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Editorial

The theme and the priorities of the *International Journal of Research in E-learning* (IJREL) reflect the conceptual principles underlying the modernization of education and the reform of the educational systems in European countries, as well as national development strategies for the 21st century. One of the European Union's key educational objectives is the provision of equal opportunities for all with regard to access to learning and knowledge, regardless of gender, financial and physical ability, and place of residence. That is why distance learning has now been granted a status of high priority. If introduced on a wide scale, distance learning and teaching may make significant contribution toward the achievement of educational goals in the member states.

IJREL was founded in 2015 at the Faculty of Ethnology (now Arts) and Sciences of Education (University of Silesia in Katowice), which has a longtime experience of comprehensive introduction of e-learning and contemporary ICT technologies and strengthening and widening international cooperation. This resulted in another international scientific project IRNet, that is, *International Research Network for 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 journal focuses on the research devoted to e-learning in the digital world.

The present volume includes nine articles gathered in four chapters. Chapter I, entitled "Theoretical and Methodological Aspects of E-learning," includes three articles. The first article, prepared by Jolanta Szulc from the University of Silesia in Katowice, is devoted to distance learning, its current status, and research directions. The text aims to discuss current trends in research in distance learning (DL), such as definitions and characteristics of DL, current directions for research in DL. Among those we may find measuring transactional distance in web-based learning environments, problem-based learning (PBL) in DL, development of learning content and tasks for massive open online courses (MOOCs), effects of online course efficiency perceptions on student evaluation of teaching (SET) measures, new technologies in DL, the use of metacognitive and affective model of

self-regulated learning (MASRL), a questionnaire (scale of constructivist learning in higher education settings [CLHES]) as a method of research of constructivist learning environment in higher education, Transactional Distance (TD) theory in DL and online community culture. The summary and conclusions focus particularly on the use of DL methods in higher education.

The article "Video Library of Mathematics Lessons as a Means of Methodical Preparation of Future Primary School Teachers" was prepared by a team of researchers from Ukraine, Svitlana Skvortsova, Maryna Haran, and Olena Sagan. The authors discuss the use of lesson video recording in the process of forming the professional competence of future mathematics teachers. A video library has been created which includes videos of real mathematics lessons conducted in primary school and videos showing solutions to certain tasks, commented by the pupils and structured according to classes and topics. The authors have developed approaches to the use of the video library by teachers of mathematics methodology in primary school and primary education teacher training programme. The effectiveness of using the video library as a means of studying the course Methods of Teaching Mathematics in primary school was confirmed experimentally by introducing the video library into the educational process of three universities of Ukraine.

Lucie Zormanová contributed the article entitled "Students' Motives for Attending E-learning Master Degree Courses." The paper presents the research results on students' motives to participate in distance learning (master's degree course) at the University of Humanities and Economics in Łódź. The research was carried out through the method of semi-structured interviews. The interviews were conducted among the first-year students of the follow-up master's degree in pedagogy. The research was carried out in the years 2016–2019, and in this period three stages of the research were completed. The research group consisted of 20 students who had work and family responsibilities and were between 35 and 48 years old. In addition, the respondents already had previous experience in combined and full-time studies. The interviews were recorded on a mobile phone and lasted about 40 minutes each. Data were analysed by means of open coding procedures. The goal of open coding was to divide thematically the analysed text. The interviews were analysed and then divided into units, which sometimes meant words, and sometimes sentences or paragraphs set according to their meaning, hence the unit was a semantic one. A code was assigned to each specified unit. Once the code list was created, the authors started to categorize data.

Chapter II "Innovative Methods and Technology in Higher Education" comprises two articles. Maryna Romaniukha, Oksana Shelomovska, and Liudmyla Sorokina in their article "Travel Blog as an ESL Teaching Tool" stressed that current stage of ICT development suggests the improvement of teaching tools, skills,

and learning outcomes. The paper discusses rich educational prospects of travel blogging for students of English as a second language (ESL). The authors suggest short theoretical overview of the research into travel blogosphere's educational opportunities, discussing a classification of travel blogs according to the type of sender vs. receiver communication. On an extensive and contemporary textual material, the paper considers such prominent features of travel storytelling as vocabulary of broadly understood semantics, compact meaning representation, strategies of presenting cultural information and verbal creativity which can be of true interest for students at B2 level and above. The reader can also learn about a few forms of activity with travel stories which are: individual special sampling with some specific focus (word play, irony, creative instances of word building), presentation of other culture by means of English, project work for a small group of enthusiasts, sampling stories by country, by area or by activity and presenting one concise story to the classroom as their own poster or a paper brochure.

The second article "Flipped Learning for Teaching Ukrainian IT Students" prepared by Kateryna Yalova, Ksenia Yashyna, and Liudmyla Sorokina is devoted to implementation of flipped learning as a way of improving educational quality for IT students. The paper presents the advantages and disadvantages of flipped learning as well as the obstacles for its adoption. Moreover, it shows modifications of educational functions, roles, actions, and interconnections of the participants during implementation of flipped learning. Flipped learning implementation algorithm has been proposed for a university discipline at Dniptovsk State Technical University, Ukraine. Uniform architecture for flipped course which consists of face-to-face and on-line parts is given and forms and requirements for e-content are described. Approaches and technologies for implementing the on-line part of flipped learning are also discussed with proposed innovative educational technologies which may be useful at the phases of meaning realization and knowledge reflection as well as for creating students' professional skills. The proposed solutions are uniform and formed by generalization of the knowledge about the data domain, they can be utilized in Ukrainian universities.

Chapter III "Virtual Educational Space, Robotics and Hybrid Reality in Business and Education" includes four articles. Mihail Petrov, Vladimir Valkanov, and Asya Stoyanova-Doycheva contributed the article "Behaviour Analysis of Agents in Virtual Educational Space" and stressed that modern teaching methods include both traditionally established approaches to the classroom and an entirely virtual approach aimed at learning from anywhere in the world at any time. The authors state that society constantly encounters increasingly popular platforms such as Coursera, Udacity, Udemy, and even YouTube, which can serve as a kind of aggregator of new knowledge. The problem which is not addressed, however, is to what extent learning is effective in the process not only of the particular course

but also within several interrelated courses of study. The text presents conceptual model for analysing behaviour of intelligent agents who acquire knowledge by use of virtual tools to support the educational process, as well as ways to analyse the behaviour of the agents in question. The article describes a conceptual architecture for an environment to analyse the behaviour of UniPlayground agents as well as different spheres of knowledge that use this environment.

Eugenia Smyrnova-Trybulska, Dawid Staniek, and Dominika Zegzuła in their article "Robotics in Education. A Survey Report: A Case Study," analyse various aspects of applying robotics. The article discusses and examines the level of preparation and motivation of children and pupils to attend robotics classes. The authors carry out a comprehensive review of research and scientific publications regarding technological, didactic, methodological, and human aspects of using robotics in education. The article presents a report on a survey of pupils' opinion on robotics in education which was conducted during the third Silesian Science Festival, and discusses the exhibition stand presenting innovative digital technologies and methods in education and business and Photon robots.

Tomasz Woźniakowski and Arkadiusz Orłowski in their article "Hybrid Reality in the Internet of Things as an Environment for Transferring Knowledge" claim that due to the development of new methods of interaction with devices, it seems important to ask questions about the possibilities of using the technology in broadly understood education. The aim of this article is to present a new measure of the objects ability to accumulate knowledge in the light of the conditions which new technologies (hybrid reality and internet of things) bring, and also to evidence a case study based on the technologies mentioned in the article. The authors have discussed features of augmented reality, presenting the application of an additional visual layer to the observed reality together with the concept of the internet of things as a network of people, processes, data, and objects. Moreover, the authors have presented the concept of using artificial intelligence supporting the transfer of knowledge as well as the classification and valuation of objects in such an environment which combines the above-mentioned technologies.

The article entitled "The Use of E-learning Platform by Flipped Classroom Method in Chemistry Lessons in Poland and Ukraine – A Case Study" was written by Małgorzata Bartoszewicz, Hanna Gulińska, and Maria Gaidova from Adam Mickiewicz University in Poznań, Poland. The objective of this article is to compare chemistry teaching in Poland and Ukraine at the primary school level by discussing the possibilities of supporting education with the use of a flipped classroom method (pre-emptive teaching) and ICT including free Google platform in chemical education. The article examines some results of tests and surveys carried out among students in Polish and Ukrainian schools in the school year of 2018/2019, pointing out students' motivation regarding ICT teaching support.

The last chapter includes two reports. The first one entitled "Innovative Digital Technologies in Education and Business at the Third Annual Silesian Science Festival 2019" was prepared by Eugenia Smyrnova-Trybulska, Dominika Zegzuła, and Dawid Staniek from the University of Silesia in Katowice, Poland. The Silesian Science Festival is an event organized by the University of Silesia in Katowice in cooperation with the Silesian University of Technology, Medical University of Silesia, the Jan Długosz University in Częstochowa, Academy of Fine Arts in Katowice, and the Jerzy Kukuczka Academy of Physical Education in Katowice. It is a regular event when specialists from almost all scientific fields meet in one place. One of the demonstration venues in the humanities and social sciences was the stand of the Silesian University's Department of Humanistic Education and Auxiliary Sciences of Pedagogy of the Faculty of Ethnology and Educational Sciences, namely, Innovative Digital Technologies in Education and Business hosted by the authors of the report. Summing up, it can be emphasized that the third edition of the Silesian Science Festival achieved its goals related to the promotion of science, popularization of new digital technologies among young users, future students, scientists, engineers, and new generation specialists. Many young people fascinated by the scientific event discovered their new passions and were inspired by science.

The second report, "Virtual University: Model, Tools, Practice (11–12 June 2019)," prepared by Eugenia Smyrnova-Trybulska and Dominika Zegzuła, is devoted to the International Scientific Conference VU2019 and describes the topics of the conference, introduces the speakers, conference activities, and provides some conclusions.

We hope that all the texts comprising this issue will be interesting to our readers and will inspire new ideas and innovations in education.

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I. Theoretical and Methodological Aspects of E-learning

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Distance Learning – the Current Status and Directions for Further Research

Abstract

The article aims to discuss current research trends in the field of Distance Learning (DL). It consists of the following parts: (1) the definitions and characteristics of DL; (2) current directions of research in the field of DL, among others: measuring transactional distance in Web-Based Learning Environments, Problem-Based Learning (PBL) in DL, development of learning content and the task for MOOCs, effects of online course efficiency perceptions on Student Evaluation of Teaching (SET) measures, new technologies for the DL, the use of metacognitive and affective model Self-Regulated Learning (MASRL), questionnaire (Constructivist Learning on a Scale Higher Settings of Education [CLHES]) as a method of research of constructivist learning environment in higher education, Transactional Distance (TD) theory in DL and online community culture; (3) summary and conclusions with a particular focus on the use of DL methods in higher education. The article is based on the study of literature registered in the databases ERIC, LISA, and LISTA.

K e y w o r d s: Constructivist Learning, Distance Learning, Massive Online Open Courses, Problem-Based Learning, Self-Regulated Learning, Student Evaluation of Teaching, Transactional Distance

Introduction

Distance education has been around for a long time, but has evolved in a number of ways. Open learning is a more recent phenomenon and its definition varies from country to country and is has been evolving over the recent years (What, 2019). Traditionally, it consisted of correspondence courses in which the student corresponded with the school via mail. Currently the following types of courses are distinguished: hybrid courses (51% or more), blended, 100% distance learning or open online courses (MOOCs) (Wikipedia, 2019a). Online courses enable Distance Learning (DL). Our considerations will begin with the presentation of the research method and the definition of DL.

The Methodology of Research

The study uses the analysis of literature on the subject registered in the following databases: Education Resources Information Center (ERIC), Library and Information Science (LISA), and Library and Information Science Abstracts (LISTA). Based on the initial analysis of the literature on the subject, seven main research topics have been identified (see sections 2.1 to 2.6). Then, in each of the databases, bibliographic records were searched according to accepted search queries (see Table 1). Subsequently, the most important and recent publications were selected and discussed. Conclusion presents the analysis of the results obtained and separates the specific subjects and research directions.

Table 1
Search results in selected databases (as of September 29, 2019)

Database name	Search query	No. of records	Publication period
ERIC	(“Transactional Distance”) AND (“Distance Learning”)	111	1988–2019
	(“Problem-Based Learning”) AND (“Distance Learning”)	142	1992–2019
	(“MOOC”) AND (“Distance Learning”)	129	2009–2019
	(“Student Evaluation of Teaching”) AND (“Distance Learning”)	70	1983–2019
	(“New Technology”) AND (“Distance Learning”)	265	1977–2018
	(“Self-Regulated Learning”) AND (“Distance Learning”)	65	2000–2019
	(“Constructivist Learning”) AND (“Distance Learning”)	56	1993–2019
LISA	(“Transactional Distance”) AND (“Distance Learning”)	22	2002–2018
	(“Problem-Based Learning”) AND (“Distance Learning”)	129	1994–2019
	(“MOOC”) AND (“Distance Learning”)	130	2012–2019
	(“Student Evaluation of Teaching”) AND (“Distance Learning”)	3	2004–2018
	(“New Technology”) AND (“Distance Learning”)	425	1982–2019
	(“Self-Regulated Learning”) AND (“Distance Learning”)	56	2002–2019
	(“Constructivist Learning”) AND (“Distance Learning”)	73	2001–2019
LISTA	(“Transactional Distance”) AND (“Distance Learning”)	6	2002–2015
	(“Problem-Based Learning”) AND (“Distance Learning”)	9	2002–2015
	(“MOOC”) AND (“Distance Learning”)	14	2014–2019
	(“Student Evaluation of Teaching”) AND (“Distance Learning”)	348	1981–2019
	(“New Technology”) AND (“Distance Learning”)	16	1988–2015
	(“Self-Regulated Learning”) AND (“Distance Learning”)	8	2012–2019
	(“Constructivist Learning”) AND (“Distance Learning”)	5	2001–2016

S o u r c e: Own work

1. The Definition and Development of Distance Learning

According to some researchers, Distance Learning (DL) (or long-distance learning) is "a way of learning remotely without being in regular face-to-face contact with a teacher in the classroom" (Midgley, 2019). Another definition assumes that DL or Distance Education (DE) is the education of students who may not always be physically present at school (Wikipedia, 2019b). In addition, we use a term such as Open and Distance Learning (ODL) – the combination of distance education (i.e., the ability to study from distance) and open learning (i.e. the ability for anyone to access the educational offer) (What, 2019).

The elements of the DL evaluation are: the legal framework, Distance Learning standards, accreditation for distance education, organising Distance Learning, teacher training, educational resources and development of distance education.

The DL supplying institutions are, among others:
1969 – The Open University (UK)
1973 – Everyman's University Tel-Aviv (Israel)
1973 – Universidad Nacional de Educación a Distancia (Spain)
1973 – Fernuniwersitat (Germany)
1975 – University of Lagos Correspondence and Open Studies Unit (Nigeria)
1978 – Universidad Nacional Abierta (Venezuela)
1984 – Open University of The Netherlands
1986 – University of Paris 8 – Vincennes – Saint Denis (France). (Korzan, 2003)

The Open University (OU) is one of the oldest universities in Europe providing DL. The OU referred to the Michael Young's (Lord Young of Dartington's) idea of the University of the Air started in former BBC television studios. The OU was established in 1969, and the first Vice-Chancellor was Professor Walter Perry. The university's administration is based at Walton Hall in Milton Keynes in Buckinghamshire, but it also has administrative centers in other parts of the UK. In addition, the university has branches in almost all European countries.

The OU teaches in English using its own unique distance learning method, called "supported open learning." The following features characterise this method: flexible, all-inclusive, supportive, and social. The OU offers certificates, diplomas, and bachelor degrees, depending on the amount of material and its level (1, 2, or 3), which correspond to the level of the first, second, or third year of study. The OU qualifications are expressed in CATS (Credit Accumulation and Transfer Scheme). The UO also grants "Open" Bachelor's degrees. The university also offers a range of MBA and MPA, MSc, MA and MEd, and MRes, as well as the professional PGCE qualification and a number of postgraduate diplomas and certificates. In

addition, the university provides the opportunity to study for a PhD. By 2013, over 200,000 students were studying at The Open University (The Open, 2019).

The beginnings of remote education in Poland date back to 1776, when the first correspondence courses were launched at the University of Krakow. They were intended for people from outside the university – for craftsmen. In 1886, the Flying University in Warsaw was established, which in 1907 – during the revolution – was legalised and adopted the name the Society of Scientific Courses. At the turn of the 19th and 20th century, other institutions dealing with distance learning were also established in Poland – the Association of Academic Courses for Women and Universal University Lectures.

In 1960, educational television was launched – "School programmes". Initially experimentally, and then systematically broadcast lectures by great scientists from large Polish academic centres. Up to 900 schools applied for the programme organised by Telewizja Polska (Polish Television). Unfortunately, it was very difficult to base their education on these programmes because it required changes to the school's lesson plans and curricula. In the years 1966–1971 in Poland, the Television Polytechnic was active, offering a preparatory programme for candidates for higher education and auxiliary materials for students.

Since the 1980s, the development of remote education in Poland corresponds to the development of this form of education in the world. In the 1990s there was a rapid development of the Internet and multimedia. Interest in remote education increased, e-learning has been created. During the period 2001–2007, there was observed a dynamic development of e-education in Poland. In 2008, the Open University of the Warsaw University was established to implement and promote the idea of lifelong education (Uniwersytet, 2019). Universities are increasingly introducing DL education. Corporate e-learning is also developing dynamically.

The report published in 2013 by the National Center for Supporting Vocational and Continuing Education presents conclusions regarding the state of distance education in Poland, in particular in the area of vocational and continuing education. The report states that:

1. A share of DL in vocational and continuing education (lifelong learning) in Poland is marginal.
2. The lack of recognition of the benefits of DL by teachers and persons managing vocational and lifelong learning institutions is the most serious reason for the limited use of this form of education organisation.
3. The number of teachers prepared for DL is insufficient for its development in vocational and contuining education.
4. The way of DL implementation in the vocational and continuing education system is highly ineffective.
5. Polish legal regulations regarding DL are inconsistent with European trends.

6. There is a lack of commonly used standards and related assessment and quality assurance systems regarding DL as well as institutions that accredit this form of education.
7. The degree of exchange and use of open didactic materials for DL is small.
8. The existing ICT infrastructure for DL does not limit its current use in vocational and continuing education learning, but is used in an ineffective manner.
9. The types of distance learning most commonly used in education professional and continuing education (lifelong learning) are not suitable for the education sector.
10. Due to the low popularity, it is difficult to talk about adjusting the current DL offer to the needs of the labour market (Chmielewski & Chomczyński, 2013).

2. Current Directions of Research in the Field

2.1 Measuring transactional distance in the Web-Based Learning Environments

Measurement of the transaction distance in the Web-Based Learning Environments is conducted using the so-called transactional distance theory. The concept of the transaction comes from Dewey (Dewey & Bentley, 1949). As explained by Boyd and Apps (1980), the transaction "connotes the interplay among the environment and the patterns of behavior in a situation." The transaction which we call distance education occurs between teachers and students in an environment characterised by a special feature separating teachers from students. This separation leads to special patterns of behaviour of the student and teacher. This separation of students and teachers has a profound impact on distance learning methods. Along with separation, there is a psychological-communication space, that is, the possibility of misunderstandings between the instructor and the students. Psychological and communication spaces between a single student and an instructor are never exactly the same. In other words, the transaction distance is a continuous variable, not discrete, and relative rather than absolute (Moore, 1997).

The literature on the subject of transactional distance was searched in selected databases and features in Table 1.

As can be seen from the presented data, most publications were registered in the ERIC database in 1988–2019. The publications concerned, among others, such the following topics: higher education (77 records), foreign countries (45 records), post-secondary education (44 records), online courses (43 records), educational

technology (41 records), student attitudes (31 records), teacher-student relationship (27 records).

Transactional distance theory was proposed in 1970 by Michael G. Moore, professor of education at Pennsylvania State University (Moore, 1972, 1973). This theory describes a course model that designates pedagogical aspects in three collections of variables. The first set consists of elements describing the structure of learning materials. The second set of variables contains elements that interact or dialogue between the teacher and students during the implementation of a curriculum. The third set creates the characteristics of each individual student, taking into account the self-management or autonomy of pupils who interact with teachers as part of the planned structure (Moore & Kearsley, 2012). These variables interact to create a transaction distance that Michael G. Moore defines as "a psychological and communication space for the crossed-up learner" (Moore, 1997, p. 22).

Many researchers have used Moore's theory as the theoretical basis to develop scales to measure transaction distances. These include: Zhang's Scale of Transactional Distance (Zhang, 2003), Relative Proximity Theory (Swart et al., 2013), Revised Scale of Transactional Distance (Paul et al., 2015), Coll-TD Scale (Wengrowicz et al., 2014), Coll-TD / F Scale (Paul et al., 2015).

Shen et al. (2015) proposed measuring the transaction distance in the online learning environment using the new method. This study was the initial attempt to operationalise Moore's distance theory by developing and validating principles measuring related elements, such as:

- Transactional distance: interpersonal closeness, sharedness, perceived learning.
- Dialogue: learner-instructor interaction and learner-learner interaction.
- Structure: learner-content interaction and learner-interface interaction.
- Learner autonomy: independence of learning and study habits.

The data provided by 227 students online was analysed using exploratory factor analysis. The results indicate that the developed method is a reliable and reliable measure of structures associated with distance theory. Despite the potential limitations, the results of the study present preliminary empirical evidence confirming the validity of a constructive theory of transaction distances.

The subject of research is also the role of communication technologies and fields of study in strengthening and reducing transaction distance in mixed learning. Factor analysis and modeling of structural equations of different communication modes (face to face, e-mail, and telephone) revealed that students experience at least part of the transaction distance when they are separated from their teachers. E-mail messages were found to have made it easier for students to attain the highest level of directness in the dialogue. The conclusion is that strategic students have the best conditions to enjoy the benefits of blended learning, and the effects of

transactional distance can be analysed further if two variables of dialogue are recognised. They are social presence (perception of the relationship between students and their guardians) and directness (temporary effects of dialogue).

The usefulness of this theory also lies in the fact that it provides instructional designers the tips on course planning: for instance, if structure, dialogue, and autonomy will be built into the course to minimise transaction distances and thus maximise learning outcomes.

2.2 Problem-Based Learning (PBL) in DL

Problem-based learning (PBL) "is a student-centered pedagogy in which students learn about a subject through the experience of solving an open-ended problem found in trigger material" (Wikipedia, 2019c, accessed 29 September 2019c). When teachers skip the problem formulation phase – by providing students with facts and procedures, without giving them a chance to develop their own questions and self-examination – students may remember the material but will not fully understand it or be able to use it. Problem-based learning (PBL) provides a framework for discovery that helps students internalise learning and leads to greater understanding.

Therefore, the PBL process does not focus on solving problems using a specific solution, but it enables the development of other skills and attributes. The PBL includes knowledge acquisition, improved group collaboration and communication (Kolmos, 2009).

The number of records regarding PBL in DL, distinguished based on the database they were found in, is presented in Table 1. As can be seen from the collected data, most publications were registered in the ERIC database in the years 1992–2019. The record numbers for selected specific topics are: distance education (124), problem-based learning (111), higher education (104), foreign countries (64), educational technology (57), postsecondary education (53), online courses (50).

The most important publications cover issues such as:

(1) The theory of learning the design and implementation of research into the digital education of medical professions, as well as the indication of areas for future research on technologically supported education in this area (Bajpai, Semwal, Bajpai, Car, & Ho Ahy, 2019).

(2) Surveys among education managers, teachers and university students about experience in the application of PBL principles, support for PBL in terms of human and infrastructure resources (Okyere, Tawiah, Lamptey, & Oduro, 2019).

(3) Research on the PBL method, for instance:

– research on the implementation of the online PBL environment and the new student evaluation method. An example of such an environment is the system called Problearn, which allows students to remotely solve problems in small

groups. The system creates behavioural profiles of students during the problem solving process and evaluates each student based on them (Tadjer, Lafifi, & Seridi-Bouchelaghem, 2018);
– examination of the impact of knowledge representations on problem-oriented learning in online learning environments. The study compared the impact of knowledge map representation with traditional hierarchical representation in relation to learning memory and problem solving efficiency. Better results were achieved by participants who used the knowledge map representation, had a better memory of educational content, especially about the relationship between knowledge nodes (Gao, Wang, & Gao, 2015);
– research on comparison of online and campus-based PBL on the example of the Swedish firefighter training system. The results showed that online PBL, compared to campus-based PBL, has evolved into a more individual, real and reading-oriented process for solving problems with instructors and self-education among students (Holmgren, 2013).

(4) Using the PBL method in building scenarios supporting library services in long-distance teaching in strategic planning. Creating a scenario for a new strategic plan should be useful for library administrators interested in discovering new ways of planning business (Casey, Cawthorne, & Citro, 2014).

2.3 Development of learning content and the task for MOOCs

Massive Online Open Courses (MOOCs) are online courses aimed at unlimited participation and open access via the Web (Kaplan & Haenlein, 2016). In addition to traditional training materials, such as filmed lectures, readings and problem sets, many MOOCs provide interactive user forums to support community interaction between students, professors and teaching assistants, as well as instant feedback for quick quizzes and assignments (Masson, 2014).

The MOOC is the latest and widely researched DL development direction, which was first introduced in 2006 and had become a popular way of learning by 2012 (Wikipedia, 2016d). The literature on the subject was searched in selected databases and is presented in Table 1.

As can be seen from the collected data, most publications regarding the topic in question were registered in the LISA database in the years 2012–2019. At the same time, the majority of them appeared in 2013 (30), and similar numbers of publications fall in 2014–2015 (respectively, 17 and 19) and in 2017–2018 (respectively, 20 and 21). The most frequently discussed specific topics were: distance learning (112), online instruction (80), open learning (30), students (30), higher education (24), academic libraries (22), computer assisted instruction CAI (20), colleges & universities (16).

The most important publications cover such issues as:

(1) The MOOC design. Some researchers believe that there is no right or wrong way to design an MOOC. However, you can take practical steps that will allow you to initiate one: 1. Select a particular MOOC platform. 2. Gather interested, committed colleagues. 3. Identify the course topic and goals. 4. Specify the course requirements. 5. Create the structure and content of the course. 6. Define the tasks and assessment methods (Turner, 2015).
(2) Creating and using MOOCs for specific tasks, for instance, literature search according to a personal study model (Hong-Jun, 2015), training librarians involved in literature search (Young, McLaren, & Maden, 2017), multi-lingual and multi-cultural MOOC for information literacy instruction (Robinson & Bawden, 2017).
(3) The use of MOOC in remote medical education. The subject of research are the following issues: domestic and foreign MOOC, the universities offering medical MOOC, the languages used in teaching medical MOOC, the identification of MOOC, and the development of domestic and foreign medical MOOC on platforms of Coursera, edX.
(4) The reviews of MOOCs. Technological changes over the years of distance learning are most frequently analysed, and how relevant and beneficial these courses can be for distance learners. The studies also contain detailed information on various MOOC platforms, such as ALISON, Coursera, EduKart, edX, Iversity, Open Learning, The Open University, Udacity. The availability of MOOCs in various countries and the activities of various institutions and companies that provide MOOCs for academic environments are examined. Theoretical studies concern the limitations of MOOCs, their future, and business models and costs for MOOCs (Nisha & Senthil, 2015; Porter, 2015).

The research methodology deserves attention here. The Massive Open Online Course (MOOC) is an educational technology that includes both education and technological innovation. Some researchers believe that currently available MOOCs are very limited in terms of research methodology for this interdisciplinary area. The latest approach proposed examining the degree of complexity of MOOC in terms related to education and IT, and determining Mooc diffusion pattern at international and country-specific levels. The research used social network analysis, bibliometrics, text mining and idea of epidemic model (Guo & Zhang, 2017).

Another issue is understanding of the MOOC setting. The use of Netnography methodology can be helpful in this regard. "Netnography is a new qualitative method devised specifically to investigate the consumer behavior of cultures and communities present on the Internet" (Kozinets, 1998, p. 366). This methodology is a specific set of research practices related to data collection, analysis, research ethics and representation, based on observation of participants in a given

community. It is often used to study interactions and experiences manifested in digital communications. It has also been used to the Coursera community description (Saadatdoost, Sim, Jafarkarimi, & Hee, 2016).

An interesting issue raised in the latest literature is the cooperation between various institutions in creating MOOCs. An example of such cooperation is the MOOC titled "Changing Weather and Climate in the Great Lakes Region", initiated by the University of Wisconsin-Madison (University of Wisconsin–Madison, accessed 29 September 2019) and the Wisconsin Library Service in 2015. 21 public libraries took part in the preparation of the course. Thanks to the cooperation, forums were created where the residents of Wisconsin will study the changing weather and climate together with university faculty, students, librarians and the staff who managed this enterprise (Ackerman et al., 2016).

2.4 Effects of online course efficiency perceptions on Student Evaluation of Teaching (SET) measures

The Student Evaluation of Teaching (SET) is often used in assessing teacher performance, in making decisions regarding promotions and the term of office of employees. There has been a debate for a long time about the use of SET to evaluate learning outcomes. In general, there are two locations in the assessment of SET utility. Proponents of this method claim that SET are useful in the formal assessment of lecturers: "SETs serve to measure a school's effectiveness in support of its core mission, are valid measures based on feedback from the recipients of educational delivery, and provide formative feedback to improve faculty accountability to the institution" (Rowan, Newness, Tetradis, Prasad, Ko, & Sanchez, 2017, p. 1362). Opponents of this method believe that SETs should not be taken into account when hiring, because higher scores in SET do not correlate with good student performance. In addition, fear of student criticism can affect how content is presented and tested. Without prejudice to the validity of each of these concepts, we will briefly list the main assumptions of this method on the example of the principles published by one of the universities.

The Student Evaluation of Teaching (SET) should be part of an overall strategy to improve student learning. The SET should be used along with other assessment methods (e.g. mid-term feedback, peer observation, teaching portfolios). The university administration and staff should specify how information on student assessment is collected and what their purpose is. This information can be used in a variety of ways (e.g., providing information for course evaluation, feedback to lecturers, contributing to promotion, making employment decisions) (Iowa, 2019).

The literature on the subject was searched in selected databases and is presented in Table 1. As can be seen from the collected data, the majority of publications were registered in the LISTA database in 1981–2019. The numbers of records for

selected specific topics are: distance education (225), computer-assisted instruction (96), internet in education (79), online education (72), alternative education (47), information literacy (40), education (39).

2.5 New technologies for the DL

Distance learning technologies are changing rapidly and are moving from one innovation to another.

One of the negative aspects of constantly evolving technology is that teachers have trouble keeping up with change. As a result, there are sometimes delays between implementing a new technology and using it as an educational tool. However, the irresistible progress of information technology opens up new perspectives for DL (GoDistanceLearning.com, 2019, accessed 29 September 2019).

The literature on the subject was searched in selected databases and is presented in Table 1. As can be seen from the collected data, most publications were registered in the LISA database in the years 1982–2019. At the same time, the largest number of publications (199) falls in 2000–2009, and in the remaining decades respectively: 2010–2019 – (160), 1990–1999 – (62). The most frequently discussed specific topics included: distance learning (140), libraries (100), studies (89), librarians (67), learning (57), academic libraries (54), education (48), information technology (48).

2.6 Other research issues

The use of Metacognitive and Affective model Self-Regulated Learning (MASRL) is an interesting research field in DL. The SRL is closely adapted to the interests of teachers. It refers to learning based on "metacognition (thinking about one's own thinking), strategic action (planning, monitoring, and assessing personal progress against the standard) and motivation to learn" (Wikipedia, 2019e, accessed 29 September 2019e). "Self-regulation" describes the process of taking control and assessing your own learning and behaviour (Ormrod, 2009).

Literature reviews indicate a positive relationship between self-regulation, the use of learning strategies and academic achievement. Research results indicate that distance learners who have successfully completed the academic module use more and/or other self-regulating learning strategies than failed students (Bothma, Monteith, 2004).

The literature on the subject was searched in selected databases and is presented in Table 1. The data in the table shows that most publications were registered in the ERIC database in the years 2000–2019. The numbers of records on selected specific topics are: higher education (51), online courses (31), postsecondary

education (29), learning strategies (25), electronic learning (23), foreign countries (23), and metacognition (20).

Questionnaire (Constructivist Learning on a Scale Higher Settings of Education [CLHES]) is a method of research of constructivist learning environment in higher education. Constructivism can be defined basically as a learning approach, which defends that students subjectively construct, interpret and reorganise their knowledge (Windschitl, 1999). This approach proves to encourage students to discover, discuss and interpret knowledge and organise educational environments to help them create and implement their own theories and motivate to reflect acquired knowledge and skills (Jonassen, 1999; Cirik, Çolak, & Kaya, 2015).

The literature on the subject was searched in selected databases and is presented in Table 1. As can be seen from the collected data, most publications were registered in the LISA database in the years 2001–2019. At the same time, most publications were published in 2007 – (10), and in other years respectively: 2004 – (7), 2005 and 2006 – after (6) publications, 2011 and 2015 – after (5) publications. Since 2016, there has been a decrease in the number of publications (two or fewer publications per year). The most frequently discussed specific topics included: distance learning (33), online instruction (23), studies (19), learning (13), students (12), academic libraries (11), information literacy (11), teaching methods (9).

Conclusions

The most researched and developed topics related to DL include:
(1) New technology for the DL: 425 bibliographic records of papers published in 1982–2019 were registered in the LISA database, although the first publications on this subject appeared in the 1970s.
(2) Student evaluation of teaching in the DL method: The largest number of bibliographic records (348) of papers published in 1981–2019 were registered in the ERIC database.
(3) Problem-based learning in the DL method: 142 bibliographic records of papers published in the years 1992–2019 were registered in the ERIC database, and 129 bibliographic records of papers published in the years 1994–2019 were registered in the LISA database.

The oldest publications related to DL come from the 1970s and 1980s. These are publications on new technologies, problem-based learning and theory of transactional distance in DL. In the latest literature on the subject, publications

on the theory of constructivist learning, self-regulated learning and MOOC are most frequently represented.

Also noteworthy are the results of the analysis of the most frequently undertaken specific topics (exactly the subjects assigned to registered publications) in the context of DL. It should be noted that the most frequently mentioned subjects are: higher education (4 mentions), academic library (3), and foreign country (3). In addition, groups of topics can be distinguished, such as: *learning* – learning strategies – electronic learning; *student* – student attitudes – teacher-student relationship; *libraries* – academic libraries – librarians; *education* – higher education – postsecondary education (see Table 2).

Table 2

List of subjects most frequently assigned to bibliographic records (number of occurrences) in selected databases (as of September 29, 2019)

Topic 2.1. Transactional Distance	Topic 2.2. Problem-Based Learning	Topic 2.3. MOOC	Topic 2.4. Student Evaluation of Teaching	Topic 2.5. New Technologies	Topic 2.6. Self-Regulated Learning	Topic 2.7. Constructivist Learning
higher education (77)	distance education (124)	distance learning (112)*	distance education (225)	distance learning (140)*	higher education 51)	distance learning (33)*
foreign countries (45)	problem-based learning (111)	online instruction (80)	computer-assisted instruction (96)	libraries (100)*	online courses (31)	online instruction (23)*
postsecondary education (44)	higher education (104)	open learning (30)*	internet in education (79)	studies (89)*	postsecondary education (29)	studies (19)*
online courses (43)	foreign countries (64)	students (30)*	online education (72)	librarians (67)*	learning strategies (25)	learning (13)*
educational technology (41)	educational technology (57)	higher education (24)*	alternative education (47)	learning (57)*	electronic learning (23)	students (12)*
student attitudes (31)	postsecon dary education (53)	academic libraries (22)	information literacy (40),	academic libraries* (54)	foreign countries (23)	academic libraries* (11)
teacher student relationship (27)	online courses (50)	computer assisted instruction - CAI (20)	education (39)	education (48)	metacognition (20)	information literacy (11)

S o u r c e: Own work

These topics/topic groups are most frequently represented in the discussed literature and reflect the directions of research in the field of DL.

In conclusion, based on the analysis of the literature on the subject, four directions for further research on DL can be distinguished: education (especially higher education), learning, libraries (especially academic libraries) and student.

The level of DL development varies from country to country. Permanent participation in vocational and lifelong learning, determining the benefits of DL, insufficient number of teachers prepared to conduct classes using DL, inefficient way of implementing DL, and no legal regulations deciding about the development of DL. The question of whether DL is the education of the future is still open.

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Jolanta Szulc

Nauka na odległość – aktualny stan i kierunki badań

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

Celem artykułu jest omówienie aktualnych trendów i badań w dziedzinie kształcenia na odległość (DL). Artykuł składa się z następujących części: (1) definicje i cechy DL; (2) współczesne kierunki badań w dziedzinie DL, w tym między innymi: mierzenie odległości transakcyjnej w internetowych środowiskach nauczania, uczenie się oparte na problemach (PBL) w DL, opracowywanie treści edukacyjnych i zadania dla MOOC, efekty wydajności kursów online, postrzeganie miar oceny nauczania przez uczniów (SET), nowe technologie dla DL, stosowanie metapoznawczego i afektywnego modelu samoregulowanego uczenia się (MASRL), kwestionariusz konstruktywistycznego uczenia się (CLHES) jako metoda badań konstruktywistycznego środowiska uczenia się w szkolnictwie wyższym, teoria odległości transakcyjnej (TD) w kulturze DL społeczności internetowej; (3) podsumowanie i wnioski ze szczególnym uwzględnieniem zastosowania metod DL w szkolnictwie wyższym. Metoda badawcza: badanie literatury zarejestrowanej w bazach danych ERIC, LISA, LISTA.

S ł o w a k l u c z o w e: nauczanie konstruktywistyczne, kształcenie na odległość, masowe otwarte kursy online, uczenie się oparte na problemach, uczenie się z samoregulacją, ocena nauczania przez uczniów, odległość transakcyjna

Jolanta Szulc

Дистанционное обучение – современное состояние и научные направления

А н н о т а ц и я

Целью статьи является обсуждение современных тенденций / исследований в области дистанционного обучения (ДЛ). Статья состоит из следующих частей: (1) определения и характеристики DL; (2) текущие направления исследований в области DL, среди прочих: измерение транзакционной дистанции в веб-среде обучения, проблемное обучение (PBL)

в DL, разработка учебного контента и задачи для MOOC, эффекты эффективности онлайн-курса представления о показателях оценки учащихся (SET), новых технологиях для DL, использования метакогнитивной и аффективной модели саморегулируемого обучения (MASRL), вопросника («Конструктивистское обучение по шкале более высокие настройки образования» [CLHES]) в качестве метода исследования конструктивистской среды обучения в высшем образовании, теории транзакционной дистанции (TD) в DL и культуре онлайн-сообщества; (3) резюме и выводы с особым акцентом на использование методов DL в высшем образовании. Метод исследования: изучение литературы, зарегистрированной в базах данных ERIC, LISA, LISTA.

К л ю ч е в ы е с л о в а: конструктивистское обучение, дистанционное обучение, массовые открытые онлайн-курсы, проблемное обучение, саморегулируемое обучение, оценка преподавания студентами, транзакционная дистанция

Jolanta Szulc

Aprendizaje a distancia: el estado actual y las direcciones de investigación

R e s u m e n

El artículo tiene como objetivo discutir las tendencias / investigaciones actuales en el campo de la educación a distancia (DL). El artículo consta de las siguientes partes: (l) las definiciones y características de DL; (2) investigación de direcciones actual en el campo de DL, entre otras: medición de la distancia transaccional en entornos de aprendizaje basados en la web, aprendizaje basado en problemas (PBL) en DL, desarrollo de contenido de aprendizaje y la tarea de MOOC, efectos de la eficiencia del curso en línea percepciones sobre las medidas de Evaluación de la Enseñanza del Estudiante (SET), nuevas tecnologías para la DL, el uso del modelo metacognitivo y afectivo de Aprendizaje Autorregulado (MASRL), cuestionario (Aprendizaje constructivista en una escala de ajustes superiores de educación [CLHES]) como método de investigación del ambiente de aprendizaje constructivista en educación superior, teoría de la distancia transaccional (TD) en DL y cultura de la comunidad en línea; (3) resumen y conclusiones con un enfoque particular en el uso de métodos DL en la educación superior. Método de investigación: estudio de la literatura registrada en las bases de datos ERIC, LISA, LISTA.

P a l a b r a s c l a v e: Aprendizaje constructivista, Aprendizaje a distancia, Cursos abiertos masivos en línea, Aprendizaje basado en problemas, Aprendizaje autorregulado, Evaluación estudiantil de la enseñanza, Distancia transaccional

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Video Library of Mathematics Lessons as a Means of Methodological Training for Future Primary School Teachers

Abstract

The authors substantiate the expediency of using video lessons and their fragments in the process of forming future teachers' professional competency. The elaborated library includes video recordings of real mathematics lessons at primary school and videos of pupils solving certain types of problems with full commentaries, structured by classes and topics. The methods of using the video library by educators in the field Methods of Teaching Mathematics in Primary School and students majoring in specialty 013 Primary Education were developed. The effectiveness of using the video library as a means of teaching the course Methods of Teaching Mathematics in Primary School was verified experimentally by introducing it into the educational process of three Ukrainian universities.

K e y w o r d s: methods of teaching mathematics in primary school, a video fragment of a mathematics lesson, video library

The formation of methodological competency in teaching mathematics to students as one of the main components of professional competency of primary school teachers in Ukraine, takes place within the course of studying the discipline Methods of Teaching Mathematics. The conducted research (Verbytsky & Bakshaeva, 1997; Skvortsova, 2015; Korol, 2005; Fritsko et al., 2007) and the practice of higher education in Ukraine proved the expediency of involving students in lectures, practical and laboratory classes in quasi-professional activities. In the process of quasi-professional activity, future teachers imitate certain elements of the teacher's activity by analysing, imitating, and reproducing the samples of primary school teacher's activity in standard and non-standard conditions. Definitely, students should systematically observe mathematics lessons at primary school, analyse them, determine the purpose of each stage of the lesson, the purpose of using certain tools and methods of teaching, the effectiveness of the teacher's actions and so on. It is possible to realise this need in practice only by attending mathematics lessons as a part of practicum period and in laboratory classes, which is not sufficient for the formation of future primary school teachers' methodological competency.

During lectures, students receive samples of future professional activities from the instructor, who analyses and simulates the activity of the teacher when considering a particular issue. In order for the instructor to be able to analyse the teacher's activity, students must first see how the teacher actually works, and this is possible by including certain fragments of lessons' videos in the content of the lecture.

In laboratory classes, observing the teacher's activity in real mathematics lessons, students present the results of their own analysis of the teacher's professional activity in teaching pupils certain topics of mathematics. Laboratory classes can be held both at school, where students observe a real mathematics lesson, and at university, as it is not always possible to arrange attending of mathematics lessons in a primary school within the schedule of the university classes. In addition, students must learn from the best examples of the teacher's methodological activity, which cannot always be provided at the school closest to the university. In this case, videos of real mathematics lessons in primary school or their fragments could be useful. In practical classes, students already have the opportunity to test themselves by imitating, playing situations related to the application of basic knowledge and methods of action, by familiarising themselves with new material, by the formation of concepts, skills and abilities. Thus, in order to organise laboratory classes conducted within the university, there is a need to provide opportunities for watching video recordings of mathematics lessons conducted by the best primary school teachers in Ukraine with their subsequent analysis.

Thus, a necessary foundation for students' quasi-professional activity is the observation of teachers' work in real mathematics lessons, which is possible both at school and at the university during laboratory classes. But, as evidenced by the analysis of normative programmes of the discipline Methods of Teaching Mathematics in Primary School in 12 higher education institutions of Ukraine, which we carried out within the framework of the summative experiment, 6 universities do not provide laboratory classes; their curriculum contains only lectures and practical classes. And this significantly reduces the possibility of involving students in the analysis of the best examples of primary school teachers' methodological activity. In this case, the importance of watching videos of real mathematics lessons in practical classes is growing.

Thus, the study of the course Methods of Teaching Mathematics requires those learning resources that create the opportunity to engage students in the analysis of mathematics lessons, and video recordings of real mathematics lessons conducted by the best primary school teachers could serve as such a tool.

The summative experiment also included a survey of 20 teachers of the subject Methods of Teaching Mathematics (K. Ushynskyi South Ukrainian National Pedagogical University, Kherson State University, Berdiansk State Pedagogical University, Vasyl Sukhomlynsky Mykolaiv National University, Vasyl Stefanyk Precarpathian National University and others); in the course of the experiment, it was found that a significant number of teachers use video materials (videos of mathematics lessons' fragments) both in the classroom (80%) and in the process of students' self-guided work (60%). Although almost all the teachers (95%) are convinced that it is appropriate to use relevant videos, only about 20% of them do so regularly, which is obviously due to the lack of these video resources. Thus, only 10% of respondents confirmed that they already have all the necessary mathematics lessons' videos, and the rest (90% of teachers) would like to have a bank of such videos to facilitate students' mastery of the subject Methods of Teaching Mathematics in Primary School (illustrations of certain stages of lessons, application of learning technologies in mathematics lessons, various forms of work or certain methodological approaches, etc.) (Skvortsova, 2017).

The lack of a substantiated selection of mathematics lessons' videos at primary school and the objective need of lecturers in the field of Methods of Teaching Mathematics for specialty 013 Primary Education to use video materials, necessitated developing the video library of mathematics lessons at primary school and introducing it into the educational process in Ukraine.

It should be noted that despite the obvious methodological expediency of using lessons' video recordings in the process of mastering methodological disciplines by future teachers, the scientific literature still does not describe the experience of creating and using such teaching aids.

Thus, the researchers (Blomberg, Sturmer, & Seidel, 2011; Masats & Dooly, 2011; Gaudin & Chalies, 2015; Noskova, Pavlova, Yakovleva, & Smyrnova-Trybulska, 2017; Smyrnova-Trybulska et al., 2016; Seidel, Blomberg, & Renkl, 2013; Christ, Arya, & MingChiu, 2017) described general aspects of using video in pedagogical education. In the scientific and methodological literature we find some references concerning the use of video materials in lectures and practical classes on the methods of mainly secondary school in the form of videos showing physical or chemical experiments, reconstruction of historical events or videos with native speakers (Michael & Sherry, 2019). Erica Litke's research is about using videos of algebra lessons in training future mathematics teachers. V. Zhelanova dwells upon the possibilities of using visualising lectures and provides an example of using "cut" fragments of video recordings of lessons in primary school within the framework of studying the subject Didactics of Primary School emphasising that it facilitates the perception of verbal, theoretical information by supporting visual impressions. Instead, the use of video recordings of mathematics lessons in primary school for methodological training of future teachers is somewhat neglected by scholars.

1. Video Library of Mathematics Lessons in Primary School as a Means of Teaching "Methods of Teaching Mathematics"

1.1. Structure, Contents and Interface of the Video Library

Based on the analysis of the Draft Sectoral Standard of Higher Education in specialty 013 Primary Education and the updated regulatory support of primary education (State Standard of Primary Education, Standard educational programmes), as well as Normative programmes of the subject Methods of Teaching Mathematics, in previous studies, we substantiated the expedient content of this academic subject (Skvortsova, 2015).

On the basis of the developed appropriate content of the subject, we determined the topics of mathematics lessons at primary school, which illustrate some issues of the Regulatory programme of the course, we selected primary school teachers from our, Southern, region of Ukraine, whose methodological activity in the field of teaching mathematics is worth following. The teachers of the institutions listed next agreed to take part in the experiment: teachers of the Nikolaev municipal board who are winners of the all-Ukrainian competition "Teacher of the year" (Hubanova T.O.), winners of regional competitions (Melnichuk L.I., Diomina T. M.), teachers and teacher trainers (Shelim O. I., Yukhymuk T.P.). We also recorded the process

of solving certain types of tasks by the college students with full commentaries. At the same time, of great interest for teaching the course Methods of Teaching Mathematics are videos of lessons of the best primary school teachers in Ukraine, which were presented at the All-Ukrainian competition "Teacher of the year".

According to the topics and subtopics determined in the content of the discipline (S. Skvortsova, 2017), all these videos were divided into fragments in order to illustrate certain aspects of lectures, practical/laboratory classes, and thus to create a video library of mathematics lessons at primary school and their fragments.

The developed video library is located in the electronic course Methods of Teaching the Educational Branch "Mathematics", created in the system of distance learning of the Kherson State University "KSU Online" (http://ksuonline.kspu.edu/course/view.php?id=1078) (Figure 1).

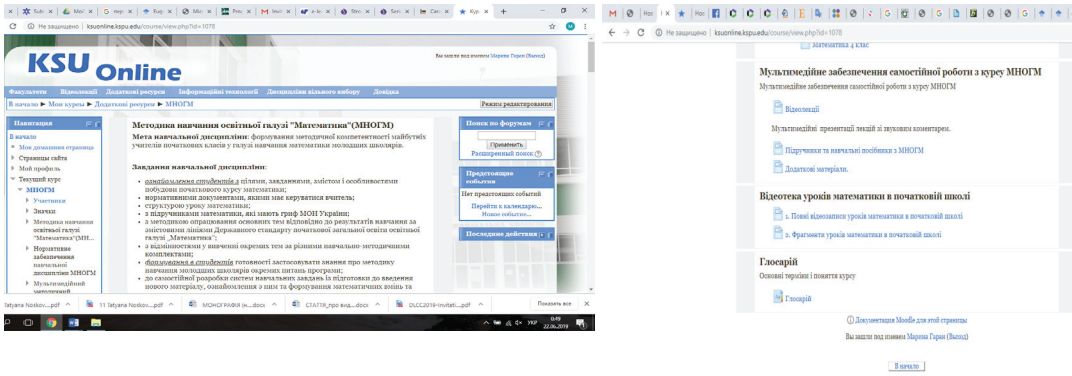

Figure 1. Location of a video library of mathematics lessons at primary school on the site of "KSU Online"
S o u r c e: Own work.

The course *Methods of Teaching Mathematics* is structured by sections, which in turn, may contain several topics. Thus, the first section contains one topic: "Methodological system of teaching mathematics to primary school pupils." The following subtopics form the content of this topic: 1. Methods of teaching mathematics as a science and as a subject. 2. The aim and objectives of teaching mathematics in primary school under the new version of the State Standard of Primary Education (2018). 3. The content of teaching mathematics at primary school. Typical educational programme for years 1–2 (2018); 3–4 (2019). 4. Methods and forms of teaching mathematics in primary school. Modern educational technologies in teaching mathematics in primary school. Lesson model built according to different learning technologies. 5. Means of teaching mathematics in primary school.

Obviously, not all the aspects of the topic should be accompanied by illustrations. The video library presents video clips that illustrate only questions 4 and 5 of the topic. Moreover, methods, forms of teaching, technologies and teaching aids are illustrated by several fragments of lessons on different topics of mathematics in the grades 1–4, which creates an opportunity for teachers of the subject Methods of Teaching Mathematics to choose a video based on their own lectures and preferences. In the video library there are fragments of applied problem-searching teaching methods, interactive technology of training; videos illustrating the work with various teaching aids in mathematics – visual aids and didactic materials (for example, textbooks, exercise books, multimedia presentations, valuable material by M. Montessori, Cuesser sticks, dominoes, sets of geometric shapes, Lego bricks, etc.).

The second section also contains one topic: "Modern mathematics lesson in primary school." The topic includes the following subtopics: 1. Calendar and thematic planning of mathematics lessons. 2. The purpose and objectives of mathematics lessons. 3. The structure of the combined lesson of mathematics. 4. Motivation of pupils' educational and cognitive activity. 5. Application of basic knowledge and students' ways of acting. 6. Familiarisation with new educational material and its mastering. 7. Consolidation. Formation of skills and abilities. 8. Reflection on students' educational and cognitive activity in the classroom.

This topic is also properly presented in the video library, in particular, subtopics 4–8 are illustrated by various video fragments that demonstrate the variability of certain stages of mathematics lessons at primary school (Figures 2 and 3).

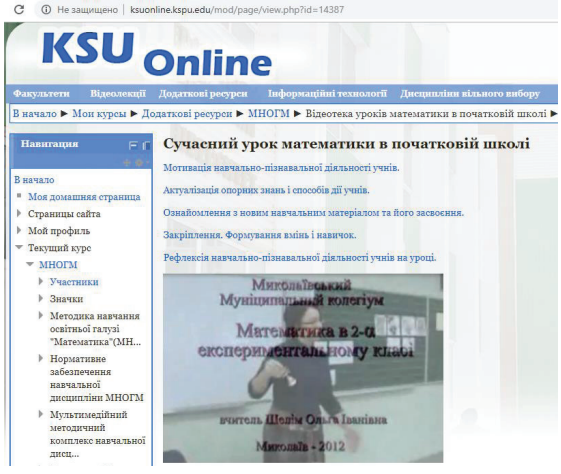

Figure 2. The section of the video library: "Modern mathematics lesson in primary school"
Source: Own work.

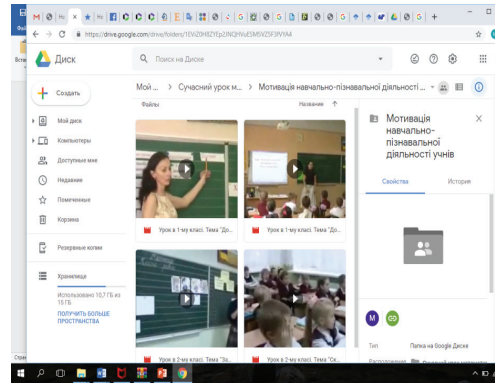

Figure 3. Content of the subsection "Motivation of pupils' educational and cognitive activity" in the second section of the video library
Source: Own work.

The third section is divided into six subsections, each of which contains several topics.

1. Methods of realising and systematising mathematical knowledge of the first-year pupils obtained in the preschool period.
2. Methods of teaching counting and arithmetic operations on numbers in the course of elementary mathematics. This section provides a study of several topics: “Methods of teaching the first ten counting numbers”; “Methods of forming computational skills of addition and subtraction within 10”; “Methods of teaching the first hundred counting numbers”; “Methods of forming computational skills of addition and subtraction within 100 not crossing the boundary”; “Methods of forming computational skills of addition and subtraction within 20 with crossing the boundary”; “Methods of forming computational skills of addition and subtraction within 100 with crossing the boundary”; “Methods of computational skills of table multiplication and division”; “Methods of studying the counting numbers in the concentre? ‘Thousand’”; “Methods of forming computational skills of addition and subtraction within 1000”; “Methods of forming computational skills beyond table multiplication and division”; “Methods of teaching multi-digit numbers counting”; “Methods of forming computational skills in the concentre? ‘Multi-digit numbers’”; “Methods of forming the understanding of the concept ‘parts of value’ ”; “Methods of forming the understanding of the concept of fraction” (Skvortsova, & Haran, 2017). Additionally, each of the topics is explained in a system of aspects: 1) the content and learning outcomes of the topic according to the Standard curriculum; 2) visual aids and didactic material; 3) the procedure for studying the topic according to current textbooks; 4) methods of teaching certain aspects of the topic; 5) implementation of the new curriculum’s content in existing textbooks.

These topics include video recordings of the lessons on updating the basic knowledge and ways of pupils’ activity, creating and solving a problem situation, pupils discovering possible way of solving the problems, as well as video recordings of pupils performing certain calculations. Thus, the teacher can include certain video fragments in the content of the lecture if necessary. In practical classes, the teacher can use videos of pupils solving certain problems both to motivate students’ learning activity and to analyse and evaluate students’ problem-solving skills (e.g. Figure 4).

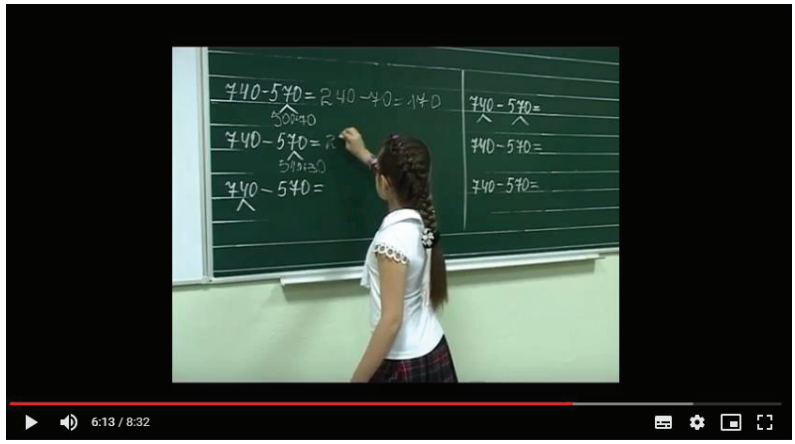

Figure 4. Video fragment of problem solving including applying the methods of calculation within a thousand
S o u r c e: Own work.

3. The subsection "Methods of teaching values and their measurement" covers the following topics: "Methods of teaching basic values and their measurement: length, weight, capacity; time," "Area of the figure." The content of the first topic unfolds in several subtopics: 1) Values in the course of elementary mathematics; 2) Learning content and outcomes; 3) Methods of studying certain topics of the curriculum: 1st grade, 2nd grade, 3rd grade, 4th grade. It is the last topic that is illustrated in the video library by video recordings of mathematics lessons in different classes of primary school, during which pupils learn about certain values.
4. "Methods of teaching mathematical expressions, equations and inequalities." The subsection is focused on the topic: "Algebraic material in the course of elementary mathematics." Its content is reflected in the following subtopics: 1) The content of the algebraic material of elementary mathematics; 2) Mathematical expressions: numeric and alphanumeric; 3) Numerical equality and inequality: the dependence of the result of the arithmetic action on the change of the component; 4) The equation; 5) Solving problems using equations; 6) Inequality with a variable.

Here, besides the videos of teacher's methodological activity, there are interesting videos of pupils' comments on solving simple and complex equations (equations in which the right part is represented by a numerical expression, equations in which one of the components is represented by a numerical expression, equations in which one of the components is given as the expression with a variable), pupils' video comments on solving inequalities with one variable in different ways.

5. The subsection: "Methods of teaching the solving of mathematical word problems" represents the following topics: "Methods of teaching the solving of mathematical word problems: general questions," "Methods of forming the skills of solving simple mathematical problems in the 1st grade"; "Methods of forming the skills of solving simple mathematical problems in the 2nd grade"; "Methods of introducing the concept of 'a complex mathematics problem'"; "Methods of forming the skills of solving simple mathematical problems in the 3rd and 4th grades"; "Methods of forming the skills of solving complex mathematical problems in the 3rd grade"; "Methods of forming the skills of solving mathematical problems finding 4-th proportional"; "Methods of forming the skills of solving mathematical problems on a double conversion to one"; "Methods of forming the skills of solving mathematical problems on proportional division," "Methods of solving the mathematical problem on finding unknown by two differences"; "Methods of forming the skills of solving mathematical problem for joint work"; "Methods of forming the skills of solving problems on the movement."

The content of each topic, which relates to the methods of forming the skills for solving typical problems, covers several subtopics: 1) the content and results of learning the topic of the new curriculum; 2) the content and methods of preparatory work; 3) introduction of a new type of tasks; 4) formation of the ability to solve problems.

In lectures and laboratory classes, teachers can use the following video clips: "Introducing simple problems to first-year pupils," "Introducing inverse problems to first-year pupils," "Introducing complex problems to second-year pupil," "Work on complex tasks," etc. In practical classes, to analyse and evaluate pupils' activity on solving simple and complex, including typical, problems, teachers can offer students to watch videos of real pupils solving them.

6. The subsection "Methods of teaching spatial relations and geometric figures," contains the topic: "Methods of teaching elements of geometry in the course of elementary school mathematics," which is studied through the following subtopics: 1) the content of the geometric material of the elementary mathematics course; 2) the order of studying the elements of geometry at primary school; 3) methods of forming geometric ideas and concepts: about a point, a line, a curve, a segment, and a broken line; polygons and their elements; an angle, types of angles; a rectangle and a square; a circle, a round and their elements; geometric shapes in space. This topic is illustrated in the video library by some video fragments: "Forming the idea about a point, a line, a curve, a segment and a broken line"; "Forming the idea about polygons and their elements"; "Forming the idea about an angle, types

of angles"; "Forming the idea about a rectangle and a square"; "Forming the idea of a circle, a round and their elements"; "Geometric shapes in space."

When developing the interface for the created video library, we proceeded from the need to provide teachers of the subject Methods of Teaching Mathematics in Primary School with the opportunity to work with both full-length videos of mathematics lessons and their fragments. Therefore, the structure of the video library contains two blocks: (1) Full-length videos of mathematics lessons at primary school. (2) Fragments of mathematics lessons at primary school. Both blocks are structured in accordance with the sections and topics determined by the content of the subject Methods of Teaching Mathematics in Primary School. The second block, which contains fragments of lessons, is also structured according to corresponding aspects of the topic. The interface consists of a list of sections, topics and subtopics, which, with the help of hyperlinks, redirects the teachers to the video file they need.

1.2. Checking the Efficacy of UsingVideo Library Materials in Forming Future Teachers' Methodological Competency

At the formative stage of the experimental study (2016–2018,) teachers of the subject Methods of Teaching Mathematics of Kherson State University, Vasyl Stefanyk Precarpathian National University, and K. Ushynskyi South Ukrainian National Pedagogical University, who were part of the experimental group, used the proposed materials of the video library in the classroom and offered them for students' self-guided work. The teachers of the subject Methods of Teaching Mathematics of Izmail State Humanities University, Berdiansk State Pedagogical University, Vasyl Sukhomlynsky Mykolaiv National University, who formed the control group of the study, used only their own materials in the educational process.

Thus, it was sufficient for the teachers of the experimental group, when preparing for the lecture, to find out, in accordance with the topic of the lesson, which topics should be illustrated with video material, and to choose from the video library the necessary lesson or video recording of pupils solving certain problems. The teacher had the opportunity to use either full-length video or its fragment using the materials of the first or second block of the video library, respectively. In addition, if there was a need to demonstrate part of the fragment, the lecturer could turn on the video from the particular moment (e.g., they could show not the whole fragment, but only part of it from 3:45 to 7:28), or edit (cut out) the required fragment of the video file using special applications (e.g., Windows Movie Maker (Smyrnova-Trybulska, 2016) (had there been an appropriate software on the computer), or by using online services such as Online Video Cutter, etc.) and add it to the lecture.

During the practical classes, the teachers of the experimental group used the materials of the video library both as material for analysing the structure of classes and teacher's activity, and to illustrate methodological approaches for mastering a particular concept or skill or in implementing a particular learning technology as a sample of activity for future teachers. In addition, teachers used video fragments of classes to motivate students' learning activity.

Using video fragments of mathematics lessons at primary school, the teacher formulated *a learning task*: to analyse and evaluate the teacher's activity on organising certain stages of the lesson.

Using video recordings of mathematics lessons at primary school, the teacher implemented another *learning task:* to assess the correctness of the solution and the completeness of its explanation by the pupil.

To perform, in course of self-guided work, tasks such as "Prepare a lesson plan and summary" or "Develop systems of learning tasks," students were offered to view video fragments of mathematics lessons at primary school as an example of implementing a plan or the system of learning tasks etc. Analysing the lesson after watching the video in the process of self-guided work, students were asked to answer the questions, such as: What is the purpose and didactic task set by the teacher for the lesson?; What is the developmental and educational task of the lesson?; What type of lesson it is?; What educational content they consolidated at the stage of applying basic knowledge?; What is the need for its application?; How the teacher organised the stage of introducing new material and methods of performing tasks?; What methods and technologies he/she used?; What educational content was offered by students at the consolidation stage?; Formation of skills and abilities; what forms of work were used by the teacher at this stage?; What was the work of students in the classroom like (activity, independence, desire to work, correct answers)?; How the teacher summed up the lesson?; Whether the teacher has solved the tasks of the lesson?; What are students' personal impressions from the lesson?; What is needed to conduct lessons at a high level?; What is the purpose of mastering the course Methods of Teaching Mathematics?; What tasks students face during the study of mathematics?, etc.

Teachers of the control group noted that they did not use lessons' video fragments in teaching the subject Methods of Teaching Mathematics in Primary School or used them only from time to time, if any were available.

At the end of teaching the course, in order to check the effectiveness of the created video library a survey of teachers was carried out. During the interview, the teachers of the experimental group mentioned the convenience of using the video library and facilitation of the process of preparing a lecture, practical or laboratory lesson; they much more often illustrated methodical approaches, technologies and

methods of teaching with video recordings. Teachers of the control group claimed that they had difficulties in selecting video recordings of lessons, so they more often declined the opportunity to use video materials.

Summing up the results of the survey, we found that according to the teachers of the experimental groups, the quality of lectures and practical classes had increased due to the practical orientation of their content, emotional impact on students, they promoted the formation of students' cognitive interest in mastering methods of teaching mathematics at primary school. They underlined a more meaningful perception of educational material by students; students noted that the use of video fragments of mathematics lessons contributed to a better memorisation of learning content due to the opportunity to reproduce and imitate the teacher's activity. The organisation of educational activity for mastering the subject Methods of Teaching Mathematics using the video library materials helped students to obtain algorithms and quasi-algorithms for solving methodological problems that arise in the process of teacher's methodological activity. According to the teachers of the experimental group, the demonstration of video fragments of real mathematics lessons at primary school facilitates the application of knowledge of the subject Methods of Teaching Mathematics in practice – in direct professional activity. Thus, due to watching and analysing the video fragments of mathematics lessons at primary school, due to the involvement of students in quasi-professional activity during practical and laboratory classes, students' practical readiness to teach pupils mathematics, in particular, a special methodological component of methodological competency is formed (Skvortsova, 2017).

In addition to interviewing the teachers of the course Methods of Teaching Mathematics," in order to determine the level of future primary school teachers' methodological competency, including its special and methodological, projecting and modelling, controlling and evaluative components, according to set criteria and indicators, a control check was conducted among students of specialty 013 Primary Education at the universities selected by us as experimental and control institutions.

We will present only generalised criteria for the formation of future primary school teachers' methodological competency in teaching mathematics at primary school.

The motivational criterion – characterises the level of formation of internal motives and motivations, aspirations for perfect professional activity in teaching mathematics, interest in professional activity, desire for professional growth and creativity in teaching mathematics to primary school pupils in future primary school teachers. *The content criterion* characterises the degree of future teacher's mastery of methodological knowledge on teaching mathematics to primary

school pupils. *The operational and activity-oriented criterion* marks the level of future primary school teacher's mastery of the system of methodological abilities and skills necessary for successful teaching mathematics to pupils; ability to construct and design mathematics lessons, use modern pedagogical technologies and introduce innovative approaches to teaching junior pupils mathematics.

Among the generalised indicators that reflect each of the described criteria, it is worth mentioning: *motivational criterion*, reflected in the desire of the future primary school teacher to perfect professional activity in teaching mathematics; *content criterion* – through methodological knowledge; operational and *activity-oriented criterion* – through methodological skills.

According to the outlined criteria and indicators, for each component of methodological competency four levels of formation of future primary school teacher's methodological competency are described: low, average, sufficient, high. Here are the generalised levels of formation of future primary school teacher's methodological competency in teaching pupils mathematics:

– *low level* – characterised by a lack of desire for perfect methodological activity on teaching pupils mathematics (motivational criterion), fragmentary methodological knowledge, skills that are insufficient to perform professional functions (content and operational criteria);
– *average level*, which is characterised by situational or poorly expressed desire to effectively teach mathematics to primary school pupils (see *motivational criterion*), partial mastery of methodological knowledge, unconscious and non-generalised skills to apply acquired knowledge, ability to work only according to the model or with the help of the teacher, etc. – *activity-oriented criterion*;
– *sufficient level,* which is characterised by a strong desire for effective teaching mathematics to primary school pupils (*motivational criterion*), the presence of complete, generalised knowledge of methodology, the skills and ability to apply it independently in educational, cognitive and practice-oriented situations (*content and operational criteria*) ;
– *high level*, which is characterised by the desire to creatively implement the acquired knowledge and skills in the process of teaching mathematics to primary school pupils (*motivational criterion*), creative approach to teaching primary school pupils mathematics and the ability to create innovative methodological approaches (*content and operational criteria*).

Check of the outlined levels of methodical competency's formation took place in the form of testing. The control check contained three tests, each of them involved determining the level of formation of special and methodological, projecting and modelling, control and evaluative components of methodological competency. It should be noted that we understand special and methodical

component as the ability to form in pupils all the elements of the subject's content, which is based on students' theoretical and practical readiness to teach any topic of the curriculum. The control and evaluative component of future primary school teachers' methodological competency manifests itself in the teacher's readiness to implement the criteria for assessing student's achievement and the ability to adequately assess student's achievement. The projecting and modelling component of the teacher's methodological competency is understood as the ability to design the learning process of the subject during the school year, to design lessons according to different teaching and methodological kits, in accordance with modern requirements, the ability to model teacher and pupil activities at each stage of the lesson aimed at achieving learning outcomes (Skvortsova S.).

Each test included both close-ended tasks involving the selection of one or more correct answers (mostly reproductive and partially productive), and open (partially productive, productive, and creative). Each test contained two options of five questions.

Testing confirmed a slightly higher level of indicators of the special and methodological component within the methodological competency of students in the experimental group, compared with the control one (Figure 5).

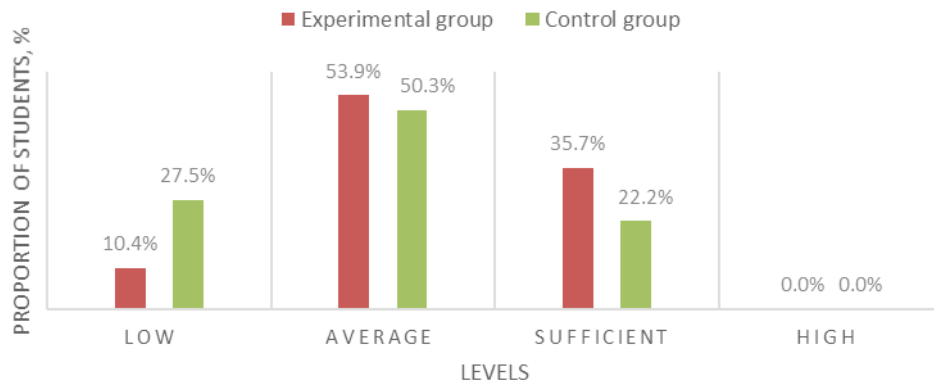

Figure 5. Distribution of experimental and control group students by the levels of formation of methodological competency's special and methodological component
S o u r c e: Own work.

Moreover, teachers noted that they noticed some influence, due to the possibility of using video fragments of mathematics lessons or videos demonstrating the thoughts of real pupils, on the formation of the control and evaluative component of future primary school teachers' methodological competency. Thus, there is an opportunity for students in the course of practical/laboratory classes when watching video fragments of lessons with pupils solving

certain problems, to evaluate pupils' answers implementing the criteria for assessing their performance. It should be noted that the control and evaluative component of the methodological competency is usually formed mainly during the direct practical training of students – during pedagogical internship, so video fragments of lessons create certain prerequisites for the formation of this component during practical/laboratory classes.

At the same time, the teachers of the control group stated that they have almost no opportunity to form the control and evaluative component of students' methodological competency in the classroom. And the students themselves, as testing showed, demonstrated a low level of implementing the criteria for assessing pupils' achievements in mathematics. Instead, students whose teachers of the experimental group worked with using the materials of the video library, showed a relatively higher level of this indicator's formation (Figure 6).

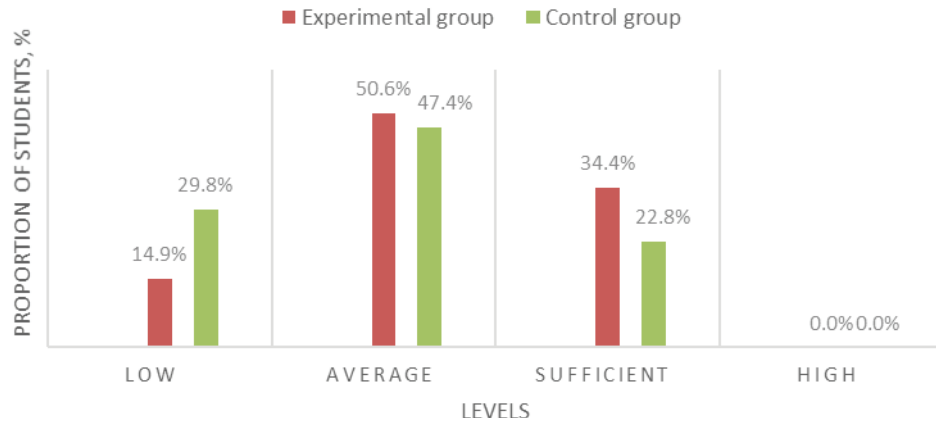

Figure 6. Distribution of experimental and control group students by the levels of the formation of methodological competency's control and evaluative component
S o u r c e: Own work.

Thus, the results of the study showed an increase in the level of the projecting and modelling component's formation in students of the experimental group (Figure 7). The students of the experimental group revealed a more thorough knowledge of the methods of organising pupils' activity and managing these activity in the process of teaching mathematics to primary school pupils; methods, forms, and means of teaching mathematics to primary school pupils, as well as the ability to select them. In addition, students who regularly had the opportunity to watch video fragments of real mathematics lessons, showed the ability to create projects of mathematics lessons according to different teaching kits.

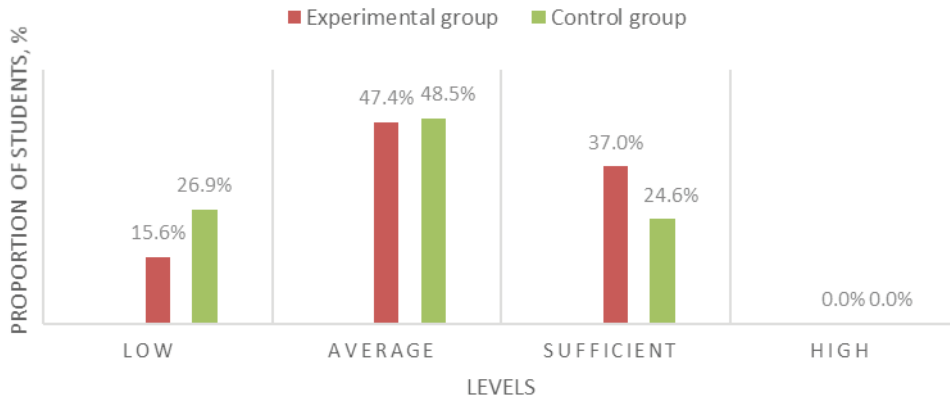

Figure 7. Distribution of experimental and control group students by the levels of formation of methodological competency's projecting and modelling component
S o u r c e: Own work.

Thus, the study confirmed the positive impact of the developed video library on the formation of future primary school teachers' methodological competency, in particular its special and methodological, control and evaluative, projecting and modelling components.

It is also worth noting that both teachers and students emphasise that the use of video fragments of real mathematics lessons in mastering the methodology of teaching mathematics generated special positive emotions stimulating positive attitude to the subject Methods of Teaching Mathematics and, among other things, contributed to the development of students' professional motives.

Conclusions

The study substantiates the expediency of using a video library in forming future teachers' professional/methodological competency. The authors created a video library which includes video fragments of real mathematics lessons at primary school and videos of pupils solving certain types of problems with their full commentaries, structured by classes and topics. The videos are divided into topics of the course Methods of Teaching Mathematics and are presented in a user-friendly interface, which is a list of topics and subtopics and which allows to go by the appropriate video links to the video required. The video library is located within the e-course "Teaching methods of the educational field 'Mathematics',"

which operates in the distance learning system of "KSU Online" on the website of Kherson State University. The method of using the video library by teachers of the subject Methods of Teaching Mathematics in Primary School and students majoring in the specialty 013 Primary Education was developed. The materials of the video library were introduced into the educational process of the three institutions of higher education of Ukraine: Kherson State University, Vasyl Stefanyk Precarpathian National University and K. Ushynskyi South Ukrainian National Pedagogical University.

Teachers of the subject Methods of Teaching Mathematics in Primary School used video materials in the classroom to illustrate methodological approaches to teaching students a separate concept or forming skills in them, as well as during the implementation of a particular learning technology, etc.; as a material for analysing the structure of the lessons and teacher's methodological activity; as an example of a teacher's activity; with the aim of motivating students' educational activity, etc.

Working with the materials of the video library during their self-guided work, students were able to analyse the teacher's activity, to find out the purpose of the pedagogical influences that they used at certain stages of the lesson, and choose the most attractive pedagogical strategy for constructing a mathematics lesson and organising communication with students. The effectiveness of using video recordings of mathematics lessons and videos of students' thoughts when solving certain problems that are part of a video library as a means of studying the course Methods of Teaching Mathematics in Primary School is confirmed experimentally.

According to the results of the study, it was found that a video library of mathematics lessons in the grades 1–4 and their fragments illustrating the relevant element of educational content (lesson structure, learning technologies, etc.), as well as videos with students thinking over some problems which show calculation methods, work on problems etc. is an effective means of teaching the course Methods of Teaching Mathematics in Primary School.

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Svitlana Skvortsova, Maryna Haran, Olena Sagan

Wideobiblioteka lekcji matematyki jako środek metodycznego przygotowania przyszłych nauczycieli szkół podstawowych

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

W artykule uzasadniono celowość wykorzystania nagrań lekcji i/lub ich fragmentów w procesie kształtowania kompetencji zawodowych przyszłych nauczycieli. Utworzono bibliotekę wideo, która zawiera filmy prezentujące lekcje matematyki w szkole podstawowej oraz filmy instruktażowe dotyczące rozwiązywania określonych rodzajów zadań przez uczniów, a także komentarze metodyczne i merytoryczne, ułożone według klas i tematów. Opracowano strategię wykorzystania biblioteki wideo dla nauczycieli nauczania matematyki w szkole podstawowej oraz program szkolenia nauczycieli w zakresie edukacji matematyki w szkole podstawowej. Skuteczność wykorzystania biblioteki wideo jako środka do studiowania kursu „Metody nauczania matematyki w szkole podstawowej" została potwierdzona eksperymentalnie poprzez trzy uniwersytety w Ukrainie, które włączyły ten kurs do programu studiów.

S ł o w a k l u c z o w e: metoda nauczania matematyki w szkole podstawowej, zapis wideo lekcji matematyki, biblioteka wideo

Светлана Скворцова, Марина Гаран, Елена Саган

Видеобиблиотека уроков математики как средство методической подготовки будущих учителей начальной школы

А н н о т а ц и я

Обоснована целесообразность использования видеозаписей уроков и их фрагментов в процессе формирования профессиональной компетентности будущих учителей. Создана видеотека, которая включает в себя видео реальных уроков математики в начальной школе и видеофильмы о решении определенных типов задач учениками с их полным комментарием, которые структурированы в соответствии с классами и темами. Разработана методика использования видеотеки для учителей методики преподавания математики в начальной школе и программы подготовки учителей начального образования. Эффективность использования видеобиблиотеки как средства изучения курса «Методика преподавания математики» в начальной школе подтверждается экспериментально путем внедрения в учебный процесс трех вузов Украины.

К л ю ч е в ы е с л о в а: методика преподавания математики в начальной школе, видеозапись занятий по математике, видеотека

Svitlana Skvortsova, Maryna Haran, Olena Sagan

Video biblioteca de lecciones de matemáticas como medio de preparación metodódica de futuros profesores de escuela primaria

R e s u m e n

Se confirma la conveniencia de utilizar la grabación de video de las lecciones y sus fragmentos en el proceso de formación de la competencia profesional de los futuros maestros. Se ha creado una videoteca, que incluye el video de lecciones reales de Matemáticas en la escuela primaria y videos de resolución de ciertos tipos de tareas de los alumnos con sus comentarios completos, que están estructurados de acuerdo con las clases y los temas. Se desarrolla la metodología de uso de la videoteca para docentes de metodología de enseñanza de las matemáticas en la escuela primaria y el programa de formación docente de Educación Primaria. La efectividad del uso de la videoteca como medio para estudiar el curso „Métodos de enseñanza de las matemáticas" en la escuela primaria se confirma experimentalmente al introducirse en el proceso educativo de tres universidades de Ucrania.

P a l a b r a s c l a v e: método de enseñanza de las matemáticas en la escuela primaria, grabación de video de lecciones de matemáticas, videoteca

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Students' Motives for Attending E-Learning Master's Degree Courses

Abstract

This paper presents the results of a research study on the motives of students to study in the distance learning form at the University of Humanities and Economics in Lodz. The research was carried out using the method of semi-structured interviews. The interviews were conducted among students of the first year of the follow-up Master's degree in Pedagogy. The research was carried out in the years 2016–2019, in this period three stages of research were realised. The research group consisted of 20 students who had work and family responsibilities and were between 35 and 48 years old. In addition, respondents already had previous experience in combined and full-time studies. The interviews were recorded on a mobile phone and lasted about 40 minutes each. Data were analysed using open coding procedures. The goal of open coding was to thematically divide the analysed text. The analysed interviews were divided into units, which sometimes meant words, and sometimes sentences or paragraphs set according to their meaning, so the unit consisted of a semantic unit. A code has been assigned to each specified unit. Once the code list was created, we started to categorise data

K e y w o r d s: distance education, University of Humanities and Economics in Lodz, semi-structured interviews, motive

Introduction

Distance education become more and more common in our society. It can be said that distance learning is an integral part of education of these days (Kiryakova, 2009).

Based on some of the already conducted research, this form of study has a lot of advantages. Distance education is a more flexibile form of study as compared with the traditional one (Kiryakova, 2009), which influences positively the balancing of family, work and study obligations (Zormanová, 2017). Among the assets of distance learning we can also consider reducing inequalities – this form of study overcomes some limitations for certain groups, such as elderly people, persons with disabilities, people from different social, cultural and economical groups (Kiryakova, 2009). Distance education is economically more efficient, because numerous learners can take part in distance learning courses (Kiryakova, 2009). It has its own pedagogical merit, too. For the benefit of distance learning we can also consider leading to different ways of conceiving knowledge generation (UNESCO, 2002). It has been concluded in research that distance education has a positive influence on performance in terms of knowledge acquisition (Leszczyński, Gotlib, Kopański, Wejnarski, Świeżewski, & Galązkowski, 2015). Another conclusion is that distance education has a positive influence on teacher's interaction with students (distance education also can increase interaction among and between the students), especially in the case of introverted learners (Frankli, Yoakam, & Warren, 1996).

The preference for distance learning expressed by students is a largely because of effectiveness of distance education together with factors contributing the flexible balancing of time, place, and work obligations (Alam, Waqar, Zaman, Shehzadi, & Mehmood, 2012).

Students' Motivation in Distance Education

Motivation is necessary for attaining success in anything. Students who are fully motivated will overcome barriers, find ways of improving skills and study successful with very little extra external support (Simpson, 2008).

Psychologist suggest different ways of thinking about motivation, including one that created two standard types of motivation – extrinsic motivation, which

arises from the outside, and intrinsic motivation, which arises from the inside (Lepper, Greene, & Nisbett, 1973).

Also, a number of theories was created which concern learning motivation of possible interest to open and distance learning educators (Simpson, 2008), for example: the Self-determination Theory (Aelterman, Vansteenkiste, & Haerens, 2019), Epistemological Identity Theory (Mansel, Greene, & DeBacker, 2004), Achievement Goal Theory (Skaalvik, 2004), Self-perceived Competence Theory (Pajares, 2004), Self-concordance Model (Kasser & Ryan, 2001).

Organisation of Distance Learning at AHE (The University of Humanities and Economics in Lodz)

AHE (The University of Humanities and Economics) operates distance learning of Bachelor's degree programmes, Master's degree programmes and lifelong learning coursesApart from its headquarters in Łódź, AHE also has a number of branches located in the following cities: Jasło, Trzcianka, Warsaw, Wodzisław Śląski, Sieradz, and Świdnica.

Teaching is organised as three meetings of students with teachers at the university during the semester, together with teaching in an online environment.

The physical meetings have the following purpose. During the first, so-called introductory meeting, the students learn the requirements for successful completion of the course. The purpose of the second meeting, the so-called midterm meeting, is to remotivate students and solve learning problems. The third meeting, the final one, is done for the purpose of course evaluation.

Distance learning takes place in an online environment that works 7 days a week, 24 hours a day. In the online environment, there are didactic materials to study: distance learning materials are both textual and audio-visual ones, and they include textbooks written specifically for distance learning; the digital environment also includes discussion boards and chats. Inside the environment, there is the possibility of measuring one's knowledge and continuous or summative evaluation of students by means of ongoing tasks, seminar papers, tests and quizzes.

Research Methodology

The research was carried out in order to improve the ongoing distance study and to increase students' motivation to study. If we better understand students and their motivation to study, we can tailor the learning environment to suit their needs.

In order to discover the motives of students to study in this form at the University of Humanities and Economics, we conducted a research in 2016–2019, each time examining students of the first year of the follow-up Master's degree programme. During the said period three phases of the research were realised.

The first phase of the research was realised in the academic year 2016/2017. The fear of insufficient theoretical saturation caused the need for data acquisition. The results of the analyses carried out at this stage of the research are elaborated upon in Zormanová (2017).

The second phase of the research was carried out in the academic year 2017/2018. The fear of insufficient theoretical saturation once again prompted the need for data acquisition. The results of the analyses carried out at this stage of the research are elaborated upon in Zormanová (2018).

The third phase of the research was carried out in the academic year 2018/2019. The aim of this stage was to obtain data from a larger number of respondents, which ensured saturation and comparison of loose student testimonies.

Table 1
Number of respondents during each phase of the research

Phase of the research	No. of respondents
First	10
Second	15
Third	20

Source: Own work

The research group consisted of 20 students who had work and family responsibilities and were between 35 and 48 years of age. In addition, respondents already had had previous experience in combined and full-time studies. The respondents were employed in various fields, such as: police, human resources, banking, consulting, healthcare, higher education, government.

From the research goal, the following research question arises: *What are the motives of respondents to study at the university?*

The main method of data collection was in-depth, semi-structured interviews. The first contact with the respondents was initiated via e-mail, in which they were informed about the purpose of the research and the topic of the interview, and later on, the date of the meeting was arranged. At the beginning of the meeting, the informants were acquainted with the research in more detail, anonymity was agreed upon and consent regarding the recording and subsequent processing of the interview for research was obtained. The interviews were recorded on a mobile phone and lasted about 40 minutes each. I also used online interviews via electronic communication to collect and refine/ data in some cases. All data were digitised to be archived on a computer and continuously analysed using the ATLAS.ti computer program.

The used analytical procedures were based on open coding. The goal of open coding was to thematically divide the analysed text. The analysed interviews were divided into units, which sometimes meant words, and sometimes sentences or paragraphs set according to their meaning, so the unit consisted of a semantic unit. A code has been assigned to each specified unit. Once the code list was created, we started to categorise data

A card laying technique was chosen to evaluate each category, based on which the text was compiled in such a way that it was a retelling of the contents of each category.

Research Results

Students' motivation to undertake studies

Given the wide diversity of respondents in terms of their professional careers, the motivating factors to undertake studies also varied greatly. The respondents worked in various fields, such as: police, human resources, banking, consulting, healthcare, higher education, and government.

During the research I identified eight categories of motivational factors:

– career advancement,
– need for continued education,
– need for a university degree,
– change of employer,
– change of professional field,
– finding a better employment,
– studying as activity productive use of free time,
– motivation from other people.

I will describe and explain individual motivational factors on specific examples.

Career advancement

This motivational factor appeared in our research in connection with the prevailing external motivation to study, when the respondent is motivated to study by the employer. Respondents are frequently motivated by the employer's promise of career advancement.

At the same time, a low internal motivation to study was found for these respondents; they feel that they study not because they want to or are interested in the given field of study, but because they need to get a Master's degree. In the testimonies, there are references to the need to obtain a Master's degree, not to acquire the necessary knowledge, and skills in the course of the studies. These students also do not talk much about their field, rather they mention the need to obtain a Master's degree, a diploma that will lead them to career advancement. The main goal for these respondents is career advancement, a more lucrative job, not graduation in a particular field and the related acquisition of new knowledge, information, skills, and increased professional competences.

Above all, this motivational factor was observed in Respondent A, who started studying at AHE and MBA at VSB in Ostrava (Master of Business Administration) concurrently in February of 2018. It resulted from the pressure from the employer, who offered him a better job and better pay if he obtain an MBA title and finish a university. As the respondent in question reported: […] *my motivation to study is the possibility to widen my chances on the job market and especially the career advancement in my current job* (Respondent A).

This motivational factor was also observed in the respondent who works at OKD (Ostrava-Karviná coal mining) as a white-collar worker and realises that there are more lucrative jobs in OKD that he might try securing if he finishes his Master's degree.

> *I found out that many of the interesting jobs for me are conditioned by a completed second level of higher education. This is not to say that I think that graduation will provide me with a lucrative job right away, but with it, I can at least apply for it. Without a Master's degree, I am not even able to take part in the selection procedure for any of those interesting positions.*
>
> Respondent B

Need for continued education

This motivational factor is popular among respondents who have to continue their education due to their profession. Continued education is part of their job

position. They are respondents who work in civil service at clerical positions, at the police or as academic teachers.

> *When taking education in general, then I study constantly. In my field of work, I see it as a must. People must constantly educate themselves, to keep up with the times and competition.*
>
> Respondent C

> *During my studies, I also keep myself in "good shape" when it comes to knowledge, which is very positive. Only a trained brain will stay in the labour market because the world is developing faster, the labour market is more dynamic, demands keep changing, and one has to keep up to be competitive. One needs to constantly learn. There are new technologies, new processes, production… Another motive for my continued education was to share information on news and trends in andragogy. This is a great asset for me, and for my work, and it's one of the main reasons I decided to study the subject at all.*
>
> Respondent Q

Need for a university degree

Although this motivational factor is also present in the respondents of the two previous categories, who study because of the fact that their job requires a Master's degree, or the respondent is promised to get a better paid and more prestigious job if they graduate, only Respondents E and Respondent G named this motivational factor directly.

Respondent E, working as a psychotherapist and coach, perceives her studies as necessary for her profession. She realises that she needs to get a formal education, a degree that will help her improve her position in the labour market, and be successful in the field of her work.

> *Mainly the degree. I need formal education for my job and profession, and to be able to move forward. My goal is to do what I enjoy doing and what I am good at, and earn money doing it; this requires experience, practise and also formal education.*
>
> Respondent E

Respondent G works at clerical position in government and is aware of the importance of a Master's degree in view of her potential career advancement and salary increase. She says that in the state administration it is not as important what

one studies or has studied, but rather just holding a degree, getting a diploma. In her statement, she mentions that many people in her field and with the same employer study "any discipline" only to have the necessary "paper" that will open another door for their further career advancement.

> *For me personally, formal education is very important and I care about completing university studies successfully. The Bachelor degree is fine and has opened many* [previously] *closed doors* [for me]*. In the case of charted salaries, I got a little extra pay compared to graduates from secondary school. At the same time, however, I feel that it is only a halfway and Master's degree is my goal. I do not know whether it is my feeling or a fact that in the area where I am active professionally, the Master's degree is the lowest needed to be taken seriously. Maybe it's not really the case, and only I feel like this. Anyhow, it is very important to me to complete the postgraduate level of university studies. My notion is that I will then be done and at peace in terms of formal study and letters around the name*
>
> Respondent G

Change of employer

This motivational factor appeared in our research in relation to career growth, the possibility of getting a better, more prestigious and better-paid job that these respondents could hold with another employer if they completed their Master's degree.

> *I want to expand my knowledge in the field. The aim is to complete the postgraduate level of university education and have a complete university education. I do not consider a Bachelor degree as anything special. In the event of a job change, I consider the university degree to be necessary. For me, the motivation is my family and the opening career growth, as well as a change of my current job.*
>
> Respondent F

Change of professional field

This motivational factor appeared in our research in connection with the interest in studying at a university in a given field of study. The following are the respondents who found that after several years of employment, their graduated field of study was no longer fulfilling and they began to be interested in pedagogy.

> *I identified my first educational need in self-reflection at the age of 18 when I was a men's tailor and worked in clothing production. During the*

> *first year of employment, I realised that this is not the work and stereotype I want to experience long-term and the idea that it would look like this until the end of my life really scared me so much that I decided to do something about it. If I didn't want to do this all my life, I'd have to go back to school. I knew I wouldn't move forward without another school. So I went and I have been studying something ever since.*
>
> Respondent G

Frequently, these respondents have decided to change the field of study in relation to a life change, such as the birth of a child, taking up maternity leave. This motivation factor was also true for Respondent D. She was on maternity leave in the time of the research. She had been a nurse before it, practising this profession for several years until she took the parental leave but she had felt that her job was not fulfilling, and she had also realised that it would have been complicated to reconcile the work of a hospital nurse in a three-shift operation with her motherly responsibilities.

> *Primarily, I wanted to completely change my field of work. I work in healthcare, but I felt like I wanted to do something completely different.*
>
> Respondent D

While on her maternal leave, the respondent started to think about a new way of self-actualisation and realised she wanted to work as a career counsellor. This student says that her motive to study "is above all, the prospect of finding a new job after [her] studies, which I hope will be more fulfilling."

This motivational factor was also recognised in three respondents who are currently working in the Czech Republic as a part of police force and are satisfied with the current employment, job position and remuneration. Given that respondents have been over 40 years old, they realise that they will one day end working for the police, and therefore, they want to secure their employability in another sector, in which the Master's degree should be of help.

> *To broaden my horizons, get to know new things when I'm done with the police, which is happening one day. With a Master's degree, I believe in my better usefulness in the civilian sector.*
>
> Respondent I

What results from their considerations is frequently a choice teaching profession, as they want to pass on their knowledge and experience, therefore choosing the pedagogical studies.

By successfully completing this further education (Master's), I could and would like to open a pedagogical door for the period when I finish my activities with the Police of the Czech Republic, i.e. the period during which I would like to teach.

Respondent O

My main motive in further education was that I would like to teach at the Police Academy of the Czech Republic in the future. In order to teach at the academy, it is important to have a university degree that I am currently extending to a Master's degree. The Careers Regulations of the Police of the Czech Republic do not allow police officers without university education to achieve non-commissioned officers and officers' ranks, for example, to be the head of the district department.

Respondent K

Finding a better employment

This motivational factor appeared in our research in relation to barriers in the labour market (a respondent who is a person with disabilities or a mother with two young children) which are currently faced by respondents who realise that if they had a Master's degree, then despite the previously existing barrier remaining, they would still have a better position in the labour market. These respondents say they hope to find a better job thanks to their postgraduate education. This motivational factor was observed in Respondent L, who works in a commercial-administrative position, but does not find the necessary self-actualisation in her work and has been looking for another job for some time. Her handicap, as she claims, is the fact that she is a mother with two small children of preschool age.

This motivational factor was also recorded in Respondent H, who has been a person with disability for several years, which significantly restricted her opportunities in the labour market. Due to her disability, after the termination of her employment, the respondent had a problem finding a satisfying job with adequately salary.

And because I am an active person, I thought right after the graduation of my children that only occasional work was not suitable for me. And again I started thinking about studying. One year later, I chose the field of study according to the possibilities I would have, considering my disability, in the labour market. After exploring the educational possibilities and getting the information that even in Česká spořitelna, a.s. where I had worked before, there was a position where I could utilise the education.

Respondent H

The foregoing motivational factor is frequently connected with potential financial reward:

> *With the follow-up Master's education, I would like to broaden my horizons and possibly hope for better salary in the future.*
>
> Respondent H

> *I want a better future for my little children.*
>
> Respondent L

Studying as productive use of free time

This motivational factor appeared in our research in relation to a lifestyle focused on personal development. For these respondents, education is productive spare- time activity, as they consider personal development and education to be a need in their lives.

Above all, this motivational factor appeared in a female Respondent M working in a trading company, satisfied in her job. This respondent is married, her husband is also studying, thus they both motivate each other. They already have adult children, and they feel they have more free time because they no longer need to care for and raise their children.

> *What was my motive to start college? Originally, I wasn't interested in getting a university degree. In my life, I was influenced by my colleague from work, whom I saw as my role-model. She was constantly educating herself, finishing up college... This had started my continued education. Not only by studying this field but also through other influences, inspired by work colleagues, I started to attend lectures by František Hroník, I attended a certified coach course, started to attend webinars on the topic of personal development and leadership, and overall changed my attitude to education. Now I can't imagine my life without it. I think it would be empty, dismal. I try to relay my motivation to learning and education to the people around me, be they colleagues at work, family members or friends. Of course, a by-product and a part of my motivation today is the achievement of a complete university education, and thus the possibility of a better position in the labour market.*
>
> Respondent M

This motivational factor frequently occurs in respondents in relation to lifestyle changes, the empting of family "nest," and the respondent's subjective feelings of additional free time and more room for their own activities and hobbies.

> *My current life situation (more free time, a sense of unfulfillment) has offered me more room for education thoughts. And I realised that I desire again to fulfil my subjective educational needs.*
>
> Respondent R

Motivation from other people

This motivational factor appeared in our research in connection with the perceived respondent's inferiority complex stemming from the fact that they had not graduated from university, while many people around them had. These respondents frequently said that they felt they wanted to "prove something" either to themselves or to others.

> *The goal of my university studies was to prove to myself, my parents and my surroundings that I was not stupid. Throughout my studies, the goal has changed and I perceive education as a possibility of development and knowledge-expansion in certain fields that I would not otherwise have access to.*
>
> Respondent N

> *Another motivation for further education was that I wanted to prove to myself that I could finish the studies; because self-fulfilment is very important to me. With this, I've got an amazing experience.*
>
> Respondent S

> *It turned out that the main motive of my further education is the desire to achieve something, to prove to myself that I am still able to develop and work on myself.*
>
> Respondent T

This motivational factor also appeared in our research in connection with contact with people who were around the respondents and inspired them to start a Master's degree – acting as certain role-models. One of the respondents said in her testimony that the people around had a large impact on her decision to start studying again, they became her role-models and inspired her. The inspirational persons she met around her, whether in the family or among her subordinates at work, had a complete university degree. This respondent says she always wanted to study at university, but unfortunately, childcare did not allow her to do so previously; when her children had grown up and did not require that much care, she had begun to think about realising her dream of achieving a complete university

education. At that time, she began to evaluate the educational level of people around her and began to notice people who were in a similar or identical situation to her and were studying Master's programmes or had already graduated. She began to perceive these people as role-models.

> *I always wanted to study at college. Unfortunately, it didn't work out right after school. When the children were older, I wanted to complete my education. For my own satisfaction, and also because I have subordinates in my work, who have a university degree, so I found it appropriate, and I was also motivated by my younger sister, who hold a Ph.D., last but not least was my husband with whom we talked about studying many times. So we went to study together.*
>
> Respondent J

This motivational factor appeared in our research in other respondents, who frequently said that their family, close relatives or friends had encouraged them to take up studies. They provided them with confidence and the sense of being able to "do it" when the respondents doubted themselves. In connection with this motivational factor, respondents frequently mentioned scepticism over their learning abilities. The scepticism was caused by their previous study failures.

> *I already studied at university right after grammar school, unfortunately, it was unsuccessful, which is something I never quite got over. I have toyed with the idea of going back to school almost constantly, but I was afraid of further failure… But I wanted to prove it to myself. Then when I discovered the field that interested me, it was a coincidence that my eternally optimistic sister (unlike me) pushed me into it at the right moment… And I would never think of continuing with a Master's programme a few years ago, my original goal was "only" bachelor's degree...*
>
> Respondent E

The motivation from people around was also noted in the respondent, who says that earlier, although he wanted to study, he was unfortunately not capable to do it for various objective reasons, and at present he felt old for studies; fortunately, his wife pushed him into it.

> *I have always wanted to study at university, but work, the birth of children and the associated problems or building a house prevented me from starting my studies before the age of 40.*

> *Motivation: For various motivational (professional) reasons, my wife wanted to go to university and I supported her. She told me to also send an application. I did it, but only to conclude the reality that I had at least tried but was already too old for university.*
>
> Respondet O

These respondents frequently mention that they can cope with the difficulty of their studies thanks to the support from the people around them, their family, who motivate them to study and support them in difficult moments when learning failures occur. The family is also very helpful in reconciling work and family responsibilities, and sometimes also provides financial support.

> *I am also motivated by the responsibility to the whole family, which is a big part of the help I get to be even able to study at all (especially my husband and parents help with babysitting, my parents help me financially as well, because at the moment, when I'm on parental leave, my study is quite challenging for all my loved ones...). The big motivation is also my sister, who graduated from PhD studies, so I would like to come close to her a bit, but mainly she supports me psychologically, encourages me and gives me energy because I often do not believe in myself and I am afraid that I will not manage...*
>
> Respondent D

Conclusions

The results of the research show that for most respondents their main motive to begin and finish studying was their current job position or potential future job position or change of employment.

Although the work was a frequently mentioned topic in the motivation category, it was not the only driving force. Respondents also sought to increase their professional competence and work on their self-development. Respondents felt the need to educate themselves and acquire knowledge to apply in practice. This category of motivation was frequently associated with a change in life-style, with the acquisition of more free time that respondents could devote to their hobbies and interests, usually in connection with the separation of children.

A certain motivation for respondents is also the support from the people around, from family and relatives, who motivate them to start their studies, encourage them during the studies, help them overcome obstacles, bridge learning problems and help to reconcile family, work and study responsibilities. The people around them are a frequent motivating factor for respondents; not only encouraging them or "kickstarting" them to study, but also due to the fact that respondents see the people around as role-models worthy of following, they see people who are in the identical or similar situation and still study or graduate with a master's degree, and the respondents say that they see inspiration in these individuals, a source of motivation to study.

Because motivation from the surroundings is important for students, it is necessary to motivate students in a virtual environment. Increasing students' motivation to study will be achieved by a tutor providing quality feedback or by an interactive online environment in which collaboration between study participants takes place. Collaborative tools include discussion forums, brainstorming, group activities, chat, tutoring, mentoring, online meetings, virtual classroom and simulation, giving students the chance to test their knowledge without risk. Feedback provided by the tutor allows students to track their own progress, increases student motivation to study, and also reduces the risk of student procrastination. A. Barešová (2011) states that participation in distance learning means that collaboration is one of the most effective stimulants.

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Lucie Zormanová

Motywy studentów do studiowania na studiach magisterskich niestacjonarnych na odległość

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

W artykule przedstawiono wyniki badań na temat motywów, dla których studenci zdecydowali się studiować na studiach niestacjonarnych na odległość w Akademii Humanistyczno-Ekonomicznej. Badania przeprowadzono metodą wywiadu półustrukturyzowanego. Grupą badaw-

czą byli studenci pierwszego roku studiów magisterskich na kierunku pedagogika. Badania przeprowadzono w latach 2016–2019. Grupa badawcza składała się z 20 studentów w wieku od 38 do 45 lat, którzy mieli obowiązki zawodowe i rodzinne. Ponadto respondenci już wcześniej studiowali na studiach stacjonarnych oraz zaocznych. Wyniki badań pokazują, że główną motywacją respondentów do studiów był awans zawodowy czy zmiana pracy. Respondenci starali się również zwiększyć swoje kompetencje zawodowe i był dla nich ważny samorozwój. Respondenci odczuwali potrzebę kształcenia się i zdobywania wiedzy, która byłaby do zastosowania w praktyce. Respondenci podkreślali także motywację pochodzącą od otoczenia, rodziny i krewnych mobilizujących ich do rozpoczęcia nauki, zachęcających do podjęcia studiów, wspierających w pokonywaniu przeszkód, rozwiązywaniu problemów i w godzeniu obowiązków rodzinnych, zawodowych i studenckich.

S ł o w a k l u c z o w e: kształcenie na odległość, AHE, metoda wywiadu półustrukturyzowanego, motyw

Lucie Zormanová

Мотивация студентов к обучению в магистратуре при заочной форме обучения

А н н о т а ц и я

В данной статье представлены результаты исследования мотивов обучения студентов в дистанционной форме в Университете гуманитарных наук и экономики в Лодзи. Исследование проводилось с использованием метода полуструктурированных интервью. Интервью проводились среди студентов первого курса магистратуры в области педагогики. Исследование проводилось в 2016–2019 годах, в этот период были реализованы три этапа исследований. Исследовательская группа состояла из 20 студентов, в возрасте от 35 до 48 лет, имеющих рабочие и семейные обязанности. Кроме того, респонденты уже имели предыдущий опыт смешанного и очного обучения. Интервью записывались на мобильный телефон и длились около 40 минут. Данные были проанализированы с использованием процедур открытого кодирования. Целью открытого кодирования было тематическое разделение анализируемого текста. Анализируемые интервью были разделены на единицы, которые означали слова, иногда предложения или абзацы, установленные в соответствии с их значением, поэтому единица состояла была семантической. Код был присвоен каждой указанной единице. Как только список кодов был создан, началась классификация данных.

К л ю ч е в ы е с л о в а: дистанционное образование, гуманитарно-экономический университет в Лодзи, полуструктурированные интервью, мотив

Lucie Zormanová

Motivos de los estudiantes para estudiar estudios de maestría a distancia

R e s u m e n

Este artículo presenta los resultados de un estudio de investigación sobre los motivos de los estudiantes para estudiar en forma de aprendizaje a distancia en la Universidad de Humanidades y Economía de Lodz. La investigación se realizó utilizando el método de entrevistas semiestructuradas. Las entrevistas se realizaron entre estudiantes del primer año de la maestría de seguimiento en pedagogía. La investigación se llevó a cabo en los años 2016–2019, en este período se realizaron tres etapas de investigación. El grupo de investigación consistió en 20 estudiantes que tenían responsabilidades laborales y familiares y tenían entre 35 y 48 años. Además, los encuestados ya tenían experiencia previa en estudios combinados y de tiempo completo. Las entrevistas fueron grabadas en un teléfono móvil y duraron unos 40 minutos. Los datos se analizaron mediante procedimientos de codificación abierta. El objetivo de la codificación abierta era dividir temáticamente el texto analizado. Las entrevistas analizadas se dividieron en unidades, que a veces significaban palabras, y a veces oraciones o párrafos establecidos según su significado, por lo que la unidad consistía en una unidad semántica. Se ha asignado un código a cada unidad especificada. Una vez que se creó la lista de códigos, comenzamos a clasificar los datos.

P a l a b r a s c l a v e: educación a distancia, Universidad de Humanidades y Economía de Lodz, entrevistas semiestructuradas, motivo

II. Innovative Methods and Technology in Higher Education

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Travel Blog as an ESL Teaching Tool

Abstract

Current stage of ICT development necessitates the improvement of teaching tools, skills, and learning outcomes. The article discusses bright educational prospects of travel blogging for students of English as a second language (ESL). The authors suggest a short theoretical overview of research into travel blogosphere's educational opportunities, while discussing a classification of travel blogs according to the type of sender vs receiver communication. On a wide and modern textual material the article considers such prominent features of travel storytelling as polysemantic vocabulary, compact meaning representation, strategies to present cultural information and verbal creativity which can be of true interest for students of B2 level and above. The readers can also learn about a few forms of activity with travel stories which are individual special sampling with some specific focus (pun, irony, creative instances of word building), presentation of foreign culture by means of English, project work for a small group of enthusiasts, sampling stories by country, by area or by activity, and presenting one concise story to the classroom, as their own post or a paper brochure.

K e y w o r d s: travel blog, English language teaching, rich semantics, verbal creativity, cultural reality

The Research Problem

New stage of ICT development offers new resources, new forms of teacher-student collaboration, which open new opportunities, among others, the following: alternative sources of information help keep curricula updated; teacher ceases to be the sole source of knowledge and understanding, thus students demonstrate their potential easier, democratic nature of collaborative learning contributes to the formation of democratic principles and values, which in turn are necessary for democratic society to function properly (Morze, Pavlova, Makhahchashvili, & Smyrnova-Trybulska, 2016, pp. 201–202).

Noskova, Pavlova and Yakovleva stress the role of social media and social learning as a realm where one can find a lot of opportunities for educational advancement. The authors stress that it is not sufficient to merely reproduce different levels (systems) of interactions between learners in the digital learning environment, but rather endeavour to accelerate the development of new skills by using new technologies (Noskova, Pavlova, & Yakovleva, 2018, p.114).

Social learning is widely discussed as it represents a type of informal learning. Stodd and Reitz argue that it is quite often based on some particular experiences and it is likely to be organised by communities of interest. This is a deeply personal environment that can become a fruitful source of learning (Stodd & Reitz, 2019, p. 269).

Educational Prospects of Travel Blogging

General overview of the travel blog genre. Nowadays, due to the development of ICTs, modern Internet users develop so-called *clip thinking.* This collage perception of reality becomes an undeniable fact and influences the evolution of such a well-known genre as the adventure essay, which in today's technological realities is called the travel blog. In terms of the origin of information, travel blogs belong to user-generated content (UGC), which is a representative of the genres of Web 2.0 (Cox et al., 2008). Being truly personal in terms of sharing knowledge, travel blogs can be considered a vivid example of social learning practice.

Interestingly, the role of personal contribution and shared interests become more and more meaningful in modern media-enhanced communication. Forecasting teaching and learning trends for 2020–2030, the European Commission presented blogs and other multimedia content as credible sources of information

for scholars (Education in Europe). The very concept of credibility of information changes the moment it is published online. Currently travel blog as a literary genre is undergoing transfomation as well. Travel blogs used to be much more uniform in terms of communicative purposes. Now, however, it is no longer a static entity with its defined purposes and constraints, but rather a changeable and dynamic medium adjusting its purposes to the audience. When it comes to online mode, travel blog as a digital genre takes into account the users' needs and reflects new contexts (Pascual, 2019, p. 161).

The research objective. In university teaching the use of Internet blogging as a general trend opens wide opportunities for enrichment and upgrading teaching of various disciplines (Poznanska & Romaniukha, 2017, p. 57). Connection and feedback loop sustaining between members of a travel-blogging platform in terms of social communication were already researched (Vasiliki & Kostas, 2009). Travel blogs, in particular, are emerging as an effective tool for improving speaking skills due to the modernity, accessibility, and authenticity of language material. Blogs can be used to teach English, as well as engaging in multidisciplinary humanities courses where students are able to potentially develop critical thinking skills (Pascual, 2019, p. 158). Discussing educational affordances of travel stories seems to be a popular topic of contemporary educational debate but in this article we would like to outline the most distinctive linguistic traits of travel blogs, exemplified by authentic textual pieces and to suggest forms of class or individual language-learning activities.

Before going into the specific features of an adventure blog, let us suggest a definition of blogs as "frequently modified web pages in which dated entries are listed in reverse chronological order" (Herring et al., 2005, p. 142).

The pre-history of modern adventure blog (travel blog or travelogue) obviously dates back to the genre of traveler notes, which has its own history. Traveler notes is an independent literary genre, with genre leeway, the dominant role of the author, the abundance of documentary elements along with artistic fiction, genre syncretism, which results in a combination of elements of other genres. Each traveler story is unique, since it reflects the cognitive style of the author or authors.

In addition, travel blog is an element of intercultural communication because it is formed by representatives of different cultures and is dedicated to a broad audience that uses English as a medium to learn about the specifics of other cultures. Moreover, travel blog stands out due to a few recognisable traits – it is entertaining, informal, lively, and informative.

Travel Blogs in Language Teaching

Types of travel blogs. A glimpse into the variety of travel blogs allows us to classify them according to the type of sender. Vasiliki and Kostas outlined the general classification with a focus on expertise of the author. According to them, blogosphere in tourism takes many forms. First of all, it contains business-to-business (B2B) and business-to-consumer (B2C) blogs, then government-to-consumer blogs (G2C) and consumer-to-consumer (C2C) blogs (Vasiliki & Kostas, 2009, p. 642).

Since this article is mainly concerned with language teaching aspects, let us dig a bit deeper into the kinds that are focused on the end user – the consumer, particularly, a student of English as a second language who also happens to be a passionate traveler. Listed below are a few more detailed consumer-focused blogs according to the type of sender.

In the category **business-to-consumer (B2C**) one can observe two main kinds of blogs. Both are exemplified by businesses – tourist accommodation booking websites:

- Corporate blog with hidden personal details of the author, limited or non-existent feedback option from readers, for example, the travel articles compiled by Booking.com (https://www.booking.com/articles.html).
- Corporate blog with open feedback option, updated by a few authors, presumably working on part-time contracts with the agency, thus, reflecting general company policy and advertising the accommodation as well as the services of the agency, for example, the travel blog of a more affordable accommodation platform Hostelworld.

Both of the mentioned sources present travel advice that is extremely user-friendly: multimodal (containing hyperlinks, images, bright colours), informal in terms of language, and quite engaging.

Another group of travel blogs (**consumer-to-consumer type (C2C**)) targeted at the consumer can be formed according to technological aspects of their creation and publishing:

- Public travel blog platforms or networks, such as: travelblog.org, travelark.org, travellerspoint.com, getjealous.com, realtravelblog.com, and travelpost.com specialise in hosting individual travel blogs, and for that reason save their authors' web-designing efforts, but at the same time they render presentations more or less uniform.
- Websites designed single-handedly, a collection of this kind can easily be found online, for example (Morilla, 2019), a truly demanding activity, allowing the author to demonstrate not only linguistic creativity in writing, but also web-designing skills while presenting their travel advice.

When we look at social communication present in travel blogs, whether they allow feedback communication or not, we assume social communication of this kind is efficient when the sender and the receiver share the axiomatic categories of self-identification, activity, goals, values, and resources (Van Dijk, 1995, p. 32). We suggest that linguistic and pragmatic aspects of this communication derive from the above-mentioned factors, even if the communicators are at different language levels. Relying on the corpus of travel stories processed, one can speculate on a generalised self-portrait of a travel blogger and their readers: "I am someone who enjoys the vibe of social life, I love to have fun and am able to enjoy small things, I love to live new experiences, cuisine, nature, and learn about cultural patterns, I would love the see the whole world but I do not have much money."

Outlined below are the main linguistics aspects of travel blogs in English that students can observe and use in their own speech practices.

The Research Results: Semantic-Stylistic Features of Travel Stories

Polysemantic vocabulary. Travel blogs, belonging to mass media in broad sense, fulfil the same communicative functions: to entertain the audience and to spare readers' efforts. Here the travel blog is very similar to printed press – in addition to the clichés, trite metaphors, the genre's economy is manifested by the use of high-frequency vocabulary with broad semantics, most often represented by nouns, for example, *thing*, *environment*, *match*, *vibe*, *buzz*, *fix*:

> *We stay in hostels to meet other people and make new friends. As a couple, you sometimes get stuck doing* ***your own thing****, so it's sometimes nice to stay at a place where you know you'll meet new people!* (Whitaker, 2018).
> *We absolutely love that hostels always have a community* ***environment*** (Griffiths, 2018).

Another group of vocabulary with rich semantics are verbs, which represent an opulent source of research in terms of contextual meaning change, for instance, *to live*, *be exposed to*, *share*, *experience* etc.. By inviting students to study the grammatical structure of these sentences and focusing them on not so typical objects of these high-frequency verbs professors help develop students' mental flexibility when they are learning new English vocabulary and trying to use it in their own expressions:

> *When you stay in a hotel you limit your travel experience and don't* ***really live*** *everything the city has to offer.* (Whitaker, 2018)
>
> *Lisbon, we wish we knew how to* ***quit*** *you. It started with a cheeky city break, nothing serious. We came back with a tan and some of those little custard tarts. Next thing we know we're spending hours on Instagram stalking #lisbon, and begging our boss to relocate Hostelworld HQ. And it seems we're not the only ones; everybody's obsessed with Lisbon right now. It's a city that will steal your heart, and leave you hungry for more.* (Dutton, 2019)

The tasks ordered to students in relation to the said rich semantics may involve focused research into the contextual meaning of these units or rendering the specific aspect of meaning into their native languages. Students of translation courses specifically could improve their written translation skills and as well as paraphrasing skills.

Compact meaning representation in English. The amount of information published by contemporary mass media on a daily basis is impressive, but at the same time each publication is limited in terms of space on the screen or the duration (for video reporting) due to economic reasons and aiming to publish storylines in concise form. Thus, in order to meet these two goals the authors present a large amount of information only implicitly, relying on readers' rich background knowledge and therefore resort to mechanisms of semantic compression. Mendzherytskaya notes that for the full grasp of information it is crucial for the so-called cognitive bases or background knowledge of communication participants to intersect in this particular language community (Mendzherytskaya, 2006, p. 52). In other words, in order to properly interpret implicit meanings from the media the addressee must have developed some background knowledge in various topics.

When communication takes place at the junction of different cultures, these implicit meanings are much more difficult to interpret because the representative of a different linguistic and cultural environment needs to activate not only linguistic knowledge, but also the cultural knowledge about this particular foreign community.

An example below contains a nomination of a specific type of modern traveller who enjoys short city breaks over the weekend – *a five to niner.* The interpretation might take a non-English speaker some time due to metonymic compression of meaning. Metonymy comes from numerals 5 and 9, denoting, respectively, the time when the working week ends on Friday afternoon and the time when the working week starts on Monday morning. Relying on resources of English word-formation, an attentive language learner might be prompted by the functions of suffix *-er*,

implying, among other interpretations, the doer, the person – an employee with specific focus on their free time over the weekend:

> *Often snap-packers don't even use any of their precious time off, choosing instead to head out on a micro adventures straight after work on a Friday, returning just in time for that glorious Monday morning commute. These weekend warriors are rapidly growing in number, and are affectionately known as "**Five to Niners**." It's incredible how easy nowadays, with all the affordable short-notice flights and hostel beds available!* (Why bite-sized backpacking…)

Compact meaning presentation may rely on various processes of word-formation (in the passages below shortening, nominalization and compounding), all of them bringing intellectual pleasure to the students from decoding the unusual form and potentially stimulating their cognition:

> *Berlin is without a doubt the best city in Europe for **urbexers** – so much history, and so many amazing abandoned spots that are easy to get to on public transport* (Dutton, 2018).
>
> *Speaking of scrumptious snacks, it would be considered sacrilege to come to Philadelphia and not sample a Philly **Cheesesteak**. What is a cheesesteak you ask? It's essentially a sandwich filled with beefsteak and melted cheese in a long hoagie roll, but trust me it is so much more than just a sandwich; in Philly it's a way of life* (Cuthbert, 2018).

By bringing learners' attention to these specific ways of compact meaning presentation professors raise students' awareness of the trends in English word-formation.

Introduction of Cultural Information

In modern interconnected world the professional competence of experts from various fields is increasingly connected to intercultural competence and professors need to take this fact into account when they are training their students – future employees. Kommers insists that the evolution of ICTs in the system of higher education presupposes strong focus on multi-culturality, thus the educators need

to be aware of "current large-scale societal challenges at the global level: restructuring economies, large scale migrations and the growing need for multicultural understanding" (Kommers, 2016, p. 14).

The very concept of intercultural competence is defined as knowledge based on people's own cultural competence within the realm of foreign cultural conventions and standards based on traditional cultural institutions, norms, and values. Intercultural competence is primarily grounded in positive attitude to the coexistence in a society with various ethnic groups. Both people and society can develop such an attitude based on the policy of voluntary adaptation of a state's social and political institutions to the needs of different cultural groups. Cultural standards are intertwined with instances of verbal behaviour. Since mastering a foreign language is not always enough for communicative success learners need to be fluent in three interconnected codes: linguistic, para-verbal, and cultural one (Selivanova, 2011, p. 275). This observation is very much in tune with that from an American businessman: "It is possible to master a foreign language. It is culture that one stumbles over" (Fixman, 1989).

The inability to coexist with others in multicultural environment coupled with insufficient motivation to mirror and accept their values is very likely to bring about the cultural shock. The said shock results from awareness that one's basic assumptions about life and familiar ways of behaving are no longer appropriate or functional (Jandt, 2010, p. 292). Intensified intercultural contacts along with today's constant flow of migrants around the world have both prompted increased scholarly interest in the phenomenon of acculturation (Schwartz, Unger,& Zamboanga, 2010).

Observing cultural patterns and specific salience of concepts demands willingness to coexist, to welcome a different point of view and reflect on it. Presumably, elements of different cultural patterns represented in travel blogs trigger in students motivation to learn and deepen their knowledge on the subject, thus developing tolerance and opening up a dialogue.

Travel blogs can trigger these cognitive processes by directly mentioning culture-specific vocabulary (with explanation provided or not), formal vocabulary in order to prompt interest and respect for cultures, different from the English-speaking one:

> *You can surf, parasail or jet ski here, or simply sunbathe and sample some of South Beach's Latin cocktails – this sultry neighbourhood's Hispanic heritage means that visitors are spoilt for choice when it comes to Cuban cuisine and drinks. Try* ***ropa vieja*** *(shredded beef in a rich tomato, pepper and spice sauce served with tortillas) and* ***yuca*** *(a garlicky root vegetable dish marinated in lime and olive oil)* (The 5 finest beaches …).

Translation students can develop their general linguistic aptitude by looking into transliteration rules for languages other than their working pair. Besides, inclusions like this serve as a powerful impulse to find out more about the cultural patterns mentioned, since they refer to real-world items and are likely to belong to an attractive culture for a specific student.

The variety of point-of-views, differences in the ways cultures cover reality may be a beneficial insight for language learners. Names for the same real-world items might be chosen according to different salient criteria. In the following example an English-speaking author uses the term "Ferris wheel," designating an amusement-park ride, where Ferris refers to the surname of the ride's designer – a 19th-century American engineer named George Ferris. Interestingly, Spanish, French, Portuguese, and Ukrainian cultures preferred other attributives when they had to name this new concept: *rueda de la fortuna* / *vuelta a mundo* (Spanish), *grande roue* (French), *roda gigante* (Portuguese). Interestingly, Russian and Ukrainian cultures have developed an informal term to denote this concept – *чортове колесо* (lit. 'devil's wheel') which contains an emotional response of fear to technological advances coming from abroad:

> *The next stop should be Ole Smokey Moonshine, a corn-whiskey distillery located in Pigeon Forge's The Island, a 23-acre entertainment area with* ***a ferris wheel*** *and ample other attractions.* (Guide to Tennessee whiskey…)

Verbal creativity. The presence of puns is yet another distinguishing feature of most travel blogs, since they follow the same guideline of entertaining the reader, this time by challenging his or her cognitive aptitude and language level. It must be mentioned, however, that this specific feature of travel blogs requires of the reader at least the B2 level of English, since they presuppose quite large amount of vocabulary and verbal flexibility.

Wordplay can take place on a variety of linguistic levels. As an example of creative word formation one can give the name of a travel blog www.everywhereist.com, which is wittily stressing the extensive travel experience of the author. Students can wonder about the morphological differences between English and their native language, they can also try to reflect upon the frequency of similar instances of word formation, where an adverb is transformed into a noun.

Playful decomposition of idioms is a frequent form of wordplay. It can trigger intense cognitive processes in students, who have sufficient scope of idiomatic expressions in their repertoire. The wordplay in the following example is made possible due to mentioning concept of rice, which is a grain (*It's a no brainer – It's a no grainer*):

> *Keen for a bit of local culture and some truly epic views? Then* ***it's a no grainer*** *to visit Tegallalang rice paddies. Go down around 5am just before the sun comes up, meet the locals, grab a coconut leaf hat and sip coconut water as you explore the phenomenal emerald-green fields* (Griffiths, 2019).

Paronymic attraction is another popular way to create engaging wordplay, leading students to intellectual pleasure of decoding the joke:

> ***6 'Can't Miss' Things to Czech Out in Prague***
> *A few hours away from most over-priced European cities, Prague is nestled in Bohemia, right in the center of the Czech Republic. Prague features a rich history, Gothic architecture, a castle, cobblestone streets, delicious food, and affordable prices*

Playful attitude to the language and to the reader, challenging readers with wordplays are all instances of a bigger communicative trend – the one of entertaining and engaging the reader. In the following piece of blog writing it is done by means of irony, quite typical of modern youth. By using irony as a stylistic device the author intends to appeal to similar patterns of lifestyle in many readers – a positive outlook on life mixed with a bit of laziness and self-pity:

> *It's usually possible to get by with just English and some imaginative sign language while travelling, but learning basic phrases in the local lingo will go a long way. ...* ***So all you have to do is become fluent in every language on the planet. Easy, right?*** *Well, it is if you've got the Hostelworld app on your phone.* (Fun & Easy Ways…)

Conclusions

In vibrant digital social environment travel blogs represent an abundant source of material for language learning. In English-language travel blogosphere we spot such prominent features as polysemantic vocabulary, compact meaning representation, specific strategies to present cultural information, and verbal creativity. These linguistic traits can obviously be observed in quite a few genres (soap operas, novels, news articles, private posts in social networking sites etc.) but it is travel blog that is potentially more attractive to younger language learners as it matches

the motivation of most of them – in the younger age most people are open to new experiences and are not so strongly bound by social responsibilities as later in life to be able to travel a lot.

Travel blogs could enrich teaching in ESL classrooms for students of all courses, intense linguistic courses, private tutoring, and undeniably – for students of philological courses. It should be noted, however, that travel blog can be used as a learning tool for B2-level students and above – those who have enough linguistic experience and flexibility.

From among the forms of student work with travel stories, it is recommended to compile individual textual collections, focused on polysemy, culture-specific concepts, wordplays, irony, creative instances of word-formation, and other similar instances of using language creatively.

Travel blogs may involve students in project group work, with the objective of sampling stories by country, by area or by activity and presenting one concise story to the classroom, as their own post or a paper brochure.

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Blog podróżniczy jako narzędzie dydaktyczne podczas lekcji języka angielskiego jako drugiego (nieojczystego)

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

Obecny etap rozwoju technologii informacyjno-komunikacyjnych stwarza możliwość doskonalenia narzędzi dydaktycznych, umiejętności i badania efektów uczenia się. Artykuł omawia szerokie perspektywy edukacyjne, jakie daje wykorzystanie gatunku bloga podróżniczego podczas lekcji języka angielskiego jako drugiego (nieojczystego) (ESL). Autorki dokonują krótkiego przeglądu teoretycznego badań nad blogosferą podróżniczą i przedstawiają klasyfikację blogów podróżniczych według rodzaju komunikacji między nadawcą a odbiorcą. Na tym materiale tekstowym artykuł rozważa tak znaczące cechy blogów podróżniczych, jak słownictwo tematyczne, strategie prezentacji informacji kulturowych i językowa kreatywność, które mogą być interesujące dla uczniów realizujących poziom B2 lub wyższy. Autorki przedstawiają również kilka propozycji pracy indywidualnej uczniów z opowieściami podróżniczymi podczas lekcji. Proponowane formy pracy obejmują: ćwiczenia lingwistyczne (gry słowne, ironia, tworzenie słów), prezentację innej kultury za pomocą języka angielskiego, pracę projektową (dla zainteresowanych), napisanie własnego tekstu blogowego lub stworzenie broszury papierowej zawierającej relację podróżniczą z danego kraju.

S ł o w a k l u c z e: blog podróżniczy, nauczanie języka angielskiego, bogata semantyka, kreatywność werbalna, realia kulturowe

Maryna Romaniukha, Oksana Shelomovska, Liudmyla Sorokina

Блог о путешествиях как инструмент обучения ESL

Аннотация

Текущая стадия развития ИКТ предполагает улучшение инструментов обучения, навыков и результатов обучения. В статье рассматриваются богатые образовательные перспективы блогов путешествий для студентов английского языка как второго (ESL). Авторы предлагают краткий теоретический обзор исследований образовательных возможностей туристической блогосферы, обсуждая классификацию блогов о путешествиях по типу связи между отправителем и получателем. На широком и современном текстовом материале в статье рассматриваются такие выдающиеся особенности повествования о путешествиях, как словарь широкой семантики, представление в компактном смысле, стратегии представления культурной информации и словесного творчества, которые могут представлять реальный интерес для студентов уровня B2 и выше. Читатель также может узнать о нескольких формах деятельности с рассказами о путешествиях, которые представляют собой индивидуальную специальную выборку с определенной направленностью (игра слов, ирония, творческие примеры построения слов), представление другой культуры с помощью английского языка, проектная работа для небольшого группа энтузиастов, выбирающая истории по странам, областям или по видам деятельности и представляющая один краткий рассказ классной комнате, в виде собственной публикации или бумажной брошюры.

Ключевые слова: туристический блог, преподавание английского языка, широкая семантика, словесное творчество, культурная реальность

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Blog de viajes como herramienta de enseñanza de ESL

Resumen

La etapa actual del desarrollo de las TIC sugiere la mejora de las herramientas de enseñanza, habilidades y resultados de aprendizaje. El documento analiza las ricas perspectivas educativas de los blogs de viajes para estudiantes de inglés como segundo idioma (ESL). Los autores sugieren una breve descripción teórica de la investigación sobre las oportunidades educativas de la blogosfera de viajes, discutiendo una clasificación de los blogs de viajes según el tipo de comunicación del remitente frente al receptor. En un material textual amplio y moderno, el documento considera características tan destacadas de la narración de viajes como vocabulario de semántica amplia, representación de significado compacta, estrategias para presentar información cultural y creatividad verbal que pueden ser de verdadero interés para estudiantes de nivel B2 y superior. El lector también puede aprender sobre algunas formas de actividad con historias de viaje que son muestras especiales individuales con un enfoque específico (juego de palabras, ironía, instancias creativas de construcción de palabras), presentación de otra cultura por medio del inglés, trabajo de proyecto

para un pequeño grupo de entusiastas, que muestrea historias por país, por área o por actividad y presenta una historia concisa al aula, como su propia publicación o un folleto en papel.

P a l a b r a s c l a v e: blog de viajes, enseñanza del idioma inglés, semántica amplia, creatividad verbal, realidad cultural.

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Flipped Learning for Teaching Ukrainian IT Students

Abstract

The paper is devoted to utilisation of flipped learning for improving educational quality for IT students. The article discusses the advantages and disadvantages of flipped learning, the obstacles for its adoption are also described. The modification of educational functions, roles, actions, and interconnections of the participants during implementation of flipped learning is shown. Flipped learning implementation algorithm is proposed for a university discipline. Uniform architecture for flipped course which consists of face-to-face and online parts is provided. Forms and requirements for e-content are described. Approaches and technologies for implementing the online part of flipped learning are also discussed. Innovative educational technologies which may be useful at the stages of meaning realisation and knowledge reflection as well as for creating professional students' skills are proposed. The proposed solutions are uniform and formed by generalisation of the knowledge about the data domain, they can be utilised at Ukrainian universities.

K e y w o r d s: flipped learning, blending learning, distance learning, IT-students teaching

Introduction

Some disadvantageous changes taking place in Ukrainian higher education system, decrease in public funding and the resulting reduction of classroom hours, moral aging of educational equipment, and increased requirements for university graduates in the Ukrainian labour market, all of those have inevitably lead to searching for new educational methodologies, tools, and technologies. The process of training skilled professionals, creative and efficient graduates is a complex one. For today's specialists whose main aim is to acquire practical skills, the problem of implementing and effective use of innovative pedagogical approaches, modern information and communication technologies (ICTs), globally successful pedagogical practices becomes a priority task (Koshechko, 2015). Application of ICT in education allows its modernisation, activation of innovative potential, development and introduction of advanced pedagogical methodologies.

The process of mastering new knowledge and competences within the course of education discipline includes the following: comprehension of theoretical lecture material, arrangement of acquiring practical skills and abilities, managing student's self-study, and examining how the new knowledge is acquired. The variety of forms and methods for combining ICT with traditional education shows that searching for methods of modernising the education system and making it up-to-date according to the requirements of the labour market is highly relevant and important. Today, one can say that the Ukrainian higher education mostly uses blending learning technology, which means, the traditional education system is to some extent supplemented by means of ICT (Korotun, 2016). IT education faces the crucial task of effective development of practical skills and abilities for future professionals involved in software development, maintenance, and quality assurance. At each stage of education, information and computer technology can provide effective tools for maintaining high level of presentation of educational materials, as well as for motivating the students to learning activities. Flipped learning methodology is analysed in the present article as a potential strategy to improve professional skills by decreasing class hours intended for theoretical material and utilising them for solution of practical problems.

The main research focus is to analyse the flipped learning technology in terms of its possible implementation as an effective tool for improving the educational process and professional competences of IT students.

General Background of the Research

A multitude of Ukrainian and foreign scholars have showcased their interest in arrangement and effective implementation of electronic, blended and distant learning in modernisation of traditional education. The approaches and methodologies for introducing the modern ICT into educational process are described, among others, in research papers by the following authors: Buhaichuk (2016), Korotun (2016), Kademiia (2016), Koziar (2015), Morze (2017), Kukharenko, and others.

Involved in development of methodologies and technologies of electronic, blended, or distant learning are the following representatives of foreign academic schools: K. Shpanagel (Germany); professors D. Bergam, A. Samson (USA); professor E. Smyrnova-Trybulska (Poland); professor C. D. Sixto (Spain); M. Capay, M. Drlik (Slovak Republic); professor P. Kommers (Netherlands), and others.

The prospects, problems, methodological principles of utilising flipped learning in Ukrainian universities in general and for teaching certain disciplines are, among others, studied in papers by Didukh (2015), Prykhodkina (2015), Romanych (2015), Popadiuk and Skurativska (2017), Chopovska, Piankovska , Yevdokymova-Lysohor, and Buhaichuk (2016). The Ukrainian project Prometheus creates online courses for launching a blended-learning project, while flipped learning model is used by teachers at the National Technical University of Ukraine (Igor Sikorsky Kyiv Polytechnic Institute) and National Technical University (Kharkiv Polytechnic Institute), Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, etc. (Buhaichuk, 2016). In 2010, Clintondale High School in Detroit (USA) became the first "flipped school" that completely switched to flipped learning concept (Didukh, 2015).

The patterns, purposes, advantages, and disadvantages of flipped learning are studied by Aaron Sams, Jonathan Bergman, Salman Khan, Kari M. Arfstrom and other researchers at different universities and in various countries. According to a 2014 survey conducted at Lesley University (Cambridge, Massachusetts), 78% of teachers said they had flipped lesson, and 96% of those who tried it said they would recommend it to other educators. Awidi and Paynter (2019) report on evaluation of the impact of a flipped classroom approach on the learning experience of students undertaking an undergraduate biology course. The results of the study by Karagol and Esen (2019) reveal that there is a positive effect of the flipped learning in academic achievement compared to traditional learning approach. The study financed by the University of Zaragoza and devoted to the analysis of flipped learning as an active learning approach is presented in Blazquez, Masluk, Gascon et al. (2019).

A variety and the number of the academic works devoted to flipped learning demonstrate the topicality and prospects of this pedagogical and learning approach.

Identification of the Research Goals

Despite the diversity and number of scholarly articles, the problem of maintaining a sufficiently professional level of teaching in higher education institutions, as well as creating useful competences in graduates remains a relevant academic and practical task and requires further research and development.

The main purpose of the study is to carry out a comparative analysis of traditional and flipped learning in the context of training IT-students. The authors defined the following objectives of the research:

1. Definition of "flipped learning", analysis of history and the preconditions for its creation, analysis of global and Ukrainian practices for its implementation at universities.
2. Determining the advantages and disadvantages of flipped learning, identifying difficulties in introducing flipped learning into education process for IT students. Determining its role and place in traditional education.
3. Presentation of "traditional learning – flipped learning" transformation scheme, description of how the roles, functions, and responsibilities of education process of participants might change.
4. Description of the generalised architecture for a lesson held in accordance with the flipped-learning model: definition of online and face-to-face learning components.
5. Description of requirements for educational e-content for a flipped lesson.

The Research Results

Introduction of ITCs into education process generated a number of definitions regarding this phenomenon:

– e-learning is an education system that provides for the availability of electronic learning content and means of communication;
– online (distance) learning is a type of e-learning, where the source of knowledge and the student are separated by distance;

– blended learning is an education technology that combines e-learning with traditional face-to-face learning. Depending on the scope and methods of applying ICTs in the traditional education system, the following types of blended learning are distinguished (Buhaichuk, 2016): rotation model assumes cyclic nature of working with teaching materials; flipped learning is an educational method which assumes that students first get acquainted with the theoretical materials using online learning tools, and then actively master the acquired skills in a classroom under the supervision of a teacher; self-blended model is a model assuming that the students can add several online courses to the main regulated curriculum;
– mobile learning (m-learning) means knowledge transmission using mobile devices with WAP and GPRS technologies (Koziar & Kademiia, 2015);
– ubiquitous learning is a phenomenon of continuous education with the use of ICTs in all areas of life and in life-long terms.

The Main Features of Flipped Learning

The inventors of flipped learning are American chemistry teachers, Aaron Sams and Jonathan Bergman, who in 2008 created lecture presentations and then recorded video collection of chemistry lessons for self-study by students (Kademiia, 2016). The rapid development of flipped learning idea is associated with another American, Salman Khan, who created the Open Educational Resources Academy in the form of video lectures (Bergmann & Sams, 2012).

The origins of flipped learning include the need to stimulate students to self-directed educational activities, modification of traditional lectures, when all educational material has to be analysed in parallel with listening or annotation, while development of practical skills and abilities is mainly delegated to off-classroom self-reliant work (Prykhodkina, 2015).

Two concepts constitute the basis of flipped learning model:

1) psychological concept: due to visualisation of the content, the educational material can be better comprehended and retained in memory for a longer period;
2) pedagogical concept: the in-classroom time would be spent more efficiently on active cognitive tasks through discussions, solution of practical problems, consolidation of theoretical knowledge, reproduction of example problems, etc.

Currently, the educational programmes for higher education students, curricula and course programmes in Ukraine regulate the ratio of classroom work vs self-study as one hour of classroom activities to three hours of self-dependent work, therefore, increasing students' motivation to self-study and self-develop-

ment of professional competences is extremely relevant problem, particularly for IT-education. The flipped learning assumes that theoretical material is studied by the students off-classroom, utilising ICTs, for example, using video lectures. Thus, the main source of theoretical knowledge is not the teacher in the classroom, but the digital materials provided remotely. The self-reliant homework and classroom work switch places: the consolidation of the educational material in classroom combines with self-reliant study of the theory. The roles and functions of the teacher and students also change. The generalised transformations during transition from the traditional education system to the flipped learning are provided in Table 1.

Table 1.
Expected transformations of the traditional education system

Problem domain	Traditional education	Flipped learning
Student	"Listen – remember – reproduce" scheme	Key role in cognitive activity (learner-centred approach). Increased responsibility for acquiring the theoretical material.
Teacher	Acting as a primary source of information (teacher-centred approach). Functions: learning process supervision and monitoring; development of learning materials for the discipline	Functions: counseling, direction and motivation to self-reliant cognitive activity; learning process coordination and monitoring; developing of interactive learning materials along with managing the e-content.
Self-study	Consolidation of theoretical knowledge, solving individual practical tasks, project development.	Prior study of theoretical material, project development.
Classroom study	Writing abstracts of theoretical material; solving practical or laboratory tasks; examining the acquired knowledge.	Consolidation of self-learned theoretical material. Obtaining practical skills and abilities. Examining the acquired knowledge.
Educational material acquisition from	Passive: from teacher to student	Active
interaction between the participants of education process	Synchronous	Synchronous during classroom lectures. Asynchronous using ICT.
Knowledge transfer methods	Interactive technologies, face-to-face learning	Interactive technologies utilising ICTs, combination of face-to-face and online learning, person-oriented approach, cooperation pedagogy

S o u r c e: own work.

According to a study by the Center for Digital Education and Sonic Foundry, among the members of Educational Exchange online community half of the US university lecturers have already used flipped learning in classrooms (Markova & Shmatok, 2018). As for introduction of flipped learning in Ukrainian universities, the consecutive steps from the lecturer's point of view are presented in Figure 1.

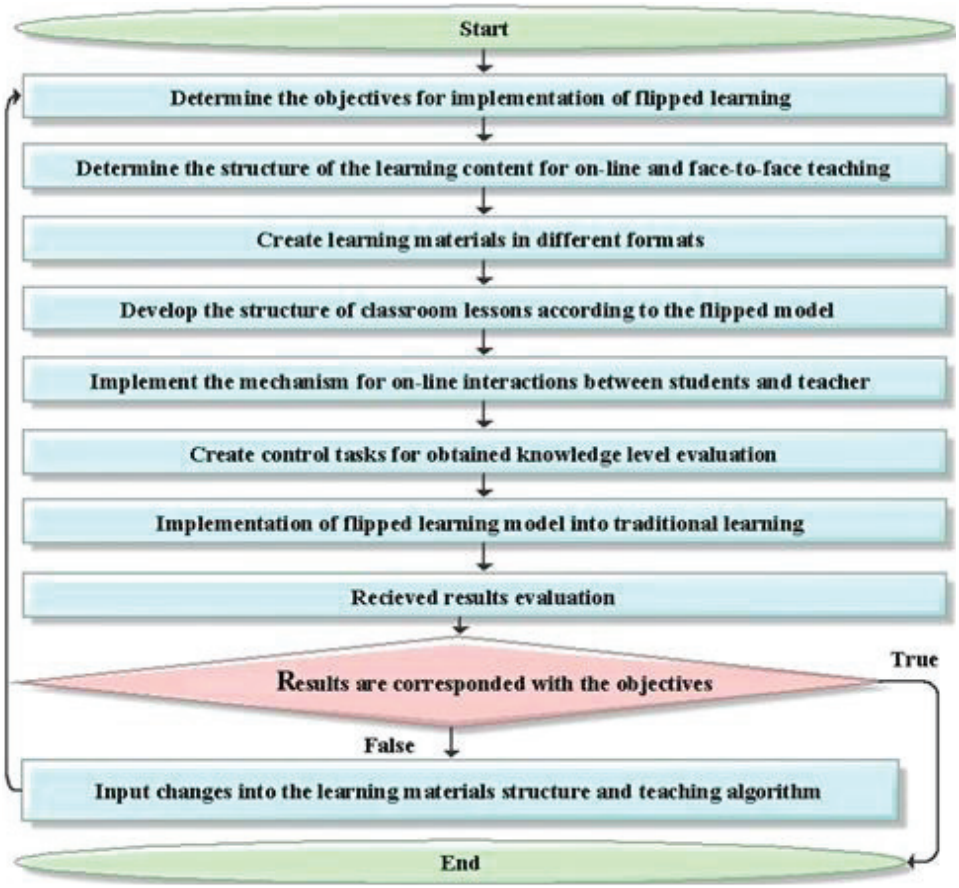

Figure 1. Flipped learning implementation algorithm
Source: own work.

To create a course using flipped learning technology, the teacher has to solve the following problems:

1. Determine the objectives for implementation of flipped learning into the selected subject.
2. Determine the amount, composition, and structure of the necessary teaching materials, namely, how to divide them into online and classroom portions.

3. Create e-learning materials, video lectures, podcasts, animations, infographics.
4. Develop the structure of classroom lessons, giving higher priorities to mastering practical skills, while using advanced pedagogical technologies.
5. Develop or apply mechanisms for interactions between the students, the e-learning materials, and the teacher by means of ICT and the Internet. Provide access to e-learning content and arrange for feedback.
6. Develop mechanisms for assessing how well the knowledge has been acquired: tests of various formats, controlling tasks, questions, and dialogues.
7. Organise education process using flipped learning model.
8. Assess and analyse the results. Make conclusion on reorganisation of education process components, as well as learning content.

Advantages and Disadvantages of Flipped Learning

The main advantage of flipped learning is the possibility of combining the advantages of online and classroom lesson under the direction and supervision of a lecturer, and the most significant positive results thereof are as follows (Romanych, 2015):

– the possibility of customising the education by the students, as well as expanding the area of their interests;
– an increase in cognitive activity, development of cooperation skills, improvement of IT-competences;
– accessibility and flexibility of the online learning environment
– improving the quality of acquired practical skills by decreasing the number of classroom hours;
– realising the responsibility and importance of self-study.
– Despite the above-mentioned advantages of flipped learning, there is a number of significant barriers to its effective use:
– increased entry threshold for flipped learning students and requirement for sufficient level of IT competences of all participants of training. This requirement can be easily met by IT students, since their basic IT competences allow them to enter the education process utilising ICT tools quite quickly. This idea was proved by the analysis of the data of students survey, the results are presented Yalova and Zavgorodnii (2016);
– the need to produce video lectures or podcasts by teachers, which is a quite time-consuming, labour-intensive additional work to be made in preparation for lessons;

– the need to replace the traditional lectures with lessons using material-comprehension technologies;
– the lack of a legal basis, as well as the role and place of flipped learning in the traditional education, the duties and rights of teachers and students;
– the students must make themselves acquainted with theoretical material prior to the lesson, failing to fulfil this requirement will result in the idea of flipped learning as to classroom work on discussion and consolidation of the material being will be nullified.

Architecture of a Course Arranged in Accordance with Flipped Learning

Concept

The architecture of each lesson implemented according to flipped learning model consists of two interrelated and mandatory parts: online part and face-to-face part (Figure 2). The online part supports the students in consolidation of theoretical material during self-study before the classroom lesson. The face-to-face part is carried out under the direction of a teacher, its purpose being mastering practical skills and formation of professional competences.

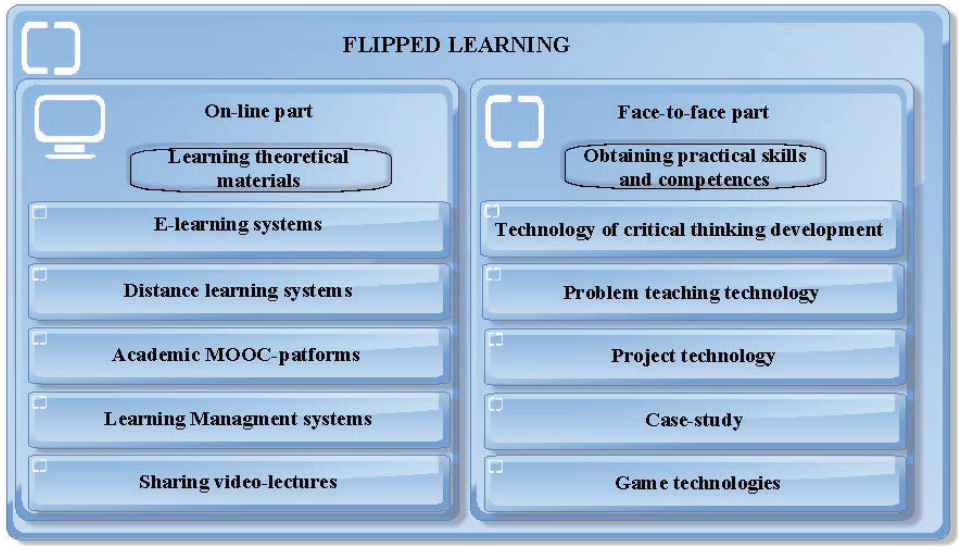

Figure 2. Flipped learning architecture
S o u r c e: own work.

Online part of flipped learning. The online part can be implemented by means of self-developed e-learning or online learning systems, academic MOOCs (massive open online courses) platforms (Yalova & Yashyna, 2017), or by means of existing commercial and non-commercial learning management systems (LMSs), which are comparedin the article by Yalova and Zavgorodnii (2016). The main task of the students regarding the online part is self-preparation prior to classroom lesson by reviewing the video materials, video lectures, and podcasts developed by the teacher. To ensure the most effective implementation of flipped learning technology, its online part shall contain the following mechanisms:

– managing the educational e-content created by lecturers in the forms of video lectures, podcasts, brief learning media materials;
– structured presentation of educational materials according to education programmes, curricula, or working plans for a subject, representation of logical and structural scheme of a subject, interconnections between topics;
– tools for presenting and viewing the educational material, implementation of online video player or download system. Presentation of educational materials using multimedia;
– mechanisms for remote examination by a teacher or self-examination.

The online part of flipped learning model allows the students to customise the learning process by arranging an individual learning pace, choosing convenient time and place to study, using the possibility of replaying the materials while focusing on points unclear to them. The main obstacle for efficient use of the online part in flipped learning is that the students do not devote enough attention to self-study and self-examination. However, the insufficient motivation to cognitive tasks performed, that teachers always encounter, will be very hard to change, whichever learning model is chosen. That is why we should not underestimate the importance of utilising the modern ICTs for motivating students to self-study and growing interest in learning process. At the same time there is a number of requirements and recommendations for the video materials:

– the videos ought to be brief, comprehensive, and engaging;
– maximum duration for a single video lecture is 30 minutes, recommended duration – l0 minutes;
– it is reasonable to divide a single topic into several videos or podcasts;
– utilising various visualisation forms: infographics, animations, video captures, for instance, actions videorecorded during coding activity;
– accounting for psychological features of the students during creation of the video, selection of fonts, structure, number of comments. Especially, one has to pay attention to tips and hints given to the students. Such hints should, on the one hand, give a student some relevant help in learning situation, on the other hand, they shall not hinder the student in his or her individual activity;

– supplementing videos with other digital materials: presentations, subtitles, tests, etc.;
– links to external additional resources: web-links to program code examples on the Internet or other educational videos.

The educational e-content should be supplemented with virtual discussion platforms or feedback mechanisms enabling communication between all participants. Arrangement of online cooperation between the students can serve as additional mechanism for motivating students to successful learning.

Pedagogical techniques for face-to-face part of flipped learning. The arrangement of face-to-face component of flipped learning is equally important. The teacher faces a number of challenges requiring considerable effort and time, since the flipped learning model assumes changes in learning process priorities. The role of the classroom work is changing, the priority shifts to acquiring practical skills and abilities according to current requirements. The face-to-face part deals with arrangement of active cognitive tasks by applying various forms of material presentation, examining the acquired knowledge, switching between learning patterns in order to enhance the cognitive abilities of the students, so that the knowledge is acquired faster and remembered for longer periods of time. In order to achieve this goal, modern pedagogical technologies can be reasonably applied – models of collective pedagogical activity on designing, organising and conducting the educational process (Koshechko, 2015) that includes three phases: the evocation of meaning, the realisation of meaning, and reflection. The authors would like to recommend the following education techniques for the phases of realisation and reflection in the process of teaching IT-students:

1. Technique of critical thinking development, which aims to teach how to discuss, evaluate, identify, and solve IT problems. It involves the following methods:
   a) cluster method assumes generalisation of information in a given problem domain and presentation of its main units in a graphical form in the form of a scheme with displayed links;
   b) table method assumes generalisation of information in a given problem domain and presenting it in table form, for instance, table of terms in the format “Keyword – Definition” or completion table in the format “I know – I do not know – I want to know – I’ve learned”;
   c) insert method is used during the realisation phase when a student learns theoretical material; it assumes marking the text with such set phrases as *I know*, *I understand*, *Contrary to what I know*, *I did not understand*. Despite the fact that this method assumes a combination of reading and writing in the classical understanding of those terms, it can also be applied to video-materials with students marking their impressions of what they see;

   d) Cinquain creation method assumes presenting the material being learned as five lines of text. The first line – one word describing the topic of the problem domain or the object. The second line – two adjectives describing the properties of the object. The third line – three verbs describing the object's characteristic actions. The fourth line – a phrase reflecting author's attitude towards the object. The fifth line – one word being a conclusion.
2. Project technique assumes taking a particular problem from the problem domain and solving it while applying the acquired knowledge and mastering new skills. Project technique implementation phases: organisational phase, search phase, conclusion phase, and reflection. This technology is especially useful for disciplines that assume development of course projects.
3. Problem learning technique assumes arrangement of self-reliant search activity for solving the given tasks; this leads to acquiring new knowledge and competences, as well as developing cognitive skills, creative thinking, etc. Generally, the problem-learning technique includes describing the problem, creating a hypothesis for its solution, outlining and discussing the ways of its verification, proving the hypothesis, and analysing the results.
4. Game-based techniques combine activities aimed at obtaining real-problem experience, as well as improving behavioural self-management. There is a number of pedagogical games, of which intellectual, cognitive, training, and subject-oriented games can be mentioned as suitable for teaching IT-students, the functions shall be distributed according to the roles of IT-project participant.
5. Case study is an interactive learning technique based on real-world and abstract situations, that is aimed not only at developing theoretical knowledge, but rather at generating practical skills and abilities. One can name the following approaches to the case-study technique:
   a) incident method, the main purpose of which is developing or improving the skills of making professional decisions accounting for lack of information, as well as rational collection and utilisation of the data required for making effective decisions. The students have to search for the information on their own, since instead of a detailed description of the problem situation and the problem domain they receive only a brief note about the incident.
   b) In-basket method is a technique aimed at developing professional competences by creating situations that are as close to the real-world problems as possible, where the student acts as a decision-maker, for instance, analysing software requirements or business process reengineering problem.

The classroom lesson in flipped learning model can consist of the following phases:

1. Motivation for learning. Definition of problem keyword, rising interest through practical activities.
2. Strengthening the knowledge acquired during online self-study: answers and questions, explaining the points that were not understood, giving examples, group work, simulation of problem situations, discussions, cross-discussion, etc.
3. Learning the new material through the solution of practical problems, developing professional competences through solving the similar tasks but with other input conditions, personal tasks, group tasks with software development functions divided between participants, fixing program bugs, code refactoring, evaluating software and interface quality, etc.
4. Assessment of material apprehension: a brief quiz or test incorporating various forms of questions: a question with a single correct option, a question with multiple correct options, or a question that shall be answered without any option.
5. Debriefing, that is, making conclusions, collecting remarks, answering questions, motivating to further self-study.

Conclusions

The article analyses the origins, preconditions, methods, and practice of introducing flipped learning concept into higher-education system in Ukraine and elsewhere. The traditional and flipped learning, as a type of blending learning, are compared. The algorithm is given for implementing the flipped learning model in IT-related subjects. It is universal, mass-applicable, result-oriented, and determined, it can be applied in Ukrainian universities. The article provides the scheme for traditional education transformation, as well as describes how the education process precedes change in flipped learning model. The architecture of the flipped learning model consists of online and face-to-face parts, for each of them the authors propose the methods, mechanisms, technologies, and software tools for their implementation.

The flipped learning is considered a relatively new approach, and therefore it is quite difficult to find research articles that would compare flipped learning to traditional approaches. The eight-year experiment, aimed at comparing the professional level of graduates who participated in flipped leaning to those of tradition system, is currently being conducted at Harvey Mudd College (Claremont, California). The preliminary assessment of the results shows that the effectiveness of

knowledge acquisition does not decrease in case of flipped learning, at the same time providing the students with the flexibility of the educational process and presentation of learning materials, thus allowing them not to worry about missing classroom lessons.

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Metoda odwróconej klasy w nauczaniu informatyki ukraińskich studentów

Streszczenie

Artykuł poświęcony jest wykorzystaniu metody odwróconej klasy (flipped classroom) w poprawie jakości kształcenia studentów kierunków informatycznych. W pracy przedstawiono zalety i wady uczenia się metodą odwróconą, opisano także przeszkody w jego wprowadzeniu. Pokazano modyfikację funkcji edukacyjnych, ról, działań i wzajemnych powiązań uczestników podczas realizacji uczenia się metodą odwróconą. Algorytm implementacji uczenia odwróconego jest proponowany dla dyscypliny uniwersyteckiej. Podano jednolity program dla kursu odwróconego, który obejmuje część stacjonarną (twarzą w twarz) i część on-line. Opisano formularze i wymagania dotyczące treści elektronicznych. Omówiono również technologie wdrażania metody uczenia się przez Internet. Zaproponowane innowacyjne technologie edukacyjne mogą być przydatne w realizacji tematów z zakresu IT, a także do tworzenia umiejętności zawodowych uczniów. Proponowane rozwiązania zostały ujednolicone, dlatego można je wykorzystać na ukraińskich uniwersytetach.

Słowa kluczowe: nauka odwrócona, nauka łączona, nauka na odległość, nauczanie studentów informatyki

Екатерина Яловая, Ксения Яшина, Людмила Сорокина

Перевернутое обучения для подготовки IT-студентов

Аннотоция

Статья посвящена рассмотрению вопроса применения перевернутого обучения как средства повышения качества подготовки соискателей высшего образования в области знаний «Информационные технологии». В статье описаны преимущества и недостатки применения перевернутого обучения, определены трудности на пути его внедрения в традиционный образовательный процесс. Представлена схема модификации образовательных функций, ролей, действий и взаимосвязей субъектов обучения в ходе реализации перевернутого обучения. Предложен алгоритм реализации модели перевернутого обучения для учебной дисциплины университета. Представлена унифицированная архитектура перевернутого курса, которая состоит из он-лайн и аудиторной составляющих. Описаны формы и требования к разработке электронного учебного контента он-лайн части перевернутого

обучения. Представлены подходы и технологии реализации он-лайн части перевернутого курса. Рекомендованы инновационные педагогические технологии, использование которых является целесообразным на этап восприятия и рефлексии знаний при формировании профессиональных компетентностей студентов. Предложенные решения являются универсальными и сформированы путем обобщения знаний о предметной области и могут быть применены в высших учебных заведениях Украины при разработке перевернутых курсов для различных специальностей.

К л ю ч е в ы е с л о в а: перевернутое обучение, смешанное обучение, дистанционное обучение, подготовка IT-студентов

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Aprendizaje invertido para la enseñanza de estudiantes ucranianos de TI

R e s u m e n

El documento está dedicado a la utilización del aprendizaje invertido para mejorar la calidad educativa de los estudiantes de TI. El documento ofrece las ventajas y desventajas del aprendizaje invertido, también se describen los obstáculos para su adopción. Se muestra la modificación de las funciones educativas, roles, acciones e interconexiones de los participantes durante la implementación del aprendizaje invertido. Se propone un algoritmo de implementación de aprendizaje invertido para una disciplina universitaria. Se proporciona una arquitectura uniforme para el curso invertido que consta de partes cara a cara y en línea. Se describen los formularios y requisitos para el contenido electrónico. También se discuten enfoques y tecnologías para implementar la parte en línea del aprendizaje invertido. Se proponen tecnologías educativas innovadoras que pueden ser útiles en las fases de realización del significado y reflexión del conocimiento, así como para crear las habilidades de los estudiantes profesionales. Las soluciones propuestas son uniformes y están formadas por la generalización del conocimiento sobre el dominio de datos, pueden utilizarse en universidades ucranianas.

P a l a b r a s c l a v e: aprendizaje invertido, aprendizaje combinado, aprendizaje a distancia, enseñanza de estudiantes de TI

III. Virtual Educational Space, Robotics and Hybrid Reality in Business and Education

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Behaviour Analysis of Agents in Virtual Educational Space

Abstract

Modern teaching methods include both traditionally established approaches to the classroom and an entirely virtual approach aimed at learning from anywhere in the world at any time. Society is constantly witnessing increasingly popular platforms such as Coursera, Udacity, Udemy, and even YouTube, which are regarded as aggregators of new knowledge.

The problem that is not addressed, however, is to what extent learning is effective in the process not only of the particular course but also within several interrelated courses of study. This article will describe a conceptual model for analysing the behaviour of intelligent agents who acquire knowledge by using virtual tools to support the educational process, as well as ways to analyse the behaviour of the agents in question.

K e y w o r d s: e-learning, intelligent agents, ITL, virtual educational space, behaviour analysis

E-learning in the last decade has become an integral part of the overall process of acquiring knowledge and skills. The European Community is increasingly actively speaking about the so-called lifelong learning, which is an integral part of the acquisition of a broad spectrum of knowledge to be developed not only within the first years of professional development of future specialists but also later technological development.

The dynamic changes in technology, as well as the increasingly globalised reality of modern society, contribute to the increasing availability of knowledge and skills platforms, such as: Khan Academy, Udacity, Udemy and Coursera. What is common among these platforms is the combination of high teaching potential with the possibilities of modern internet space to provide short and meaningful educational materials presented in the form of a text but most often a video. Professional networks, that is, Pluralsign, Laracast, and Envato Tuts+ are also a specialised part of the development of knowledge and skills. These platforms specialise in aggregating and documenting useful practices, approaches, and lessons related to software product development.

The tendency for the development of e-learning does not go beyond the university institutions, which develop their platforms to support the education process of their alumni. Within this trend, a distributed Learning Center for e-learning within the Mathematics Faculty has been developed to provide a platform for Information Technology students in which they can learn, exercise, and consolidate their knowledge (Stoyanov, 2016, 72–82).

The abovementioned platforms successfully deal with problems of distance learning, reference and knowledge delivery at any time (Stoyanov, 2010, 11–16), however they often do not take into account the behaviour of trained agents and thus make it extremely difficult to track the effectiveness of the efforts made.

It is important to note that the common idea of e-learning is by itself not enough. The fact that education is using the Internet as a means of communication does not provide any value except for the fact that everyone can access a specific information resource remotely. This concept is already proven to provide the necessary level of utility but it does not work on its own. Technologies are developing fast enough to allow access to comprehensive tools. Some of the most recent examples of such capabilities are:

– real-time training and real-time communication online;
– use of hardware components to further build efficiency in online platforms also called the Internet of Things;
– analysis of learners' behaviour and needs;
– a personal advisor who enhances and improves the learning experience;
– augmented reality and virtual reality that materialises the subject right in front of the students' eyes.

As researchers, we cannot overlook the trends, which is why the DELC platform has slowly begun to transform into a project that brings together the concepts of the so-called virtual learning space – VES (Valkanov, 2015, 322–326). The foundation of the concept is blurring the line between the virtual and the physical world. The sense of physical surroundings is presented by living breathing agents interacting with a collection of sensors strategically positioned around them. The user interacts with the sensor actively or passively and feeds the information stream to the online platform that is responsible for the decision-making process.

The UniPlayground project is an independent platform built around the concepts defined by the VES, which aims to solve a range of problems that are essential to online education not only at the university level but overall. The platform aims to create a behaviour model relevant to the educational process agents' activities and to introduce a model based on it where the educator or the platform itself can act according to students' needs (Stoyanov, 2018, 20–28).

The main target audience of the project is students or agents interested in informatics and technology. Therefore, the platform is built around a set of programming tools that emulate a real programming environment, providing all of the necessary tools for the agents to exercise, learn, and revise their skills.

The following paper is dedicated to the problems of the modern e-learning process and the potential solutions that can be introduced in the face of the UniPlayground project.

E-learning Based on Web Information System

E-learning is not possible if the process is not implemented within a framework of a specific information system that allows supervisors to constantly monitor the behaviour process of learners (Popchev, 2019). There are several specifications describing processes where both training and verification of the learning material can be carried out. An example of such a concept is the SCORM standard that describes the technological aspect of verifying acquired knowledge and skills. Systems should not be viewed in isolation but they should always be classified in several ways (SCORM Explained).

Passive and Active Systems

Depending on the level of interaction between the information system, it can be divided into active and passive. Passive systems integrate only components

aimed at acquiring knowledge, regardless of additional activities related to user interaction and obtaining additional information from its actions.

General-purpose and specialised. If the system is aimed at users with a broad knowledge base and does not imply a specific approach to knowledge verification, then this system meets the general conditions and cannot be labelled general-purpose. The specialised approach requires the provision of processes, whose understanding is part of the professional training of a specific professional group or a precisely specified set of pre-trained agents who can cope with the knowledge.

Behaviour-driven and data-driven. The systems that are developed within our database are called data-driven. They develop an asset of knowledge that depends only on the efforts of the service agents. The change of knowledge will affect already active information units by expanding or updating them. Systems based on consumer behaviour develop this idea by adding the unit to study the behaviour of learners as well as training agents. With the development of knowledge and skills, the system learns and adapts to the current agent's approach and provides a different experience depending on a set of achievements over time.

Problems in the Analysis of Educational Results

When we talk about such an analysis of the results, we have to ask a few questions: (1) What are the characteristics of the agents that work with the system?; (2) What kind of problems are solved?; (3) What is the agents' activity?; (4) When is the interaction with the system and what is its duration? The answer to each of these questions can give us key characteristics of the necessary conditions we have to achieve to say that we can judge whether the behaviour of the agents can be adequately analysed (Kehayova, 2016, 784–788).

What are the Characteristics of the Agents that Work with the System?

It is a fundamental question we need to ask before we start analysing behaviour. In the context of software education, the concept that is being studied is often the study of technology by writing a software code using language constructs that we call programming language (Stoyanova-Doycheva, 2019). The understanding of this matter can be enhanced or deepened if the agent whose behaviour we analyse is studying the subject. Then this activity can be reduced but is not limited to:

– studying the material at school;
– active work on projects related to building software products;
– interest in areas of knowledge that have a strong correlation with the relevant problem, such as the field of mathematics or other engineering sciences.

Knowledge of such activities in the agent's past enables us to assess to what extent the complexity of the outcome that would be achieved by the agent within the course would be due to the knowledge gained during the course of engagement with the subject matter or experience before the course. Such a definition is also a point of departure in the analysis of agent behaviour within related courses, thus making it very clear whether the results of past activities have been maintained and used adequately in current ones.

How can we get information about the agents' knowledge? The technical problem of finding preliminary agent data can be divided into two parts, namely, collecting preliminary knowledge and gathering knowledge within their activity. Within the course, the activity of the agents is assessed by means defined by the supervisor of the discipline, but within the preliminary stage when knowledge is minimal, two approaches can be used.

Preliminary knowledge survey. This is a set of questions aimed at directing the supervisor to the course in which it will be most appropriate for the trained agent's purposes (Todorov, 2016, 753–757). The system used for training can be based on the agents' responses as well as a small sample of their core skills. It can provide activities appropriate to the agent's level. The point is that not all agents have an equal start, experience or educational background. The ability to learn is a complex set of skills that is further supported by the agent's professional experience or the time spent studying the relevant problems in high school or university (Stoyanova-Doycheva, 2019).

Let us approach the problem with an example. Student A and Student B have the same educational statistics; they have the same academic background and at this moment in their life they are trying to learn a specific programming technology. Student A spends his/her time attending lectures or learning from notes and watching video tutorials and explanations, trying to make sense of the problems. Student B spends the majority of his/her time outside of school and does not attend any classes. The result is that the score of the two students is nearly identical. Why does Student B score a nearly perfect score? The answer to this question requires an in-depth analysis. Before we answer, we should ask the following: what is the subject that the two students are learning? and what is the background of Student A and Student B?

It turns out that the technical subjects that suggest a lot more practical skills based on experience and repetitions are handled better by students that are currently working or already have experience with them. It is no secret that the IT industry is expanding at an incredible pace and the majority of the employees are young people who have daily working experience with technology. So, in this example, the experience of Student B is giving him/her a head start over the majority of the efforts that Student A will make during a fixed period. This example also outlines another problem that the survey can solve: namely, the problem of wasting the time and effort of a student who has prior knowledge regarding the subject. For the system to be fair, we must challenge the students regardless of their level of knowledge. Therefore, having a piece of information in advance, we can approach the problem intelligently and be very flexible in the assignments that the supervisor gives to every single student.

Data derived from previous courses. As previously mentioned, the analysis of agent behaviour helps provide information within related courses. This information is much more valuable than the pre-order because it provides an up-to-date and completely objective starting point for the agent's level based on the knowledge and skills shown at this stage of his or her training.

What Kind of Problems They Solve?

Not every problem can be adequately addressed and classified when the agents actively communicate with an information system; the responsibility for their assessment can be divided into three parts.

Evaluation of the system itself. Evaluation of the system itself by means of techniques such as artificial intelligence, machine self-learning, and temporal analysis. This analysis may be sufficiently objective because it takes into account only the input data of the agent without calling into question characteristics such as racial classification, sympathy for the agent, other characteristics that may increase or decrease the assessment coefficient by its final or intermediate performance.

Teacher assessment. Teacher assessment, based on the impressions of one or several course managers, is primarily subjective because of the factors mentioned above, however, with much more weight than the machine-generated one, due to the specific circumstances which are important for the course, defined and conducted by the same lecturer.

Assessment from another student. This is another course participant who has faced the same or a similar set of problems and can give an adequate assessment of the work of an equal subject. The advantage of this activity is that usually the weight of the final score is distributed among a group of active agents, and thus the average score has a great potential to be closer to reality than the subjective assessment of the other two parameters. The main negative aspect is the need for a fine calibration in which it is quite often necessary to intervene in the above two agents' activities to obtain a definitive result and to minimise the injury to the evaluated agent. To classify the behaviour of the agent, the system must keep a record of the actions taken, as well as information on the evaluation of each agent. The examples that will be given in this article are related to the development of software products within the context of writing and analysing software code.

What is the Agents' Activity?

At the core of the behavioural analysis is, of course, the agents' activity. To make the correct evaluation, the theory of interval temporal logic is used, which is a flexible methodology for describing processes that occur over time. Interaction of agents with the system is done through a set of activities that can be classified in general in the following categories:

- getting knowledge: Activities related to the perception of information in any format, text, illustrative or video content.
- knowledge check: Agents solve a problem defined by their supervisor or system.
- assessment of knowledge: Agents assess the problems solved and consolidate their knowledge by classifying the work of other agents based on their current ones.

The process is collaborative, with a system that records a file of all committed actions. To be effective and reliable, the information collected should be often obtained and sufficiently complete, and, in particular, not compromised by technical problems or negative behaviour of the calibrating agents.

UniPlayground Project Architecture

The system is conventionally divided into two large modules that manage the main application capabilities. Administration and supervision is a component that contains the main interfaces to manage ongoing courses and projects that a user interacts with. At the same time, it also combines administrative interfaces to create new or up-to-date current learning processes.

Jobseekers are in continuous communication with the other modules of the system, and they play the role of a client application. It is important to emphasise that the client part communicates with the other components using a set of system components called supervisors that support the application management process between the two layers of the application.

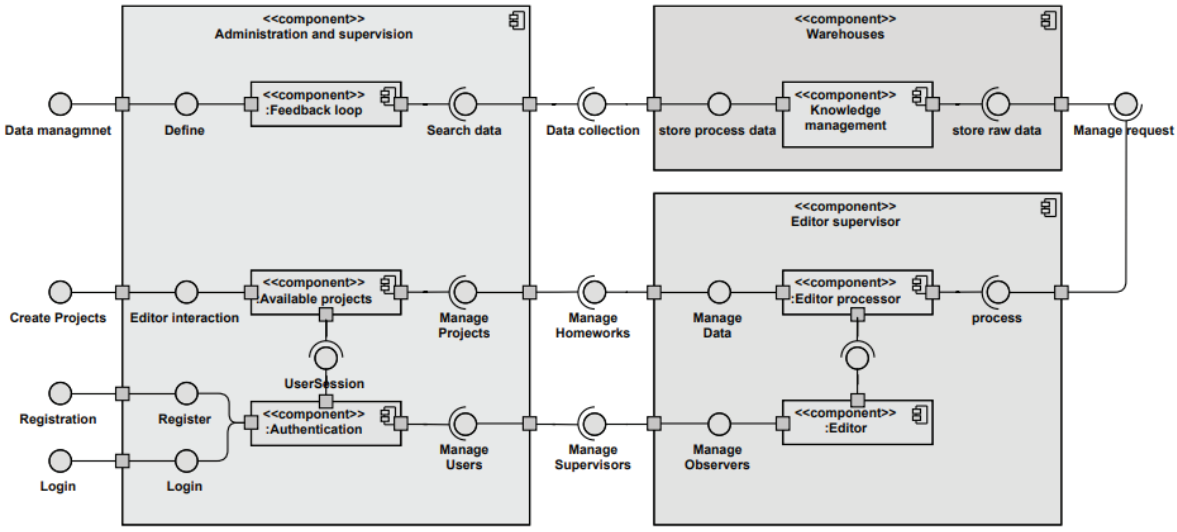

Figure 1. Communication process in UniPlayground.
S o u r c e: the author's own work

This division allows flexibility when introducing different client implements within the platform. At present, the development is based on a web application due to the specifics of the sessions, but without any logic. Logic can be delivered within a mobile application or even an Internet of Things application, that is, a stand-alone hardware component that interacts with the environment.

As mentioned before, the virtual learning space is a concept that blurs the boundary between the physical world and the virtual world, making it possible for interfaces to be replaced by devices that are not traditionally characteristic of day-to-day operation with information systems such as cameras, motion switches, and motion sensors.

Knowledge Supervisor

The supervisor module editor is the main system for managing the interaction between the learner and the system. There are the following important tasks:
Educational tasks
– management of the learning process;

– tutorials;
– returning information.

Analytical tasks
– loop CPU management;
– managing a bug box;
– interface communication;
– communication with the analytical module.

Data Supervisor

Considering the consistency of data transfer, not all information that is generated is equally important for the final analysis of the agent behaviour. For example, a majority of the information that is generated by operations regarding search and reading of publications is classified as important because it gives the analysing algorithm a context for measuring user expectations. The listed component flags the input data generated by the collection of event processors and labels it by categories. The classified data is then sent to a queue which is going to be resolved in a later state of the data process life-cycle.

Knowledge Supervisor

The knowledge management and analysis of user behaviour are done in the so-called Data analysis and Warehousing module of the platform. Information is not analysed in real-time but is subject to storage and processing over a long period. The main tasks of the module are locked into the following activities:
– storage of non-normalised information resources;
– classification of input data from solving information problems;
– classification of input data received when completing survey resources as well as user behaviour within the system, reading articles, links, and other information resources;
– processing of temporal activities that are viewed at a given interval in time and space;
– the output of this module builds profiles of all participants in the training process. Profiles serve both the individual guidelines of each agent and the validation of the flow of actions the teacher takes in the learning process.

Example

If it is necessary to conduct a course for beginners, and the level set by the supervisor is too high, the results will be reflected in the final report, taking into account the previous experience of all the students and thus easily defining a model to serve as the basis of evaluation for the actions taken and their validity towards the environment. Because of that, a model of the training process that is valid for the system parameters will be created. Data collection for the analysis goes

through several important phases in which different components of the system are responsible for the correct distribution of the received information resource. The process is divided into four parts:

– data collection – data collection is possible through an application interface. The common interface for approaching behaviour analysis is a web or desktop-centric application that feeds itself with user input. But the modern approach to this problem can be achieved using mobile applications for tracking data activity and also an Internet of Things-based approach for storing data based on user events/movement and operations with the surrounding environment.
– data transformation;
– data classification;
– data analysis and processing.

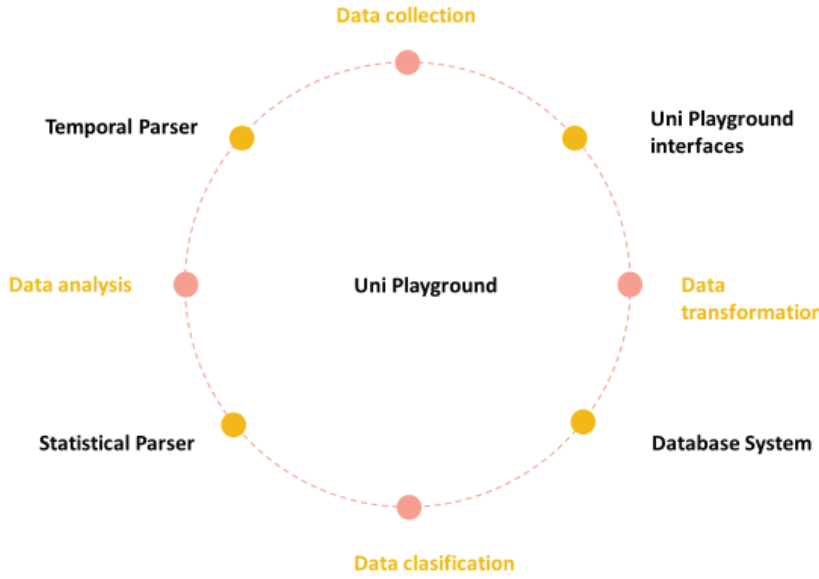

Figure 2. Data analysis and collection cycle
S o u r c e: the author's own work

Implementation of the UniPlayground Project

The implementation of the project is divided into three stages:

– development of the application core;

– development of application modules providing an environment for conducting a specific discipline;
– development of a temporary parser to analyse the obtained data results.

The UniPlayground information system is organised as a set of information services, combining a poly-technological approach to solving a wide range of issues. In its overall model, the system consists of three components:
– client part – providing system interfaces;
– administration layer – provides functionality for both the teaching process management and the overall process of analytical tool definition for analysing activities specific to the supervisor;
– aggregation layer – receives, processes, and transforms received data from the system;
– temporal layer – takes care of the classification and analysis of the processed data;
– service layer – implements the functionalities of the individual training modules as well as the general logic of the information system.

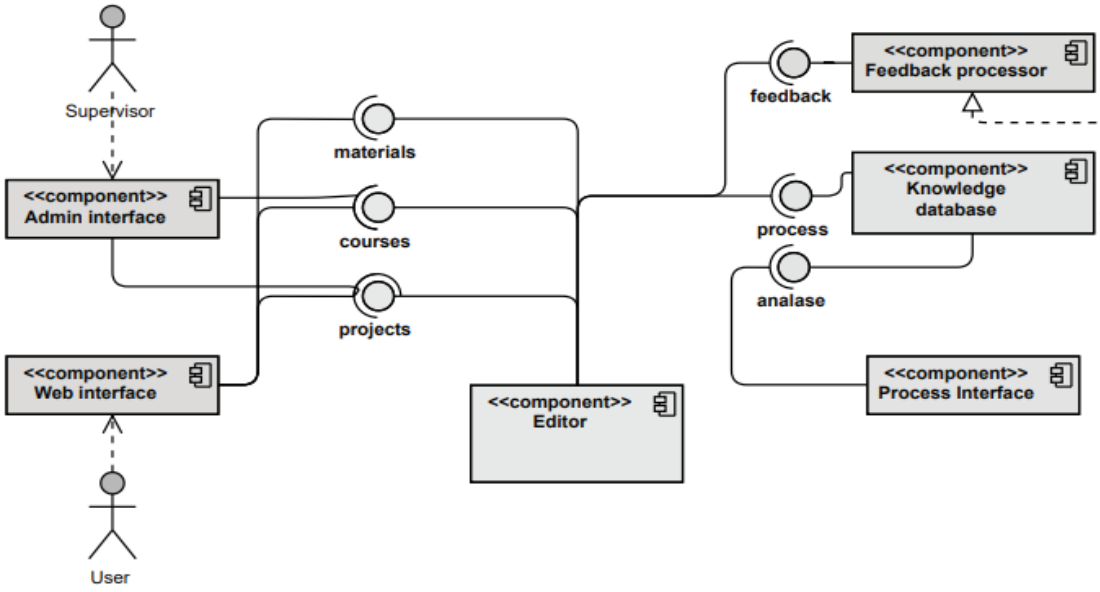

Figure 3. Process of user communication.
S o u r c e: the author's own work

The Multi-Layer Division provides exceptional flexibility in distributing applications, both between individual information infrastructures, but also across multiple different types of client environments. Learning in a virtual environment

is an interactive process that involves the use of devices of any kind, both static and mobile. The client part of the application is completely independent of system logs and can be subject to both the specific needs of the school or academic establishment if the classes are held at school, as well as the specific needs of the users if the classes are open to the general public. The main component of the so-called interfaces is graphic editors. Focusing primarily on the needs of software training, the system aims to provide a specific implementation that addresses the needs of learning in a particular programming language. The graphics editor aims to organise a set of controls to communicate with the service layer of the system and provide the necessary information to the users. Actions typically associated with learners' work with graphic editors can be divided into the following categories:

– defining a program component;
– program component execution;
– obtaining system results.

Each program component is associated with a specific graphics editor that aims to communicate with the service module specified for that purpose. The service modules form the overall functional model of the application. They are heterogeneous in terms of their programming logic and can be defined in any programming language. They are organised around the concept of separating the tasks of independent components and thus avoid the monolithic approach at the expense of easy and independent distribution within any information infrastructure. The static processes are:

– authentication and authorisation of user agents;
– managing educational processes;
– defining content;
– managing interface communication – graphic editors.

Dynamic processes are all processes that aim to retrieve information about a particular subject or group of subjects based on changes in the environmental characteristics.

Collecting and Using Results Based on the Specific Time Interval

An important part in the process of managing consumer behaviour plays the layer analysing the evolution and revolution of user actions over time. Such an analysis enables the interested units in the system to gain a clear idea regarding the movement of the learner in the educational process as part of their training, while also enabling the trainee's potential to develop their knowledge within the framework of a variety of courses involving related content that builds on existing ones.

For the needs of the application, it is necessary to build a formal model and on its basis to develop an algorithm for monitoring and classifying such behaviour. The actions of the user will always be considered at some time, with predefined characteristics of their knowledge and skills. For this reason, we can use the concepts of temporal logic and, in particular, temporal logic intervals, which offer a convenient formality, providing a set of logical constructs that help us achieve this task.

At present, the integration of time interval logic management tools can only be linked to the development of Ben Moskowski and his Tempura interpreter, which can process complex ITL expressions and produce a logical final result. The demonstration of whether a system is valid or not can be found in the answer to the logical statements aimed at checking a set of facts that are considered at the time of the analysis (Moszkowski, 1985).

Direct integration of the temporal interpreter is not an adequate solution, given that data analysis can be limited to reducing all input arguments to a set of interval temporal expressions. For this purpose, a tool for the runtime verification of systems using Interval Temporal Logic (ITL) has been developed. It provides syntactic constructs that are equally feasible by the Tempura interpreter. The basic concept provided by the tool is the ability to dynamically verify the system's status.

The main problem with the development is that they do not provide adequate tools for easy and fast development of system verification conditions, namely, the required statements whose validity we are testing are subject to research by the developer. Unfortunately, they are not at all trivial for development and quite often involve knowledge of the whole system, which can hardly be obtained if we need to analyse a small data set.

For this reason, it was necessary to create a suitable interface for the already existing technologies for which the following features are required:

– easy integration within existing systems without the need to write additional source code;
– ability to access knowledge databases that can be used directly in expressions for validation and proof of status of the system under consideration;
– ability to add external services, libraries, and scripts to classify data arrays;
– introduction of an easy syntax to define expressions that closely resemble a high-level programming language that is suitable and convenient to work by both software developers and agents not familiar with the logic of interval time processes.

To fulfil those conditions, it was necessary to define an additional layer of communication called System Tempura, that is, an independent interpreting mechanism managing the interval temporal processes into the Web-based

infrastructure. Figure 3 shows a sample diagram of the communication between the System Tempura module and the software solutions on which the tool is based.

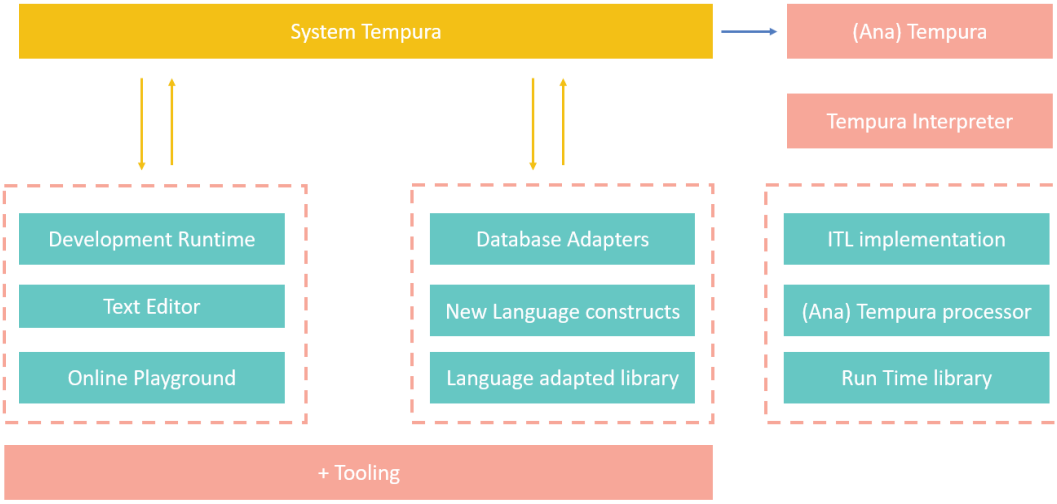

Figure 4. Communication process in System Tempura.
S o u r c e: the author's own work.

The communication between different layers of the interpreter mechanism is accomplished by HTTP communication, which makes the integration of the component fully flexible and does not interfere with existing systems. The Interpretation Mechanism aims to analyse expressions and sequences called formulas that describe interval logic aimed at analysing the behaviour of one or a group of learning agents in the context of the UniPlayground environment or any other one that meets similar information requirements. To organise a proper communication environment, the System Tempura interpreter manages its input process using additional tools embedded in the UniPlayground information system. Such tools are editors to manage language formulas, as well as a management environment for the formula implementation process. All processed queries are transcribed to an equivalent AnaTempura code and serve as an entry point for the interpretation of related processes in the context of which the final result of the defined formula is reached.

Behaviour Analysis in E-learning Platforms

Systems generating information on the behaviour of trainees provide an adequate and fairly detailed view of the educational behaviour of anyone actively working with them. Lack of data itself is also a valid statistic that can easily show dissatisfaction, lack of time or misunderstanding of material. The processing of this information over time can lead to the disclosure of interesting templates and relationships between the context of the environment, the teaching material, and the qualities of the agents currently being trained in a particular subject or matter.

The UniPlayground system examines a set of concepts described by enabling the training staff to define and diversify the system to collect learner behaviour data in a way that does not compromise the overall interaction with the system and the other agents in the system. The results of this research are going to be processed over three years of education and internal training classification of the work and development of students at Plovdiv University. Any valid statistical information is going to be published in order to present a complete theoretical model of behaviour analysis of agent behaviour based on a specific educational topic and representative sample.

The Study Results and Discussion

The experimental application testing was conducted by the use of one base group and two experimental groups in the duration of one academic year. The base group consisted of students with different experience in computer science and a different level of knowledge and educational background. The base group experienced the educational process by using only guidance directly influenced by the core facilitator team of the course. The other two control groups experienced the same education process but using only the application processes developed in UniPlayground by the same team. The resource utilisation and application exercise analysis was approximately three times greater compared to the traditional educational process. Information regarding the parameter of the base and the control group is presented in Table 1.

Table 1
Base experimental group parameters (the author's own work)

Academic year	Total participants	Participants with IT experience	Participants with no previous knowledge in IT
First	2	1	1
Second	10	5	5
Third	10	5	5
Fourth	10	5	5

Table 2
Control experimental group parameters (the author's own work)

Academic year	Total participants	Participants with IT experience	Participants with no previous knowledge in IT
First	2	1	1
Second	10	5	5
Third	10	5	5
Fourth	10	5	5

The time spent facilitating already developed exercises was cut in half thanks to the built-in analytics process. The single most important improvement was found in the overall track record of incorrect behaviour. For every single student, the facilitator had access to the full range of mistakes done over the course of their education and also the range of improvement based on faculty guidance.

There is no doubt that for a correct assertion of the provided results, it is necessary to have the corrected data spawn across a significant period for the results to be critically analysed and assessed. Using the long-term data classification process is necessary for predicting a range of behaviour that is going to be observed if the control group consists of students that exhibit a specific range of behaviour or have a collection of specific strengths and weaknesses necessary to achieve results over a specific course. The observed results can be generalised and used for a broad range of online education and electronic education at the university or even at a company level.

Acknowledgements

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Conclusion

One of the most challenging topics related to e-learning today is that of evaluating the work and competences of learners within the course. In this line of thought, the involvement of the teaching staff as well as of the supervisors and assistants responsible for conduct or successful facilitation must be taken into account. The answer to this problem will enable us to develop adequate tools that will give us more accurate information about the statistical status of each agent as well as the overall commitment of course facilitators to the work they have done.

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Analiza zachowania agentów w wirtualnej przestrzeni edukacyjnej

Streszczenie

Nowoczesne metody nauczania obejmują zarówno tradycyjnie ustalone podejście do klasy, jak i całkowicie wirtualne podejście mające na celu uczenie się z dowolnego miejsca na świecie w dowolnym momencie. Społeczeństwo stale obserwuje coraz bardziej popularne platformy, takie jak Coursera, Udacity, Udemy, a nawet YouTube, które są agregatorami nowej wiedzy.

Problemem, który nie został rozwiązany, jest jednak to, w jakim stopniu uczenie się jest skuteczne w obrębie nie tylko danego kursu, ale także w ramach kilku powiązanych ze sobą kursów. W artykule opisano model koncepcyjny, służący do analizy zachowania inteligentnych agentów, którzy zdobywają wiedzę za pomocą narzędzi wirtualnych w celu wsparcia procesu edukacyjnego. Opisano także sposoby analizy zachowania danych agentów.

W artykule przedstawiono koncepcję środowiska w analizie zachowań agentów UniPlayground, a także różne obszary wiedzy korzystające z tego środowiska.

S ł o w a k l u c z o w e: e-learning, intelligent agents, ITL, wirtualna przestrzeń edukacyjna, analiza zachowań

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Поведенческий анализ агентов в виртуальном образовательном пространстве

А н н о т а ц и я

Современные методы обучения включают в себя как традиционно установленные подходы к занятиям в классе, так и полностью виртуальный подход, направленный на обучение в любой точке мира в любое время. Общество постоянно отслеживает все более популярные платформы, такие как Coursera, Udacity, Udemy и даже YouTube, которые являются своего рода агрегатором новых знаний.

Однако проблема, которая не решается, заключается в том, в какой степени обучение эффективно в процессе не только конкретного курса, но также и в рамках нескольких взаимосвязанных курсов обучения. В этой статье будет описана концептуальная модель для анализа поведения интеллектуальных агентов, которые получают знания с использованием виртуальных инструментов для поддержки образовательного процесса, а также способы анализа поведения рассматриваемых агентов.

В статье будет описана концептуальная архитектура среды для анализа поведения агентов UniPlayground, а также различных областей знаний, использующих эту среду.

К л ю ч е в ы е с л о в а: электронное обучение, интеллектуальные агенты, ITL, виртуальное образовательное пространство, анализ поведения.

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Análisis de comportamiento de agentes en espacio educativo virtual

R e s u m e n

Los métodos de enseñanza modernos incluyen enfoques del aula tradicionalmente establecidos y un enfoque completamente virtual destinado a aprender desde cualquier parte del mundo en cualquier momento. La sociedad observa constantemente plataformas cada vez más populares, como Coursera, Udacity, Udemy e incluso YouTube, que son una especie de agregador de nuevos conocimientos.

Sin embargo, el problema que no se aborda es en qué medida el aprendizaje es efectivo en el proceso no solo del curso en particular sino también dentro de varios cursos de estudio interrelacionados. Este artículo describirá un modelo conceptual para analizar el comportamiento de los

agentes inteligentes que adquieren conocimiento utilizando herramientas virtuales para apoyar el proceso educativo, así como las formas de analizar el comportamiento de los agentes en cuestión.

El artículo describirá una arquitectura conceptual para un entorno para analizar el comportamiento de los agentes de UniPlayground, así como las diferentes esferas de conocimiento que utilizan este entorno.

P a l a b r a s c l a v e: eLearning, agentes inteligentes, ITL, espacio educativo virtual, análisis de comportamiento.

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Robotics in Education
A Survey Report: Case Study

Abstract

This article analyses various aspects of using robotics in education and examines the level of preparation and motivation of children and pupils. The authors carry out a comprehensive review of research and scientific publications regarding technological, didactical, methodological, and human aspects of using robotics in education. The article presents a report on a survey on pupils' opinion on robotics in education, which was conducted during the third Silesian Science Festival, and discusses the exhibition stand presenting innovative digital technologies and methods in education and business as well as Photon robots.

K e y w o r d s: robots, educational robots, robotics in education, STEM education, survey

Programming and educational robots – elements of teaching implemented in accordance with the new core curriculum – start from early school education and thus require teachers and other people working with children and young people to improve the methodology of teaching this area of knowledge. The new detailed content on algorithmics and programming introduced to the core curriculum has become a novelty also for teachers (Bobko, Bubula, Marek, Sala, & Wójciak, 2018, p. 7). This has also confirmed earlier Research (Smyrnova-Trybulska, Morze, Kommers, Zuziak, & Gladun, 2017). Additionally, "robots are slowly being incorporated in our society and the number of service robots has in 2008 already outnumbered industrial robots (IFR, 2008). Robots are slowly beginning a process of seamless integration in everyday lives both at home and at school. This impact of social robotics is even more crucial for children and teenagers, where robots can be used for their development and intellectual growth" (Mubin, Stevens, Shahid, Mahmud, & Dong, 2013, p. 1). It is also very important that comprehensive research should continue into various aspects of using robotics in education and the children's and pupils' level of preparation and motivation should continue to be studied.

The article presents the results of a survey carried out among participants of the third Silesian Science Festival 2019. The data were obtained from those individuals who attended workshops and visited the exhibition stand presenting innovative digital technologies in education and business, organised by the Department of Humanistic Education and Auxiliary Sciences of Pedagogy of the Faculty of Ethnology and Sciences of Education at the University of Silesia in Cieszyn, Poland. The respondents aged 6–15 included primary school pupils.

The aim of the survey was to measure interest in the Photon educational robot among primary school pupils and thus in the topic of programming. Particular attention was paid to the availability of this robot or a similar one in the school environment, the desire to have such a device at home and the awareness of the robot's usefulness in development and learning.

Background. Examples of Robotics in Education

"Educational Robotics (ER) has revealed several benefits in the educational context, not only helping the teaching of disciplines, but also making possible the development of several abilities, such as teamwork, problem-solving, and creativity. Among various robotics kits, LEGO® Robotics has shown one of the best results considering some evaluated criteria (modularity level, hardware, cur-

riculum, price, etc.). Some studies analyse the teaching practices, some compare technologies, and others evaluate the kits in a pedagogical way. However, it is essential to investigate all these contexts together in order to improve the impact produced by the ER in education and to know the best teaching practices associated with the most powerful technologies" (Souza, Andrade, Sampaio, & Araujoy, 2018, p. 1). Using LEGO® Robotics in educational process was described, studied, and analysed in articles by Smyrnova-Trybulska, Morze, Zuziak, and Gladun (2016), while designing and programming robots in schools was discussed by Zuziak (2013).

"Lego Mindstorms robots have been subject to many research studies in the last two decades. Most of this research discuss advantage and disadvantage of using Lego Mindstorms robots as educational tool in a wide range of subjects such as computer science (Cliburn, 2006), engineering (Khalaf, Balawi, Hitt, & Radaideh, 2010), computer programming (Cliburn, 2006; Ewert, Schilberg, & Jeschke, 2013), mechatronics (Tokuyasu, 2007), artificial intelligence (Klassner, 2002), etc. Furthermore, robots can be integrated in course curricula at all levels of education; from elementary school (Hixon, 2007) to university level (Cliburn, 2006; Khalaf et al., 2010; Tokuyasu, 2007; Klassner, 2002)" (Zaharija, Granić, & Grubač, 2014, p. 209).

Various ways using of Robotics in Education have been discussed in numerous publications. "Robotics in Education (R-in-E) tries to strengthen the learning skills of future engineers and scientists by means of robot-based projects. Both at school and in college, presenting robots in the classroom will give students a more interesting (and fun) vision of science and engineering, and they will be able to observe directly the practical application of theoretical concepts in the fields of mathematics and technology. R-in-E is inclusive in nature, which can lead students to orient their university studies in fields related to the STEM subjects" (Curto & Moreno, 2016, p. 3).

The American researchers Lixiao Huang, Terri Varnado, and Douglas Gillan (2013) in their study stressed that "this research explored the emotional attachment that students might develop towards robots that they built in a 2-month period, as well as the factors that contributed to their emotions towards the robots. The research studied 16 students enrolled in the robotics class in the fall 2012 semester who completed a specially-designed questionnaire. The results showed that students had strong positive emotions towards their robots" (Huang, Varnado, & Gillan, 2013, p. 1825).

In another research the authors focus on the following: Allan Zollman wrote about STEM literacy: "a general consensus that everyone needs to be STEM literate. But there is a difference between literacy and being literate. STEM literacy should not be viewed as a content area but as a deictic means (composed of skills,

abilities, factual knowledge, procedures, concepts, and metacognitive capacities) to gain further learning" (Zollman, 2012, p. 12). The author in his research provided a "brief background of literacy definitions in STEM and present[ed] a description of STEM literacy based upon (1) cognitive, (2) affective, and (3) psychomotor learning theory domains. The paper stress[ed] the need to evolve from learning for STEM literacy to using STEM literacy for learning to satisfy our societal, economic, and personal needs" (Zollman, 2012, p. 12).

Anne Jolly (2014) developed and described six characteristics of a great STEM lesson:

1. STEM lessons focus on real-world issues and problems. […]
2. STEM lessons are guided by the engineering design process. […]
3. STEM lessons immerse students in hands-on inquiry and open-ended exploration. […]
4. STEM lessons involve students in productive teamwork. […]
5. STEM lessons apply rigorous math and science content your students are learning. […]
6. STEM lessons allow for multiple right answers and reframe failure as a necessary part of learning. (Jolly, 2014)

Based on her recent research, five trends were identified in Technology Education (Figure 1).

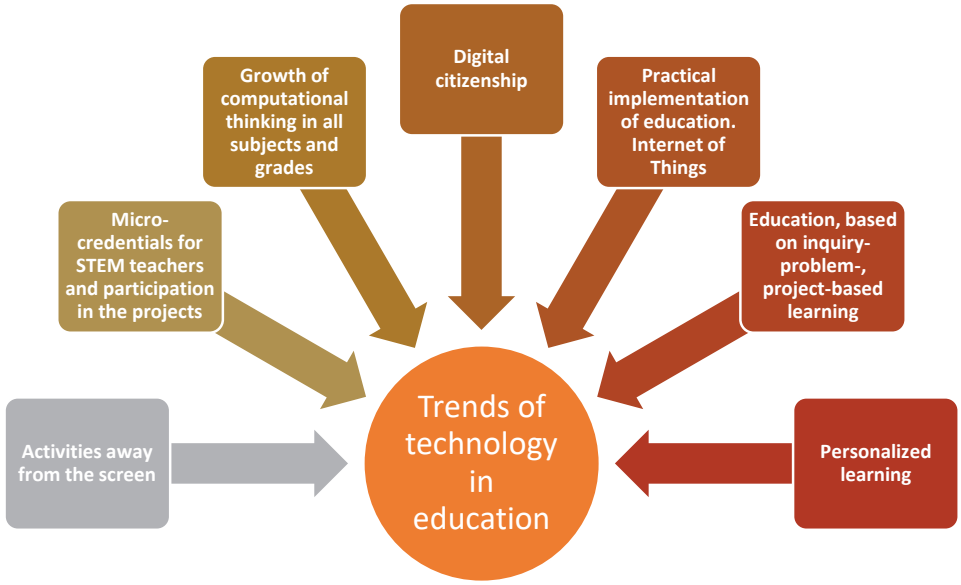

Figure 1. Trends of technology in education.
Source: Authors' own work based on Mo Qureshi (2019)

Other authors Borys Crnokić, Miroslav Grubišić, and Tomislav Volarić presented "different possibilities of using mobile robots in education. Through the application of the mobile mechatronic robotic system Robotino researchers show the possibilities of developing interactive lectures and exercises in order to raise the quality of education and to provide new competencies for students. The application of a robot as a real system supports strengthening specific areas of knowledge and skills that the students develop through design, creation, assembly, and operating with the robot. This way of learning contains a very important element and that is 'layful learning' or learning through play. Along with technical competences, combining this method with teamwork improves also social skills and motivation for learning […]" (Crnokić, Grubišić, & Volarić, 2017, p. 15). The authors "present an application of the robot in education on examples of modelling and designing of mechatronic systems, simulating and parameters monitoring the mechatronic systems, and collecting, processing and application of data from sensors in mechatronic systems" (Crnokić, Grubišić, & Volarić, 2017, p.15).

Researchers Tony Belpaeme, James Kennedy, Aditi Ramachandran, Brian Scassellati, and Fumihide Tanaka, focus on social robots for education study. They particularly stressed that "social robots can be used in education as tutors or peer learners. They have been shown to be effective in increasing cognitive and affective outcomes and have achieved outcomes similar to those of human tutoring on restricted tasks. This is largely because of their physical presence which traditional learning technologies lack" (Belpaeme, Kennedy, Ramachandran, Scassellati, & Tanaka, 2018, p. 1).

Some Aspects of Using Robots in Education

Active implementation of robotics and programming during school lessons, carried out on the basis of a demanding core curriculum, requires the teacher to properly select the equipment sets on which she/he wants to base her/his classes. Among the basic criteria that such a set should meet is, which is definitely worth highlighting, access to a friendly programming environment that allows students to easily, and in stages, explore the secrets of cooperation with the robot. In the perspective of longer work, it also becomes important to choose such a set that enables independent expansion and the expansion of interaction options. Everyone, even the most passionate robot at the beginning, loses its attractiveness as students' skills increase. The development of mobile technologies means that mobile devices (e.g., smartphones, tablets) are being increasingly used for operation and programming.

Considering their convenience, small requirements for access to a constant power source, as well as their universality (students have their own equipment, which means that there is no need to make additional purchases), it becomes possible to conduct robotics classes, for example, during a school trip or outdoors. It is also extremely important to choose a device with such level of sophistication so as not to discourage students from using it.

When deciding on a specific model of an educational robot for children whose first contact with robotics is to be based on this device, the teacher should apply the principle of small steps. Authors (Mubin, Stevens, Shahid, Mahmud, & Dong, 2013) developed their proposal for classification of robots and thus presented a "choice of robots across subject domains and across background knowledge required in computing (the darker the colour, the more computing knowledge is required to use/interact with the robot in that cell)" (p. 4) according to a subject type, that is, an electronic robotic kit, a mechanical robotic kit, and a humanoid robot (p. 4). We agree with the authors that we do not intend that robots should replace human teachers but highlight the added value that robots can bring to the classroom in the form of a stimulating, engaging, and instructive teaching aid. Table 1 presents an overview of robots for use in education, taking into account several basic criteria: set name, company manufacturer, website address, level of advancement, dedicated software, and development options.

Table 1
An overview of robots for use in education

Name of the set	Expanda-bility	Dedicated software	Level of advancement	Company producer Website
LoFi Robot	Big	NO	Intermediate	LOFI Sp. z o.o. https://www.lofirobot.com/
Makeblock Mbot	Average	YES	Intermediate	Makeblock Co., Ltd https://www.makeblock.com/
Ozobot	Small	YES	Beginner	EduSense Sp. z o.o. http://www.ozobot.pl/
Lego Mindstorm	Big	YES	Full	Lego Group https://www.lego.com/pl-pl/mindstorms
Dash and Dot	Small	YES	Beginner	Wonder Polska Sp. z o.o. Sp. k. http://makewonder.pl/
Photon	Small	YES	Full	Photon Entertainment sp. z o.o. https://photonrobot.com/pl/

S o u r c e: Authors' own work

The robot has been created for children of all ages. Its service is adapted to various stages of children's development, their abilities and perception abilities. Applications have as many as four interfaces that enable diversity learning for both pre-school children and children from 5 to 12 years of age (https://photonrobot.com/pl).

The Photon robot, which was the subject of interest of the surveyed children, is an interactive educational toy. The robot is integrated with a dedicated application for any mobile device (smartphone or tablet). The main advantage of Photon is learning the basics of programming and using its capabilities to support the learning of other subjects (e.g., a foreign language). The producers' assumption is to tame school children with new technologies in education. Develop their creativity, logical thinking, and overall development. It is intended for children from preschool to 12 years old. It is worth noting that the Photon robot is a Polish product (https://photonrobot.com/pl/). The Photon robot is an interactive educational robot that introduces children to the world of new technologies through a mobile application and related experiences and experiments. Photon supports children in developing the basic skills of our time. It helps them develop creativity, the ability to think logically, learn the basics of programming and understand the operation of the sensors it is equipped with.

The robot develops with the child. Photon is designed for independent and individual learning at home, where the child develops his/her robot. All tasks and experiments are based on a story in the application, in which the user helps Photon to overcome new challenges while learning the basics of programming and logical thinking. Photon's skills are closely dependent on the child's progress. When we take the robot out of the box [...] it cannot do anything at all. Children must help it learn everything from scratch – how to move, what colours we have, how to react to the environment with the sensors in which the robot is equipped.

Research Results

The study was conducted on the basis of a questionnaire distributed among 69 children, which provided the basis for this analysis. The questionnaire contains six questions, including an open one indicating the age of the respondents (Q 1. How old are you?...), one closed multiple choice question determining the sex of the respondents (Q2. Boy/girl). Both questions are important enough to determine the percentage distribution and the relationship between age and gender and interest in the experimental object. Four single-choice closed questions directly

related to those respondents' interaction and opinions on the Photon educational robot who ended the fun immediately before the survey, which was important for the research results.

Q3. Why did you find the educational robot fascinating?

a) I liked it visually and I want it to be my friend.
b) It evokes positive emotions and a sense of happiness in me.
c) I have long wanted to get to know it better and learn how to control it.
d) I have long wanted to get to know it better and learn to program it.
e) I think that it will be useful for me for further development and learning.
f) Other _____

Q4. Do you have contact with robots in school/kindergarten?

a) yes
b) no

Q5. Would you like to have a robot at home and play/learn with it?

a) yes
b) no

Q6. If YES, then how often:

a) once a month
b) once a week
c) every day (how many hours? _____).

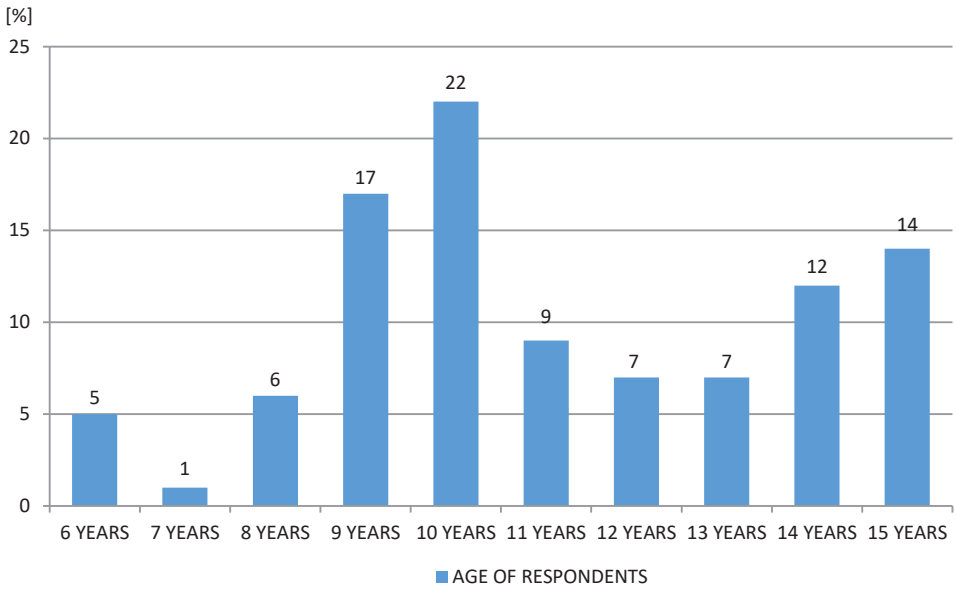

Figure 2. Percentage distribution of the children surveyed by age.
S o u r c e: Authors' own work.

The group of respondents were children from 6 to 15 years old, with the most numerous group at the age of nine (12 children, which accounted for 17% of the number of respondents) and ten years (15 children, which accounted for 22% of the number of respondents). Three children at the age of six responded to the survey, which constituted 5% of the respondents, one child at the age of seven (1%), four children at the age of eight (6%), six children at the age of 11 (9%), five children aged 12 and 13 (7%). Considering the size of the group, as many as eight answers were obtained from 14-year-old children (12%) and ten answers from 15-year-old children (14%). Data are presented in Figure 2.

The percentage distribution of the study group by gender (Figure 3) indicates an almost even number of both 33 boys and 36 girls, which gives a percentage ratio of 52% girls to 48% boys.

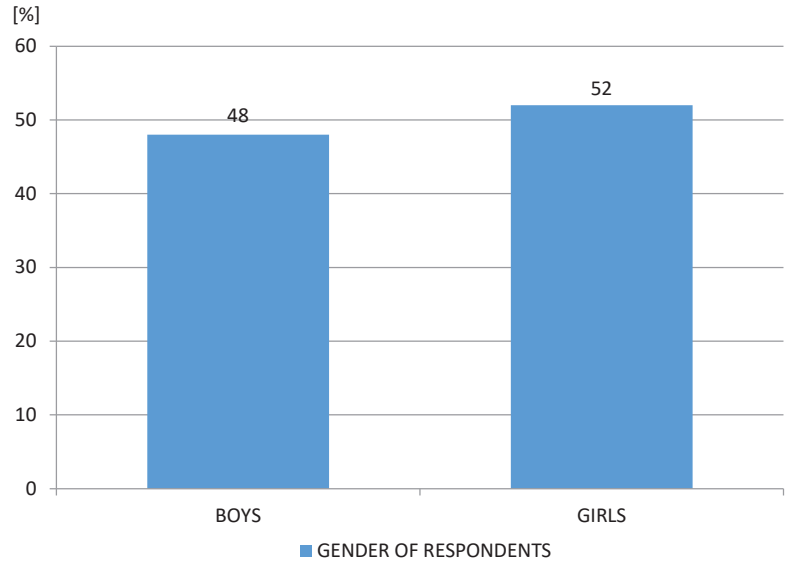

Figure 3. Percentage distribution of the children surveyed by gender.
S o u r c e: Authors' own work.

In the third question, the surveyed children were asked to indicate the reason for their interest in the educational robot. The question was closed with multiple choice. The results of the question were analysed in two ways: the blue line indicates generally the answers given, where the reference point is the number of answers given. The red line indicates the percentage ratio of the number of responses to the number of respondents. The reference point here is the number of respondents. Most, 26 students (38% of the responses), indicated that they liked the robot because it is visually pleasant. Not much less, seventeen children (25%

of the responses), talked about positive emotions towards the robot. Eleven children (16% of the answers) already knew the robot and wanted to learn to control it. Thirteen children (19% of the answers) already knew the robot before and had information that the robot was used to learn programming and expressed willingness to learn. A large number of 20 students (29% of the responses) thought that the work could be used to learn or develop their own interests. Two children (3%) said that controlling the robots is pleasant. The data are shown in Figure 4. Taking into consideration the summary of the percentage ratio of answers given to the number of respondents, the most common answer among children is also answer (a) indicating the visual qualities of the Photon robot (29%), whereas slightly lesser number of children (23%) indicated answer (e) appreciating the educational functions of the device. Indications for the answers from the following points do not differ much in percentage: 19% of the students thought that the robot evokes positive emotions, 12% of the students were already familiar with the robot and wanted to learn to control it, while 15% showed a desire to learn programming.

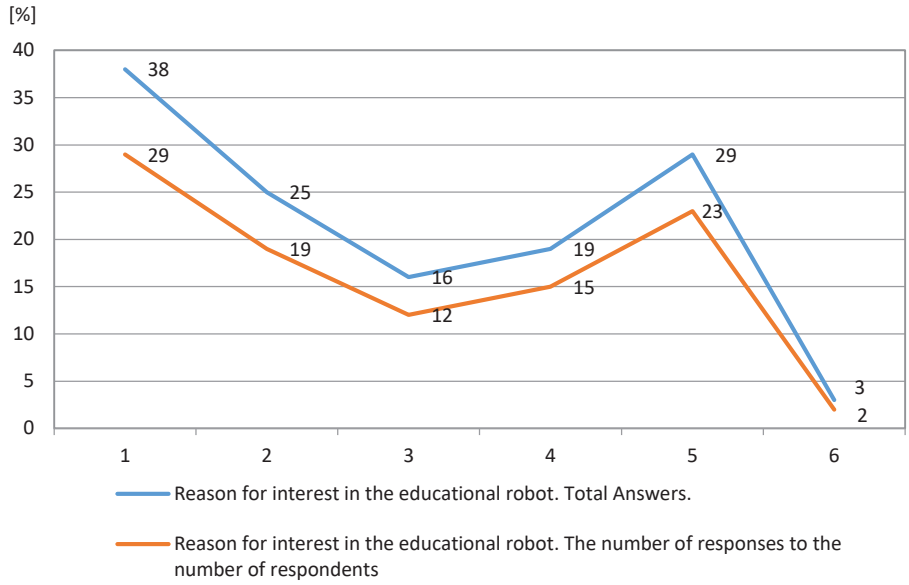

Figure 4. Percentage distribution of answers to the reason for interest in the educational robot.

1 – a) I liked it visually and I want him to be my friend; 2 – b) It evokes positive emotions and a sense of happiness in me; 3 – c) I have long wanted to get to know it better and learn how to control it; 4 – d) I have long wanted to get to know it better and learn to program it; 5 – e) I think that it will be useful for me for further development and learning; 6 – f) Other

S o u r c e: Authors' own work

An important part of the study was obtaining information on the availability of Photon or other similar robots in the school or kindergarten environment. Twenty-four children said they had the option of using a robot at school (52%). On the other hand, a large majority of 45 children said they did not have such an opportunity, which constituted as many as 65% of the respondents (Figure 5).

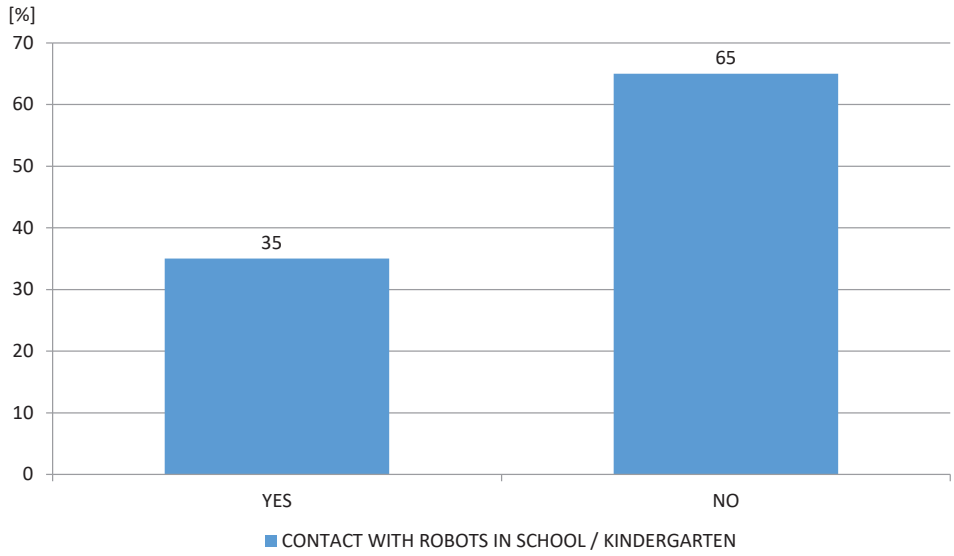

Figure 5. Percentage distribution of answers regarding children's contact with robots at school or kindergarten.
S o u r c e: Authors' own work.

As Figure 6 shows, the robot has attracted the children's interest. When the children were asked whether would like to have Photon at home, as many as 62 children confirmed (90%). And only seven children stated that they would not like to have Photon at home (10%). The information depicted in Figure 6 indicates the percentage distribution of affirmative answers given about the desire to have an educational robot at home and the potential frequency of using the robot. Ten children (25% of affirmative answers to question 5) said they could use the educational robot almost around the clock. Eight children (20%) could not say how much time a day they would like to use the robot and could use it for two hours a day. The remaining answers are at a comparable level of three to five percent of those surveyed for a specific time period, that is, from half an hour to 4 hours, 10 hours, 12 hours, 16 hours, and 23 hours a day. The exception is the time of one hour, which was indicated by five children, therefore 12% of the respondents (Figure 7).

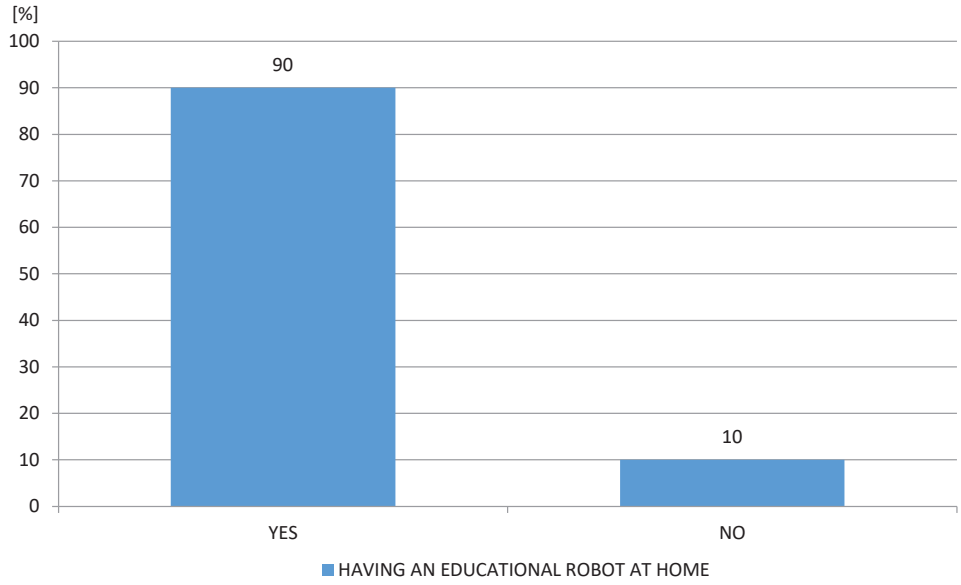

Figure 6. Percentage distribution of answers given about the desire to have an educational robot at home.

S o u r c e: Authors' own work.

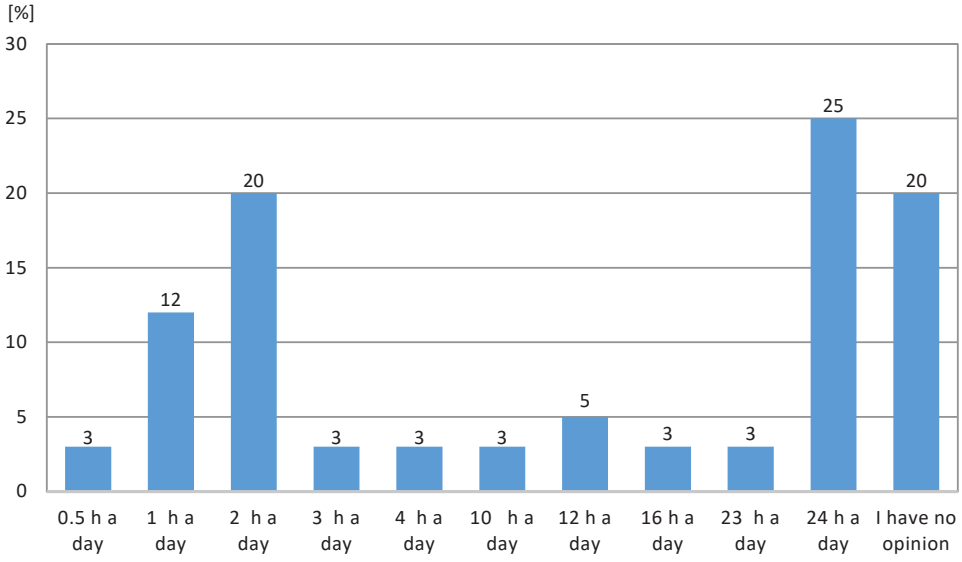

Figure 7. Percentage distribution of affirmative answers given about the desire to have an educational robot at home. Frequency of use.

S o u r c e: Authors' own work

The results of statistical analyses of the responses have been presented below. Table 2 includes the descriptive statistics. Table 3 shows the comparison of Mann-Whitney test of age with the answers given to question 6.

Table 2.
Descriptive statistics

Variable		Aggregated results descriptive statistics (empirical data ROBOTS (3) -all)			
	GENDER	N valid	Median	Minimum	Maximum
AGE	BOY	33	**9.0000**	6.0000	10.0000
QUESTION 6	BOY	33	B	A	C
AGE	GIRL	36	**13.5000**	10.0000	15.0000
QUESTION 6	GIRL	36	C	C	C

Table 3.
A comparison of the Mann-Whitney test of age with the answers to question 6

Variable	Mann-Whitney U test (with continuity correction) (empirical data ROBOTS (3) –all) Relative to variable: GENDER The marked results are significant from p < .05000		
	N valid. BOY	N valid. GIRL	p
AGE	33	36	0.000000
QUESTION 6	33	36	0.000000

There are significant differences in age between sexes ($p < 0.0001$). Girls' age is higher and there are significant differences in providing answers to question 6 ($p < 0.0001$), namely, girls chose c (every day) whereas boys chose answer b (once a week) (see Figures 8 and 9).

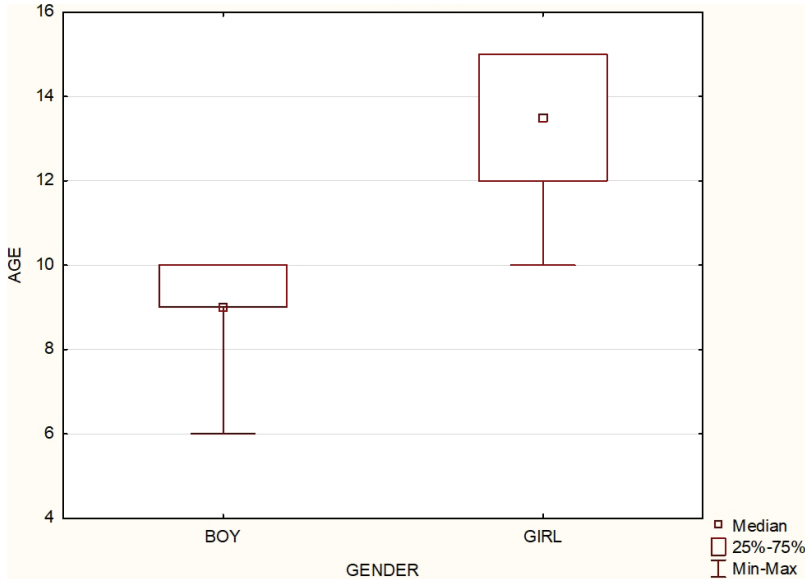

Figure 8.

Age variable.

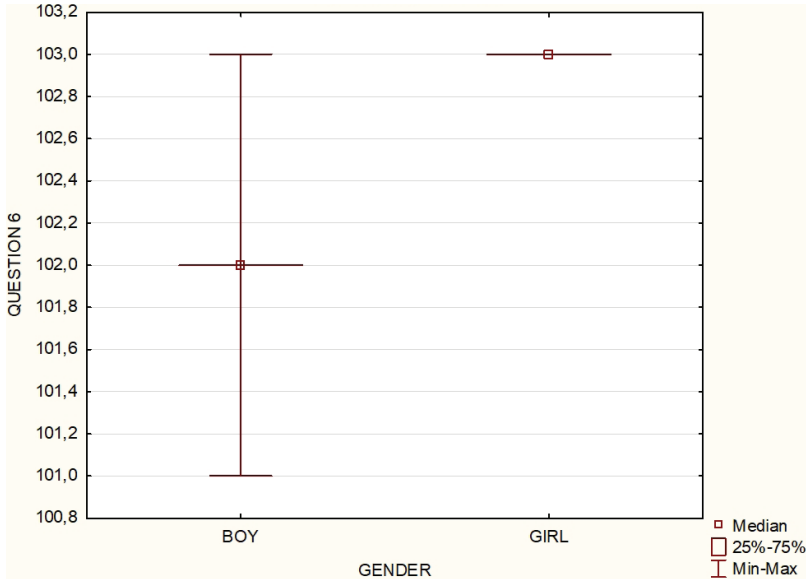

Figure 9.

Variable: Question 6.

Conclusions

When paying attention to a large group of children who would like to have a Photon robot at home, it can be argued that the educational Photon is an attractive device for children. As the above data shows, children appreciate not only the visual qualities but, above all, the basic ability of the device such as learning programming and support for general development. Children familiar with the subject of programming could eagerly use it as a tool for further development or help in learning. Beginners, on the other hand, also appreciate the educational possibilities of a robot or object for a pleasant pastime. It is puzzling, however, that a very small percentage of children have the opportunity to interact with this or similar device in the school environment.

Research analysis shows that considerable interest the respondents showed in relation to the Photon robot could be ascribed to the quality of knowledge acquired by students during classes. Therefore, it is worth considering the possibilities of implementing educational robots in the didactic process in primary schools, and the fun elements that undoubtedly allow the robot to skilfully integrate into the methodological cycle.

Aknowledgments

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Eugenia Smyrnova-Trybulska, Dawid Staniek, Dominika Zegzuła

Robotyka w edukacji w opinii uczniów Raport z ankiety: studium przypadku

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

W artykule dokonano analizy różnych aspektów zastosowania robotyki w edukacji oraz przedstawiono poziom przygotowania i motywacji dzieci i uczniów. Autorzy przeprowadzili kompleksowy przegląd publikacji naukowych dotyczących technologicznych, dydaktycznych, metodologicznych i ludzkich aspektów wykorzystania robotyki w edukacji. W artykule przedstawiono raport z badania opinii uczniów na temat robotyki w edukacji. Badanie przeprowadzono podczas trzeciego Śląskiego Festiwalu Nauki, dlatego artykuł opisuje również stoisko festiwalowe prezentujące „Innowacyjne technologie i metody cyfrowe w edukacji i biznesie" oraz roboty Photon.

S ł o w a k l u c z o w e: roboty, roboty edukacyjne, robotyka w edukacji, edukacja STEM, ankieta

Eugenia Smyrnova-Trybulska, Dawid Staniek, Dominika Zegzuła

Робототехника в образовании: мнения учащихся Тематическое исследование

Аннотация

В данной статье анализируются различные аспекты использования робототехники в образовании, а также анализируется уровень подготовки и мотивации детей и школьников. Авторы проводят всесторонний обзор научных публикаций, касающихся технологических, дидактических, методологических и гуманитарных аспектов использования робототехники в образовании. В статье представлен отчет об опросе учеников о робототехнике в образовании, который был проведен во время третьего Силезского научного фестиваля, а также показан стенд выставки, на котором представлены экспонаты «Инновационные цифровые технологии и методы в образовании и бизнесе» и роботы Фотоны (Photon).

Ключевые слова: роботы, образовательные роботы, робототехника в образовании, STEM образование, опрос

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Robótica en la educación: en la opinión de los alumnos Informe de encuesta: un estudio de caso

Resumen

Eeste artículo analiza varios aspectos del uso de la robótica en la educación y examina el nivel de preparación y motivación de niños y alumnos. Los autores llevan a cabo una revisión exhaustiva de investigaciones y publicaciones científicas sobre aspectos tecnológicos, didácticos, metodológicos y humanos del uso de la robótica en la educación. El artículo presenta un informe sobre una encuesta sobre la opinión de los alumnos sobre Robótica en educación que se realizó durante el tercer Festival de Ciencia de Silesia, y discute el stand de exhibición que presenta “Tecnologías y métodos digitales innovadores en educación y negocios” y Robots Photon.

Palabras clave: Robots, robots educativos, Robótica en educación, educación STEM, encuesta.

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Hybrid Reality in the Internet of Things as an Environment for Transferring Knowledge

Abstract

The paper presents features and applications of hybrid reality technology and the Internet of Things. The analysed thesis states that such a solution is a favourable environment for the dissemination of knowledge through the concept of interaction of objects of postulated environment with the theoretical model of knowledge objects. The article discusses an initial version of the potential information system method. The method, in the form of a mathematical formula, makes it possible to evaluate objects in the postulated space. The article presents the case study implementing a similar environment in the service of advanced industrial equipment. The results of the analysis indicate a high potential of the postulated solution, which requires further refinement and research. At the same time, the practice of the implementation case points to technological and organisational threats which should be neutralised to ensure a high probability of the project's success.

K e y w o r d s: virtual reality, augmented reality, knowledge management, accumulation of knowledge

Due to the development of new interaction methods with devices, it seems important to ask questions about the possibilities of using technology in broadly understood education. The aim of this article is to present a new measure of the objects ability to accumulate knowledge in the light of the conditions that new technologies (hybrid reality and Internet of Things) bring, and also to present a case study based on the technologies mentioned in the article. The article discusses the features of augmented reality, presenting the application of an additional visual layer to the observed reality together with the concept of the Internet of Things as a network of people, processes, data, and objects. The concept of using artificial intelligence supporting the transfer of knowledge as well as the classification and valuation of objects in such an environment that combines the above-mentioned technologies will also be presented.

Classification of Artificial Reality

When we analyse the history of the development of user interfaces for information systems, we notice a constant trend to approach the methods of communication and interaction between man and machine, reflecting the natural capabilities of the human senses and the way in which the human functions in the real world. The objects in the paper are understood as physical objects (devices, people, creatures, places, symbols) and digital objects (entities, properties, activities and processes).

Augmented Reality

Augmented Reality (AR) is based on the integration of digital information into the user's real-time environment. Augmented Reality does not create a new, full, virtual 3D world (for it deals with virtual reality), but it extends and complements the one we know. In other words, it converges and connects digital and physical worlds into a uniform visual impression (Żur, 2013). It is important to preserve the physics of objects and proper orientation in relation to the reference system as well as other spatial relations. AR applications are written in 3D programs that allow programmers to associate animation or contextual digital information in a computer program with an AR tag in the real world. When an application or browser plug-in of a computing device receives digital information from a known tag, it begins to execute the tag code and places the correct image or images.

Virtual Reality

Virtual Reality (VR) is a fully computer-generated simulation of a 3D image or environment with which it is possible to interact in a seemingly real or physical way. It is also the use of information technology to create the effect of an interactive three-dimensional world in which each object has the sense (property) of being present in this space (Bryson, 1999). The user is equipped with special electronic equipment, such as a helmet with a built-in screen or/and gloves with sensors. It is a completely artificially created space. The interaction of the observer and objects that most often reflect the physics of such interactions in the real space are important. Direct references to real space usually do not occur at all.

Mixed Reality

The hybrid reality (Mixed Reality) is a combination of the real world and the virtual one, in order to create a new environment where physical and digital objects can interact. It, in fact, a combination of augmented and virtual reality (de Souza e Silva & Sutko, 2009). Objects superimposed on a real image may have more opportunities to enter into a variety of relationships with each other and with an observer. In a perfect world, devices used to apply artificial reality to a perceived image should be transparent. The Google Glass market experiment was the first step towards the dissemination of this mode of operation. On the glasses, there was a picture that provided contextual information needed by the user. There was no current specific spatial relations and extensive interactions in this solution, but the platform constituting the foundations of such a solution in the future was commercialised and made available to a wide range of users. The product has not gained much consumer recognition (Reynolds, 2015). Its implementation for technical reasons differed somewhat from the assumption of transparency. Glasses definitely differed from other frames. In addition, they caused asymmetries in the face image, which in the medical sciences is often described as a symptom of dysmorphia indicating various diseases. In social communication, the image of the face and the ability to read information from it is extremely important. Devices that allow the use of AR should not build a barrier in this regard.

Assuming that the physical layer should be transparent, an interesting solution seems to be the concept of contact lenses with a built-in liquid crystal display. In daylight, the backlight of such a matrix could be passive. It is a device that uses a small amount of energy so it could be powered through a communication channel, for example, RFID 5.8 GHz. It would not only provide data exchange, but also provide electricity by induction (Adhikari, 2016). As for the interaction of the observer with the objects superimposed in space, the sensor could be supplemented by sensors glued to nail plates. Such a solution would ensure precise interpretation of various gestures. The operating procedure in hybrid reality mode is as follows:

1. Identification of the object through a marker.
2. The graphic representation in the added reality layer is displayed by means of appropriate devices imposing an artificial image on the real one.
3. The object maintains the appropriate spatial relations.
4. The object presents various possibilities of interaction as part of the internet formula of the universe.
5. The object exhibits spatial relations with the observer through various sensors that map the observer's movements.

Internet of Things and Connection with Artificial Reality

The Internet of Things is comprised of three kinds of connections: machine-machine, human-machine and human-human. For the Internet of Things to become a reality, it is necessary to develop and implement technologies that, on the one hand, will allow unconnected elements of the physical world to be connected together, and on the other, they will enable the use of a huge amount of data generated by them. Nowadays, the most common method of connecting physical objects with internet is QR Code (Koreňová & Hvorecký, 2018). Meanwhile, it is estimated today that 12.5 billion devices are connected to the Internet, which is only 1 percent of objects that could potentially be plugged into the network. It is estimated that in 2020, between 25 and 50 billion devices will be connected to the network (Jaślan, 2015). The integration of data, processes, people and devices (Figure 1) along with artificial intelligence opens up many new opportunities in the area of acquiring knowledge and using it (Ravi & Shalinie, 2020). Processes that combine existing data with objects and individuals ultimately form the so-called intelligent spaces (Brachman, 2017), collections of beings of various types, which interacting with each other generate information and knowledge resources.

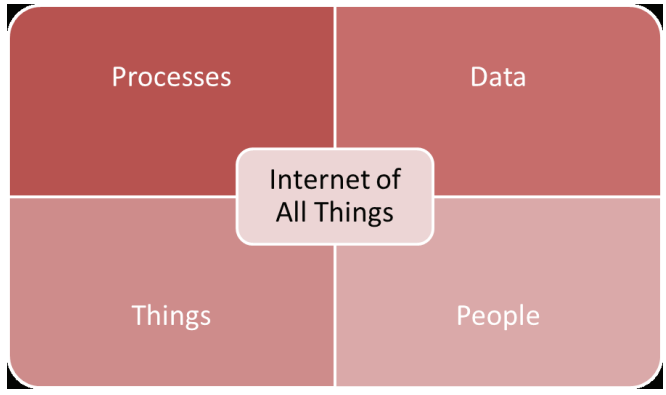

Figure 1. The Internet of Things
S o u r c e: the authors' own study based on Cisco materials.

The subject of this study is to present the possibilities of combining hybrid reality and the Internet of Everything in the context of knowledge management. Merill, Li and Jones identify four types of knowledge objects: entities, properties, activities and processes: "Beings are represented by physical objects such as devices, people, creatures, places, symbols, etc. Properties mean measurable and irrational attributes of beings" (Merill, Li, & Jones, 1991). Activities are actions that the learner can undertake towards beings. Processes, on the other hand, correspond to events that change the values and properties of beings and are triggered by activities or other processes.

The above classification is very similar to the list of components of the Internet of Things. It seems natural, therefore, to extrapolate this classification in terms of technology in which knowledge facilities can be given new properties. To automate the process of acquiring knowledge in objects, one can refer to the notion of inheritance known from computer science. The classes of objects are indispensable for this. A given physical object, for example, a refrigerator, would belong to the classes of knowledge: refrigeration, mechatronics, etc., then sub-classes: refrigerators, a specific line of refrigerators and a specific type and specimen. After identifying such an object in a hybrid reality by the use of the Internet of Things, that is, through the process of combining data and objects, the knowledge would be inherited from the classes to which it belongs. A physical object that does not have to be a device at all (see, for example, the field of wheat and the definition of being within the framework of knowledge objects in the further part of this article) may not have the ability to accumulate knowledge or even record data in itself. In order for the inheritance and "learning" of the object to take place, it is necessary to have a virtual representation of the object on the Internet of Things in the form of a specific avatar or simulator.

In the proposed concept, explained above, it seems necessary to introduce an application layer in which an avatar of an individual object is created ad hoc and based on inheritance from its classes and then through interactions with other objects, such as technical documentation, instructions or courses. If we allow the possibility of incorporating advanced artificial intelligence into this layer, the appropriate connections could form spontaneously. It is necessary in this case to have a fairly complete semantic network, which identifies through metadata within the ontology: first, belonging to classes, second, making the contents of the knowledge object or its avatars readable for devices, which allows verification of the usefulness of establishing interactions.

The authors of this study suggest the introduction of a new value: the measure of the accumulation of object knowledge. The indicator (measure) is most often understood as a number expressing the level of a given phenomenon. The most

important feature of the indicator is the comparability of its value, allowing to determine the position of a given object compared to other objects (Rogala & Rycharski, 2006). In this case, it will be the term *saturation* of an object with knowledge in the context of others as a function of interaction with other objects and inheritance in the classroom. It is, therefore, a function of several features, also called diagnostic variables. There is a multiplicity of attributes so we can define the meter as synthetic or aggregate. The characteristics that influence the index can be included in the set of stimulants, that is, variables whose higher value indicates a higher level of the phenomenon (object) and thus works in a way that stimulates development (Kompa, 2009).

The measure of the accumulation of knowledge by the object is postulated to refer to the number of interactions with other objects, their quality and weight, plus the value of the measure of accumulation of knowledge resulting from inheritance in classes.

$$A_m = \sum_{i=1}^{n} q_i a_i + DA_m = \sum_{i=1}^{n} q_i a_i + D$$

The A_m measure is the value corresponding to the accumulation of knowledge of the object *m*.

q_i – quality of i-th interaction expressed in time, assessed on a scale or based on the analysis of measurable results,

a_i – a measure of the accumulation of knowledge of the i-th object with which the interaction took place,

D – measure of the accumulation of knowledge resulting from inheritance in classes.

The measure of the accumulation of object's knowledge is nothing but a measurable property of being (compare with the classification of knowledge objects), and interaction is an activity leading to the process of transforming the properties of an object (being). It seems possible to develop a comprehensive standard, method and system using these technologies, which would become common on a similar scale as Google search, but limited to the aspect of acquiring and accumulating the knowledge of all entities. The possibility of registering this type of transformations and building the weight of objects in the context of their importance as objects of knowledge would give rise to new possibilities. A network that fosters the development of knowledge can arise spontaneously. In the context of the presented method, it is postulated to consider two levels of interaction, the first one – associated with the area of skills, and the second one – with broadly understood knowledge:

The first level:
– objects are presented in relation to the context of their use;
– the object itself offers information and knowledge about itself in accordance with the context;
– the object provides knowledge and information in the area of skills depending on the role of the being with which it interacts, for example, the fridge helps the user or the serviceman.

The second level:
– the object itself presents the areas of knowledge related to it based on the analysis of previously registered user's relations with other objects, their regularity of duration and detail.
– in this way, the object can indicate areas of knowledge necessary to achieve a full understanding of both the object itself and the accompanying phenomena, for example, by offering courses, postgraduate studies or majors (this type of link would be possible within the inheritance of knowledge areas in classes).

It is important to emphasise that each time it is not a physical object that leads a "conversation," only the previously mentioned object avatar in the application layer of the postulated knowledge transfer environment, containing artificial intelligence that associates behavioural patterns and context and initiates interaction based on the evaluation of existing relationships. Figure 2 illustrates an example of human interaction with an object that is part of nature, namely, of a wheat field:

Figure 2. Interaction of a natural object with a human being

S o u r c e: the authors' own study (translation: "I have noticed that you have been searching recently for the difference between wheat and rye. I am wheat. It is nice to meet you. We are almost like sisters with rye. But not twins. If you wanted to see rye, it is not far from here… Would you like me to give you directions?")

In the above example the user has a specific dialogue with an object that is identified in a hybrid reality through the techniques of the Internet of Things, connected with the avatar of its type of existence, and having a certain classification and inheriting knowledge interacting with other beings (rye) that match the profile of previous interactions human. The activity initiated and "proposed" by the object is aimed at starting a process that will lead to a change in the properties of being (human), that is, the state of knowledge in the area.

Case Study

Figure 3 presents an analysis of the case of the implementation of the system combining the Internet of Universes with Hybrid Reality, made by the Polish company PSC Transition Technologies for Fiat Chrysler Automotive. The aim of the project was to use the hybrid reality and the Internet of Things to support knowledge of the robotic production lines. The implementation was started with support for maintenance and maintenance through the IoT solution combined with the use of Mixed Reality for employees of this department. The project was implemented with the use of a tablet and glasses for Augmented Reality as a user interface, which significantly improves the performance of daily tasks by employees. In everyday operations, the objects that are avatars of the essential components of machines used for car production are identified before employees' eyes. Facilities have multiple connections with sources of knowledge. Glasses can display the process of device replacement taking place in three dimensions, preserving spatial relations with reality. It is a simulation of three-dimensional objects in motion. The process is initiated by the action of interacting the serviced device with other related knowledge objects, such as instructions or technical specifications, presented contextually.

The project, after extending it to all elements of robotics on new lines, reduces the operational costs of the service by automating and unifying service tasks and optimising the structure of the internal maintenance service as well as internal communication. As a consequence, it shortens the duration of service procedures by increasing their effectiveness. The completely unexpected but desired result of the project was the development of new purchasing procedures, so that the necessary elements needed to attach new machines and robots to the system were available along with the installation of production machines on the hall (e.g., relevant 3D CAD drawings of machines). On the basis of reports and post-implementation data, made available by PSC Transition Technologies and the interview with implementation participants, the authors of the study carried out a SWOT analysis of the applied solution.

Table 1
SWOT analysis of the implementation case in FCA

Strenghts	Weaknesses
S1 – employees receive one environment to obtain the necessary information and knowledge.	W1 – knowledge base available within one environment.
S2 – the environment is very ergonomic and intuitive because access is carried out through activities simulating reality.	W2 – lack of reference to employees' habits regarding traditional sources of information and knowledge acquisition, including informal ones.
S3 – all information and knowledge are given in context, which eliminates time-consuming searches.	W3 – dependence on technologies and specific devices that require expensive service and maintenance.
Opportunities	**Threats**
O1 – opportunity to better profit by reduction of service operational costs through automation and unification of service tasks.	T1 – a threat to production continuity in the event of technical failures.
O2 – opportunity for be flexible in labour market by shortening the time of adapting new employees to applicable procedures.	T2 – over-routine procedures that do not take informal knowledge, which is not collected in any way.
O3 – opportunity for better cooperation with machinery producers by development of new purchase procedures, so that the necessary elements needed to connect new machines and robots to the system were available together with the installation of the machine on the hall (e.g., appropriate drawings of 3D CAD machines).	T3 – non-adjustment of accessory manufacturers due to the lack of knowledge objects associated with the product, which increases the cost of adjustment.

S o u r c e: the authors' own study

The components from the SWOT table were subjected by the authors to the analysis of their own impact using a three-point scale from 0 to 2 (no impact, weak, strong). Conclusions regarding the impact force were taken during the discussion with the authors of the post-implementation reports and on the basis of the analysis of their conclusions and the data cited.

Table 2
Point analysis of the SWOT ties strength

	O1	O2	O3	T1	T2	T3
S1	2	2	0	1	2	0
S2	1	2	0	0	1	0
S3	2	2	0	0	1	1
W1	0	0	0	0	1	1
W2	1	1	0	0	2	1
W3	0	0	1	2	0	1

S o u r c e: the authors' own study

Point analysis of relationships from individual quarters of the Table 2:
S/O = 11, S/T = 6, W/O = 3, W/T = 8

The highest score of the first quadrant suggests that thanks to the new technology used, the company is dominated by strengths, and in its environment strongly associated with them – it is a strategy of strong expansion and development using both factors. At the same time, the high point score of the fourth quarter shows a certain paradox and commands exceptional attention while minimising the strength of links between weaknesses and external threats.

Summary

The publication presents a combination of hybrid reality technologies and the Internet of Things. The thesis attempts to establish that such a combination is a favourable environment for spreading knowledge. In the course of the study, it was possible to combine the concepts of the interaction of objects of the postulated knowledge transfer environment with the measure of the accumulation of knowledge objects. The initial version of the method is presented in the form of a mathematical formula that allows valuing objects in such space. The case of implementation of a similar environment in the service of advanced industrial equipment has been presented and analysed. In conclusion, one should note the high potential of the postulated solution, which requires further refinement and research. At the same time, the practice of the implementation case points to

technological and organisational threats which should be neutralised to ensure a high probability of the project's success.

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Rzeczywistość hybrydowa w Internecie Wszechrzeczy jako środowisko do transferu wiedzy

Streszczenie

W publikacji przedstawiono cechy i zastosowania technologii rzeczywistości hybrydowej oraz Internetu Wszechrzeczy. Przeanalizowano tezę, że takie zestawienie stanowi korzystne środowisko do rozprzestrzeniania wiedzy poprzez koncepcję interakcji obiektów postulowanego środowiska z teoretycznym modelem obiektów wiedzy. Przedstawiono wstępną wersję metody potencjalnego systemu informatycznego. Metoda ta, w postaci formuły matematycznej umożliwia wartościowanie obiektów w postulowanej przestrzeni. Przedstawiono przypadek wdrożenia zbliżonego środowiska w praktyce serwisowej zaawansowanych urządzeń przemysłowych. Wyniki analiz wskazują na wysoki potencjał postulowanego rozwiązania, które wymaga dalszego uściślania i badań. Jednocześnie praktyka przypadku wdrożenia wskazuje na zagrożenia technologiczne i organizacyjne, które należy neutralizować, aby zapewnić wysokie prawdopodobieństwo sukcesu przedsięwzięcia.

Słowa kluczowe: Rzeczywistość wirtualna, rzeczywistość rozszerzona, zarządzanie wiedzą, akumulacja wiedzy

Tomasz Woźniakowski, Arkadiusz Orłowski

Гибридная реальность в интернете вещей как среда для передачи знаний

Аннотация

В статье представлены особенности и применения технологий гибридной реальности и Интернета вещей. В анализируемом тезисе утверждается, что такое решение является благоприятной средой для распространения знаний через концепцию взаимодействия объектов постулируемой среды с теоретической моделью объектов знаний. Представлена первоначальная версия метода потенциальной информационной системы. Этот метод в форме математической формулы позволяет оценивать объекты в постулируемом пространстве. Представлено тематическое исследование внедрения аналогичной среды в обслуживании современного промышленного оборудования. Результаты анализа указывают на высокий потенциал постулируемого решения, что требует дальнейшей доработки и исследования. В то же время, практика реализации проекта указывает на технологические и организационные угрозы, которые следует нейтрализовать, чтобы обеспечить высокую вероятность успеха проекта.

Ключевые слова: Виртуальная реальность, дополненная реальность, управление знаниями, накопление знаний

Realidad híbrida en Internet de todas las cosas Como un ambiente para transferir conocimiento

R e s u m e n

El documento presenta características y aplicaciones de la tecnología de realidad híbrida e Internet de todas las cosas. La tesis analizada establece que dicha solución es un entorno favorable para la difusión del conocimiento a través del concepto de interacción de los objetos del entorno postulado con el modelo teórico de los objetos de conocimiento. Se presenta una versión inicial del método potencial del sistema de información. Este método, en forma de fórmula matemática, permite evaluar objetos en el espacio postulado. Se presenta el estudio de caso que implementa un entorno similar al servicio de equipos industriales avanzados. Los resultados del análisis indican un alto potencial de la solución postulada, que requiere un mayor refinamiento e investigación. Al mismo tiempo, la práctica del caso de implementación apunta a amenazas tecnológicas y organizativas que deben neutralizarse para garantizar una alta probabilidad de éxito del proyecto.

P a l a b r a s c l a v e: Realidad virtual, realidad aumentada, gestión del conocimiento, acumulación de conocimiento

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The Use of E-Learning Platform by Flipped Classroom Method in Chemistry Lessons in Poland and Ukraine – Case Study

Abstract

The objective of this article is to compare chemistry teaching in Poland and Ukraine at the primary schools level by discussing the possibilities of supporting education using a flipped classroom method (preemptive teaching) and ICT including free Google platform in chemical education. The article peruses some results of tests and surveys carried out among students in Polish and Ukrainian schools in the school year of 2018/2019 pointing out students' motivation regarding ICT teaching support.

K e y w o r d s: teaching chemistry, flipped classroom, Poland and Ukraine, ICT, Google platform

The chemistry core curriculum in primary schools in Poland largely resembles the chemistry core curriculum in primary schools in Ukraine. The first years of

teaching chemistry in a primary school (in Poland, for 2 years, 2 classes a week, in Ukraine, 3 years, 1.5 classes in the seventh grade, which means 1 class a week and 2 classes every other week, and 2 classes in the eighth and ninth grade) cover the same content. Additionally, there are two levels of education – the basic and the advanced one. The advanced level in Poland starts in high school and takes 3 school years (2.5 years). From 2019/2020, it will take 4 years of learning. In Ukrainian schools, the scope of material depends on a type of school, chemical education starts in the eighth grade and it takes 4 years (specialised schools) or in the tenth grade during the last two years of high school education (specialised classes).

Students in both countries use course books. In Poland, most publishing houses offer additionally electronic workbooks, multi-books, educational video sets facilitating chemical education. Course books in Poland focus more on graphics than on a written content through interesting and modern depiction of learning material in the form of infographics and photos as well as charts presenting chemistry experiments. In Ukrainian course books, learning material is provided in chunks and a written content dominates over graphics with very little attention paid to scientific experiments.

The strategy of preemptive teaching, a flipped classroom, also known as reverse teaching (King, 1993), is a modern teaching method which blends the traditional model of classroom instruction with digital solutions. The main objective of a flipped classroom is the shift of roles in a "student-teacher" dynamic. The roles get reversed and students are encouraged to do their homework prior to a lesson. As for teachers, the method provides them with more tools and time during a class. The strategy of preemptive teaching consists of four stages: activation, processing, systematisation, evaluation and assessment (Dylak, 2013) with relevant activities assigned to each stage.

The Research Problem

The research's objective was to examine motivation and efficiency of a flipped classroom instructional strategy facilitated by ICT in teaching chemistry in primary schools in Poland and Ukraine. In order for the objective to be achieved, multimedia materials and tests were prepared and placed on the platform. The platform of choice was free educational platform Google Classroom where teachers and students were able to communicate, exchange extra materials and test their newly acquired skills.

The teachers must set up the classrooms and invite students to join them giving them a "classroom code" generated by Classroom or sending them an invitation via an application.

The students from the research and control groups, after joining the virtual classroom, get an access to a tool resembling a social network where in a "classes stream" they can, for instance, share necessary files with their classmates, contact other students and exchange information.

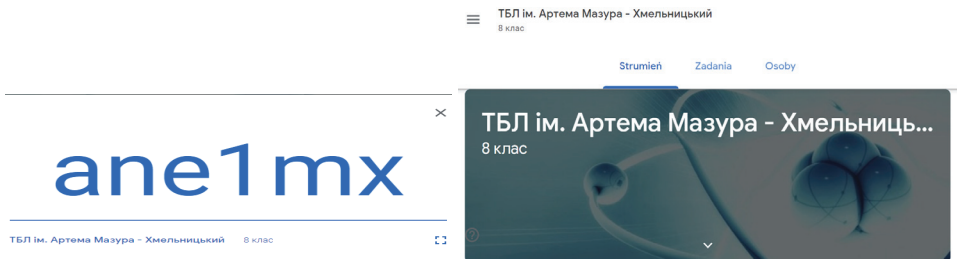

Figure 1. Left – classroom code, right – a website of a selected group
S o u r c e: Own work in Google Classroom.

On a website assigned to a particular class, a teacher posts learning materials for students that they have to get familiar with before the lesson – a research group, or after the lesson – a control group. Each topic is added in a separate post with relevant attachments (e.g. presentation, video, follow-up exercises, graphics, test).

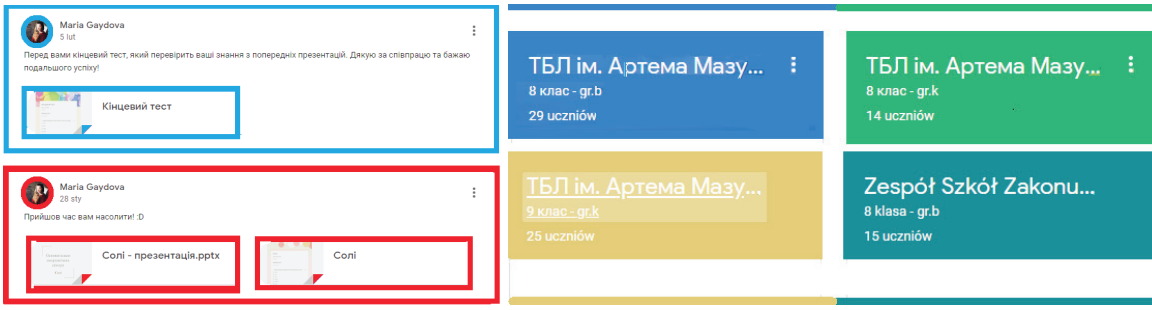

Figure 2. Left – examples of materials, right – schools presented on free Google platform
S o u r c e: Own work in Google Classroom.

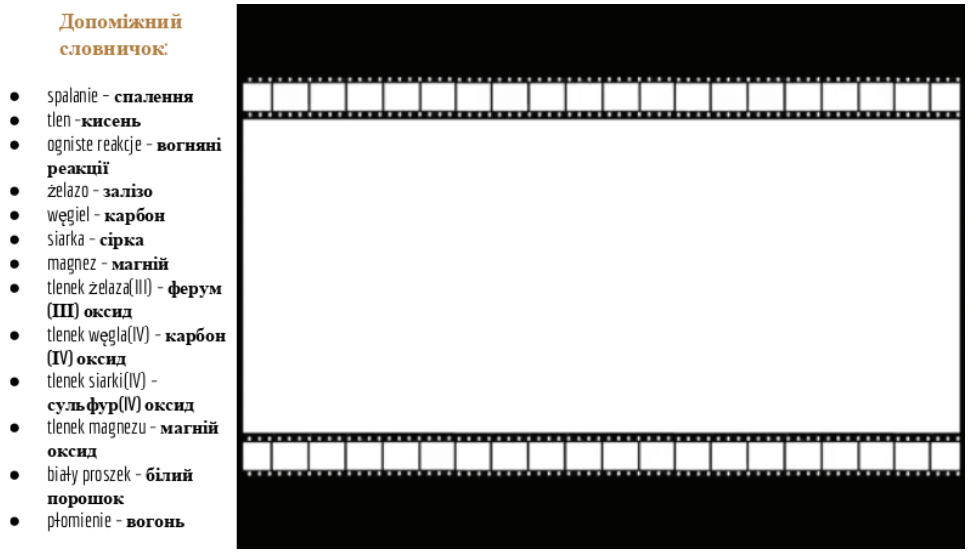

Figure 3. Screen shot from a presentation – video

S o u r c e: Own work in Google Classroom (available online).
N o t e: Students in a Ukrainian school learn Polish – the glossary has been drafted to help students with chemistry terms they were not familiar with up to this point.

Process of Educational Research

The research covered the students of the seventh and the eighth grade from General Education School Complex no. 4 in Poznań, the St. Józef Kalasancjusz School Complex of Piarists Order in Poznań, and the eighth and the ninth grade of A. Mazur Multi-Profile Technical High School in Khmelnytskyi.

Table 1
No. of students taking part in the research

Schools' locations	No. of students	Research group	Control group
Poland*	58	31	27
Ukraine	98	59	39

* Due to teachers' strike in Poland, some topics have not been covered
S o u r c e: Own work.

In order to conduct the educational research in all three schools, two classes were selected and divided into the research and the control group. The research group's task was to prepare selected topics at home before the lesson using materials on Google Classroom platform and other sources (e.g. videos from popular science channels and EU projects posted on YouTube, links to websites). The students from control group worked on the same topics in a traditional manner, that is, using the very same materials, doing the same experiments and assignments as homework, only after the lesson. The source of additional learning materials was a computer software *Mobilna chemia* (*Mobile Chemistry*), general education e-book *Chemia. Świat pod lupą* (*Chemistry, the World under a Magnifying Glass*), other Internet websites and chemistry course books, including *Chemia Nowej Ery* (*Chemistry. The New Era*), *Ciekawa chemia* (*Interesting Chemistry*), and *Хімія* (*Chemistry*) *for High Schools*, to name but a few.

Division of the groups into the research and the control ones involved the whole class and not only the particular groups of students. The research group followed their curriculum using the preemptive method, the control group followed their curriculum in line with the traditional method. The decision concerning the division was based on organisation of school life, ability to communicate the contents and comparable academic achievements in parallel classes.

The task of the research group in the activation and the processing stage (about 45 minutes) was to get familiar with the learning material on the platform and preparing for the class. The students were also allowed to use other sources (course books, the Internet). The final part of the *processing stage* was a test which helped the students evaluate their knowledge and show a teacher which issues the students struggle with and which issues they failed to comprehend. *The systematisation stage* gave the teacher a possibility to conduct the lesson in a different, more attractive way. The systematisation stage was established with the teacher during organisation meeting before the research started. The teachers were responsible for conducting the lesson according to a script drafted by Mariia Gaidova as a part of her MA thesis and for motivating their students to study using the preemptive method. This way of cooperation was selected for a reason. First, students are more efficient in learning new contents when it is presented by "their" teacher, they are more focused and less stressed out than when they have to deal with a person they do not know. Secondly, in case of conducting lessons in one school and not conducting them in the other (due to distance and time conditions), the findings would not be suitable for comparison.

The Research Findings

The selected topics of the educational research – the case study, from "Non-organic Chemistry" and "Organic Chemistry" were consistent with the core curriculum and distribution of materials in selected schools. "Non-organic Chemistry" unit consisted of four topics: oxides, hydroxides, acids, and salts. "Organic Chemistry" unit consisted of three topics: unsaturated hydrocarbons; alkanes, aaturated hydrocarbons; olefines, saturated hydrocarbons; alkynes.

Students in the research groups got familiar with the materials on the e-learning platform and did partial tests before the lesson, whereas the control group students did their tests after the lesson. Both groups wrote their final tests after completing the entire unit. When the students passed the partial tests, they received the additional points that influenced their final score, which was an additional motivation for them.

Table 2
Collective table – final tests results in percentage

Final test	U 8th grade research group	U 8th grade control group	U 9th grade research group	U 9th grade control group	PL 8th grade research group	PL 8th grade control group
Average results in points	4.5	2.9	4.3	3.7	4.3	3.7
Average results in percentage	90	58	86	74	86	74

U – Ukrainian school, PL – Polish school
S o u r c e: Own work

Summary of Results

As may be seen in a collective Table 2, the final tests results of the Ukrainian and the Polish school, shows that the research groups which applied the preemptive method scored better than the corresponding control groups. The research group from the 8th grade of the Ukrainian school achieved the highest score of 90%,

however it cannot be compared with the corresponding 7th grade from the Polish school as the final test did not take place because of teachers' strike. The 9th grade of the Ukrainian school achieved the same research result of 86%, as the corresponding 8th grade of Polish school.

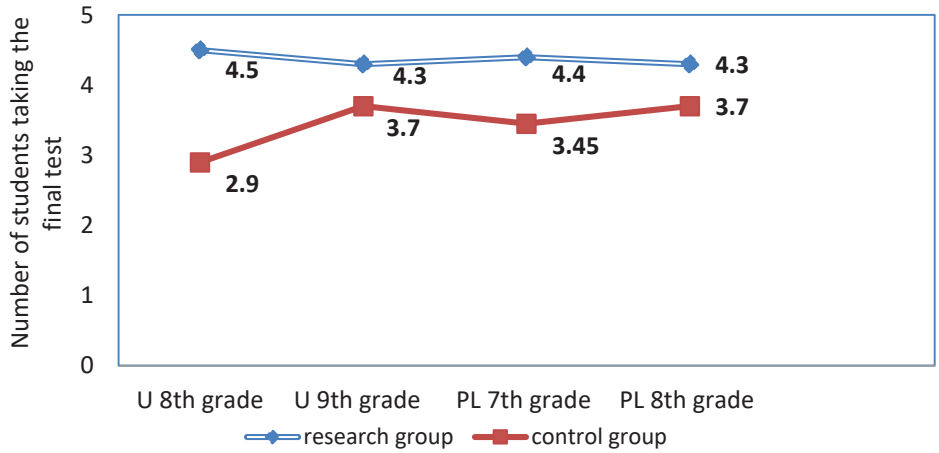

Figure 4. Final test results
S o u r c e: Own work.
N o t e: U – Ukrainian school; PL – Polish school; PL 7th grade total partial test result without final test.

After comparing the average results of the final tests of all groups taking part in the research (expressed by a number of students who took the test), it was concluded that the students of the 8th grade from the Ukrainian school achieved the highest score in the final test, namely 90%. In this class, 84% of students took the test (24 out of 29).

The second highest score, 86%, was achieved by two groups: the research group of the 9th grade from Ukraine (the test was taken by all students) and the corresponding research group of the 8th grade from Poland (the test was taken by 10 out of 15 students).

The result of 74% in the final test was achieved by: the control group of the 9th grade from Ukraine (the test was taken by all students) and the corresponding control group of the 8th grade from Poland (the test was taken by 8 out of 15 students).

The lowest score was achieved by the control group from the 8th grade in Ukraine which studied using the traditional method. The final result may have been affected by the significant amount of material for the test and the fact that all students took the final tests, not only the best ones. The results of the corresponding

class, that is, the 7th grade in Polish school could not be taken into account as due to teachers' strike the students did not get the chance to take the final test.

Conclusions

In order to meet the needs of the modern information society, one must constantly improve the education system. The effectiveness of teaching today's students fully depends on the implementation and use in the study of modern information and communication technologies, including network services that allow you to create an appropriate pedagogy and technology support base of modern information systems for educational purposes (Morze, Spivak, & Smyrnova-Trybulska, 2014). Therefore, the conducted research has proven to be justified. The collected data demonstrate that all groups involved achieved the average or high scores, however, students from the Ukrainian school were more motivated to learn and interested in ICT materials they were provided with for self-study than their counterparts from the Polish schools. The number of students visiting Google Classroom and attendance in all classes in the Ukrainian school was 94%, whereas the results for the Polish students were respectively 33% for the 7th grade and 64% for the 8th grade. Not all students used the opportunity to improve their marks with additional points that fostered the right motivation and their desire for self-access learning.

Why did the Ukrainian students spend more time on the learning platform and achieved better results than the students from Poland? The survey and the interviews with the students and teachers revealed that a significant factor was the difference between teaching chemistry in both countries. Schools in Ukraine provide their students with the right equipment and chemical reagents, whereas multimedia resources are less accessible, which makes Ukrainian students more open to gaining new knowledge that is presented in a different, more attractive way. Therefore, the perspective of expending the use of ICT in Ukrainian schools appears to be very encouraging (Nakaznyi, Sorokina, & Romaniukha, 2015, pp. 60–61). Polish students have an access to more interesting course books, e-workbooks, an opportunity to conduct chemical experiments at school, which could have resulted in a lower motivation to do some extra work outside of the classroom. The lower score and insufficient motivation of the Polish students was also affected by teachers' strike in Poland.

In teaching natural sciences including chemistry, IT may turn out to be very beneficial. Multimedia training has an impact on nearly all human senses and when

compared with traditional teaching it proves to be more efficient when it comes to picking up new knowledge (by 56%), provides better comprehension of a topic (by 50–60%), saves time (by 37–70%), improves the pace of learning (by 60%) and the scope of gained knowledge (by 25–50%), and generates less misunderstanding in transferring knowledge (by 20–40%) (Steinbrink, 1999), which, in combination with the preemptive teaching, seems promising. In chemical higher education, the student learns laboratory classes at home beforehand, which is the first step to implement the pre-emptive method. There has been an increasing number of reports for flipped learning in chemistry at higher education institutions (Seery, 2015; Melissa, 2017; Pienta, 2016). "The flipped learning approach is likely to be a significant teaching and learning method over the next decade as more educators seek to improve the value and quality of their in-class time by creating a space for active learning. Progress on this will enhance the likelihood that the approach, which is already in favour with students, will be viewed as a rigorous one that can finally challenge the hegemony of the didactic lecture in higher education chemistry" (Seery, 2015, pp. 758–759).

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Wykorzystanie platformy e-learningowej metodą odwróconej klasy na lekcjach chemii w Polsce i na Ukrainie – studium przypadku

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

Celem artykułu jest porównanie nauczania chemii w Polsce i na Ukrainie na poziomie szkoły podstawowej poprzez omówienie możliwości wspomagania kształcenia z wykorzystywaniem metody odwróconej klasy (nauczania wyprzedzającego) oraz ICT w tym darmowej platformy Google w edukacji chemicznej. Niniejszy artykuł analizuje niektóre wyniki testów i ankiet przeprowadzone wśród uczniów szkoły polskiej i ukraińskiej w roku szkolnym 2018/2019 wskazując motywacje uczniów dotyczące wspomagania nauczania ICT.

S ł o w a k l u c z o w e: nauczanie chemii, odwrócona klasa, Polska i Ukraina, ICT, platforma Google

Małgorzata Bartoszewicz, Hanna Gulińska, Mariia Gaidova

Использование платформы электронного обучения методом перевернутого класса на уроках химии в Польше и Украине – тематическое исследование

А н н о т а ц и я

Цель этой статьи - сравнить преподавание химии в Польше и Украине на уровне основной школы, обсудив возможности поддержки образования с использованием метода перевернутого класса (упреждающее обучение) и ИКТ, включая бесплатную платформу Google на примере химического образования. В статье рассматриваются некоторые результаты тестов и опросов, проведенных среди учащихся польских и украинских школ в 2018/2019 учебном году, которые указывают на мотивацию учащихся в отношении поддержки обучения ИКТ.

К л ю ч е в ы е с л о в а: преподавание химии, перевернутый класс, Польша и Украина, ИКТ, платформа Google

Małgorzata Bartoszewicz, Hanna Gulińska, Mariia Gaidova

El uso de la plataforma de e-learning en las clases de química. por método de aula invertida en Polonia y Ucrania – estudio de caso

R e s u m e n

El objetivo del artículo es comparar la enseñanza de la química en Polonia y Ucrania a nivel de escuela primaria discutiendo las posibilidades de apoyar la educación con el uso del método de clase invertida (educación preescolar) y las TIC, incluida la plataforma gratuita de Google en educación química. El artículo analiza algunos de los resultados de las pruebas y encuestas realizadas entre estudiantes de escuelas polacas y ucranianas en el año académico 2018/2019, indicando la motivación de los estudiantes para apoyar la enseñanza de las TIC.

P a l a b r a s c l a v e: enseñanza de química, aula invertida, Polonia y Ucrania, TIC, plataforma Google

IV. Reports

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Innovative Digital Technologies in Education and Business at the Third Annual Silesian Science Festival 2019

The Silesian Science Festival is an annual event organised by the University of Silesia in Katowice in cooperation with the Silesian University of Technology, Medical University of Silesia, the Jan Długosz University in Częstochowa, Academy of Fine Arts in Katowice, and The Jerzy Kukuczka Academy of Physical Education in Katowice. At the festival, specialists from almost all scientific/academic fields meet in one place. They are grouped into the following areas:

– literature, culture, and society;
– technology and development of exact sciences;
– medicine and health;
– art, design, and architecture;
– environmental protection and climate change;
– IT and game design.

It is worth noting that the Silesian Science Festival is a member of the European Science Engagement Association, which provides an opportunity for international reach, which is confirmed by the participation of attendees from various countries. As the organisers put it, "the mission of the festival is

to contribute to the development of knowledge society. By inspiring cognitive curiosity in people of all ages, we want to stimulate broad interest in science, respect for researchers and their achievements. We want to develop awareness of the benefits that society derives from scientific research and, in particular, to confirm and strengthen the Silesian region residents' sense of pride and benefit from having in the voivodeship excellent academic centres and their contribution to global science." (Media materials available at the festival's website https://admin.slaskifestiwalnauki.pl/sites/default/files/downloads/informacje_o_3._sfn.pdf?_ga=2.216842770.522796379.1548798900-1311627597.1544201688). General director and coordinator of the entire project is Professor Ryszard Koziołek, the Rector of the University of Silesia in Katowice. In addition, a team of scientists and volunteers from all the host universities is helping to organise this event.

The Silesian Science Festival is a fairly new feature on the map of cultural events in Katowice. In 2019, the third edition took place. It seems, however, that it is worth setting aside some time to attend such an event. On January 12–14, 2019, hundreds of children, adolescents, and adults had the opportunity to choose, according to their interests, from among several hundred scientific attractions, such as:

– workshops run by specialists in specific fields of science, addressing, for example: the question of "What is there in the desert and wilderness?; Chinese for beginners, 3D workshops; LEGO robots; science in your hands – physical and chemical workshops; using games in didactics and glottodidactics; Lund University Physics & Lasershow and many more (the festival schedule is available on URL: https://www.slaskifestiwalnauki.pl/harmonogram-festiwalu);
– talks given by specialists and well-known people who often make the headlines, for example, a NASA astronaut Nicole Stott; a famous German physicist, the 1987 Nobel Prize winner Johannes Georg Bednorz; a British traveller, adventurer, alpinist and a populariser of survival skills, Edward Michael Grylls, better known as Bear Grylls;
– experimental stands presented particular areas of knowledge: exact sciences, natural sciences, technical sciences, the humanities and social sciences, medicine and health, and art. At each of these stands, visitors had the opportunity not only to view exhibits of prehistoric geological formations but also to experience the physical and chemical experiments involved, learn how to speak Yiddish or Chinese languages, take a walk in virtual reality or experience weightlessness, or even taste local preserves, made according to traditional recipes;
– other zones, such as: an e-sport point, a learning stop, off science – garage inventions, science cinema, and a children's zone.

One of the demonstration venues in the humanities and social sciences was the stand of the Department of Humanistic Education and Auxiliary Sciences of Pedagogy of the Faculty of Ethnology and Educational Sciences (University of

Silesia in Katowice). The stand, labelled as the Innovative Digital Technologies in Education and Business, was supervised by Professor Eugenia Smyrnova-Trybulska, with the active participation of PhD students of the Department, Dominika Zegzuła, MSc, and Dawid Staniek, MSc.

Apart from many other activities, the faculty is engaged in the promotion of new technologies in education, e-learning, multimedia education, and robotics in education. At the festival, the representatives of the faculty (Professor Eugenia Smyrnova-Trybulska, dr. hab.; PhD students Dominika Zegzuła, MSc, and Dawid Staniek, MSc (see Photos 1 and 2) promoted the idea of new solutions in education through conversations with the visitors, both pupils and teachers, as well as secondary school students about the programmes offered by the University of Silesia, including "E-learning in Cultural Diversity." Digital technologies in education and business are becoming a reality and even a necessity in the modern world which is transmuting into an augmented reality and cyberspace. The aim of the presentation was to encourage and inspire young people to develop their digital abilities and competencies and to engage the youth in the creation of a virtual information and education space, and to help them select future innovative university courses and professions related to IT.

Photo 1. Participants of the third Annual Silesian Science Festival 2019 (photo by Tomasz Trybulski)

Photo 2. Participants of the third Annual Silesian Science Festival 2019 (photo by Tomasz Trybulski)

In particular, the following research categories, technologies, methods, and forms were presented and discussed:

– virtual educational environment/virtual classroom;
– e-learning;
– personalized learning;
– computer stories (digital storytelling);
– teaching/learning information;
– e-books;
– gamification;
– teaching/learning in cooperation;
– mobile learning/m-learning;
– cyberspace;
– SMART technologies;
– STEM education;
– teaching in the cloud/cloud computing;
– MOOC;
– self-generated content (APPShed);
– competence approach;

– flipped classroom;
– LMS (Learning Management System), Moodle;
– CMS (Content Management System);
– teaching/learning in asynchronous synchronous mode;
– iconographics;
– robotics;
– neural networks;
– social media.

The Photon robots aroused considerable curiosity, especially among children. What also drew much attention was the possibility to learn programming the Photon robots (see Photos 3 and 5) as well as an artificial hand controlled by forearm muscles.

As part of the Silesian Science Festival, in addition to the exhibitors' stands in the main hall, various workshops were held for visitors. They were designed to popularise science to wide audiences in a very attractive and friendly form. One of such activities was a workshop CyberFun prepared by a PhD student at the Faculty of Arts and Educational Sciences, Dawid Staniek. His research interests, combining modern technology, electronics, and social sciences (pedagogics) helped

Photo 3. Participants of the workshop conducted during the third Annual Silesian Science Festival 2019 (photo by Eugenia Smyrnova-Trybulska)

him to develop a workshop which presented the possibilities of combining biology, 3D printing technology and programming. The workshop participants had the opportunity to learn how the human body generates electrical impulses and how they can be used after digital processing (see Photo 4).

Photo 4. Participants of the workshop conducted by Dawid Staniek during the third Annual Silesian Science Festival 2019 (photo by Eugenia Smyrnova-Trybulska)

For the purposes of the activities, a hand prosthesis had been printed, then fitted with an electronic controller and a mechanical actuating part. After numerous volunteers had been connected to EMG apparatus (an electromyograph) – they had the opportunity to drive the movement of the fingers in the test prosthesis with their own muscles. This seemingly simple experience both provided an opportunity for numerous discussions (with parents who were interested in how the prototype had been made), and delighted and surprised children testing the hand (see Photos 3 and 5). Such a simple experiment showed that in order to prepare a functional prototype, a minimum of knowledge and resources is sufficient – the development and popularisation of 3D printers, reduction in the prices of consumables – gives hope for implementing these solutions in everyday life of persons with amputation.

Another experiment also drew positive reaction from the children participating in the workshop. This time, they had the opportunity, using their nervous system, to control devices connected directly to the power grid (galvanic separation).

Photo 5. Participants of the workshop, conducted during the third Annual Silesian Science Festival 2019 (photo by Eugenia Smyrnova-Trybulska)

A complementary part of the workshop was a parallel demonstration of the capabilities of Photon robots. Courtesy of the Information Society Development Foundation and its Mobile Advisors network, an opportunity was provided to borrow robots and present them as part of the Silesian Science Festival. This extremely well thought-out project of Polish specialists, engineers, designers proves its worth in the initial phases of teaching robotics. Thanks to a dedicated application that allows grading the level of difficulty (from basic control of a robot's movements to writing source code), teaching programming to early school-aged children is at your fingertips. In addition, the manufacturer took care of the visual aspect of its device and its reliability. As a result, a great deal of attendees wanted to establish contact with Photons.

The workshops were conducted on an open basis, and the participants, after the completion of the workshop, were allowed to ask questions, which they eagerly did. Summing up the workshop part, it can be concluded that the formula for

popularising science through active forms of presenting its achievements is and will continue to be the best way to stimulate young people to develop their interests and passions, which should make educators stop and think, and further improve their daily teaching activities.

As an additional attraction, teachers attending the event were shown examples of educational activities utilising popular apps for the school's day-to-day didactics. As research activity, a survey was conducted of selected 69 school-age students who visited the Photon robot stand.

Particular attention was paid to the availability of this robot or a similar one in the children's school environment, which was motivated by the desire to have such a device at home and awareness of the robot's usefulness in development and learning.

Summing up, it can be emphasised that the third edition of the Silesian Science Festival achieved its goals related to the promotion of science, the popularisation of new digital technologies among younger users, future students, scientists, engineers, and new generation specialists. Many young people fascinated by the scientific event discovered their new passions and were inspired by science.

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Virtual University: Model, Tools, Practice (11–12 June 2019)

Teaching children and adults at all levels of education of the last decade is synchronous with and pertinent to the development of new technologies. All aspects of transfer didactics, methodology, and the process of shaping the young generation using contemporary ICT tools and e-learning are in the centre of attention of researchers from various fields. They analyse and research e-learning and digital tools used in education and present the results at the conference fora visited by specialists from areas of study oscillating around the topic of digital education and digital society.

One of the most important events in Poland in this field is the annual Virtual University Conference: Model, Tools, Practice. The symposium has a rich, 19-year-old tradition. Every year, the conference is alternately organised by Warsaw higher education institutions: Polish-Japanese Academy of Information Technology, Warsaw University of Life Sciences, University of Warsaw, and Warsaw University of Technology.

A considerable participation of the Digital Competence Centre of the University of Warsaw and the Polish Scientific Association for Internet Education is also worth mentioning. The original idea of the conference in 2001 was directly related to the creation of study programmes implemented via the Internet and dedicated to lecturers at Warsaw University of Technology as an opportunity to learn more about distance learning tools and techniques from foreign scientists. Currently, the event serves as a place of polemics among the best specialists in

the field of digitally supported education from all over Poland. It is a tradition that the deadline for submitting papers is always mid-June. On June 11–12, 2019, the 19th edition of the conference under the slogan "Digital Labyrinths" took place. Chief coordinator of the Conference is professor Bogdan Galwas, the Head of the Organising Committee is professor Elżbieta Piwowarska from Warsaw University of Technology.

The conference offered a number of speeches, workshops, and poster sessions. The guests of the University of Warsaw were 45 speakers, representatives of universities from all over Poland, grouped into ten sessions, with (including two didactic and two workshop ones) dealt with the following problems:

– new trends in e-education in Poland, Europe, and the world;
– e-learning in schools, colleges, and companies;
– sociological, pedagogical, and psychological aspects of e-education;
– educational portals, e-learning platforms, virtual laboratories;
– applications of multimedia and artificial intelligence in e-education;
– open educational and scientific resources;
– the role of e-education in lifelong learning;
– knowledge management at the university through the electronic means;
– teaching management systems;
– educational platforms, e-learning and e-learning supporting software, virtual laboratories, Web 2.0 and E-Learning 2.0.

Ceremonial opening of the conference was held by Vice-Rector for Development, prof. UW dr hab. Anna Giza-Poleszczuk. Session one – "Contexts of the Digital Revolution" – was moderated by dr. Izabella Bednarczyk-Bochenek. Among the presenters were: prof. Jerzy Wilkin "University in the Time of Post-truth," journalist Jacek Żakowski "Democracy or A.I.-ocracy," Aleksander Pawlicki "Character Shaping in the Digital Age," prof. Jerzy Mischke "A Slim University, or What University We Need." After the session, there was time for discussion.

Session two – "Academic E-learning" – was run by dr. eng. Elżbieta Piwowarska and consisted of the following presentations, by prof. Bogdan Galwas "Tools and Models of Education," prof. Arkadiusz Orłowski "The Reality of Virtual Teaching," prof. Lech Banachowski, dr. Aldona Drabik, prof. Paweł Nowacki "Summary of Experiences in Conducting Online Classes at the Polish-Japanese Academy of Information Technology," Anna Warda-Ritzen, "Blackboard – Building Accessibility and Cooperation at the University with the Use of E-learning," and dr. Izabella Bednarczyk-Bochenek and Dorota Sidor "Change. Revolution or Evolution?"

In total, there were eight conference sessions devoted to such issues as open education, open science, digital humanities, tools and technologies of digital

education, research in e-learning and didactics, various projects. Additionally, posters related to each session were constantly available during the conference. Full conference programme was available on https://vu2019.ckc.uw.edu.pl/node/17.

One of the speeches in session 4b, which was devoted to the research in e-learning and in didactics, was the presentation of research results on "Digital Internet Resources in the Learning and Development of Future Educators – A Case Study" conducted under the program "Faculty Platform for Distance Education in Raising the Quality in Shaping the Competences of Future and Active Teachers" and delivered by Eugenia Smyrnova-Trybulska and Dominika Zegzuła from the Department of Humanities Education and Auxiliary Sciences of Pedagogy of the University of Silesia in Cieszyn, Poland. The speakers also referred to certain theoretical aspects of ICT competence and soft competences, including the use of IT tools in search for information.

The workshop sessions of the Centre of New Technologies (CeNT) of the University of Warsaw were abundant in practical knowledge. The participants had a choice of two workshops, namely:

- "The Use of Mobile Applications in Education – Mathematics and Natural Sciences": a workshop session directly related to teaching mathematics, technically showing the possibilities of *Geogebra*. The session was run by Anna Łukomska and Beata Kotarba.
- "The Use of Mobile Applications in Education – The Humanities": a workshop session which referred to teaching humanities and digital communication, technically showing an overview of the latest and best applications and programmes which can be used to plan work with the student. The session was run by dr. Kinga Białek and dr. Iwona Kołodziejek.

The whole event raised topics relevant to contemporary education: Which direction is it heading for and is this direction right? What are and should be the standards of digital society education? And also topics which touch upon the future of education in the context of continuous technological development. Those who did not have an opportunity to take advantage of direct participation in the conference are encouraged to read the summary entitled "On the Labyrinths of Digital Content at the Conference Virtual University VU'19" presented by Anna Pacholak on the e-mentor website (http://www.e-mentor.edu.pl/artykul/index/numer/79/id/1415) or the Facebook page of the Digital Competence Centre of the University of Warsaw (https://www.facebook.com/watch/?v=2327535897307796) and the best speeches coming soon in the *E-mentor* journal, selected in the *Eduakcja* journal (https://eduakcja.eu/index.php/pl/), *International Journal of Research in E-learning* (www.ijrel.us.edu.pl) and *Studies in Logic, Grammar and Rhetoric*. Issue on Logical, Statistical and Computer Methods in Medicine (2018) (http://logika.uwb.edu.pl/studies/).

We would like to express our warmest thanks to all the Coordinators, Organisers, and Speakers for the opportunity to participate in this wonderful scientific event.

On behalf of the Organisers, we are looking forward to the 20th Jubilee Edition, which will be held online on December 14–15, 2020, http://vu2020.okno.pw.edu.pl.

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