 caused the greatest problems, where the correctness of the answers was only 25%. For

group 3, the most difficult question was question 4, where the correctness of the answers was 38.8%. When analysing all answers, the questions that caused problems for the students were questions 3, 4, 5, 6, 7, and 9. The least problematic questions were questions 1, 2, 8, and 10, where the correctness of the answers was over 75%.

Table 2
Recorded test parameters for users in Group 1

Recorded parameters	Users' ID											
	1	2	3	4	5	6	7	8	9	10	11	12
Hint- number of clicks	0	0	0	0	0	0	0	0	0	0	0	0
Instruction- number of clicks	0	1	0	0	1	1	0	0	1	0	0	0
Time devoted to the title page	17	6	7	9	24	17	19	18	24	25	3	3
Time devoted to question 1	0	1	0	0	1	1	0	0	1	0	0	0
Time devoted to question 2	17	6	7	9	24	17	19	18	24	25	3	3
Time devoted to question 3	8	16	30	16	22	27	24	15	9	8	6	8
Time devoted to question 4	4	11	9	11	12	9	5	16	8	6	7	9
Time devoted to question 5	17	9	10	20	11	12	12	7	7	11	13	6
Time devoted to question 6	11	16	16	13	21	17	16	28	19	13	11	10
Time devoted to question 7	50	36	17	32	11	27	24	16	31	36	17	10
Time devoted to question 8	15	44	29	27	48	30	14	24	23	30	19	14
Time devoted to question 9	14	12	6	26	30	38	29	22	10	15	15	10
Time devoted to question 10	23	8	24	8	8	10	7	7	10	35	5	5
No. of attempts – question 1	37	20	25	35	18	16	23	24	43	31	17	9
No. of attempts – question 2	6	10	14	12	5	12	8	7	15	10	11	5
No. of attempts – question 3	1	1	1	1	2	9	1	4	1	2	1	1
No. of attempts – question 4	1	2	4	1	2	1	2	1	1	2	2	2
No. of attempts – question 5	1	2	1	1	2	1	2	2	1	5	2	1
No. of attempts – question 6	1	4	1	1	2	1	1	27	1	2	1	2
No. of attempts – question 7	2	2	1	6	2	2	2	2	2	2	1	2
No. of attempts – question 8	2	4	1	2	2	4	1	2	1	2	1	1
No. of attempts – question 9	1	2	1	2	2	2	2	2	1	2	1	1
No. of attempts – question 10	1	2	3	2	2	1	2	2	1	4	1	2

The average time devoted to solving particular questions and the average number of attempts for all users are presented in Fig. 5. The measured times for questions 4, 5, and 6, which turned out to be the most difficult ones, correlate (−0.55) with the correctness of the answers given by the students.

At the same time, the increased number of attempts at answering is visible for these questions. This proves that students analysed these questions longer, often changing the final answer (on average more than 2 times). For the remaining questions, the number of attempts is at a similar level.

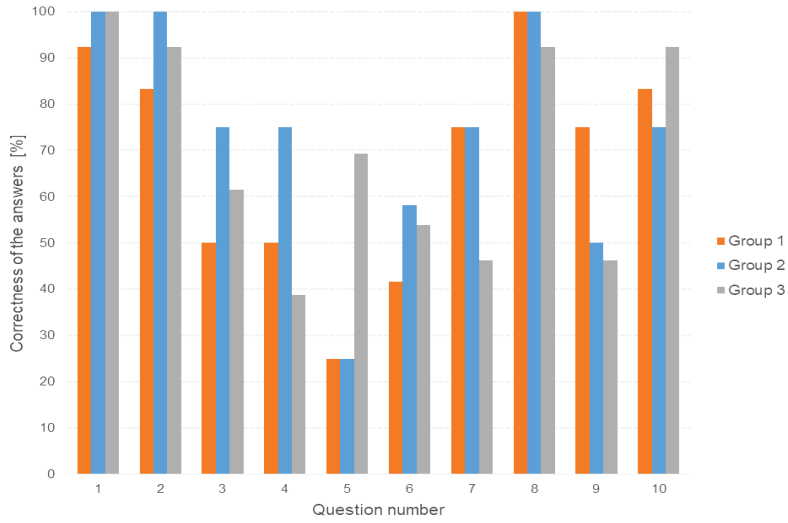

Figure 4. Correctness of the answers given for all groups.
S o u r c e s: Author's own work

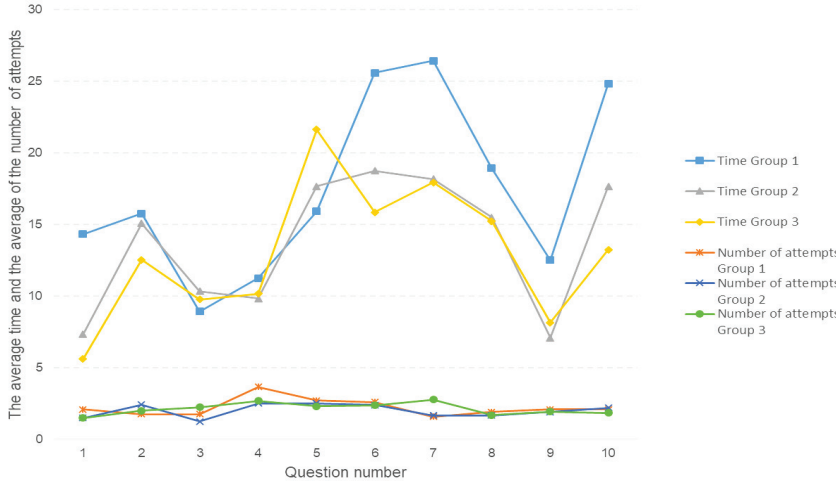

Figure 5. The average time devoted to solving particular questions and the average of the number of attempts.
S o u r c e s: Author's own work

The arrangement of questions did not significantly affect the answers provided; nevertheless, in the survey responses, users indicated the vertical arrangement of questions as the preferred one. When assessing the graphic design, users definitely pointed to the questions where a subdued (grey-blue) graphic design was used compared to an aggressive (red-yellow) design.

Conclusions

On the basis of the conducted research, it may be concluded that the 'User activity monitoring' application implemented on the Quizer platform allows for examining the parameters of users' activity and the results achieved by them. It facilitates the analysis and interpretation of data as well as determination of the occurring correlations. The tool makes it possible to record for each user (or groups of users) such parameters as the number of clicks on hints and instructions, correctness of given hints, time spent on the title page, time devoted to individual questions, and number of attempts for each question.

The application indicates which questions were easy for users and which were difficult for them. Such information makes it possible to analyse these questions, and thus find the causes of user's problems. This allows for the correction of the provided content during the teaching process itself, which can significantly affect the teaching process, contributing to an increase in its effectiveness. The tool enables the compilation of data obtained both for individual users and for individual groups; it makes it possible to observe which groups fared best and which were the weakest in particular questions and where the reason for such a state of affairs may lie. Based on the research, the following conclusions have been drawn:

1. The correctness of the answers correlates with the number of attempts to answer it (-0.65). The time devoted to a given question was usually high for questions with low correctness of answers.
2. When analysing the answers from the survey questions, the vertical arrangement of answers seems to be the clearest/most legible. The courses designed should use subdued graphic design. In the users' opinion, graphic design is important for focusing on the task. Aggressive screen graphics distracts the user and extends the test execution time. Additionally, users expressed positive opinions on the inclusion of hints and instructions in the course.
3. The user activity monitoring module allows for a wide configuration of the measured parameters, which may contribute to the correction of content included in the course and its distribution, and thus to an increase of the test's effectiveness.

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Krzysztof Dziedzic

Pomiar zaangażowania studentów podczas rozwiązywania testów w e-kursach

S t r e s z c z e n i e

Trwająca pandemia wirusa SARS-CoV-2 znacząco uwarunkowała proces kształcenia młodzieży. Dotknęło to zarówno młodzież kształcącą się na poziomie podstawowym, średnim i wyższym, jak również osoby podnoszące swoje kompetencje poprzez różne kursy i szkolenia. Trwający praktycznie nieustannie lockdown w oświacie spowodował, że nauczanie na odległość, pełniące najczęściej rolę uzupełniającą, obecnie jest podstawową formą kształcenia. Sytuacja ta niejako wymusiła dobór i dostosowanie do rodzaju zajęć oraz poziomów kształcenia dostępnych narzędzi e-learningowych. Pomimo dużych postępów w rozwoju technologii e-learningowych w dalszym ciągu problemem podczas zajęć jest podbudzanie i utrzymanie zainteresowania ucznia prezentowanymi treściami oraz monitoring jego aktywności. Problem ten dotyczy również kształcenia studentów kierunków informatycznych w zagadnieniach związanych z grafiką komputerową. Obecnie preferowany jest model nauczania na odległość (distance learning) wykorzystujący różne technologie i narzędzia informatyczne pozwalający realizować pracę synchroniczną i asynchroniczną. Szybkie uzyskiwanie danych o aktywności uczniów pozwala na dostosowanie formy i zawartości prezentowanych treści do ich oczekiwań. Umożliwia również identyfikowanie zagadnień przysparzających uczniom dużych trudności. Niniejsza praca omawia nowoczesne rozwiązania i trendy w projektowaniu kursów e-learningowych na podstawie nowej interaktywnej platformy e-learningowej „Quizer". Zaprezentowano i omówiono wyniki badania aktywności studentów kierunku informatyka podczas rozwiązywania testów e-learningowych z zakresu grafiki komputerowej. Celem badań jest określenie efektywności e-kursu z wykorzystaniem modułu monitorowania aktywności użytkowników zaprojektowanego i wdrożonego na platformie e-learningowej

Quizer. Poprawność odpowiedzi koreluje z liczbą prób udzielenia odpowiedzi (0.65). Czas poświęcony na dane pytanie był zazwyczaj długi dla pytań o małej poprawności odpowiedzi.

S ł o w a k l u c z o w e: e-learning, platforma e-learningowa, kurs e-learningowy, monitoring aktywności

Кшиштоф Дзедзиц

Уровень активности студентов во время решения тестов в е-курсах

А н н о т а ц и я

Продолжающаяся пандемия вируса атипичной пневмонии (SARS-CoV-2) существенно обусловило систему образования молодежи. Она затронула также учеников и студентов, получающих начальное, среднее и высшее образование, а также тех, кто повышает свою квалификацию с помощью различных курсов переподготовки. Практически непрерывный локдаун в сфере образовании означает, что дистанционное обучение, которое чаще всего играло вспомогательную роль, в настоящее время является основной формой образования. Такая ситуация, в некотором смысле, заставила пересмотреть имеющиеся средства электронного обучения и адаптировать их к типам классов и уровню образования. Несмотря на большой прогресс в развитии технологий электронного обучения, во время занятий все еще остается проблемой то, как вызвать и поддержать интерес учащихся к предоставляемым материалам, а также как контролировать их деятельность. Быстрое получение данных об активности студентов позволяет скорректировать форму и содержание обучающего материала в соответствии с их ожиданиями, а также позволяет выявить проблемы, которые вызывают большие трудности у студентов. Эта проблема касается также обучения студентов компьютерных наук по вопросам, связанным с компьютерной графикой. В настоящее время предпочтительной моделью является дистанционное обучение, использующее различные технологии и IT-инструменты, и позволяющее выполнять синхронную и асинхронную работу. В данной статье рассматриваются современные решения и тенденции в разработке курсов электронного обучения на базе новой интерактивной платформы электронного обучения «Quizer». Целью исследования было определение эффективности курса с помощью модуля мониторинга активности пользователей, разработанного и реализованного для платформы электронного обучения Quizer. Правильность ответов коррелирует с количеством попыток ответа (0.65). Время, посвященное данному вопросу, обычно было большим для вопросов с низкой правильностью ответов.

К л ю ч е в ы е с л о в а: электронное обучение, платформа электронного обучения, курс электронного обучения, мониторинг деятельности

Measuring Student Involvement When Taking Tests in E-learning Courses

Krzysztof Dziedzic

Medir la participación de los estudiantes al realizar pruebas en cursos electrónicos

Resumen

La actual pandemia originada por el SARS-CoV-2, ha afectado significativamente al proceso educativo de los jóvenes. Esto ha afectado a jóvenes de educación primaria, secundaria y terciaria, así como a personas que mejoran sus competencias a través de diversos cursos y formaciones. Debido al bloqueo prácticamente constante de la educación, la educación a distancia, que a menudo desempeña un papel complementario, es ahora la forma básica de educación. Esta situación obligó a seleccionar y adaptar las herramientas de e-learning disponibles al tipo de clases y niveles educativos. A pesar de los importantes avances en el desarrollo de las tecnologías de e-learning, el problema sigue despertando y manteniendo el interés del alumno por los contenidos presentados y el seguimiento de su actividad. Este problema también concierne a la educación de los estudiantes de ciencias de la computación en temas relacionados con los gráficos por computadora. Actualmente, el modelo preferido de aprendizaje a distancia se basa en diversas tecnologías y herramientas informáticas que permiten la implementación del trabajo sincrónico y asincrónico. Los datos rápidos sobre la actividad de los estudiantes permiten ajustar la forma y el contenido del contenido presentado a sus expectativas. También permite identificar problemas que plantean grandes dificultades a los estudiantes. Este artículo analiza las soluciones modernas y las tendencias en el diseño de cursos de aprendizaje electrónico basados en la nueva plataforma interactiva de aprendizaje electrónico "Quizer". Se presentaron y discutieron los resultados de la investigación sobre la actividad de los estudiantes de informática en la resolución de pruebas de e-learning en el campo de la infografía. El objetivo de la investigación es determinar la efectividad del curso electrónico con el uso del módulo de monitoreo de la actividad de los usuarios diseñado e implementado en la plataforma de aprendizaje electrónico Quizer. La exactitud de la respuesta se correlaciona con el número de intentos de responder (0.65). El tiempo dedicado a una pregunta determinada suele ser largo para las preguntas con poca exactitud de respuesta.

Palabras clave: e-learning, plataforma de e-learning, curso de e-learning, seguimiento de actividades

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Małgorzata Wieczorek-Tomaszewska
Bibliotheca Nostra
The Academy of Physical Education named after Jerzy Kukuczka in Katowice, Poland
http://orcid.org/0000-0002-7493-4071

Visual Literacy as a Dimension of the Young Generation's Cultural Capital – Comparative Research

Abstract

The subject of the research presented in the article, related to visual literacy, is to determine the scope and quality of the phenomenon of communication in the area of symbolic communication. Individual dispositions of information users were taken into account, creating a set of behaviors and reactions, views and concepts, personal beliefs and inclinations that determine the way of life and thinking – the so-called Habitus by Pierre Bourdieu. The aim was to create the characteristics of the examined representatives of the young generation and to determine their predispositions to symbolize (search for references). The research was carried out on two comparative groups of research participants from Poland and Italy in order to examine the quality of contemporary visual communication and the predisposition of information users to visualization, and their adaptation to the visual form of expression. The research meets the educational demand for a modern form of education, taking into account the modern informational live environment and media immersion in the visual reality of the participants of the education process.

K e y w o r d s: visual literacy, visual competence, visual communication, visual culture, visual learning environment

Visual Competences as the Basis for Participation in the Information Culture

Contemporary perception of reality through the prism of an image is a natural form of functioning in today's society. Information takes a heterogeneous visual form in the form of, for example, immersive virtual worlds created using new media and digital graphics – but also traditional – audiovisual realizations or works of art, as well as monochromatic and polychromatic photography. Each of them interacts with the surrounding world, being an element of perception and cognition.

From the perspective of information users, the image provides new content, illustrates the issues, phenomena and objects discussed, organizes and systematizes didactic content, shapes views, and promotes values and attitudes. The outstanding theorist of graphic design, Bergström, analyzing the construction of cognitive and emotionally colored visual projects, first of all emphasizes the functions of informing, organizing, teaching, illustrating, showing, explaining, dazzling, and making them more attractive (Bergström, 2009).

The enormous potential of visual forms that can be used in educational and informational practice is currently implemented mainly in terms of the visual function, facilitating the reading of the content contained in the text message, e.g., in the form of textbook didactic materials, such as graphic layouts, diagrams, illustrations, and photos. Their role is to support the perception of educational content in terms of information through a comprehensive approach to textual and graphic content, which makes it possible to see connections and relationships between individual elements of the message. Increasingly, education recognizes the property of pictorial forms of knowledge transfer, which, supported by new technologies, makes the education process more effective by using interactive possibilities of searching, saving, interpreting, imaging, analyzing, and creating (Kubalíková & Trabalíková, 2016).

Contemporary forms of digital recording combine images, text, sound, and film in one message, enhancing the information impact. Websites, multimedia, virtual worlds, interactive installations, digital videos, computer games, computer animations, cinema, and human-computer interface create a new dimension of visuality, which was created as a result of computerization of culture (Manovich, 2006). The widespread aestheticization of culture caused by the influence of new media, apart from intellectual threats, is an opportunity for education. Educational activities enter the areas where the boundary between art and visual activity is blurred, making it possible to incorporate design practices and craftsmanship of the workshop to your needs. We are dealing with an information society with a global

visual literacy shaped by an image culture developed over the ages, supported by civilization achievements (technology), with a synesthetic mindset. It awaits such forms of information and knowledge transfer that stimulate development, where visual logic plays the main role in building cognitive structures. Visual interpretative contexts work together to present successive areas of interpretation and create new knowledge patterns and inspire creativity in the creation and reception of image messages (Schnettler, 2009; 2013).

Free participation in culture, in accordance with its norms and values, enables such acquired individual abilities and dispositions, defined by cultural competences, which guarantee full adaptation in society. The condition for cultural assimilation is the ability to recognize the meanings and content of culture acquired during socialization and education. Meanings are created in the course of culture's development – they are passed on, absorbed, and transformed by successive generations. It is through activity and creativity that an individual has an impact on changing the content of culture, can create and enrich cultural capital with new values and models. The information society of the 21st century requires distinguishing between the adaptive abilities of participation in culture and a set of features redefining the concept of competence, giving them a new meaning adapted to the needs of the present day. Development conditions, supported by technology and digital information realizations, including activities in the field of mental activity, self-improvement, development, creativity, self-discipline, and the ability to set goals and make decisions, should play a fundamental role here. Modern society is becoming more visual than textual. The transformation, provoked by the omnipresence of images and visual media interfering with human life, made it possible for everyone to create new forms of expression and use visual content. Visual competences allow a person to become involved in the life of a visually-oriented society and thus fully participate in culture.

Scientific research on visual skills

In the interdisciplinary environment of higher education, he is able to:

> define the type and scope of the necessary visual materials (1), effectively and efficiently search, reach and share the necessary images and visual media (2), interpret and analyze the meanings of images and visual materials in historical, cultural and social contexts (3), evaluate images and their sources (4), use images for effective visualization (5), design and create pictorial meanings (6), understand the ethical, legal, social and economic issues related to the process of creating and using images and visual mass media, especially regarding sharing and using copyright of visual materials (7). (Wieczorek-Tomaszewska, 2014)

The document published in the USA is a methodological basis for similar visual literacy research programs conducted in Poland, in educational and e-learning environments, including those in which the author participates (http://edu-mwt.manifo.com/badania/, Visual Literacy Standards Task Force) (Wieczorek-Tomaszewska, 2014).

Technological and cultural changes in the 21st century mean that the position of visual messages in culture is now increasing. Technology, multimedia, and access to information affect the perception and use of visual media. There is also a change in the paradigm of learning about visual skills, indicating the necessity of updating educational activities in this regard even more (Thompson & Beene, 2020).

Currently, the use of various techniques and methods of visualization is aimed at developing a new scientific paradigm based not only on linear texts, but also on multidimensional, dynamic images (Osińska & Osiński, 2018). Very wide application of visualization techniques, which covers the areas of scientific and technological activity, is based on an interdisciplinary formula. In modern scientific environments, the subject of visualization is related to the methods of analyzing large data sets and their graphical representation, i.e., with advanced IT knowledge. However, in practice, the creation of interdisciplinary teams of scientists results in the creation of ready-made visualization applications that do not require the use of advanced mathematical and technological methods. It seems that this is the direction of the development of visualization methods, with the support of which visual sets of knowledge representations can be used, enabling the visualization of knowledge.

Methodology of Research

General background of own research

The methodological basis for the analysis is the research on participation in visual and informational culture, which gives an idea of the condition of perception of image messages (Batorowska, 2015). They cover two spheres of interest; the first is quantitative research, which allows to determine the scope of the pictorial form of communication within the information culture, and the second is based on qualitative studies of image perception by respondents and information conveyed through the image.

Both the number of visual search strategies and their quality depend on external factors. The description of these zones has been deepened with an analysis pointing to the cultural and informational determinants which determine the choice of the pictorial form of communication. An interesting psychological and aesthetic perspective shows both the influence of the local milieu of the partici-

pants of cultural life and transfers the problems of perception into a wider context of information science and civilization.

For this purpose, considerations on the development of a pictorial form of communication in Poland were confronted with similar experiences of the representatives of Mediterranean nations – in this case, Italians. The state of knowledge about the culture of the image and the level of visual literacy of young Italians, building their own knowledge structures just like young Poles, became the basis for nomological, typological, and comparative analysis. Data analysis made it possible to respond to the theory about the cultural centers and peripheries of Europe, confirming the need for the development of image competences through education.

The aim of the research was therefore to determine the level and the necessary scope of visual competences as part of the information standards which a participant of culture should be equipped with in order to be able to correctly read visual texts of culture in the form of pictorial information structures and to decode their meanings. Information and visual competences enable the understanding and contextual analysis of culture, based on intellectual, ethical, aesthetic, and technical elements used in the creation of information architecture.

Instrument and procedures

The aforementioned scope of research was developed and carried out in 2014/2015 and repeated in an electronic version in 2015/2016 and 2017/2018 in Poland and Italy. The following research techniques were adopted in the diagnostic procedure: for quantitative research: questionnaire, text analysis, and projection technique; for qualitative research: participant observation – research through collective experience.

The questionnaire was used to implement selected research techniques (Babbie, 2006). The questions of the survey were asked to the respondents in order to make mental identification in the context of their historical, social and cultural knowledge and to determine their level of participation in visual culture in relation to social life, at home, at school, in the peer and professional environment, in the church , on the go, etc.The full range of questions was prepared in Polish (Ankieta) and Italian (Inchiesta) and made available to the respondents on the web.

A Comparative Analysis of the Italian (Inchiesta) and Polish (Ankieta) Versions

Respondents' Social Status

Taking into account the education of parents and grandparents, comparable results of the study of Polish and Italian students in terms of social status of the respondents and the level of education of previous generations show that both groups represent a similar social position.

When confronted with Polish research, the Italian questionnaire interviews show dependence of the number of images in the possession of parents on social status. In Italy, research participants whose parents are educated have more images, are able to describe them correctly, and accept the visual form of expression in contemporary cultural communication. Such dependence does not exist in the group studied in the Polish version.

Examination of Aesthetic Dispositions

The number of paintings that Italian respondents have in their homes is higher than that declared by Polish respondents.

Table 1
Comparison of the number of paintings in the homes of Italian and Polish respondents

Nationality of respondents	Number of respondents	Number of images	Average (arithmetic mean) number of paintings in respondents' homes
Polish	253	2093	~8 images
Italian	132	1299	~10 images
Total	385	3392	~9 images

Sources: Own work

In Poland, 253 people declared that they had approximately 2,092 paintings (100 people have 827 – 46%). In Italy, 132 respondents declared having about 1,299 paintings (100 people have 984 – 54%). This constitutes an 8% advantage of the Italian group of respondents over the Polish one in the number of paintings owned by 100 people (Table 1, Figure 1).

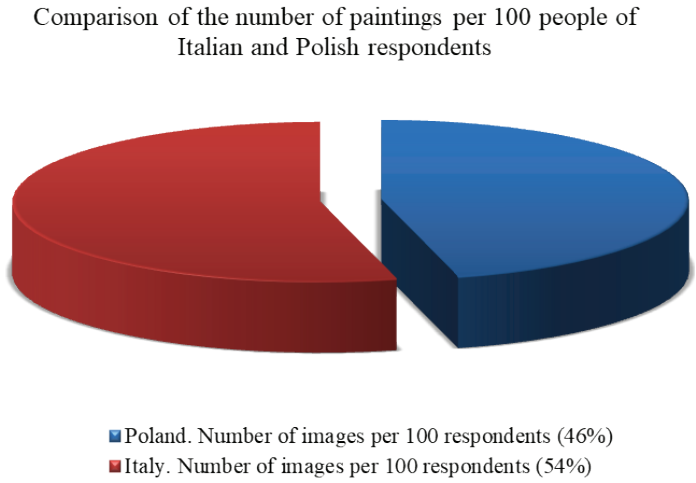

Figure 1. Percentage distribution of the number of images owned by respondents in Italy and Poland.
S o u r c e s: Own work

Table 2
Distribution of the number of paintings in the apartments of Polish and Italian respondents

	Number of paintings in the respondent's apartment																							
	0	1	2	3	4	5	6	7	8	9	10	12	14	15	16	17	18	20	21	25	30	40	71	~
	Number of respondents who have the above-mentioned number of paintings in the apartmens in Poland and Italy apartment in Italy																							
Pl	16	7	31	35	28	36	13	13	10	8	29	5	2	14	2	1	0	13	1	1	7	1	1	0
It	3	0	21	9	4	11	10	9	8	0	10	2	0	3	0	0	16	0	0	11	8	0	0	4

S o u r c e s: Own work

Another research problem is the analysis of the respondents' aesthetic preferences based on the quality of the works of art they have, the level of pictorial literacy, and the influence of family traditions on the selection of works. The assumption of the study – about the emotional attachment of the respondents to the described artifacts – was to result in the stimulation of long-term memory associated with facts and events semantically and episodically related to the images.

The Respondents' Skills in the Field of Painting Attribution: Image Title

The respondents demonstrated the ability to recognize and describe the image in the Italian edition of the survey at a level similar to that of respondents in Poland.

In the Italian group, 258 people could name their paintings and 474 could not, i.e., the result was 35% to 65% for Italians and 33% to 67% for Poles, respectively. The results indicate the level of visual skills in both groups of respondents at an average level, with a 2% advantage in favor of the surveyed Italians (Table 3).

Table 3
Comparison of the ability to recognize and describe images

Respondent's nationality	The respondent can name the picture	The respondent cannot name the picture
Italian	258 (~35%)	474 (~65%)
Polish	364 (~33%)	741 (~67%)

S o u r c e s: Own work

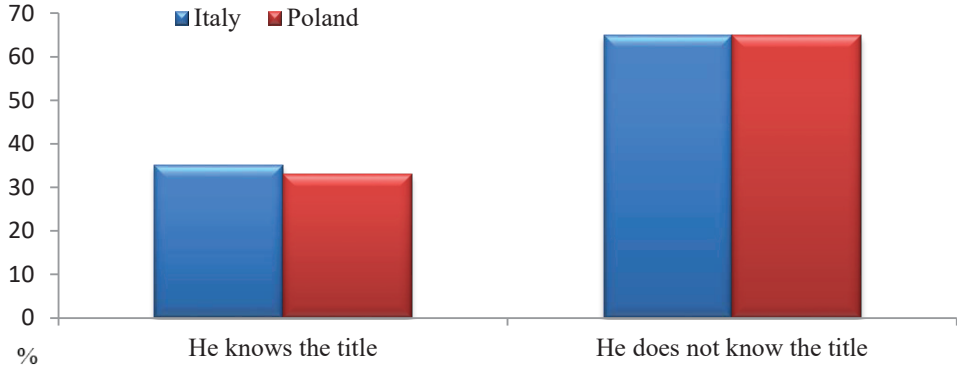

Figure 2. Comparison of the ability to recognize and describe the subject of an image among Italian and Polish respondents.
S o u r c e s: Own work

The Respondents' Skills in the Field of Painting Attribution: Subject Matter of the Painting

The study of the ability to recognize the subject of visual representations in pictures and the exploration of aesthetic preferences also yielded comparable results.

Table 4

The results of the study of the preferences of choosing the subject of images by respondents in Italy and Poland

Number of image	Topics provided by respondents			
Topic of the painting	According to the Italian survey		According to the Polish survey	
	Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1. landscape	384	47%	318	29%
2. portrait	126	17%	145	13%
3. still life	67	9%	169	15%
4. religious	43	6%	311	28%
5. historic	42	6%	71	6%
6. animal studies	36	5%	57	5%
7. mythology	31	4%	0	0%
8. abstraction	30	4%	71	6%
9. genre scene	–	–	57	5%
10. act	9	1%	62	6%
11. group portrait	–	–	26	2%
12. not recognized	6	1%	8	1%
Total	732	100%	1105	100%

S o u r c e s: Own work

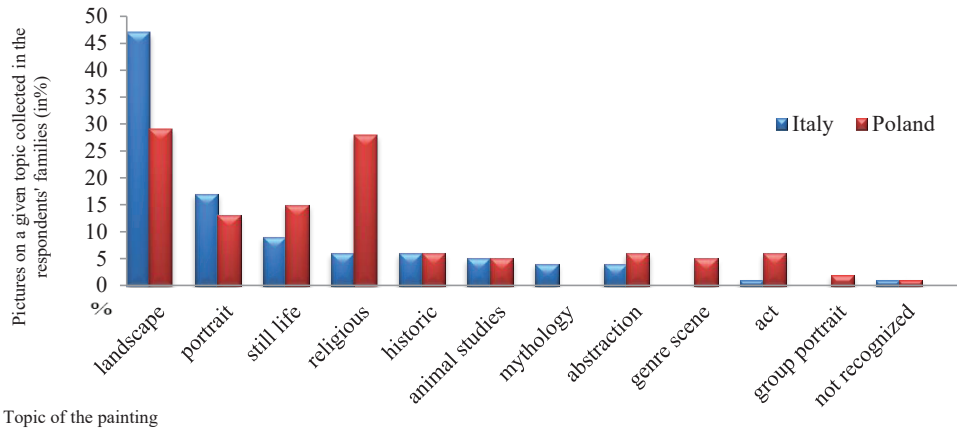

Figure 3. Comparison of the results of the preference survey in the choice of topic by Italian and Polish respondents.

S o u r c e s: Own work

In the Italian survey, the respondents mentioned landscape as the most common in their homes (47%); in fact, it was an attractive topic for both surveyed groups (Poland – 29%). The traditions of landscape painting date back to antiquity in Europe. The skills to reproduce nature were one of the most typical features of painting, initially as a background for the presented historical, mythological, religious or decorative events, and then, as a separate topic, which later became a pretext for artistic experiments, such as, for example, in impressionism. Both among the respondents in Poland and in Italy, landscape painting is considered a traditional medium of content that satisfies aesthetic tastes of the average participant in culture.

Next in the order of choice made by Polish respondents are religious topics, covering as much as 27%, while in the case of Italian ones, such paintings scored a minimum interest of 6% (Table 4).

The next preferential items in the selection of the subject of paintings are taken interchangeably: portrait (Italians – 17%, Poles – 13%) and still life (Italians – 9%, Poles – 15%). The choice of such topics demonstrates the traditional nature of the respondents' communication needs and their family backgrounds. Works of art satisfy their needs in terms of symbolization, in the forms of customary representations which are a direct connotation to the world of values, aesthetics, and beauty, commonly recognized as typical (Figure 3).

The Respondents' Skills in the Field of Painting Attribution: Execution Technique

Similar to the Polish edition, the respondents in the Italian one declared preferences in relation to oil painting (Italy – 52%, Poland – 37%), considered as a traditional way of expressing themselves in art due to specific features such as color, space, and mimesis (Table 5).

Table 5

Comparison of the preferences of artistic techniques of paintings in the homes of Italian and Polish respondents – number and percentage distribution

Number of visual	Techniques recognized by respondents			
	According to the Italian survey		According to the Polish survey	
Visual techniques	Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1. Oil painting	384	52%	410	37%
2. Watercolor	78	11%	99	9%
3. Print (reproduction, poster)	66	9%	150	14%

4.	Crayon	66	9%	85	8%
5.	Drawing	24	3%	51	5%
6.	Graphics	18	2%	42	4%
7.	Icon	12	2%	0	0%
8.	Photography	6	1%	83	7%
9.	Crayon	0	0%	62	6%
10.	Other	78	11%	117	10%
	Total	732	100%	1105	100%

Sources: Own work

Such painting uses oil paints mixed with pigments applied to a taut, primed canvas or other type of support (board, cardboard). Painterly creativity corresponds to the rules appropriate for the period in which it is created and causes the formation of various styles, directions, and forms. It is the most representative form of contact with art, articulated through the acceptance of the form combined with the fascination and admiration for the work, expressed by the fact of acquiring it. Besides, the oil painting technique is an expensive technique – this is usually reflected in the price of the painting.

Having an oil painting is a testimony to a certain social status expressed by surrounding oneself with goods of a specific material value. Artists and people of culture constitute a separate group here, in whose natural surroundings works of art are obtained in circles similar to their interests and passion of their own. For them, knowledge and professionalism are other reasons for having valuable works of art that become the object of research or business.

A slightly cheaper technique of fine arts – watercolor, both in Polish and Italian study, was recognized by the respondents as an important source of symbolic message (Italy – 11%, Poland – 12%). It is a very difficult technique of covering paper with watercolors without the possibility of making corrections and retouching. It is used by portraitists, landscape painters, and illustrators, both in Italy and Poland (Table 5).

The next most common images in the homes of the respondents are reproductions. In both groups, they account for the leading – third in Italy (9%) and second in Poland (14%) – share among the owned works. It can be a manifestation of unadulterated fascination with an artistic phenomenon expressed in the will to commune with a specific representation in a way that mediates meaning. It can also express the aesthetics of mass culture, which sees the perceived reality from the perspective of the copy and not the original. In the era of technical reproduction,

the aura of the work dies – the work is taken out of tradition and a mass is created instead of uniqueness (Table 5, Figure 4).

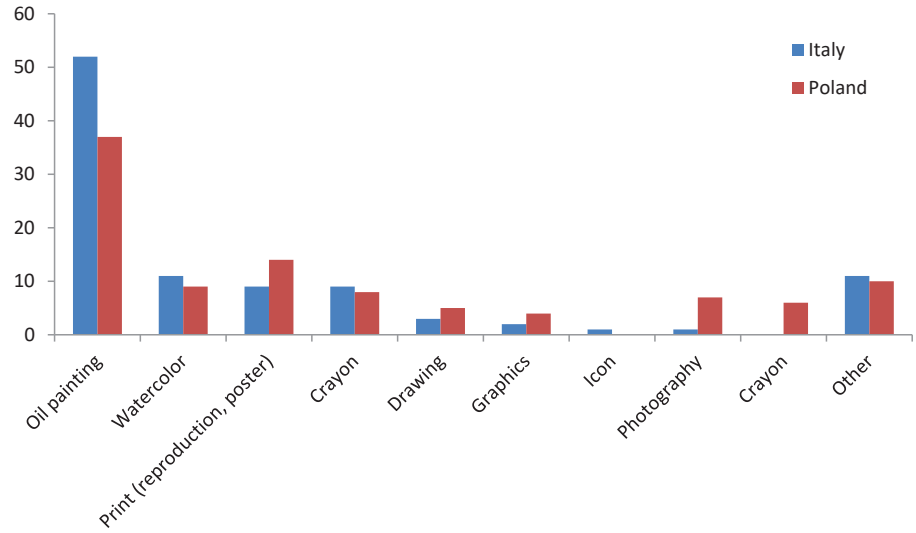

Figure 4. Comparison of the preferences of artistic techniques of paintings in the homes of Italian and Polish respondents.

S o u r c e s: Own work

The Respondents' Skills in the Field of Painting Attribution: Image Author

The author is known by 26% of Italian respondents and not known by 74%. In the Polish study, these proportions were 10% and 90%, respectively. The ability to attribute images in the case of Italian respondents was almost twice as good as that of their Polish counterparts (Table 6, Figure 4).

Table 6

Comparing image attribution skills of respondents from Italy and Poland

Knowing or not knowing who the author of the painting is	Italian respondents		Polish respondents	
	Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
Respondent knows the author of the painting	192	26%	104	10%
No knowledge of the author of the painting	540	74%	1001	90%
T o t a l	732	100%	1105	100%

S o u r c e s: Own work

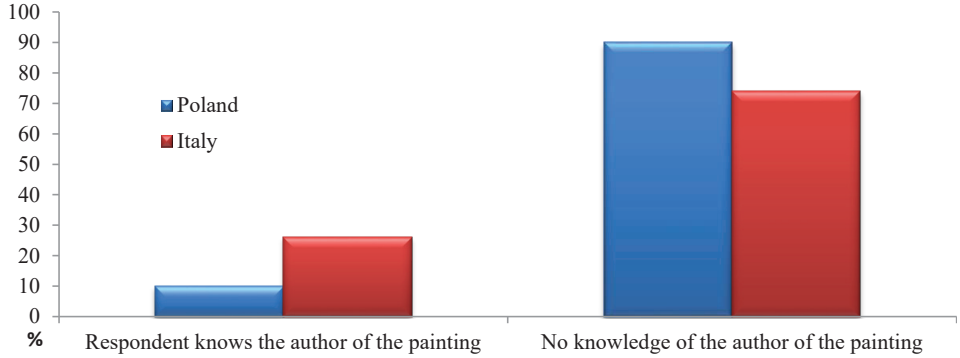

Figure 5. Comparison of knowledge levels about the authorship of images owned by respondents.

Sources: Own work

The Respondents' Skills in the Field of Painting Attribution: Date the Painting Was Created

Dating of paintings held by respondents was also better in the group of Italian respondents (the date of the painting is known to 69% of the surveyed Italians and 46% of the surveyed Poles). In the homes of Italian respondents, as in Poland, there are mainly contemporary paintings from the 20th and 21st centuries (59% – Italians, 41% – Poles), but also (1%) several unique 18th- and 19th-century works (icons) (Table 7, Figure 6).

Table 7

Dating of painting by respondents from Italy and Poland

	Date of painting completion	Italian respondent		Polish respondents	
		Number Distribution	Percentage Distribution	Number Distribution	Percentage Distribution
1.	18th century	7	1%	–	0%
2.	19th century	11	2%	24	2%
3.	19th / 20th century	19	2%	12	1%
4.	Beg. 20th century	36	5%	25	2%
5.	20th century	251	34%	100	9%
6.	20th / 21st century	183	25%	351	32%
7.	I do not know	225	31%	593	54%
	Total	732	100%	1105	100%

Sources: Own work

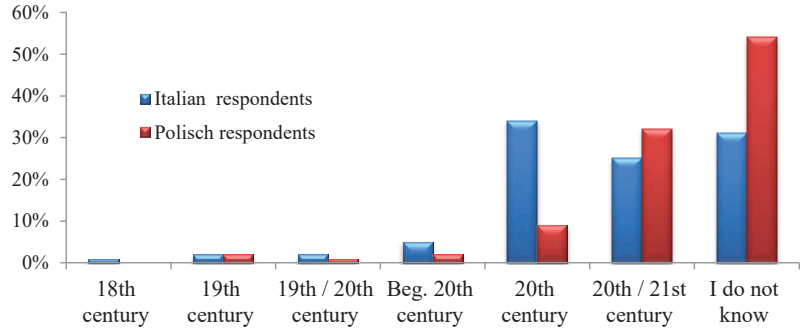

Figure 6. Comparison of respondents' skills in terms of image attribution – date of image completion.
S o u r c e s: Own work

The list of the authors of the paintings provided by Italian respondents is interesting from a cultural point of view. Research penetration allowed for a qualitative analysis of cultural goods stored in respondents' homes. In connection with dating, authorship, and formal analysis, it indicates the collections which feature the oldest works – icons which date back to the turn of the 18th and 19th centuries; there are also works by the Impressionists – Sisley, Klimt, and Cezanne – as well as 19th century painters (E. Roesler Franz, 1845–1907) and architects (Friedensreich Hundertwasser, 1828–2000), along with reproductions, for example of Salvador Dali. The paintings of contemporary authors, including famous representatives of contemporary Italian painting, dominate. The authors of the works also include parents, friends, and acquaintances of the respondents, and the respondents themselves.

The names of several famous painters, such as Kossak, Fałat, and Filipkiewicz from the turn of the 19th and 20th centuries appeared in Polish reviews. The paintings described are mainly works painted on canvas or cardboard with oil paint and reproductions of works by great masters. Most often, they are contemporary forms, but also include paintings from the 19th and early 20th centuries.

The Study of Aesthetic Preferences over Three Generations (Grandparents, Parents, and Children)

The results were comparable for Polish and Italian respondents alike. In the survey, they provided information about the important role of parents in making decisions and selecting works of art in their homes. This is for a number of reasons. First, the property status and the right to decide are in the hands of those who finance the maintenance of the house. Considering the age range of the respondents (from 20 to 36 years old), it can be concluded that most of them are not independent to the extent that would allow them to run their own home, as they are people who study or are just starting work.

Table 8
Results of the study of generational aesthetic preferences from Italy and Poland

How long has the picture been in the respondent's possession?	Italian respondents		Polish respondents	
Who contributed to its placement at home?	Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1. It has always been there	204	28%	203	18,5%
2. Grandparents	48	6%	137	12,5%
3. Parents	312	43%	429	39%
4. Me (the respondent)	144	20%	280	25%
5. I do not know	24	3%	56	5%
Total	732	100%	1105	100%

Sources: Own work

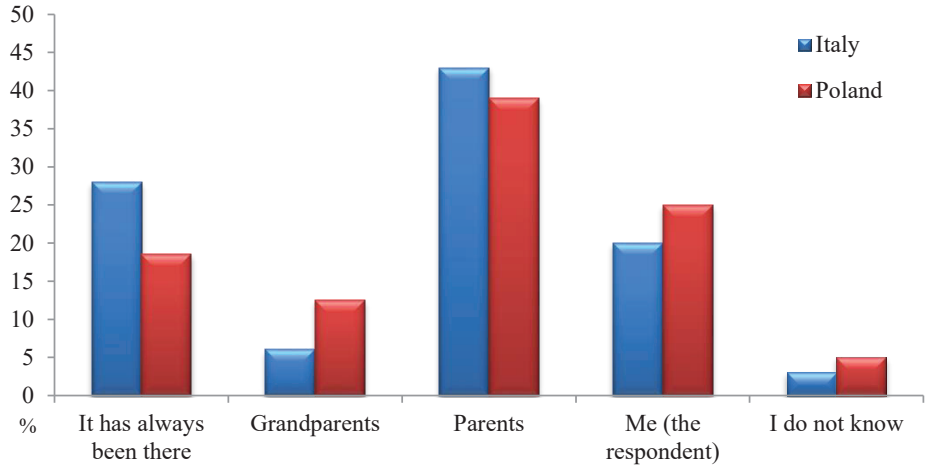

Figure 7. Comparison of generational aesthetic preferences.
Sources: Own work

The next distribution of values shows variation between respondent groups. In Italy, a fairly significant percentage (28%) of respondents confirmed that they pass paintings down from generation to generation as a continuation of generational traditions. In Poland, the role of animators of cultural life is taken over by the respondents themselves, who choose and buy paintings for their homes (Italy – 20%, Poland – 25%). They confirm the belief in the symbolic and communicative meaning of the image acquired through education, socialization, and upbringing. Grandparents are claimed to have had the least influence on the aesthetic preferences of the respondents (Italy – 6%, Poland – 12.5%) (Table 8, Figure 7).

Both in the Italian and Polish context, the respondents update their views on art by confronting the old with the new. Contemporary visual communication related to modern technologies enables the transfer of information and makes it formally more attractive, hence the strong tendency to reject old views in favor of new ones, which is conditioned by generational change. However, it is a continuation of a multi-generational cultural sequence that prefers to be surrounded by images as an expression of acceptance and fascination with the visual form of expression.

Reconnaissance of the Way of Thinking about the World in the Context of Historical, Social, and Cultural Changes, and Participation in Contemporary Visual Culture

Comparison of the ways of thinking about the world by Polish and Italian respondents.

The attempt to define the personality and disposition of the respondents participating in the survey was made on the basis of the statements made in the survey on the behavior, attitudes, and opinions concerning the analyzed aspects of culture, visual communication, and participation in culture.

The first task performed by the respondents was to indicate their own attitude to the perceived visual reality.

The respondents had the opportunity to define their personality in terms of psychology, communication, and anthropology, which determine their attitudes. The selected aspect of perception of the world represented by the respondents was treated as an individual feature shaped as a result of the process of upbringing, socialization, and education, referring to the cultural pattern as a recognized way of thinking and adapting to life in the community.

Table 9
Comparison of respondents' ways of thinking about the world

	Ways of thinking about the world	Italian respondents		Polish respondents	
		Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1.	Psychological aspect	35	27%	78	31%
2.	Anthropological aspect	61	46%	119	47%
3.	Information aspect	20	15%	42	17%
4.	Other	16	12%	14	5%
	Total	132	100%	253	100%

Sources: Own work

In the case of the Polish edition of the survey, almost half of the respondents (47%) declared an anthropological way of perceiving visual phenomena, which, in principle, approves of pluralistic and individual activities aimed at breaking cultural stereotypes and affirms creative independence in the continuity of social processes and cultural change.

Similarly, Italian respondents selected the anthropological aspect of perceiving reality as the most appropriate cultural model (46%), chose a personal, moral, ethical, and aesthetic standard.

In the second place, the respondents accepted the psychological interpretations surrounding reality and the perception of the world through the prism of the analysis of the impact of psychological phenomena on humans (Italy – 31%, Poland – 27%).

The third type of the proposed worldview is the interpretation of phenomena in the context of communicative interpersonal relationships, individuals, groups, society, and interactions between them (Italy – 15%, Poland – 17%) (Table 9, Figure 8).

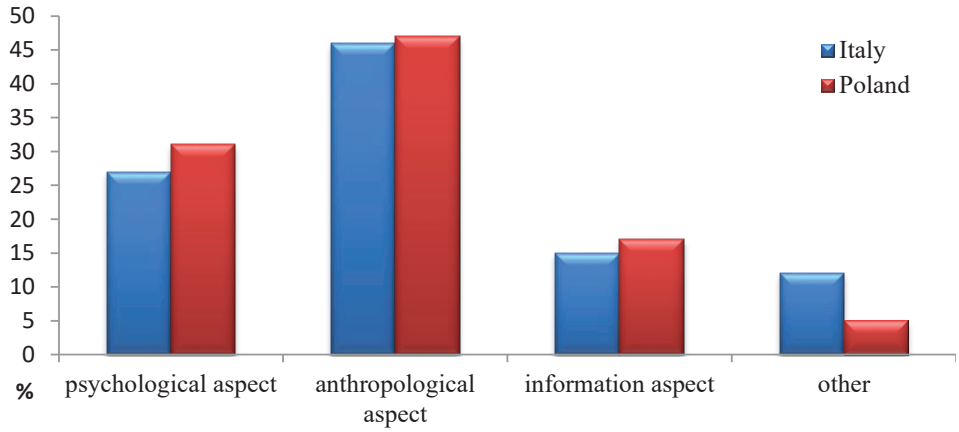

Figure 8. Perception of reality. Comparison of the ways of thinking about the world.
Sources: Own work

Research on attitudes and behavior models (Nęcka, 2020).

According to the Italian interview, the main factor in acquiring a work of art by the respondents is fascination (37%). In Poland, this stimulus is second (31%) (Table 10, Figure 9). Emotions, as strong feelings of a positive or negative nature, are mental processes of cognition. They give objects and phenomena a qualitative dimension, assigning them meaning and value. A characteristic feature of the feeling of fascination – a positive emotion – is a constant desire to stay in touch with a work of art, which is still a source of admiration and inspiration to take actions in symbolic communication.

Table 10
Recognizing respondents' preferences in choosing an image Models of behavior and attitudes

Image selection preferences by respondents	Italian respondents		Polish respondents	
	Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1. Fascination	96	37%	95	31%
2. Interest	36	14%	119	39%
3. Snobbery	42	16%	42	13%
4. A reflexive-aesthetic attitude	36	14%	14	5%
5. Negation	30	11%	22	7%
6. Other	21	8%	14	5%
Total	261	100%	306	100%

S o u r c e s: Own work

Snobbery, as an attempt to adapt to the environment in order to gain acceptance and impress with the features which are not authentic, also serves as motivation for wanting to own a painting, according to 16% of Italian respondents. In fact, snobbery as a stimulus to obtain a painting should not be viewed negatively because such sources of aesthetic inspiration have been influencing the ambitions of patrons, collectors, and sponsors of artistic activity for centuries. In Poland, the respondents considered it to be the third factor influencing the behavior that stimulates finding a job (13%) (Table 10, Figure 89).

In the third place in the Italian survey, respondents cited interest as a qualitative justification for their choices regarding works of art – a substantive reflection on the phenomenon of visual communication (14%). In Poland, however, as many as 39% of the respondents indicated as a priority action due to interest, expressing the need for knowledge and research, supported by opinion-forming information from professionals (galleries, critics) (Table 10, Figure 8).

The psychologically motivated reflexive-aesthetic attitude, which was chosen by 5% of respondents in Poland and 12% in Italy, is the result of the presence of internal impulses in the psychoanalytical sense; these are subconscious, based on previous experiences, and stimulate action, e.g. to buy works of art.

On the other hand, 9% of respondents in Poland and 1% in Italy negated the need to use the image as a visual form of communication and its importance in human life. This percentage of young people does not see the need to surround themselves with works of art. They are not the subject of fascination, interest, or unconscious, let alone snobbish desires (Table 10, Figure 9).

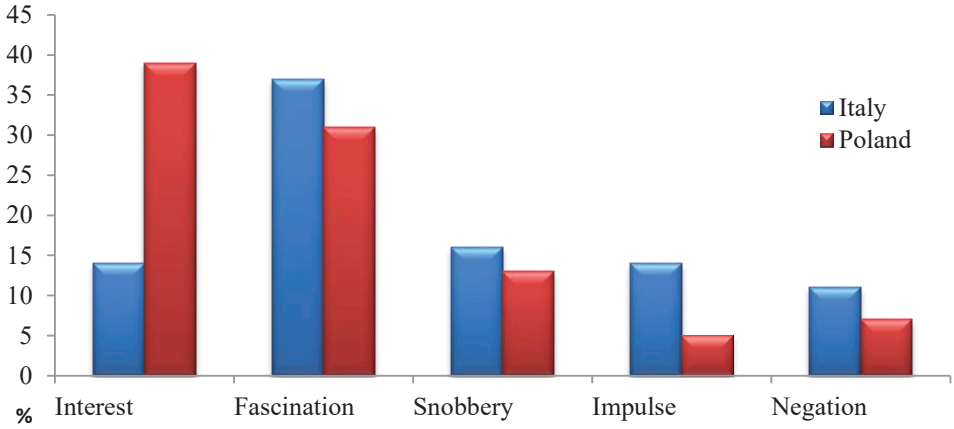

Figure 9. Comparison of behavior models. Image selection preferences by respondents from Italy and Poland.
S o u r c e s: Own work

The place of the image in the mediated perception of the world among Italian and Polish respondents. Models of behavior and attitudes.

Another issue that became the subject of research in the questionnaire interview concerned the role of the image in the perception of socio-cultural reality. We feel the existence of the external world through our senses; its perception is mediated and resides in the structures of our mind. The world is not given to us directly – we have access to it through co-created mental phenomena. The image is our main experience and we use it to shape our perception of reality. The reading of visual cultural texts analyzed in the research was based on the recognition of behavioral models as a kind of attitude towards pictorial phenomena (expressive, cognitive, mirror reception).

As the first plane of perception, the respondents in both countries – 66% in Poland and 39% in Italy – indicated the cognitive category. Secondly, they declared objective perception of reality as a message in the form of a mirror image of cultural facts and events (Italy – 35%, Poland – 20%). The third – expressive perception of pictorial reality, dependent on subjective factors – was chosen by 16% of Italian and 13% of Polish respondents.

This strong support of the respondents, both Poles and Italians, for the cognitive aspect of perceiving the phenomena of the external world proves their maturity and processing of information in order to expand knowledge about the world (Table 11, Figure 10).

Table 11
Study of the place of the image in the mediated perception of the world among Italian and Polish respondents. Models of behavior and attitudes

Image position in mediated perception of reality	Italian respondents		Polish respondents	
	Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1. Mirror effect	66	35%	52	20%
2. Expression in reception	30	16%	34	13%
3. Cognitive function	72	39%	172	66%
6. Other	18	10%	2	1%
Total	276	100%	260	100%

S o u r c e s: Own work

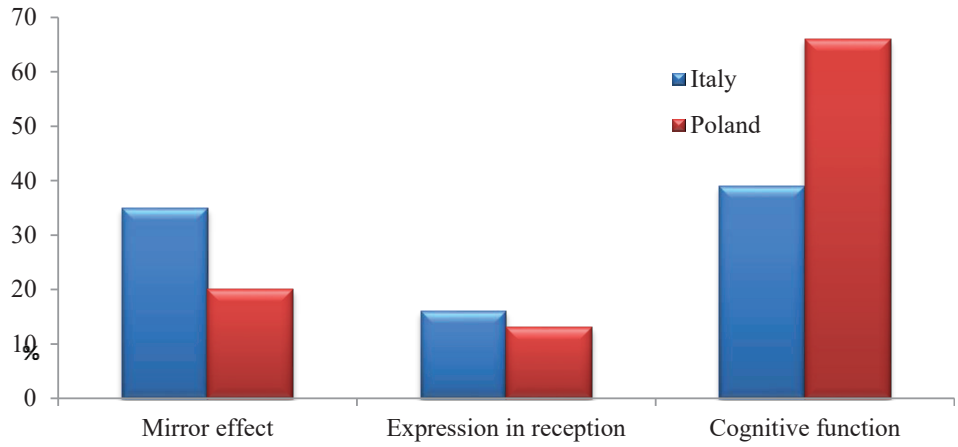

Figure 10. Comparison of behavior models. Image position in mediated perception of reality.
S o u r c e s: Own work

Image Impact

Research on the influence of an image on shaping attitudes. The transgressive function.

The study was conducted during Easter and Christmas, i.e., during the periods of increased religiosity, when transgression mainly leads to deeper reflection on the values of the temporal world. However, only Poles described it as an emotional experience confirming faith and sanctity (30%) in the context of earthly imperfection and universality of religious behavior (Table 10, Figure 12). They

gave transgression an unequivocal meaning of religious experience, referring to tradition, faith, and patriotism.

Table 12
Examination of the influence of the image on the shaping of attitudes. Comparison of the significance of the transgression function among Italian and Polish respondents

Image selection – respondents' preferences	Italian respondents		Polish respondents	
	Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1. Faith	18	10%	77	30%
2. Reflection	81	46%	124	49%
3. Rationalism	60	34%	48	19%
6. Other	18	10%	4	2%
Total	177	100%	253	100%

S o u r c e s: Own work

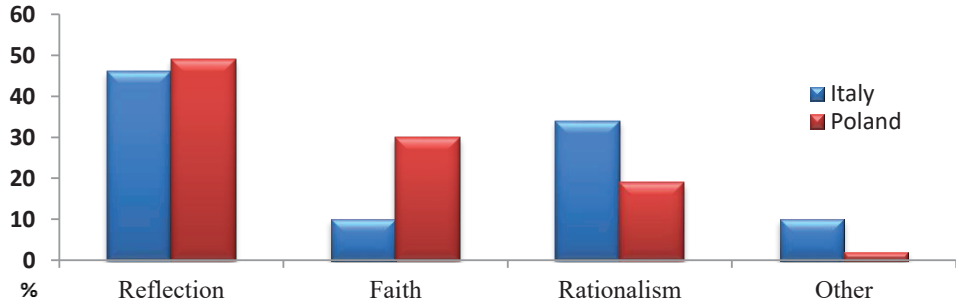

Figure 11. Comparison of the significance of the transgression function among Italian and Polish respondents.
S o u r c e s: Own work

Research on the influence of the image on the shaping of attitudes. Tolerance.

Shaping attitudes under the influence of external factors – images, in the case of visual communication – takes place during an act of communication in which the intention of the message influences postural processes. Influences in the study focused on the attitude of tolerance that respondents were made aware of through verbal information, indoctrination, and emotional simulations in confrontation with the represented and real world. The results showed that the respondents under-

stand the social function of the image in modeling attitudes differently, confirming the hypothesis that this process requires active participation of the perceiving person, conditioned by the state of their personality traits shaped by education, socialization, and upbringing.

Through multi-level interpretations of visual arts, the surveyed Italians (57%) and Poles (71%) learned tolerance, counteracting xenophobia and resolving conflicts – features considered to be the basis of a democratic and open society. Respondents from Italy, however, prefer the relaxing role of the image to reception of messages aimed at tolerance (20%), which is important in shaping the attitude of acceptance of the behavior and views of other people, as well as themselves (Italians – 27%, Poles – 12%). Negation of the influence of the image on building the attitude of tolerance was signaled by 9% of Italians and 15% of Poles (Table 13, Figure 12).

Table 13
Study of the influence of the image on the development of the attitude of tolerance

	Shaping the attitude of tolerance	Italian respondents		Polish respondents	
		Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1.	Inspires tolerance	54	20%	136	54%
2.	Resolves conflicts	60	23%	27	11%
3.	Respondent rejects xenophobia	36	14%	14	6%
6.	Awakens a sense of humor	72	27%	31	12%
7.	The image does not affect the respondent	24	9%	39	15%
8.	Other	18	2%	5	2%
	Total		100%		100%

S o u r c e s: Own work

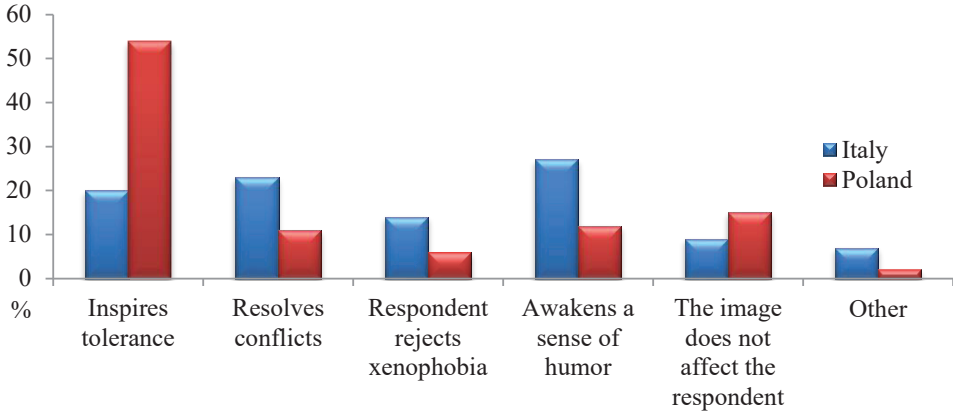

Figure 12. Comparison of the impact of the image on shaping the attitude of tolerance among Italian and Polish respondents.
S o u r c e s: Own work

Researching the educational function of visual messages.

A comparison of the statements of Italian and Polish respondents in the context of the educational meaning of the image indicates the visual transfer of knowledge as a universally recognized form of educational expression (Italy – 40%, Poland – 45%). Next, Italian respondents deem persuasion (33%) helpful in conveying information in the context of creating didactic visual materials. Poles, on the otherhand, see the visualization of knowledge as the message focused on values (35%). Both groups appreciate the cognitive and educational opportunities offered by the visual message and the broader, contemporary understanding of image culture (Table 14, Figure 13).

Table 14
Study of the educational function of the visual message among Italian and Polish respondents

	Image selection preferences by respondents	Italian respondents		Polish respondents	
		Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1.	Values	48	22%	90	35%
2.	Knowledge, skills	90	40%	113	45%
3.	Persuasion	73	33%	48	19%
6.	Other	12	5%	2	1%
	Total	248	100%	253	100%

S o u r c e s: Own work

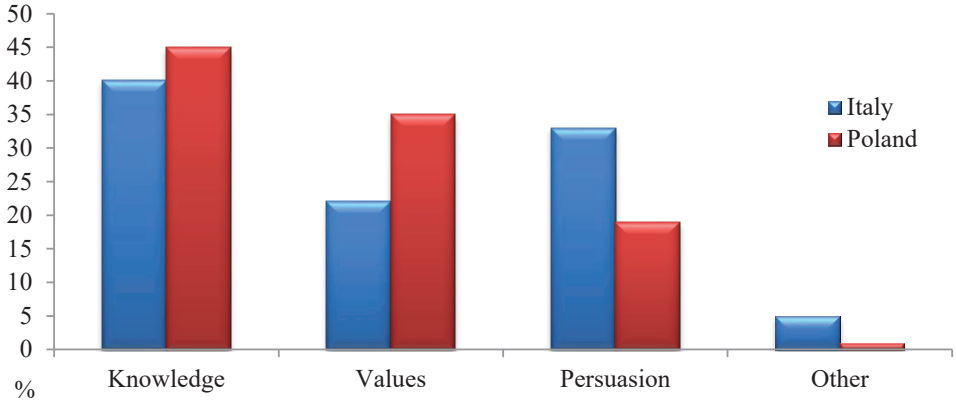

Figure 13. Comparison of the importance of the educational function of the visual message.

S o u r c e s: Own work

Image influence. Cultural pluralism.

Cultural pluralism, like tolerance, is a phenomenon characteristic of democratic societies that recognize ethnic equality, beliefs, and cultural diversity.

In the survey, 77% of Polish respondents and 70% of Italian respondents admitted that the image can be used for social integration, arousing positive interest in other cultures, diversity of perception and reading the meanings of recognized artifacts (Table 15, Figure 14).

Table 15

Image impact. Research on cultural pluralism among Italian and Polish respondents

	Image selection preferences	Italian respondents		Polish respondents	
		Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1.	Conservatism	27	16%	50	20%
2.	Pluralism	123	72%	196	77%
3.	Other	21	12%	7	3%
	Total	171	100%	253	100%

S o u r c e s: Own work

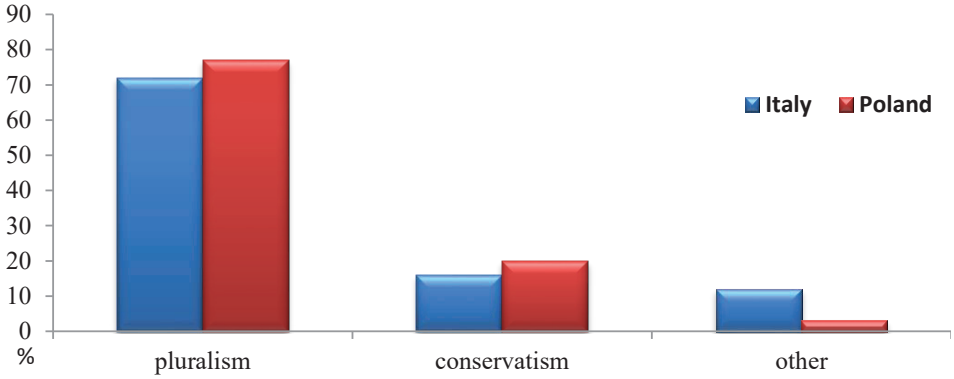

Figure 14. Comparison of the influence of the image on the shaping of attitudes. Cultural pluralism.
S o u r c e s: Own work

The theory of collecting as an element of everyday anthropology.

In their research, Italian respondents identified aesthetic motivation as the main reason for creating a collection of works of art. In the era of consumerism of modern society, contact with works of art, i.e. objects of aesthetic value, allows them to rise above economic and ideological utilitarianism, to reach the essence of art – beauty. 50% of Italian respondents indicated the aesthetic criterion as the leading one. According to Poles, in the same study, the creation of a collection is a phenomenon so distant and, above all, elitist that it is associated with snobbery, an attempt to break into the upper social class with the help of valuable and prestigious works of art. 49% of Polish respondents indicated snobbery and prestige

Table 16
Motivations for collecting images in Italian and Polish respondents

Image selection preferences		Italian respondents		Polish respondents	
		Numerical distribution	Percentage distribution	Numerical distribution	Percentage distribution
1.	Business	12	5%	16	2%
2.	Prestige	19	9%	424	49%
3.	Family traditions	48	21%	264	31%
4.	Connoisseurship	18	8%	80	8%
5.	Beauty	114	50%	76	9%
6.	Other	17	7%	0	0
	Total	228	100%	860	100%

S o u r c e s: Own work

as the reason for collecting. However, common to both groups (48% – Italy, 31% – Poland) is the understanding of the collection as a way of life resulting from family traditions. The knowledge of collecting is confirmed by only 8% of Italians and 9% of Poles. The least appreciated were behaviors for which collecting is a source of income (Italians – 5%, Poles – 2%) (Table 14, Figure 15). The respondents associate it with negative reference to the material value of art related to ethics, morality, and cultural knowledge.

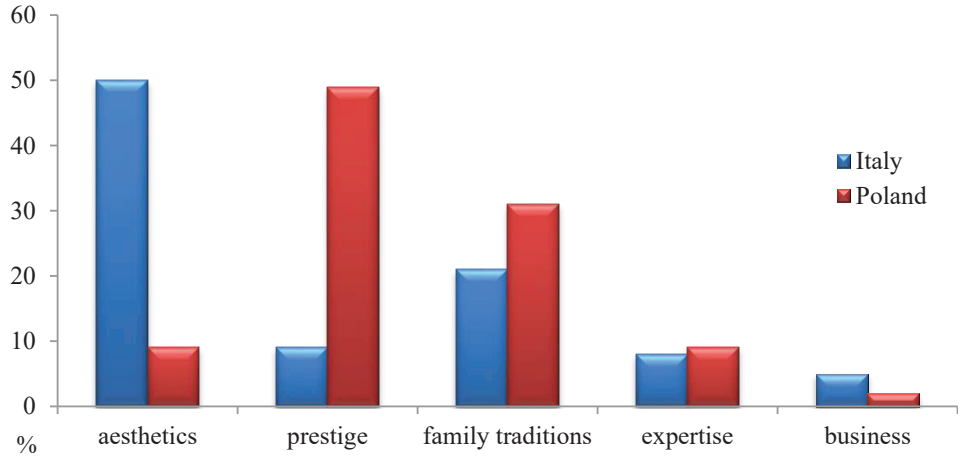

Figure 15. Comparison of motivating factors to create a collection of images.
S o u r c e s: Own work

Discussion and Conclusions

The qualitative analysis of the participation of the young generation in culture, in the aspect of users' perception of visual messages, showed that, at present, information awareness of digital natives is a component of cultural competences necessary to read not only a traditional image, but also a structured visual message (Prensky, 2001). The attempt to define this kind of ability in the context of visual literacy was the aim of this research.

Several elements necessary for the formation of cultural competences can be listed. First, it is necessary to characterize a given community in terms of its historical and social development, and to examine value systems that determine the way of life of individuals, their styles and cognitive orientations. Schemes of expectations towards visual works should indicate the existing environmental

patterns of culture that have their source in psychological and cultural determinants. Then, it is necessary to identify the attitudes and behaviors of information users in relation to the role and importance of image in the life of the information society, as well as motivation, fascination, and needs – the factors determining visual reception.

In the research, the problem of visual qualifications as an element of education about information through art has been set in a broader European context thanks to the comparative analysis of the degree of image reception in Poland with the Mediterranean perspective registered in Italy. In this way, the process of symbolizing was distinguished, marked psychologically, educatively, and informatively. The young generation of Italians, at the academic level, was subjected to a quantitative and qualitative research similar to that conducted on young Poles. The similarities and differences in the reception of visual culture became the subject of formal and theoretical analysis, and the results showed contradictions in mentality, as well as worldview coherence within the studied cultural groups. The results of the analysis will be useful in designing educational activities for visual and informational literacy and in creating visual information architecture understood as building structures and organizing content so that users can read information and transform it into knowledge.

Research on the manifestations of participation in image culture, in the context of informational behavior, also indicated a specific cultural code for individual societies. The conditions of such a code depend on many factors which have been highlighted in the research. They are common to many countries and fit into the overall model of the development of the European civilization.

Theoretical analyzes and empirical research refer to the cognitive-informational nature of visual communication, consisting in the creation, transmission, and interpretation of images based on intuitive reception, under the influence of learned perceptual practices shaped on the basis of cultural meanings. In this context, taking into account the pictorial nature of contemporary communication, visual literacy is a qualitative element and a guarantee of continuity of a cultural message, based on the possessed visual knowledge and information competences. The conducted quantitative and qualitative research, which penetrates the circles of the future Polish and Italian intelligentsia in the field of visual literacy, within the information culture they represent, is an attempt to draw attention to competence and educational shortages in this field.

The functioning of a young person within the virtual educational and information space, which is currently identified in the living and learning environment, is combined with the ability to formulate and specify information needs in relation to the available visual material.

Contemporary culture forces its participants to be able to communicate efficiently within a wide range of problems which are often articulated by images in the social space. 21st century society is becoming more and more visual. These information needs are now being met by the emergence of visual representations of knowledge in the form of modern, semiotically coded images. They remain traditional only in the sphere of the concept of imaging but, in terms of form, content, and impact, they set far more specialized goals, such as, for example, infographics (Pulak & Wieczorek-Tomaszewska, 2011).

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Małgorzata Wieczorek-Tomaszewska

Umiejętności wizualne jako wymiar kapitału kulturowego młodego pokolenia – badania porównawcze

Streszczenie

Przedmiotem badań przedstawionych w artykule, związanych z *visual literacy*, jest określenie zakresu i jakości zjawiska porozumiewania się w obszarze komunikacji symbolicznej. Uwzględniono indywidualne dyspozycje użytkowników informacji, tworząc zbiór zachowań i reakcji, poglądów i koncepcji, osobistych przekonań i skłonności, które determinują sposób życia i myślenia – tzw. Habitus wg Pierre'a Bourdieu. Celem było stworzenie charakterystyki badanych przedstawicieli młodego pokolenia i określenie ich predyspozycji do symbolizowania (poszukiwania odniesień). Badania przeprowadzone zostały na dwóch porównawczych populacjach z Polski i Włoch w celu uzyskania odpowiedzi na pytanie o jakość współczesnej komunikacji wizualnej i predyspozycje użytkowników informacji do wizualizacji oraz o ich kondycję adaptacyjną do wizualnej formy ekspresji. Badania wychodzą naprzeciw zapotrzebowaniu edukacyjnemu na nowoczesną formę edukacji, uwzględniającą współczesne informacyjne środowisko życia i medialne zanurzenie w wizualnej rzeczywistości uczestników procesu edukacji.

Słowa kluczowe: umiejętności wizualne, kompetencje wizualne, komunikacja wizualna, kultura wizualna

Малгожата Вечорек-Томашевска

Визуальная грамотность как измерение культурного капитала молодого поколения – сравнительное исследование

Аннотация

Предметом исследования представленного в статье исследования, связанного с визуальной грамотностью, является определение масштабов и качества феномена коммуникации в сфере символической коммуникации. Учитывались индивидуальные предрасположенности пользователей информации, создавая набор моделей поведения и реакций, взглядов и концепций, личных убеждений и наклонностей, определяющих образ жизни и мышления – так называемые Habitus Пьера Бурдье. Цель заключалась в создании характеристик исследуемых представителей молодого поколения и определении их символической предрасположенности

(поиск референсов). Исследование проводилось на двух сравнительных популяциях Польши и Италии, чтобы ответить на вопрос о качестве современной визуальной коммуникации и предрасположенности пользователей информации к визуализации, а также об их адаптивном состоянии к визуальной форме выражения. Исследование удовлетворяет образовательную потребность в современной форме обучения с учетом современной информационной среды жизни и медийного погружения в визуальную реальность участников образовательного процесса.

Ключевые слова: визуальная грамотность, визуальная компетентность, визуальная коммуникация, визуальная культура, визуальная среда обучения

Małgorzata Wieczorek-Tomaszewska

La alfabetización visual como dimensión del capital cultural de la generación joven – investigación comparada

Resumen

El tema de la investigación que se presenta en el artículo, relacionada con la alfabetización visual, es definir el alcance y la calidad del fenómeno de la comunicación en el área de la comunicación simbólica. Se tuvieron en cuenta las disposiciones individuales de los usuarios de la información, creando un conjunto de comportamientos y reacciones, visiones y conceptos, creencias e inclinaciones personales que determinan la forma de vida y pensamiento – el llamado Habitus de Pierre Bourdieu. El objetivo era crear las características de los representantes examinados de la generación joven y determinar su predisposición a simbolizar (búsqueda de referencias). La investigación se llevó a cabo en dos poblaciones comparativas de Polonia e Italia con el fin de responder a la pregunta sobre la calidad de la comunicación visual contemporánea y la predisposición de los usuarios de la información a la visualización, y sobre su condición de adaptación a la forma visual de expresión. La investigación responde a la demanda educativa de una forma de educación moderna, teniendo en cuenta el entorno de la vida informativa contemporánea y la inmersión de los medios en la realidad visual de los participantes del proceso educativo.

Palabras clave: alfabetización visual, competencia visual, comunicación visual, cultura visual, entorno de aprendizaje visual

IV. Reports

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Eugenia Smyrnova-Trybulska
University of Silesia, Poland
https://orcid.org/0000-0003-1227-014X

A Report from the International Scientific Conference "Theoretical and Practical Aspects of Distance learning" DLCC2020 (www.dlcc.us.edu.pl) entitled "Innovative Educational Technologies, Tools and Methods for E-learning", held at the University of Silesia online, Poland, October 12th and 13th, 2020

The 12th edition of the International Scientific Conference, "Theoretical and Practical Aspects of Distance learning" DLCC2020 (www.dlcc.us.edu.pl) was held under the theme "Innovative Educational Technologies, Tools and Methods for E-learning" and reported results of the FITPED project and MOOC for Educational Sciences. The conference was held on October 12th and 13th, 2020, at the University of Silesia online. It was organised by the Faculty of Arts and Educational Sciences in Cieszyn, the Faculty of Computer Science and Materials Sciences in Sosnowiec and the University of Silesia in Katowice (Poland). Since the conference took place during the COVID-19 pandemic, and was held online using Adobe Connect and virtual rooms.

The Conference was organized under the auspices of the Rector of the University of Silesia in Katowice – Prof. dr hab. Andrzej Kowalczyk, Dean of the Faculty of Social Sciences – Prof. dr hab. Zenon Gajdzica, Dean of the Faculty of Arts and Educational Sciences – Prof. dr hab. Krzysztof Bąk, Head of the Institute of Pedagogy – Prof. dr hab. Ewa Jarosz, Dean of the Faculty of Computer Science and Materials Science – Prof. dr hab. Danuta Stróż, and Chair of the Institute of Computer Science – Prof. dr hab. inż. Piotr Porwolik.

The co-organisers were the University of Ostrava (Czech Republic), the Silesian University in Opava (Czech Republic), the Constantine Philosopher University in Nitra (Slovakia), the Twente University (the Netherlands), the University of Extremadura (Spain), the Curtin University in Perth (Australia), the Borys Grinchenko Kiev University (Ukraine), the Herzen State Pedagogical University of Russia (Russia), the Dneprodzerzhinsk State Technical University (Ukraine), the Ministry of Science and Higher Education (Poland), the Polish Pedagogical Association (Branch in Cieszyn, Poland), the Polish Scientific Association of Internet Education, IADIS – International Association for the Development of the Information Society, and SEA – the Polish Academic E-Learning Association.

The conference topics comprised the following thematic sections:

Innovative Educational Technologies, Tools and Methods for E-learning

- Educational Technologies for e-learning;
- Modern ICT Tools for e-learning – review, implementation, opportunities for effectiveness learning and teaching;
- Innovative Methods for e-learning – theoretical and practical aspects;
- MOOCs – the methodology of design, conducting, implementation and evaluation;
- Artificial intelligence (AI), augmented reality (AR), virtual reality (VR);
- Selected Web 2.0 and Web 3.0 technologies;
- LMS, CMS, VSCR, SSA, and CSA;
- Cloud computing environment, social media, multimedia resources;
- (video)tutorial design;
- Simulations, models in e-learning and distance learning;
- Networking, distance learning systems;
- M-learning.

E-learning and Internationalisation in higher education

- E-environment and Cyberspace;
- Contemporary trends in world education – globalization, internationalization, mobility;
- The legal, social, human, scientific and technical aspects of distance learning and e-learning in different countries;
- European and national standards of e-learning's quality evaluation;
- The psychological and ethical aspects of distance learning and e-learning in different countries;
- Collaborative learning in e-learning;
- The E-environment of the University;

– SMART Universities and SMART Technology in education;
– E-learning in a sustainable society;
– Comparative approaches.

E-learning and STEM Education

– Robots and Coding in education;
– Immersive learning environments. Blockchain. Bots;
– The Internet of things. 3D printing;
– STEM education – contemporary trends and challenges;
– Successful examples of e-learning;
– Distance learning in the humanities and science;
– The quality of teaching and training;
– The evaluation of synchronous and asynchronous teaching and learning; methodology and good examples.

Development of Key and Soft Competences in E-learning

– The effective development of teachers' digital skills;
– Key competences and soft skills in the digital society;
– The use of e-learning in improving the level of students' digital competences;
– E-learning for the humanities;
– E-learning for science and technologies;
– E-Learning and Lifelong Learning;
– Self-learning based on Internet technology.

DLCC conferences are traditionally organised as a part of international projects and this one was an opportunity for the presentation of research results, in particular of *E-learning as a road to communicating in the multicultural environment*, supported by the International Visegrad Fund (IVF) in 2009. The conferences held from 2014 to 2018 were the essential events to summarise the results of the 4-year-long project entitled IRNet "International Research Network for the Study and Development of New Tools and Methods for Advanced Pedagogical Science in the Field of ICT Instruments, E-Learning and Intercultural Competences" (www.irnet.us.edu.pl). The project has been carried out within the 7th Framework Program and financed by the European Commission and the Polish Ministry of Science and Higher Education. The start of the new international project "FITPED – Work-based Learning in Future IT Professionals' Education" (www.fitped.eu), involving Constantine the Philosopher University in Nitra, Slovakia (coordinator), the University of Silesia in Katowice, Poland, the Pedagogical University of Cracow, Poland, Mendel University in Brno, Czech

Republic, University of Las Palmas de Gran Canaria, Spain, Helix5, Netherlands, and Teacher.sk, Slovakia, was determined by the digitization of the society and the automation of many processes which provide new opportunities and types of jobs. The number of employees employed in the IT sector is continually growing. Employers in the European Union thus state that there is an increasing lack of IT specialists, mainly in the field of software development, data analysis and data science.

Experts from 10 countries, namely Australia, Bulgaria, Czechia, Poland, Portugal, Russia, Slovakia, Spain, Ukraine, and Turkey, reflected on innovative educational technologies, tools and methods for e-learning, as they presented their research results, contemporary trends and scientific, as well as an educational projects devoted to MOOCs, Artificial intelligence (AI), augmented reality (AR), virtual reality (VR), Selected Web 2.0 and Web 3.0 technology, LMS, CMS, STEM, and other topics related to mobile learning.

The speakers from the Universidade Lusiada de Lisboa (Portugal), the Comenius University in Bratislava (Slovakia), Plovdiv University "Paisii Hilendarski" (Bulgaria), Borys Grinchenko Kyiv University (Ukraine), Gdansk University of Technology (Poland), Herzen State Pedagogical University of Russia, St. Petersburg (Russia), Jagiellonian University (Poland), Warsaw University (Poland), Silesian University in Opava (Czech Republic), University of Silesia in Katowice (Poland), Lisbone Lusiada University, Lisbone (Portugal), K.D. Ushynskyi South Ukrainian National Pedagogical University (Ukraine), Mykhailo Drahomanov National Pedagogical University, Kyiv, (Ukraine), Dniprovsk State Technical University (Ukraine), University of Ostrava (Czech Republic), Pedagogical University of Krakow (Poland), University of Social Sciences and Humanities in Warsaw (Poland), Instituto Superior de Tecnologias Avançads (Portugal), Makarenko Sumy State Pedagogical University (Ukraine), Ternopil University (Ukraine), Kherson State University (Ukraine), Izmail State University of Humanities (Ukraine), and other educational institutions delivered lectures providing insights into interesting studies, presented their recent research results and discussed their further scientific work (Smyrnova-Trybulska, 2020, pp. 11–12).

The guests and conference members were welcomed by the Dean of the Faculty of Social Sciences Prof. dr hab. Zenon Gajdzica, Vice-Dean of the Faculty of Arts and Sciences of Education on Cooperation, Barbara Głyda, PhD, Head of the Institute of Computer Science Prof. dr hab. inż. Piotr Porwoli.

The programme comprised two plenary lectures, two conference sessions and a round table debate. Keynote speakers of the conference were well-known experts and scientists. Pedro Isaias (Australia) entitled his lecture "Just Blend It! Design Framework For Blended Learning In Higher Education"; Antonio dos Reis (Por-

tugal) presented the lecture: "How Can You Make An Unforgettable Presentation" (Photo 1); Nataliia Morze (Ukraine) presented the report on "Providing Quality Education During Times of The Pandemic" (Photo 2); Tomayess Issa (Australia) delivered a presentation "Reflective Journal Assessment To Enhance Students' Personal And Professional Skills".

Pedro Isaias, PhD, is an associate professor at the Information Systems and Technology Management School of The University of New South Wales (UNSW – Sydney), Australia. Previously, he was an associate professor at the University of Queensland, Brisbane, Australia. Before moving to Australia, he worked at the Universidade Aberta (Portuguese Open University) in Lisbon, Portugal, where he was responsible for several courses and served as the head of the master degree program in Management/MBA. Pedro Isaias was the head of the master's degree program in Electronic Commerce and Internet for 10 years. He holds a PhD in Information Management (in information and decision systems) from the NOVA University of Lisbon. He is also the author of several books, book chapters, papers, and research reports, all in the field of information systems. He headed several conferences and workshops within the aforementioned research field. He has also been responsible for the scientific coordination of several EU-funded research projects. Moreover, he is a member of the editorial board of several journals and program committee member of several conferences and workshops. Currently, he conducts research activity related to MIS in general and, more specifically, to learning technologies, data analytics, business intelligence, digital transformation, e-business, and WWW related areas. He is the President of the International Association for Development of the Information Society (IADIS) since 2001. At the International Association for Development of the Information Society: President of the association with more than 2,000 associate members and 11 staff members; of global management and strategic planning activities; responsible for the Scientific Advisory Board; Co-ordinator of ISRLab (Information Society Research Lab); responsible for EU project coordination, elaboration and proposals. He is member of the Australian Computer Society and ASCILITE; Senior Fellow of the Higher Education Academy (HEA) in the UK (April 2018); and supervisor of more than 60 doctoral and master theses and dissertations. He is member of over 30 International Conferences and Workshops Program Committees; member or keynote/invited speaker for over 20 conferences and workshops; member of journal review and editorial boards of 5 high-scoring journals, and a lot of Conference Proceedings indexed in WoS and Scopus.

Nataliia Morze, Professor, dr hab., Vice Rector on IT, Chief of the Department of Computer Science at the Borys Grinchenko Kyiv University, Ukraine.

State expert of the National ICT Program in Education, Elaboration of the National System of In-Service Teacher Training and School Heads Training in accordance with the ICT. Trainer of the Microsoft program "Cooperation learning". She is responsible for the Elaboration of the Teachers Technological Standards on National Level, Senior Trainer of the Word Intel program "Teach for the Future"; elaboration of distance learning courses for teachers and students; elaboration of the State programme of computer science for professionals, high schools and universities; introduction and implementation of computer science in education of Ukraine. She is also teachers' trainer in computer science. Furthermore, she is the author of more than 300 publications, articles and monographs (70 books on e-learning, critical thinking, interactive methods, and IT-teaching). The title of her keynote lecture was "Big data in Education".

Antonio dos Reis, PhD, retired professor. The Graal Institute's Head and scientific coordinator, teacher and consulting adviser in e-learning multimedia projects. Coordinator of the research project *Teacher's skills for the school of the future*. Consulting adviser of the university for the implementation of virtual classrooms; consulting adviser of WeZupport, Sweden, for the e-Campus global project; consulting adviser of the Move Nations Course concerned with 3D environments in education. Coordinator of the post-graduation course *Pedagogic and didactic skills in e-learning and multimedia* (2008/09); Coordinator of the post-graduation course in *Pedagogic and didactic skills in e-learning*, teacher at Azores University (2007/08); Coordinating trainer of teacher trainers in the Portuguese Ministry of Education. Distance learning platform, Webmaster and multimedia coordinator in 2006 ISEG UTL (Technical University Lisbon). Scientific Coordinator of the pilot project *The school of the future – Today*. International conferences key speaker and conference chair at *Azores – Online learning conference and Workshop 2008/2009.* Education website coordinator at: www.thegraal.net. More than 500 videos of conferences and pedagogic contents, e-round tables and debates. YouTube Contents channel: www.youtube.com/user/antonodreis. Moodle platform administrator: http://thegraal.ccems.pt/. The title of his keynote lecture was "500 Years around the world in the road of digital society".

Among the speakers of the Conference Session, "Innovative Educational Technologies, Tools and Methods for E-learning" (Moderated by Magdalena Roszak and Mariusz Marczak) which was held on October 12th, 2020 (Monday) (online in Adobe Connect) were Anna Ślósarz (Poland) with a presentation on "The Moodle Community Platform Versus The Microsoft Teams Corporate Application"; Mariusz Boryczka, Małgorzata Przybyła-Kasperek, Iwona Polak, Arkadiusz Nowakowski, Eugenia Smyrnova-Trybulska, Katarzyna Trynda, Beata Zielosko, and Krzysztof Żabiński (Poland) with a presentation "FITPED – Project

Progressing And Some First Results"; Tomas Barot, Lilla Korenova, Radek Krpec, and Renata Vagova (Slovakia) with a presentation on "The Utilization Of Mathematical Software In Favor Of Tutoring Processes; Mariusz Marczak (Poland) with a presentation "Using Linguistic Analysis To Funnel Student Translators' Post-Online-Exchange Reflections Towards Selected Aspects Of Translator Competence"; David Buchtela and Dana Vynikarová (Czechia) with a presentation on "The Connection Between Ontouml And Knowledge Representation Model Of Student Activities", Todorka Glushkova, Stanimir Stoyanov, Veneta Tabakova-Komsalova, Maria Grancharova-Hristova, and Irina Krasteva (Bulgaria) with a presentation on "An Approach To Teaching Artificial Intelligence In School".

An E-round table debate on "The Tools to Be a Good Teacher and a Good Student in the Digital Age" was held during the second day of the Conference. It was chaired by Antonio dos Reis and Eugenia Smyrnova-Trybulska (Photo 3). The topics of the E-round table debate were conducted online in Adobe Connect and these were as follows:

1) Challenges of Online Learning and Teaching in the Covid-19 Pandemic Time. Or Could We Ensure the Quality of Education?
2) E-Learning as an Interdisciplinary Science; Methodical, Scientific, and Legal Aspects – International Experience;
3) New Competences and New Specialization in the Digital Age and in the Global World;
4) Active Learning Methods in Online Education.

Participants:
Xabier Basogain (Spain)
Tomayess Issa (Australia)
Nataliia Morze (Ukraine)
Olga Yakovleva (Russia)
Paulo Pinto (Portugal)

A short discussion was held after each lecture and every speaker responded to 1–2 question from the audience (Photo 4). The moderators mentioned some conclusions at the end of the sessions.

The second day of the conference, October 13th, 2020 (Tuesday), also comprised: a plenary and conference session, as per the Conference Programme.

The speakers during the second day of the conference were Iwona Mokwa-Tarnowska (Poland) "High-Quality Online Language Teaching During The Pandemic – The Gdansk University of Technology Experience"; Nuno Silva, Izabel Alvarez, Paulo Pinto (Portugal) "E-Learning Implementation – From Action To Equity In An International Higher Education Institution"; Pedro Ramos Brandao

(Portugal) “Digital Transformation Of The Learning Environment In The University”; Eugenia Smyrnova-Trybulska (Poland), Nataliia Morze (Ukraine), and Iryna Sekret (Turkey) “MOOCs As Contemporary Tools Of Learning And Teaching Online: Conception Of The MOOCs ‘Contemporary ICT-Tools And Method For Creative Education’”; Svetlana Kulikova and Olga Yakovleva (Russian Federation) “Individualised Paths Of Mastering An Electronic Course Content”; Tomasz Kopczyński (Poland) “Chooses Aspects Of Moocs ‘Introduction To The Computative Thinking’”; Eugenia Smyrnova-Trybulska, Jolanta Szulc, and Renata Frączek (Poland) “Moocs – The Sources Of Scientific Information In The Internet – Conception And Main Assumption”.

In the afternoon session, the participant reports, full presentations and posters presented were authored by Milena Janakova (Czechia) “E-Learning Using Modern Technologies To Support Innovations Based On Scientific Approach”; Mariia Boiko, Nataliia Morze, and Liliia Varchenko-Trotsenko (Ukraine) “Communication And Cooperation In Distance Learning”; Lucie Zormanova (Poland) “Learning Strategies Applied by University Students in the Distance Learning System”; Oksana Strutynska and Mariia Umryk (Ukraine) “Distance Learning Tools And Trends: A Local Survey Of The Ukrainian Educators”, Svitlana Skvortsova and Ruslana Romanyshyn (Ukraine) “Using Online Simulators For The Formation Of Primary School Learners’ Computing Skills”; Mirosław Kisiel (Poland) “Music Education In The Aspect Of Distance Learning”; Oksana Buinytska and Svitlana Vasylenko (Ukraine) “E-Learning To Ensure The Educational Services’ Quality In University Distance Learning”; Halyna Henseruk, Bogdan Buyak, Volodymyr Kravets, Hryhorii Tereshchuk, and Mariya Boiko (Ukraine) “Learning Strategies Applied By University Students In The Distance Learning System”; Małgorzata Wieczorek-Tomaszewska (Poland) “Visual Literacy In Contemporary Culture Comparative Research”; Oksana Shelomovska, Liudmila Sorokina, Maryna Romaniukha, Natalya Sorokina, and Iryna Machulina (Ukraine) “Cloud Technologies For University Training Of Students In Socio-Humanitarian Specialties And Future Public Servants In A Global Pandemic”; Tetiana Vakaliuk and Oksana Chernysh (Ukraine) “Electronic Multilingual Terminological Dictionary Compilation As A Means Of Students Professional And Language Competence Development”; Kateryna Yalova, Liudmila Sorokina, Kseniia Yashyna, Oksana Shelomovska, Oleksandr Shumeiko, and Kostiantyn Bohomaz (Ukraine) “E-Learning System Development and Implementation: the University Experience”.

At the end of the conference, Eugenia Smyrnova-Trybulska presented conclusions and invited everyone to participate in the next edition of the conference DLCC2021.

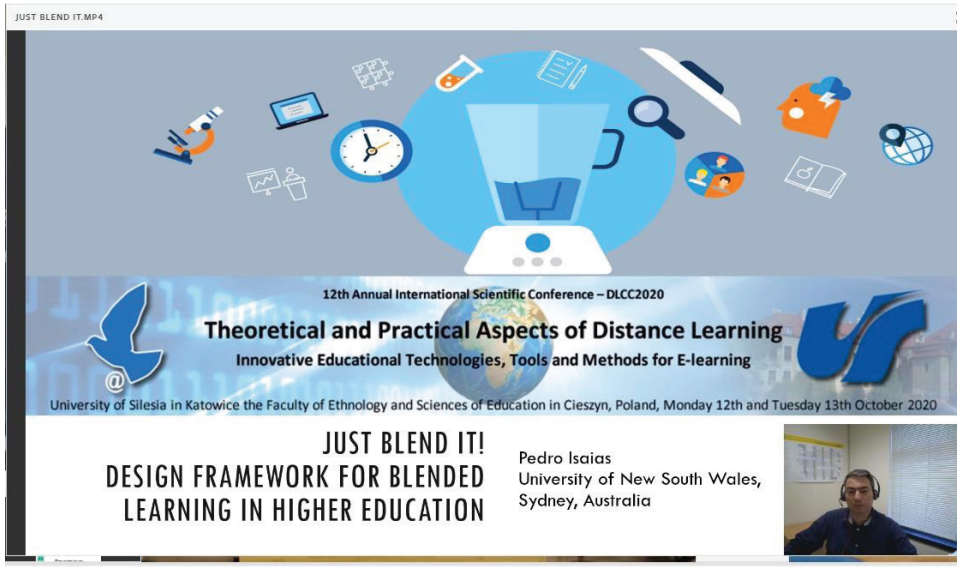

Photo 1. Pedro Isaias (Australia) delivered the lecture "Just Blend It!: Design Framework for Blended Learning In Higher Education", online video in *Adobe Connect*
S o u r c e: *Copy Screen from Adobe Connect conference session's virtual room*

Photo 2. Nataliia Morze (Ukraine) presented the report "Providing Quality Education During a Pandemic"
S o u r c e: *Copy Screen from Adobe Connect conference session's virtual room*

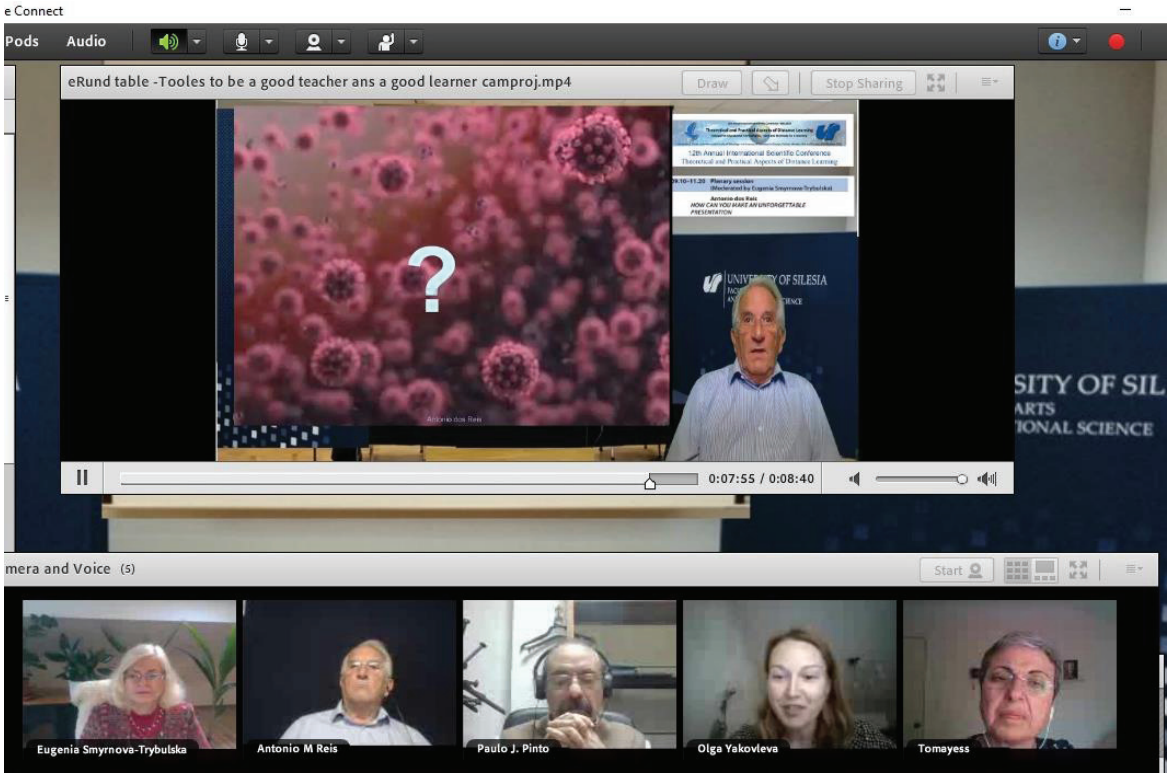

Photo 3. Participants of the E-round table debate on the tools required of a good teacher and a good student in the digital age, moderated by Antonio dos Reis (Portugal) (second left) and Eugenia Smyrnova-Trybulska (Poland) (the first left). The participants were experts from different countries: Paulo Pinto (Portugal) (third left), Olga Yakovleva (Russia) (fourth left), Tomayess Issa (Australia) (fifth left), who participated in person and in the remote mode.

S o u r c e: *Copy Screen from Adobe Connect conference session*

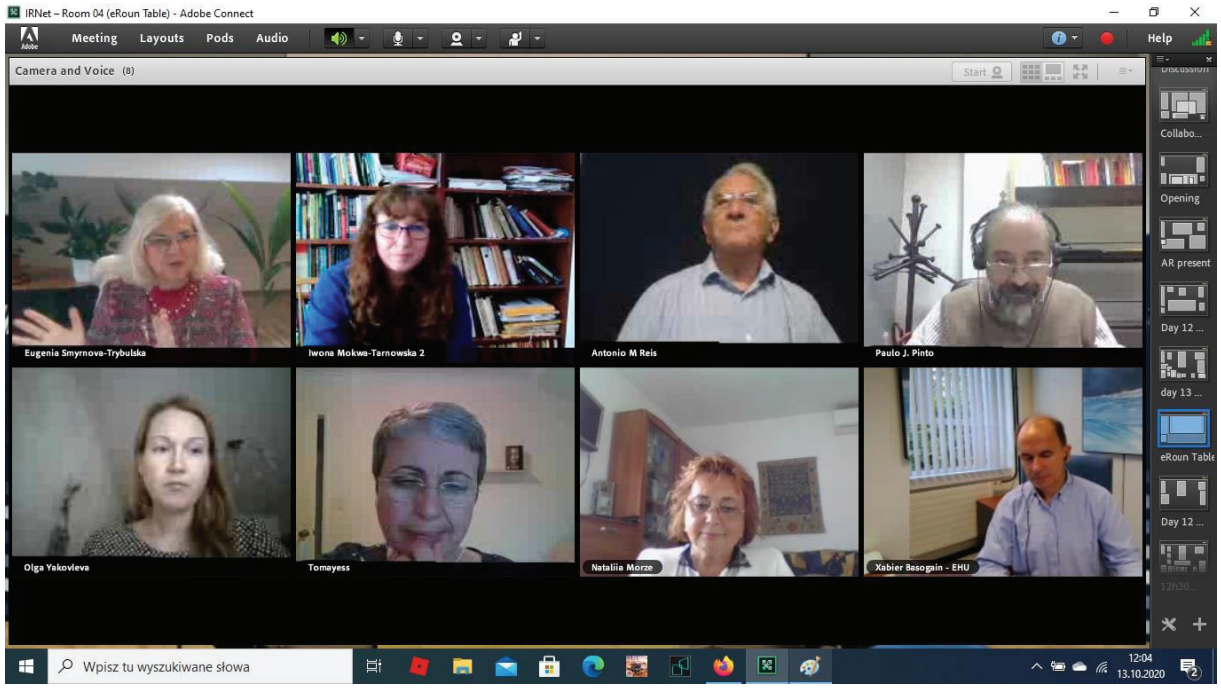

Photo 4. Participants of the E-round table debate on the tools to be a good teacher and a good student in the digital age, moderated by Antonio dos Reis (Portugal) (third left) and Eugenia Smyrnova-Trybulska (Poland) (the first left). The participants were experts and scientists from different countries: Iwona Mokwa-Tarnowska (Poland) (second left, the first line), Paulo Pinto (Portugal) (fourth left), Olga Yakovleva (Russia) (the first left, the second line), Tomayess Issa (Australia) (second left), Nataliia Morze (Ukraine) (third left), and Xabier Basogain (Spain) (fourth left), who participated in remote mode.

S o u r c e: *Copy Screen from Adobe Connect conference session*

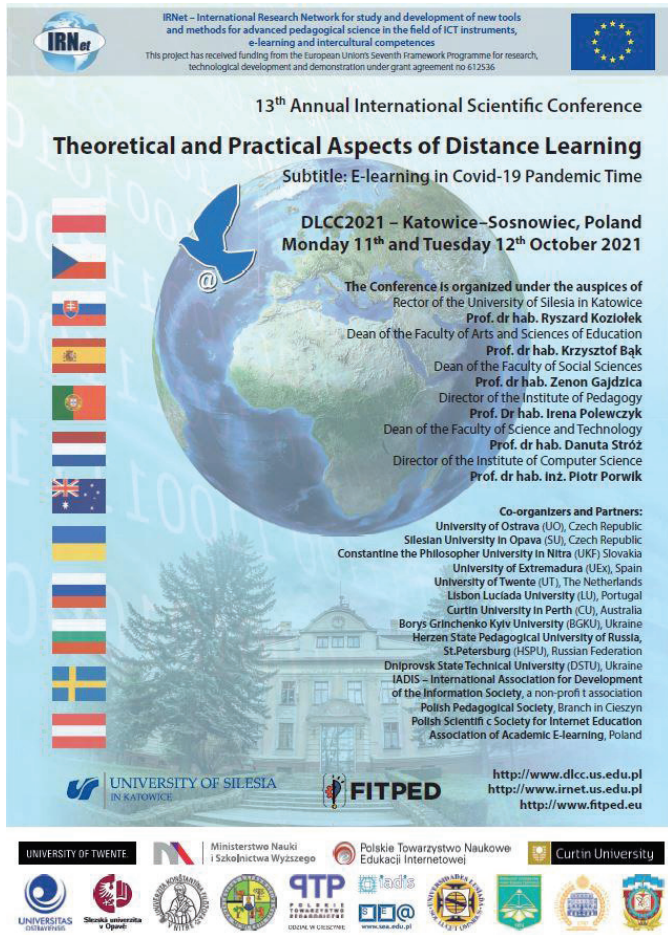

Photo 5. DLCC2020 conference poster
Author of the poster: *Ireneusz Olsza*

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Contributors

Isabel Alvarez – PhD, Associate Professor, Lusiada University in Lisbon, Istec, Portugal, email: alvarez@edu.ulusiada.pt

Juan Arias Abelaira – PhD, Associate Professor, Alcala University, Spain, email: Juan.ariasa@edu.uah.es

Nadia Balyk – PhD, Associate Professor, Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine, email: nadbal@fizmat.tnpu.edu.ua

Hanne-Lore Bobáková – PhDr, Ph.D., Assistant Professor, School of Business Administration, Silesian University in Opava, Czech Republic, email: bobakova@opf.slu.cz

Tetiana Britskan – PhD student, Izmail State University of Humanities, Izmail, Ukraine, email: britskan1994@gmail.com

Martina Chylková – Mgr, Assistant, School of Business Administration, Department of Tourism and Leisure Activities, Silesian University in Opava, Czech Republic, email: chylkova@opf.slu.cz

Krzysztof Dziedzic – PhD, Associate Professor, Department of Computer Science, Electrical Engineering and Computer Science Faculty, Lublin University of Technology, Poland, email: k.dziedzic@pollub.pl

Rafael Martín Espada – PhD, Associate Professor, Extremadura University, Spain, email: rmmartin@unex.es

Inna Grod – PhD, Associate Professor, Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine, email: grod@fizmat.tnpu.edu.ua

Juan Arias Masa – PhD hab., Full Professor, Extremadura University, Spain, email: jarias@unex.es

Vasyl Oleksiuk – PhD, Associate Professor, Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine. email: oleksyuk@fizmat.tnpu.edu.ua

Nuno Silva – PhD, Associate Professor, Lusiada University in Lisbon, Portugal, mail: nsas@ulusiada.pt

Svitlana Skvortsova – PhD hab., Full Professor, South Ukrainian National Pedagogical University named after K. Ushynsky, Odesa, Ukraine, email: skvo08@i.ua

Oksana Strutynska – PhD hab., Associate Professor, Department of IT and programming, Faculty of Mathematics, Informatics and Physics, National Pedagogical Dragomanov University, Ukraine, email: o.v.strutynska@npu.edu.ua

Galyna Shmyger – PhD, Associate Professor, Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine, email: shmyger@fizmat.tnpu.edu.ua

Eugenia Smyrnova-Trybulska – PhD hab., Associate Professor, the Faculty of Arts and Educational Sciences, The Institute of Pedagogy, University of Silesia in Katowice, Poland, email: esmyrnova@us.edu.pl

Mariia Umryk – PhD, Associate Professor, Department of IT and programming, Faculty of Mathematics, Informatics and Physics, National Pedagogical Dragomanov University, Ukraine, email: m.a.umryk@npu.edu.ua

Yaroslav Vasylenko – PhD, Associate Professor, Ternopil Volodymyr Hnatiuk National Pedagogical University, Ukraine, email: yava@fizmat.tnpu.edu.ua

Małgorzata Wieczorek-Tomaszewska – Mgr, Bibliotheca Nostra, The Academy of Physical Education named after Jerzy Kukuczka in Katowice, Poland m.wieczorek.tomaszewska@gmail.com

Lucie Zormanová – PhD, Associate Professor, The Faculty of Social Science, The Institute of Pedagogy, University of Silesia in Katowice, Poland, email: lucie.zormanova@us.edu.pl

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Contact
International Journal of Research in E-learning
University of Silesia
Faculty of Arts and Sciences of Education
Bielska 62, 43-400 Cieszyn, Poland
phone: +48 33 854 61 13
fax: +48 33 854 61 01
email: esmyrnova@us.edu.pl

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