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Editorial

The present volume includes ten articles gathered in four parts. Part I is entitled "E-learning in the development of key competences and skills in higher education" and includes four articles.

The first article, entitled "Integrating E-learning for Administrative Staff Professional Development: An Inside View from Moroccan Higher Education Institutions," was prepared by Layla Ajrouh from Faculty of Humanities, Moulay Ismail University, Meknes, Morocco and Karima Slamti, Faculty of Humanities, Cadi Ayyad University, Marrakech, Morocco. They stressed, among other issues, that online learning is increasingly solicited around the world. Higher education (HE) is also concerned as it operates in an uncertain global environment, where communication and information technology are the fundamental keys. The study seeks to examine the Moroccan employees' perceptions towards this innovative way of learning and its impact on their professional development. It also aims at investigating the presence of distance learning as a growing approach within the administration of Moroccan universities. The research presented shows the increasing necessity of integrating new ways of learning in Higher Education Administrations (HEAs). This work yields to the acceptance of the research hypothesis $H_{1,}$ which states that e-learning is not promoted for employees' career advancement in Moroccan HEAs. This study recommends an anticipatory vision to go beyond any reticence to change, since the online learning approach would bring more productivity and success for the administrative structures and the employees themselves, in addition to more institutional alignment with the revolutionary digital world.

The second article "Elementary Music Education in the Era of Remote Teaching – Constraints and Prospects for Development" is authored by Mirosław Kisiel from the University of Silesia in Katowice, Poland. In the discourse undertaken, an attempt was made to indicate the limits and perspectives for the development of music education within the context of distance teaching. The specificity of music education based on experience, emotions in action, the creative approach to an artistic creation and expressive action requires special attention in this regard. The teacher is expected to develop a new strategy for action, which in the existing

educational situation will result in an increase in students' interest in music by using the contemporary information and communication tools, namely, the specific tools of e-communication.

Pedro Ramos Brandao from Evora University (CIDHEUS), Portugal is the author of the article "Cloud Computing and Distance Learning in Computer Science." His research demonstrates that the use of laboratories for the development of curricular work in the area of information technology exclusively supported by cloud computing technology does not decrease the level of learning and assessment objects on the part of students. This scenario arose due to the need to interrupt face-to-face classes in physical laboratories as a result of the COVID-19 pandemic. The author compares the results and their correlations to various evaluative successes in different curricular units.

The article "Online Collaborative Learning to Enhance Educational Outcomes of English Language Courses," was prepared by Iwona Mokwa-Tarnowska from the Gdańsk University of Technology, Poland. Her study has various aims and objectives, and examines various syllabi of e-learning, blended learning and web-enhanced courses, meant for a particular group of undergraduates or postgraduates. She found that they may vary substantially. However different they are, they are likely to show behaviourist ideas embodied in their instructional design. A plethora of online tools, text based, image based, multimodal production and collaborative ones, can increase students' learning experiences, as they offer opportunities for interactions that are not available in a traditional, instructivist-centered classroom settings. Thus, a university language course with web-enhanced components offers more versatile learning options than face-to-face classes, which may result in students becoming more competent and competitive workers in the years to come. By using online tools such as ThingLink, mural, quip, easel.ly, infogram and venngage to collect and critically analyse data, they learn in a new active way and in a more genuine environment. This way of engaging students helps them to achieve learning outcomes structured around communication, teamwork, media literacy and language skills. These ideas are supported by students' opinions and attitudes expressed in the surveys conducted at the Gdańsk University of Technology in the years 2017–2019.

Part II "Innovative Methods and Technology in Higher Education" consists of three articles. The first study and article is entitled "Application of Computer Mathematical Tools in the University Training of Computer Science and Mathematics Pre-service Teachers," and was authored by Olena Semenikhina, Volodymyr Proshkin, Olha Naboka from Ukraine. It considers the problem of the application of computer mathematical tools in the process of the professional training of future teachers of computer science and mathematics. The two classes of mathematical software are identified: systems of computer mathematics, which use traditional

notation and methods of writing formulas and programs of dynamic mathematics, which provide the possibility of dynamic changes in the original mathematical structure. The concepts are specified as follows: "a program of dynamic mathematics," "computer mathematical tool." The methodical receptions provided in PDM are allocated and the authors outline the methodical features of the application of computer mathematical tools. The peculiarities of the educational process with the use of PDM are indicated: rethinking of forms and methods of teaching, use of non-standard and creative tasks, rational choice of software environment, evaluation of learning outcomes, etc. The results of an experiment related to the study of the influence of programs of dynamic mathematics on the level of students' academic achievements are presented. The necessity of the preparation of future teachers of mathematics and computer science for use of the specified toolkit in the course of professional activity is specified.

Iwona Ruta-Sominka and Anna Budzińska from the Institute for Child Development, Gdańsk, are the authors of the article entitled "Using the Application Friendly Schedule on a Tablet to Promote Independence in Children with Autism Spectrum Disorder." The prevalence of autism spectrum disorder (ASD) has increased in recent decades. The need to provide evidence-based practices in the field of ASD is also growing. The Institute for Child Development (IWRD) in Poland is offering science-based intervention to children with autism, based on the model developed initially by McClannahan and Krantz (1993) in the Princeton Child Development Institute, USA. Their research and clinical experience show that activity schedules are very effective in teaching people with autism many new skills. However, as stressed by the authors, activity schedules in the "traditional" paper version could lead to stigmatization while used in a social environment. It is essential to give people with autism spectrum disorder socially acceptable tools, which can help them to function more independently. The intensive development of modern technologies, as well as an easy access to various types of mobile devices inspired the authors to implement tablets into their treatment of children with ASD. Friendly Schedule is an application for children and youth with autism and related disorders, developed as a joint initiative of the Gdańsk University of Technology and the Institute for Child Development. The application was created as a "non-profit" project. In the IWRD program, the application Friendly Schedule is used to teach students with autism a variety of new skills, including verbal and social behaviours.

The aim of the third article, "Padlet as a Modern Form of E-learning in the context of Sugata Mitra's Research – a New Model of Education" prepared by Tomasz Piotr Kopczyński from the University of Silesia and Kamil Szpyt from Andrzej Frycz Modrzewski Kraków University, presents the results of surveys concerning the Padlet tool. The authors analyze contemporary trends in education, legal

regulations and research, which are part of the new model of education. The text contains descriptions of research results from 230 surveys conducted on students in relation to three categories. The first category presents the results of the evaluation of Padlet as a tool for content segregation, the second category concerns the evaluation of Padlet in terms of the function of group work, and the third category concerns the functionality and comparison of the Padlet tool with other similar tools. The researchers stressed that in the current educational situation caused by the global coronavirus pandemic SARS-Covid-2 causing the disease called COVID-19, the evaluation and presentation of research results related to distance learning tools and methods is very necessary.

The third part "Theoretical, Methodological and Practical Aspects of ICT and E-learning in Education" includes three articles. The international team of authors: Natalia Maria Ruman from the University of Silesia, Faculty of Arts and Sciences on Education, Martha Finger, Stephan Sampt from Kirchliche Pädagogische Hochschule Wien/Krems and Zdenek Mruzek from Albrechtova Stredni Škola in Český Těšín presented their research entitled "The Role of Information Technology in Ecological Education in the Context of Cooperation between High Schools from Poland, Austria and the Czech Republic" and stressed that contemporary ecological problems of the world can not only be studied as a survey of knowledge, opinions and attitudes, but also as a project designed to stimulate society from an early age to responsibility concerning the protection of the environment and increase individual ecological awareness. The article is a summary of the work carried out under the project of three cooperating schools representing Poland, Austria and the Czech Republic. The aim of the project was to consider the importance of ecology at the level of participating secondary schools in selected countries and the use of technology to implement this project. International project coordinators were interviewed. The questions concerned: application of technology in an international school project, summary of the effects of the Polish school's cooperation with foreign schools and new challenges in the digital school environment. A qualitative study was also carried out. The project was also analyzed in terms of the activities included in it, and its effects were presented.

Rapid technological development in recent years has contributed to numerous changes in many areas of life, including education and communication, as stressed by Ewa Kozłowska from the Gdańsk University of Technology, Poland, who is the author of the second article of Part III, "Using Moodle as a Solution to Interdisciplinary E-collaboration Issues." The researcher discusses various issues including establishing interdisciplinary collaboration, which brings many benefits; however, it is often associated with numerous problems and inconveniences, as well as the need of constant improvement, lifelong learning, professional development (CPD) and finding an effective way of transferring information. Living in a constant rush

makes the logical order of transferring information a key aspect, as more and more operations are being done chaotically, using multiple online tools. Although collaboration happens to be complicated even for colleagues specializing in different aspects of the same profession, establishing cooperation between specific groups of interdisciplinary specialists, such as engineers and physicians, has a significant impact on modern diagnostics and medical treatment development. Based on some selected case studies investigated at the Gdańsk University of Technology and the Medical University of Gdańsk, supported by an overview of the available education and collaboration tools, a solution based on the Moodle LMS platform has been proposed, implemented, and analysed.

Natalia Maria Ruman, Agata Pokładnik from the University of Silesia, Faculty of Arts and Sciences on Education, Poland consider in their research entitled "The Interactive Board – an Indispensable Device in Upper Secondary Education" various dynamic social transformations and the lives of modern children and young people. In these conditions, the school should use modern educational technologies to a greater extent than ever before. One of the great opportunities to increase the attractiveness of the school for students is to use, for example, an interactive board that offers great opportunities in this regard. Children and young people living in the world of multimedia devices have been taught to demand surprises, news and a faster pace for information. Therefore, they have different expectations for school education. For a greater use of modern technologies in school, it is necessary to prepare and motivate the teachers. The article presents the educational values of this type of teaching aids, as well as their use by teachers in upper secondary school.

Part IV "Reports" comprises the article entitled "The Report on 11th Annual International Scientific Conference DLCC2019" prepared by Eugenia Smyrnova-Trybulska from the University of Silesia, Poland, which is devoted to the International Scientific Conference DLCC2019 entitled "E-learning and STEM Education." The article describes the topics of the conference, speakers, conference activities, along with a few presented conclusions.

We hope that all the articles will be interesting for our readers and will inspire them with new ideas, innovations and trends in education.

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I. Theoretical and Methodological Aspects of E-learning

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Integrating E-learning for Administrative Staff Professional Development: An Inside View from Moroccan Higher Education Institutions

Abstract

Online learning is increasingly solicited around the world within and across several sectors. It also involves higher education (HE), as it operates in a global, unstable environment, where communication and information technology are the fundamental keys. This study seeks to examine the Moroccan employees' perception of this innovative way of learning and its impact on their professional development. It also aims at investigating the presence of distance learning as an approach growing in popularity within the administration of Moroccan universities. This qualitative study uses a semi-structured interview with 76 employees in seven Moroccan Higher Education Institutions (HEIs). The results reveal that the majority of participants have rarely used online learning, in spite of their willingness and insistence on its positive impact on their professional progress. The interviewees reported their proactive view to accelerate the implementation of digital learning to meet the world standards, as it would also serve as an appropriate way for their continuous professional development and their ability to face critical situations. The present research shows the significant necessity of integrating new ways of learning in Higher Education Administrations (HEAs). The present work assumes the research

hypothesis H_1: e-learning is not promoted for employees' career advancement in Moroccan HEAs. This study recommends an anticipatory vision to transgress any reticence to change, since online learning approach would bring more productivity and success for the administrations and the employees themselves, as well as closer institutional alignment with the revolutionary digital world.

K e y w o r d s: Online learning, professional development, career advancement, university administrations, uncertain environment, digital world

The world is moving forward and "what might have been relevant in years past may not be relevant today" (DePalma, 2019, p.72). Indeed, this applies to all sectors. That is why it is important to mobilize and make the necessary changes that respond effectively to the market needs. The labour environment is very dynamic and "employee continuing education and training has become a key requirement for employers and employees" (Schaefer et al., 2019, p. 1354). Professional development of the workplace is the only way to keep employees informed, up-to-date and knowledgeable in their field of work. Simonenko et al., 2019 explain that "the catalyst for the transformation of the world at the moment is modern digital technology," and that "such a conclusion was made in 2017 at the World Economic Forum." Thus, e-learning is one of the highly recommended ways to introduce changes in the world, higher education and specifically in the professional advancement. Le, Duong, Tran, and Do (2018) define e-learning as "a method of teaching and learning using electronic media, e-learning is also called web-based, online learning, distributed learning, computer-assisted instruction and internet-based learning" (p. 132). The nature of distance learning makes the online environment more and more solicited as another way for sustainable professional advancement. Feldacker, Jacob, Chung, Nartker, and Kim (2017) assure that "to fill gaps in knowledge and skills, effective continuing professional opportunities are needed" (p. 1). In this regard, "e-learning opportunities can bring expert knowledge and provide a flexible learning option adaptable to local setting" (Feldacker et al., 2017, p.1).

Today, e-learning benefits from major innovations in technology and communication to bring more adequate and appropriate knowledge in administrations. Blaga (2019) states that "with the rapid development of the Internet, the Web has become a global, interactive, dynamic, economic, democratic environment, as well as a learning and teaching environment" (p. 42). With the contemporary business world expectations, Higher Education Institutions (HEIs) are urged to make the workplace a real opportunity for professional growth, which "is indeed a lifelong

process" used to "maintain, update, develop, and enhance professional skills, knowledge, and attitudes" (Jiandani, Bogam, Shah, Prabhu, & Taksande, 2016, p. 106). DePalma (2019) believes that "it is important to develop and evolve into a better employee in any profession, regardless of your current role" (p. 72). To achieve this, institutions should consider e-learning in their employees' career plan. Thus, online learning has been broadly used as an innovative model for continuous professional development (Le, Duong, Tran, & Do, 2018, p. 131).

Online learning is an appropriate modern way recommended for making the learning process more flexible and accessible to a larger audience and it has a positive impact on employees' performance. Accordingly, Sun JooYoo and Huang (2016), "e-learning systems are gaining in popularity in the workplace due to their many advantages" (p. 577). It is known that the use of technology in learning provides more flexibility and reliability to this process of acquiring, imparting and enlarging knowledge. Distance learning allows sharing knowledge to a large extent and is considered to be a new approach to learning beyond the classroom (Scott et al., 2016, p. 266). However, there exist insignificant literature related to online learning for professional development sustainability.

E-learning has not been widely used in the Moroccan Higher Education Administrations (HEAs). Stein et al. (2011) explained that "lack of appropriate professional development" could be the main "reason e-learning has not 'taken off' as one might have expected" (p. 146). Therefore, it is vital to explore the related perception of the Moroccan administrative employees, in order to promote this innovative way of learning in the sector. Hence, adopting this new learning method "requires an institutional approach to professional development, in order to cater for the different levels and requirements of staff" (Wilson, 2012, p. 892).

Online learning could be promoted and implemented effectively, yet it depends on how proactive and profound the vision of the leaders of the sector is to face the uncertain world. Internet-based learning facilitates the work process which is less money consuming and more time saving for the institution. It is considered the miracle of the century, since it makes service and knowledge closer and available for all, especially in difficult and unpredictable situations when being online becomes a necessity, not just an option. By implementing this approach, the Moroccan Higher Education (HE) administration, could improve the quality of work and be able to cope with the new world challenges. Smyrnova-Trybulska et al. (2018) affirm that "[d]igital technologies provide innovative openings to partnerships and exchanges and pose a number of challenges" (p. 30), which should be addressed by HEIs. Consequently, employees would reach their ultimate goal of developing personally and professionally and become operational in the dynamic educational environment.

Research Problem

This study explores online learning as an aspect that is neglected in the field of professional development of employees in Higher Education Administrations. There is a lack of online programs targeting the enhancement of administrative staff performance to assure the sustainability of work quality, either physically "on-site" or remotely "online."

Research Aim

The objective of this study is to identify the university employees' perception of online learning for their professional development, and also to investigate the presence of online programs offered to the administrative staff at Moroccan universities.

Research Questions

The present study seeks to answer some pertinent questions to explore the employees' perception of the research subject:

– To what extent is online learning present for the administrative staff in the Moroccan Higher Education Institutions?
– To what extent does e-learning contribute to the professional development of the administrative employees in the Moroccan HEIs?

Research Hypothesis

These hypotheses are raised:

H_0: Online learning is promoted for the employees' continuous professional development in Moroccan Higher Education Administrations (HEAs).

H_1: Online learning is not promoted for the employees' continuous professional development in Moroccan HEAs.

By testing the hypotheses, we accept H0 (H0 is more probable) or we reject H0 and accept H1 (H1 is more probable). This will lead to clear answers to the research questions and will show the impact of online learning on Moroccan HE administration against the background of the needs of the era.

Methodology of Research

This study provides insights into the degree of existence and usefulness of online learning in Moroccan HEIs. It seeks to examine the perception of the administrative staff concerning what this innovative way of learning may bring to their individual professional advancement and institutional effectiveness as a whole. This study adopts a qualitative research methodology, since it helps to acquire data from real-life experience of the participants.

Research Sample and Instrument

The research population is 76 interviewees, 36 males and 40 females, most of them with long years of experience at different administrative departments. The research environment is seven public and private Moroccan HEIs. The present study utilizes a semi-structured interview with a qualitative research methodology. The semi-structured interview explores, collects and examines the interviewees' answers, and it also provides them with flexibility to express feedback beyond the given questions, which is an added value for the analysis of the responses.

Data Collection and Analysis

Before starting the research data collection, which took nearly four months beginning from December 2019, a testing process was conducted by consulting 14 people

from the target population. The data collection test helped in making adjustment related to language, avoiding some confusion, and rebuilding some questions' structures for better understanding. Most of the interviews were conducted face to face, the remaining ones were held remotely at the beginning of the confinement period (late March 2020). The data for this study were collected through direct physical, as well as distance discussions including e-conferences, phone calls, social media and chat groups. The collected data were based on the interviewees' real-life professional experience.

The interview questions were organized in such a way so that they could be analyzed in light of the research questions; they constituted a mixture of open and open-ended questions. Some interviewees went beyond the structured interview questions, which made the data collection rich with unexpected but very pertinent information and contributed to the effectiveness and reliability of the analysis. The results were analyzed in an inductive way according to the emergent themes which would help to answer the research questions and lead to acceptance or rejection of the hypotheses. The aim was to ensure that all responses were noted and accurately stated.

A detailed table of the interviewees' answers per interview question was then established. An overall summary was given for each question based upon the responses. Frequent keywords and/or phrases were first highlighted and then extracted from the responses in order to deduce the common points which would help to identify the research themes. Interviews lasted approximately 30 minutes.

Research Results

All the interview results were satisfactory, since they provided valuable insights into the research subject. The interviews were interpreted and analysed in a qualitative method through forming themes related to the research and interview questions, in order to accept or reject the hypotheses. The following are the two raised themes of the interview analysis:

Theme1: online learning for professional development in HE administrations requires implementation.

Almost all the interviewees (n=68) said "no" and stressed that they have never been introduced to any online program which would help them develop new skills and increase their professional knowledge. Other respondents (n=72) said "yes"

to the prospect of benefiting from online learning programs outside their working hours, during nights or weekends, for instance. Unfortunately, even this option was never planned by the top management, as stated by some of the interviewees (n=16).

Most of the participants (n=53) affirmed that there is no harm in learning via electronic means, only 23 interviewees responded negatively to the same question, as they fear educing new technological devices. One of them stated: "we are more interested in acquiring knowledge no matter how." Twelve interviewees clearly declared that online learning is very adequate and may be useful in critical situations. For them, face to face learning could occur when necessary and possible. Digital learning could be conducted through video conferencing with instructors or through other technological ways to acquire the desired knowledge and implicitly develop computer skills. This opinion was expressed by 32 interviewees.

One of the participants suggested: "since we are an academic and a learning environment, administration could get faculty members as pedagogical agents to participate in the promotion of e-learning for administrative staff, professors or even students." Another interviewee said: "we are a Higher Education Institution; it is easy for the administration to establish conventions and be part of consortiums for staff online learning." The majority of respondents (n=64) insisted on the fact that face to face learning is no longer the only option for learning since the virtual way is a good alternative which can lead to the same learning outcomes. They expressed their desire to learn, no matter what the teaching way was, physical or remote. Some interviewees (n=25) assured that the employees were able to manage their time between work and learning and adapt the scheduled online programs to their professional interests and needs.

All the interviewees (100%) expressed keen interest in online programs within their institutions to align with the global world of technology. One of them declared "yes, we would like to have such initiatives, we all need professional advancement, since caring about the staff is a sign of development." The employees (50%) promised, as recognition to the institution, that their high productivity and performance will be maintained or even increased for more institutional progress and success.

An interviewee specified: "each one of us is eager to develop professionally to foster his/her competencies, increase their income and reach self-enrichment, e-learning for us is the best alternative!" Then, the majority agreed (n=59) that if higher education institutions invest in online programs to the benefit of the administrative staff, they would have positive work results and would cope with the dynamic technological environment effectively and be able to align with the present generation of connectivity.

Theme2: Adopting e-learning in HE environment for the administrative staff needs a proactive vision.

Most of the participants (n=62) believed that opting for e-learning could bring a positive results in terms of acquiring new and advanced knowledge, and change attitudes as well. All interviewees found interesting to adopt online learning programs that would elevate their professional level and enhance their performance. One of them stated: "this is definitely right for us!" and explained that future development in higher education depends on the degree of its alignment with the world technological challenges. 71 participants affirmed that it was high time to implement effective e-learning projects for the sake of the institutional success at all levels.

One participant expressed his view by saying: "there are so many positive sides of e-learning: despite our busy schedule we would satisfy our curiosity and stay in touch with the global world." Another employee insisted on the fact that developed countries encourage their employees towards continuous professional development which would prioritize e-learning. He added: "it's a pity, in our case the hindrance comes from individuals with opposed mindset!"

Almost all the interviewees (n=68) confirmed that the will should come from their institution, to allow their employees in a way or another, to develop professionally. One of the participants added: "in addition to e-learning, our institutions might invite professionals to give lectures, workshops and training to keep sustainable development in administration, the aim is that the top management should develop a visionary strategic plan to promote an internet-based learning approach." Three interviewees insisted that their institutions should manage to build up collaborations with international universities. They explained that these collaborations will provide mutual benefits, as they will help employees learn how others think, operate, manage and negotiate. For them, collaborations also facilitate sharing expertise and rendering the implementation process possible and rapid.

There was also a stress on the efficiency of web-based learning that depends on the openness to international standards and best practices. A participant added: "What we are doing right now is getting knowledge from each other, sometimes it works, but most of the time we are not open to the best global practices; we just do it our way!" In the same context, nine interviewees reported that e-learning would build a community of knowledge and make them aware of the international standards that they may look forward to adopting in their institutions.

The majority of the interviewees (n=54) insisted on the urgent need for professional development, and considered e-learning as a futuristic way to advance professional abilities in the higher education administrations and to make these

institutions stay alert for any unpredictable or alarming situations in which technology would serve as the best refuge. One of them said: "Yes, as an employee, I'd like to benefit from online learning programs, but the administration should have the will to support and prepare the infrastructure for that." She added that the mindset of HEIs leaders should change from "we'll deal with it when it happens," a last-minute plan, to "let's anticipate and be innovative!" For her, it is mandatory that the Moroccan HE should adapt its educational system to the requirements of the era.

Discussion

This study is an attempt to investigate the presence of online learning in Higher Education Institutions. It also seeks to identify the perception of administrative employees vis-à-vis this way of learning, so as to improve the higher education system and build their career at different levels. This exploratory study uses a qualitative method to examine this issue in depth and presents its reality for more related improvement. The research results revealed that online learning is not used for staff development in Moroccan universities. However, according to the responses, a visionary approach in adopting online programs was expressed for both administrative professional advancement and for the institutional global alignment with the digital age. This shows awareness of the dynamic market and the key requirement of the new era (Schaefer et al., 2019). The education sector should be in the front line of staying up-dated and alerted to the new world challenges, being open to collaboration and exchange (Smyrnova-Trybulska et al., 2018) and also providing a good example to other sectors with regard to employees' professional development.

The interviewees believe that online learning is beneficial to the individual and to the institution in terms of knowledge and savings of time and cost. Online learning is not limited, as it is open and could take place at any time and from anywhere with a larger audience and less effort. This agrees with what the participants (n=9) voiced as open to the external world to benefit and learn from the best practices and international standards. What matters most for the employees is to build new kind of relations and communities worldwide, based on knowledge exchange, be it paid or free. In all cases, participants (n=59) confirmed that investing in the implementation of online programs for staff needs a follow-up, well planned structure, promotion and any needed financial support. Unfortunately, it is difficult to assume that such a project in higher administration will succeed easily, sometimes administrations have poor internet connection, do not have IT

competencies to train and assist staff. Furthermore, some institutions may not be able to pay the cost of e-learning.

According to the interviews and the participants' feedback on the issue of interacting with virtual instructors, some interviewees (n=64) believe that online learning is a good alternative which has the same influence and benefit as face-to-face interaction, and would make a positive change in their lives. Others urged the administration to communicate and promote free and accessible online programs to adapt to their professional and personal needs. Moreover, employees (n=62) expressed their willingness to develop professionally and gain personal satisfaction as well, which would change attitudes and bring a positive atmosphere to the workplace and wellness in the higher education environment as a whole. Hence, distance learning would help to meet the uncertainties of the global world which favors the use of technology in all sectors.

The research findings show that, in Moroccan HEAs, online approach is still a novelty or unknown at all. Adopting online learning as a technology for employees' professional development is almost absent in HEAs in Morocco. However, this approach is one of the best ways used around the world. This study is also "an acknowledgement that the biggest hindrance to the uptake of e-learning is people" (Stein et al., 2011, p. 146). In this regard, one of the interviewees explained that the blockage comes from individuals with personal convictions against change, or others with uncertain feelings for trying new things, which was also implicitly expressed by other participants. Two participants claimed that it is the duty and responsibility of the top management to make online programs available and adaptable for their employees by providing the necessary support and infrastructure. That is why it was recommended by the participants that the Moroccan HEAs should reconsider their staff professional development needs.

This study has shown a strong determination of the employees in acquiring knowledge, with a focus on online learning since it brings pedagogical and conversational agents which enhance learning, and "fills gaps in knowledge and skills" (Feldacker et al., 2017, p. 1). In other words, the administrative staff find it easier to study in an online environment just to seize the opportunity to develop their competencies since "e-learning opportunities can bring expert knowledge and provide a flexible learning option adaptable to local setting" (Feldacker et al., 2017, p. 1). This staff training, in mastering their field of expertise via e-learning, would open new horizons for sharing knowledge, exchanging experience, and building collaborations which should be adaptable to each institution's context.

Nowadays, e-learning makes a huge change in people's lives and administration staff are also concerned; however, there is a lack of initiatives from the decision makers, they are disregarding e-learning as a way which could guarantee

professional advancement for all (Le, Duong, Tran & Do, 2018). The employees do not oppose the framework (Scott et al., 2016) that the learning process might take, they only look for building their career to serve their institutions efficiently for better productivity. Thus, to cope with the dynamic higher education sector, Moroccan universities should manage their resources effectively and wisely invest in its key asset, which is the human capital based on international standards. The HEIs' leaders may also involve the academic staff in enhancing e-learning for the administrative employees, since the professors are more familiar with computer-based learning, as solicited by the interviewees. Today, the digital community is taking the lead in transforming the world (Simonenko et al., 2019). In this regard, it was proclaimed that the Moroccan universities were still behind in implementing distance learning and also manifested the resistance of some parties, individuals, with different views concerning digitalizing the sector.

This analysis leads to the rejection of H_0 and the acceptance of H_1 that online learning for administrative staff within the Higher Education Institutions is not promoted. The limitations of this study may be due to the restricted literature in this field of research, as less importance has been given to online learning related to professional development. This work is intended to make higher education administrative leaders conscious of the urgent need to build a long term strategic vision which would prioritize the adoption of this innovative online learning as an academic educational weapon to overcome future critical, sudden and circumstantial situations. Distance learning is no longer an option; instead, it is mandatory for staff professional development in HEIs in Morocco and the world as well.

Conclusions

The development of a nation relies on the development of its education, thus investing in education is the main concern of all countries worldwide. The current study presents a growing approach towards adopting e-learning programs for administrative professional development in Moroccan Higher Education Institutions. The study also shows the common thoughts and a proactive vision of higher education employees regarding e-learning, and the importance of utilizing this advanced and emerging way of learning in HEIs, specifically in the administrations. The university units and departments are connected thanks to the administrative staff, the core body which facilitates the institutional internal and external collaboration. That is why the professional advancement of university administrative employees is mandatory.

This exploratory study uses a qualitative research methodology with a semi-structured interview instrument to collect the employees' views on the research subject. The participants reported the absence and the urgent need for online learning programs within university administrations. This revolutionary way of learning would help the administrative staff balance their performance at work and their professional advancement. According to the interviewees' responses, e-learning is still not perceived as a futuristic strategy for their institutions. Decision makers do not follow up and effectively assess the implementation process of this digital learning project within administrations. It is crystal clear that there is a lack of knowledge and awareness of the necessity of adopting online learning and the benefits it can bring for both the staff and the institution to face the uncertain world.

Recommendations

This study suggests an urgent assessment and new directions to be implemented concerning staff professional development in Moroccan university administrations. The open spirit and the global vision of the leaders are necessary to facilitate the adoption of online learning for staff's continuous development in Higher Education administration.

To cope with the dynamic HE environment, Moroccan universities should use its resources effectively and invest more in its human capital. Evaluating the existing professional development processes and assessing the employees' needs in terms of online training is mandatory to align with the institutional strategic plan. It is recommended that the administrations set smart goals to develop the online approach by choosing credible and appropriate programs, developing formal processes, working within distance learning-based consortiums and collaborating with other universities inside and outside of Morocco. To illustrate, collaboration is crucial in such cases for cost saving because the same programs may be offered for different groups in different places.

It is advisable that the decision makers set the necessary infrastructure for the organization readiness, and the necessary training for staff, prior to the implementation for better learning outcomes. It is also important to identify, understand and work out any barriers, be it technical, financial, or human, which could block the achievement of the e-learning project. Larger research with larger sample in terms of population and institutions is also recommended for more in-depth exploration and more consistent results.

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Layla Ajrouh, Karima Slamti

Integracja e-learningu dla rozwoju zawodowego personelu administracyjnego: spojrzenie od wewnątrz z marokańskich instytucji szkolnictwa wyższego

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

Na całym świecie nauka online rozwija się w różnych sektorach i obszarach. Szkolnictwo wyższe (HE) jest również zaniepokojone, ponieważ działa w niepewnym globalnym środowisku, w którym komunikacja i technologie informacyjne są podstawowymi kategoriami. Niniejsze badanie ma na celu analizę postrzegania innowacji uczenia się online przez marokańskich pracowników i jego wpływu na rozwój zawodowy. Ma również na celu zbadanie obecności nauczania na odległość jako rosnącego trendu w administracji marokańskich uniwersytetów. W tym badaniu jakościowym zastosowano częściowo ustrukturyzowany wywiad z 76 pracownikami siedmiu marokańskich instytucji szkolnictwa wyższego (HEI). Wyniki pokazują, że większość uczestników rzadko korzysta z uczenia się online, pomimo przekonania o jego pozytywnym wpływie na postęp zawodowy. Respondenci przedstawili swoje proaktywne poglądy na przyspieszenie wdrażania cyfrowego uczenia się w celu spełnienia światowych standardów międzynarodowych, ponieważ przyczyniłoby się to do ich ciągłego rozwoju zawodowego i umiejętności radzenia sobie w sytuacjach krytycznych. Niniejsze badanie wskazuje na konieczność integracji nowych sposobów uczenia się w administracji szkolnictwa wyższego (HEA), a także prowadzi do przyjęcia hipotezy badawczej H1, zgodnie z którą e-learning nie jest promowany w celu awansu zawodowego pracowników w marokańskich HEA. Sformułowane wnioski przedstawiają wizję potrzeby zmian, ponieważ uczenie się online zwiastuje zwiększoną produktywność i skuteczniejsze działanie administracji i samych pracowników, a także instytucjonalną adaptację do zrewolucjonizowanego świata cyfrowego.

S ł o w a k l u c z o w e: kształcenie online, rozwój zawodowy, awans zawodowy, administracja uniwersytecka, niepewne środowisko, świat cyfrowy

Layla Ajrouh, Karima Slamti

Integración del aprendizaje electrónico para el desarrollo profesional del personal administrativo: una visión interna de las instituciones marroquíes de educación superior

R e s u m e n

El aprendizaje en línea se está incrementando en todo el mundo en varios sectores. La Educación Superior (HE) también está preocupada, ya que opera en un entorno global incierto, donde la comunicación y la tecnología de la información son las claves fundamentales. Este estudio busca examinar las percepciones de los empleados marroquíes hacia esta forma innovadora de aprendizaje y su impacto en su desarrollo profesional. También tiene como objetivo investigar la presencia de la educación a distancia como un enfoque creciente dentro de la administración de las universidades

marroquíes. Este estudio cualitativo utiliza una entrevista semiestructurada con 76 empleados en 7 instituciones marroquíes de educación superior (IES). Los resultados revelan que la mayoría de los participantes rara vez ha utilizado el aprendizaje en línea, a pesar de su voluntad e insistencia en su impacto positivo en su progreso profesional. Los entrevistados informaron su visión proactiva para acelerar la implementación del aprendizaje digital para cumplir con los estándares internacionales mundiales, ya que también serviría como una forma adecuada para su desarrollo profesional continuo y su capacidad para enfrentar situaciones críticas. La presente investigación muestra la gran necesidad de integrar nuevas formas de aprendizaje en las Administraciones de Educación Superior (HEA). Este estudio lleva a la aceptación de la hipótesis de investigación H1 de que el e-learning no se promueve para el avance profesional de los empleados en los HEA marroquíes. Este estudio recomienda una visión anticipada para ir más allá de cualquier reticencia al cambio, ya que el enfoque de aprendizaje en línea traería más productividad y éxito para las administraciones y los propios empleados, además de una mayor alineación institucional con el revolucionario mundo digital.

P a l a b r a s c l a v e: aprendizaje en línea, desarrollo profesional, avance profesional, administraciones universitarias, entorno incierto, mundo digital

Лейла Аджрух, Карима Сламти

Интеграция электронного обучения для профессионального развития административного персонала: взгляд изнутри марокканских высших учебных заведений

А н н о т а ц и я

Онлайн обучение развивается во всем мире в различных секторах. В высшем образовании проявляется обеспокоенность тем, что оно работает в глобальной неопределенной среде, где коммуникация и информационные технологии являются фундаментальными. Это исследование направлено на изучение восприятия марокканскими сотрудниками инновационного способа обучения и его влияния на их профессиональное развитие. Оно также направлен на изучение дистанционного обучения с точки зрения администрации марокканских университетов. В качественном исследовании используется полу структурированное интервью с 76 сотрудниками 7 марокканских высших учебных заведений. Результаты показывают, что большинство участников редко используют онлайн-обучение, несмотря на их готовность и положительное влияние онлайн-обучения на профессиональное развитие. Респонденты сообщили о своей активной позиции по ускорению внедрения цифрового обучения в соответствии с мировыми международными стандартами, поскольку это также послужило бы подходящим способом для их непрерывного профессионального развития и их способности противостоять критическим ситуациям. Настоящее исследование показывает большую необходимость интеграции новых способов обучения в администрации высшего образования. Это исследование позволяет принять гипотезу H1 о том, что электронное обучение не способствует карьерному росту сотрудников в марокканских вузах. В этом исследовании рекомендуется упреждающее видение, выходящее за рамки любого сдерживания изменений,

поскольку переход к онлайн-обучению принесет большую продуктивность и успех для администраций и самих сотрудников, а также большую институциональную согласованность с революционным цифровым миром.

К л ю ч е в ы е с л о в а: онлайн-обучение, профессиональное развитие, продвижение по службе, администрация университета, неопределенная среда, цифровой мир

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Elementary Music Education in the Era of Remote Teaching – Constraints and Prospects for Development

Abstract

In the discourse undertaken, an attempt was made to indicate the limits and perspectives for the development of music education of distance teaching. The specificity of music education based on experience, emotions in action, a creative approach to an artistic creation and expressive action requires special attention in this regard. The teacher is expected to develop a new strategy for action, which in the existing educational situation will result in an increase in students' interest in music. Obtaining satisfactory results should be seen in the use of teaching methods and forms appropriate for the given situation and means of communication.

K e y w o r d s: childhood education, teacher, music, distance learning.

At present, as technology evolves, the education in Poland is changing. The slow but systematic presence of e-learning as a new teaching method in our country has become popular and necessary (Hyla, 2012, p. 20). This method has proven to be the only possible effective way for teachers to work during the world pandemic of COVID-19 and the nationwide lockdown. From day to day, schools had to shift to a new teaching and learning technique and use the available electronic media and communication platforms. Music education, which deals with fleeting and

abstract values based on impressions, creations, experience and skills training, has also been included in the subjects which underwent such a change (Ruokonen & Ruismäki, 2016, p. 109). The child who needs support, motivation, peer-to-peer contact, role model as well as reinforcement of positive reactions and behaviour styles is crucial throughout the entire music teaching process. Likewise, the teacher and the parent play significant roles, as they are not only guardians but also educational partners in the early school education stage.

Children as Recipients of Music in Elementary Education

Children observe the world through a direct perception of the reality which surrounds them, whereas media provide an indirect way to know various phenomena, processes and facts perceived and communicated by other people (Juszczyk, 2002, p. 16). Children commune with virtual "reality" every day, devoting more and more time to it. Young people increase their media experience by spending lots of time with their computer, tablet or mobile phone. In many cases, these devices influence the creation of behavioural patterns in children, form their tastes and opinions and become not only a learning environment, but also an upbringing environment, affecting the recipients' activities (Jorgensen, 2003, p. 63).

Music in early school education is an important part of the educational and didactic process. Its place at the level of early childhood education is different; it is dictated by the needs and capabilities of the individual, and to some extent by the expectations of teachers, schools and parents (Kisiel, 2012, p. 20). Music, singing and dancing in elementary education stimulate the overall development of the student, while at the same time support young people in preparation for participation in a broadly understood culture. The tasks of the music class described in the related literature are aimed at arousing long-lasting artistic interest among the young generation in the future. The overall developmental value of music is also significant; it stimulates activity, improves memory and concentration, trains persistence engagement and observation. Music also helps people to express their feelings, practise motion coordination and good body posture. By stimulating creativity and imagination, it develops communication skills. The role of the school and the properly qualified teacher is extremely important in this area (Green, 2006, p. 101). In many cases, teachers act as the only music educators to bring a child into the world of artistic values. It is also important for the teacher to be the organiser of the didactic and educational process, the music animator and the trainer for acquiring skills in basic forms of musical activity (Weiner, 2010,

p. 33). Professional teacher-oriented performance will only produce the expected results, if the teachers carry out their tasks as a specific musical dialogue in a multi-dimensional communication channel.

The core curriculum is the basic educational document that sets out the procedures in the area of music education in elementary classes (Journal of Laws, 2017, pp. 44–46). The content of the curriculum in this area comprises five sections. The first section "Listening to Music" is about receiving and identifying sounds, responding to music signals, distinguishing sounds and voices, listening to and analysing simple songs. The second section "Musical Expression" contains guidelines for: humming and singing children's songs, creating children's own melodies, attaching importance to voice emission and performing some of the recommended songs, including the Polish national anthem. The third section "Motion Improvisation" proposes the presentation of musical and non-musical content with moves, the creation of musical and motion choreographies as well as learning the steps of a chosen dance. Music education is also practising music understood as: the ability to use school percussion instruments, creating the children's own sound toys, experimenting and creating musical accompaniment to songs, motion, games and learning to play melody instruments: the chime, Western concert flute and flageolet. The last section refers to the skill to "record sounds." It includes learning different ways of recording sound and music, saving simple rhythmic and melody diagrams while playing through the use of pictograms, colours, numbers and simple notations.

Musical education, which improves the recipients' listening perception, emotional sphere, aesthetic sensitivity and creative expression, is recommended for use in integrated education in the daily curriculum. The core resources in a teaching and educational institution, in particular classrooms equipped with modern media and teaching materials, play an important role in the organisation of the educational and upbringing process. They make it possible for teachers and students to carry out more effectively the process of acquiring music skills in terms of reception, recording sound and music, seeking valuable artistic presentations and information to enhance their knowledge of music. Multimedia can be an excellent teaching aid, if used reasonably. Using them should follow from the theory of learning music based on experiencing, acting and learning (Kisiel, 2016, p. 109). The use of multimedia in elementary education can make a significant contribution to: facilitating the combination of learning with playing, increasing motivation for learning and allowing individual learning. Key multimedia features are as follows: activating/motivating, cognitive/creative, practising, control, upbringing and therapeutic (Juszczyk-Rygałło, 2013, p. 80). In pedagogical practice, the teacher generally uses methods that make children actively participate in the teaching and learning process. The combination of interdisciplinary, pedagogical, psychologi-

cal and neurodidactic approaches shows that the basis for obtaining information is an active exploration, where the senses working together in registration of the sensations play a crucial role (Gołaszewska, 1999, p. 29). This also applies to those areas which we know through the media. In such a recognised perception, there are intertwined periods of activity, reception, observation and experience.

Methodology of Research

The conducted research was of a qualitative nature, the text includes the quoted statements of selected respondents and the results of the Internet query (Flick, 2008, p. 36).

The aim of the study was to show: the state of music education in grades 1–3 following the introduction of the lockdown, constraints and prospects for developing methods and forms of work carried out in remote teaching of music and the results of education and professional satisfaction with the performance of such work. The purpose of the query was to present information on the music education during distance learning.

The test sample was selected in a targeted manner as a non-random selection of respondents. The survey was completed by teachers with different musical training background, various experience in working with media and multimedia instant messaging clients as well as different professional seniority.[1] The data presented in this chapter were obtained by a partially categorised interview (Babbie, 1992, p. 327). The analysis of the collected data is presented in the following parts of the work.

Teachers and Students in the Face of Remote Teaching – Search for Data

Rapid social changes, mainly caused by the World Health Organisation's declaration of the COVID-19 pandemic resulted in perturbation in Polish education. It was due to the regulations by the Minister of National Education published in the

[1] The survey was conducted in July and August 2020 among early school education teachers in selected towns in the Agglomeration of Upper Silesia and Zagłębie.

second quarter of 2020, which announced the introduction of the remote teaching policy (Journal of Laws, 2020). According to these documents, the e-textbooks platform and programmes broadcast by the Polish Television (TVP) and the Polish Radio supported this type of teaching. The use of resources designated and prepared by teachers was also permitted. The class could be delivered in such a way that students undertook certain activities as assigned by the teacher to confirm that they were familiar with the material and this provided the basis for grading. Online lessons did not necessarily mean real-time classes via a selected instant messaging client. The students were able to complete certain assignments at home, such as filling in their workbooks, making notes and preparing a project. In the case of children of early school age, these classes could be carried out by informing their parents of the available resources and possible forms that could be adopted to perform the tasks at home. A new "children teach parents" movement has emerged to encourage the youngest ones to stay at home and study together with adults.[2]

In the opinion of practitioners and some teachers-researchers, remote training managed to achieve, more or less, the learning objectives of the existing core curriculum. It was much more difficult with the educational function of school, and the worst one was with the caring function, as was pointed out in the public debate by Sylwia Jaskulska.[3] Following many discussions, the educational authorities decided that, despite these shortcomings, distance learning would be carried out until the end of the school year. Primary schools also introduced caring and educational activities for pupils whose parents continued to work despite the ongoing pandemic.

During the pandemic crisis, educational television programmes, radio programmes and webinars were introduced in the public media addressed to students of different educational levels. What should be emphasised is that music education applications such as Music Education for Children, GoNoodle, Kids and Motion, Virtual Instruments, Music Games, Colourful Virtual Piano, etc. were made available on websites.[4] Teachers carrying out music education for grades 1–3 could use the Music Inspiration for the Textbook package available on the Internet (Hamerski et al., 2014, pp. 6–11), which aimed to stimulate educators to undertake various musical activities. Another aid for published assignments included music notes and lyrics for the month-to-month learning and the related games, practical advice and tips on how to learn and use songs, games to be played throughout the school year and ideas to help introducing the children into the world of music (Jóźwiak

[2] https://crl.org.pl/2020/03/12/dzieci-ucza-rodzicow-w-domu [accessed 26.08.2020].

[3] https://www.wirtualnemedia.pl/artykul/na-zdalnej-edukacji-najbardziej-ucierpiala-funkcja-opiekuncza-szkoly-dlaczego-koronawirus [accessed 22.08.2020].

[4] Internet inquiry: https://www.edumuz.pl; https://www.gonoodle.com; http://interactivesites.weebly.com; http://www.colorpiano.info [accessed 23.08.2020].

et al., 2015, pp. 7–13). The additional content also contained suggestions for songs to be listened to and interesting forms of visualisation. The authors also inserted references to associated audio tracks, such as a sample for vocal practice, audio material of various sounds and beats, links to audio and video tracks which illustrate playing the chromatic chime or teaching steps of a selected dance, as well as links to websites of institutions which promote music culture (Muzeum Dźwięku, Muzykoteka Szkolna, Narodowy Instytut Fryderyka Chopina, Scholaris – a portal addressed to teachers, and others).[5] A collection of vocal songs prepared by methodical consultants was published as visual resources (musical notes and song lyrics) as well as soundtracks written in vocal-instrumental and instrumental versions. The resources were available for teachers to download as separate files, print or present in PowerPoint. With a multimedia table (by directly connecting to the indicated website), the teacher received access to all the resources posted (Kisiel, 2018, p. 60). The teacher's broadcasting to the student's home could be done by software or video transmission from an external video camera. During this period, some publishers started to work on preparing their own multimedia proposals for the programmes and textbooks that were developed. They were designed to help the teachers organise varied and effective activities so that each lesson would be an extraordinary adventure.[6]

An objective view of the available analysed educational content leads to a moderate, albeit critical reflection. The content of the selected web pages shows that the creators of the virtual space resources were those of the "digital immigrants" generation. Despite having excellent technology and resources to fully exploit the potential of multimedia, publishing institutions offered young recipients a text-based message, with minimal reference to the combination and smooth transition from broadcasting to interactive resources. In some cases, a video camera-shot talk was referred to as a "multimedia lecture," intended for listeners attending a meeting with a teacher. Also, the resources that were supposed to be interactive, referred to as "games" or multimedia instructions often proved to be a text-based summary of information or a collection of illustrations. The virtual space also offered programmes where a young person could graphically present the melody using the basic music symbols, build the students' own rhythm diagrams and create the students' own composition with the option to listen to it. An interesting application seems to be a musical class, where teachers and students can play an improvised melody after adding an additional keyboard, changing and correcting it several times. Later, it could be saved in a musical form and redirected to the computer to play it as a readable melody on the selected instrument. This phenom-

[5] Educational resources, http://www.ore.edu.pl [accessed 12.12.2017].

[6] Multimedia for a new primary school, http://www.nowaera.pl [accessed 7.01.2018].

enon should be interpreted as a valuable change in the presentation of the music teaching material.

Music in Remote Elementary Education – Intentional Study

The analysis in this part of the report includes reflections by elementary education teachers on music education in remote teaching.

As a general rule, elementary education classes should be conducted under an integrated education strategy. Hence, the teachers' opinions refer to the included general views regarding remote teaching that are the same for the entire educational and upbringing process. For the surveyed teachers, the period of the lockdown and remote teaching was associated above all with uncertainty, chaos and attempts to find themselves in a new situation, so that they could do their best in performing their work. The search for effective forms of work resulted in a choice of communication methods, such as sending short text messages, e-mailing, using e-logs, as well as experimenting with a variety of applications and platforms designed for remote communication. The surveyed teachers admit that they were initially afraid to conduct remote classes because they had no competence in this area and that such activities were omitted in schools they work for. Only people who had private experience with communicating with Messenger, Skype or Facebook had a seemingly easy task. As they themselves admit, for each of them the time taken to carry out remote teaching became the time of searching, testing and struggling with IT issues. The teachers quickly understood their limitations and felt the need to improve their digital communication skills. They received help from their colleagues, their life partners, or their family, including their children. Unfortunately, the period of seeking effective tools to implement the forms of work that are affordable for students was not coordinated by educational institutions.

The respondents point out the technical limitations reported by parents of the youngest students, one computer station for all the family members, limited access to a fixed Internet connection, no camera or printer. There are also opinions stating that the remote education for young pupils forced parents to be more involved in the preparation of their child's home work station, ensuring that their child's time is efficiently managed in front of the computer, preparing materials, explaining difficulties, monitoring work and maintaining constant contact with the teacher in order to send the work and assignments completed by the children. The surveyed teachers observed low motivation among their students over time, which resulted from missing contact with their peer group. Another reason was, as one of the re-

spondents explained, the congestion of the information provided, the instructions without the possibility of consultation or exchanging views. In the early education period, the process of acquiring knowledge by a young person usually takes place through games, discovery, experience and mutual observation. The relationships created in this type of activities become the core of shaping behaviour for students, add faith in overcoming difficulties and make them mentally stronger. No one, even the highly engaged parents, can replace the peer group, which is a source of positive energy for children.

Throughout the entire period of the lockdown, a shift in the form of remote teaching could be observed. The teachers' initial reference to the textbooks, workbooks and scanned resources sent by email was enhanced by providing educational videos and e-textbooks to students or initiating remote contact lessons. The surveyed teachers indicate that the online activities did not solve all the problems and did not effectively replace traditional teaching. In the interview, the respondents highlighted interferences preventing smooth lessons both on the part of the teachers and the learners, including different quality and technical fitness equipment, a lean time frame as well as limited capacity of internet connection. The situation made teachers uncomfortable and frustrated, while parents were upset and dissatisfied, which sometimes resulted in difficult situations and symptoms of a feeling of exclusion. Several respondents admit that they tried to develop their own lessons, encouraging students to participate in project activities, leaving room for expression of their emotions, creating an area of autonomy and self-assessment and fitness. Such events did not fully deliver the expected results. Technical, premises-related and teaching aid constraints on both the teacher and student working at home, as well as the small number of online recipients did not encourage them to be the only contact form. It can be assumed that the majority of the activities were mixed, where the teacher on the one hand contacted the students via a selected platform such as ZOOM or Clickmeeting, and on the other hand used an e-log and email, sending the relevant resources to his or her students. Despite these drawbacks, the respondents claimed that if necessary again in the future, remote teaching would now be easier for them. At present, the surveyed teachers declare to have a better knowledge of digital tools and a greater understanding of access to communication platforms and online resources. They also appreciate the value of the innovations undertaken and made available to allow them for the freedom to experiment in pedagogical practice. Some of them have also developed effective ways of assessing student's activities and the art of transforming exercises and content in such a way that it could be used for remote learning. Not without significance is the value of the collection of teaching resources in electronic recording: pictures, boards, videos, programmes and broadcasting. Remote courses on online learning provided to the surveyed teachers were also very helpful. Webinars

and Teach Meets with teachers were appreciated by those who wanted to share their ideas on solving difficulties and sharing the results of good practice. There is no doubt that the motivation of students to learn, increasing their involvement and strengthening their independence, while paying attention to computer hygiene, remains to be considered and improved. In the statements, the essence of building and maintaining peer relationships for full educational processes was emphasised.

Discussion

Music education was in the background of the combination of events. It is particularly difficult in the remote teaching system, as even the best-ever instant messaging client will not replace the natural contact with the teacher. The practice of making music together and learning through imitating the appropriate performance model becomes hardly possible. Transferring too much theoretical content does not support the basic idea of developing musical sensitivity, building students' music skills and increasing curiosity and interest in music. The surveyed teachers indicate first of all that there was no professional equipment for recording music and playing it back that would allow the curriculum to be properly implemented. A lot of concern was placed on several instruments at the disposal of the student at home. Therefore, most of the information on music classes was limited to citing the content and instructions from the textbooks, workbooks, or websites and YouTube videos with music, or children's songs. As the respondents pointed out, in a traditional class, students typically listen to pieces of work that they later comment on and learn to express their opinions. However, earlier, the teacher points to what the students should be aware of during the listening process and assigns the tasks to be done, which usually facilitates the perception. The creativity of the surveyed teachers suggests that their students could also be encouraged to play music remotely using various attributes, such as a scarf or a coloured band of tissue paper. As they themselves admitted, this required educators to prepare an appropriate comment that would be understood not only by the students but also by their guardians. Some of the respondents recommend that their students make a visual illustration of the work being listened to or reflect the mood of the music with a colour. Others focus on the possibility of making a rattle from groats and, for example, a yogurt box. Plastic rice bottles were a great substitute for maracas, which children could use in playing a song. In the opinion of the respondents, it was the perfect time to play home music on anything, invite siblings and parents, or even go for a recording of their own percussion song. This task was carried out

with a greater interest by boys. In their feedback to the teachers, some parents were not happy with the proposals the teachers made, others on the contrary, admitted that these musical activities brought the family members closer together. Not all the students submitted their own music productions for assessment. Following the interview of the respondents and its analysis, we jointly conclude that perhaps the guardians missed sufficient determination to go to such lengths or there was a fear of being ridiculed. But there were exceptions. As one of the respondents points out, in her class the girls selected a song by one of their favourite artists and, with the help of the adults, they recorded their own performance and sent a video to the teacher as a result of their collaborative work. The situation with dancing was not so optimistic, but also in this area there appeared some creativity. One of the teachers recorded the "Chocolate" dance and game, performed by herself and her children, and posted it as a video on her Facebook profile, sharing it with her students. It turned out, as she reported later, some children, both girls and boys, accepted the idea with a positive attitude. They encouraged their parents and presented their own performance with an equal volubility. This was not the case with playing a melodic instrument: the chime, flageolet or flute. The teachers claimed this aspect to be a failure. The lack of direct contact with learners and the negligence of parents in this respect are the main reasons for such an omission. In the study group, only one teacher, fascinated with the flageolet playing, boasted that despite the limitations of remote teaching, she was able to maintain her children's musical activity in the third grade. This was possible thanks to the earlier systematic work with the instrument and the availability of the tablature needed to read the melody of the track being learned and the recorded music pattern.

The assessment of the student's work seems obvious when carrying out studies on the implementation of the educational process. When they initiated remote teaching activities, the teachers promoted interesting ideas, motivation and encouragement to playing music, thereby as they claimed, they wanted to encourage students and their parents to act. In the opinion of one respondent, the fun and the music played together, and subsequent attempt to register and edit the video was a good way to manage the time of the family.

As the reports show, the period of remote teaching from a time distance was a stimulus for the teachers in question to develop a creative approach to the implementation of the core curriculum content. It also gave them an opportunity for educational experimentation, acquiring new competences and overcoming their own weaknesses and limitations.

Conclusion

The educational practice presented in the interviews shows that in the age of remote teaching in elementary education classes both positive and negative aspects of implementing the musical education are observed. Progress is identified in the selection of games and exercises as well as the possibility of free avaliability of sound resources. In the case of music skills presentation and actions in the area of diverse forms of musical activity and delivery of performance experience, there is a significant regress. Some teachers appreciate the possibility of flexible working time, but most of them complained about work overload and stress due to the use of new means of communication on such a large scale. The surveyed teachers demonstrate creativity and entrepreneurship in providing themselves with work tools, but they also report numerous limitations in their musical activities. Among the problems mentioned, they point out limited contact with parents and pupils, difficulty in motivating all students to engage in music activity, confusion and helplessness related to the large number of directives, information and recommendations, difficult control of the effectiveness of the actions undertaken and inability to fully implement the recommended music activity areas. The analysis of the available resources made it possible to prepare recommendations. These relate to both the choice of a single communication platform and the setting of harmonised standards for remote teaching, including the assessment of student activity in different spheres.

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Mirosław Kisiel

Podstawowa edukacja muzyczna w erze nauczania na odległość – ograniczenia i perspektywy rozwoju

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

W podjętym dyskursie dokonano próby wskazania granic i perspektyw rozwoju nauczania na odległość edukacji muzycznej. Specyfika edukacji muzycznej opartej na doświadczeniu, emocjach w działaniu, twórczym podejściu do twórczości artystycznej i ekspresyjnym działaniu wymaga w tym zakresie szczególnej uwagi. Od nauczyciela oczekuje się opracowania nowej strategii działania, która w istniejącej sytuacji edukacyjnej spowoduje wzrost zainteresowania uczniów muzyką. Osiągnięcie zadowalających efektów należy upatrywać w stosowaniu odpowiednich do danej sytuacji metod i form nauczania oraz środków komunikacji.

S ł o w a k l u c z o w e: edukacja dziecięca, nauczyciel, muzyka, kształcenie na odległość

Мирослав Кисель

Начальное музыкальное образование в эпоху дистанционного обучения – ограничения и перспективы развития

А н н о т а ц и я

В данном дискурсе была сделана попытка определения пределов и перспектив развития дистанционного обучения в музыкальном образовании. Особого внимания в этой связи требует анализ специфики музыкального образования, основанного на опыте, эмоциях в действии, творческом подходе к художественному творчеству и выразительному действию. От учителя требуется разработка новой стратегии действий, которая в существующей образовательной ситуации приведет к повышению интереса учащихся к музыке. Достижение удовлетворительных результатов следует видеть в использовании методов и форм обучения, соответствующих данной ситуации и средствам общения.

К л ю ч е в ы е с л о в а: начальное образование, педагог, музыка, дистанционное обучение

Mirosław Kisiel

La educación musical elemental en la era de la enseñanza a distancia – limitaciones y perspectivas de desarrollo

R e s u m e n

En el discurso emprendido se intentó señalar los límites y perspectivas para el desarrollo de la educación musical a distancia. La especificidad de la educación musical basada en la experiencia, las emociones en acción, el enfoque creativo de una creación artística y la acción expresiva requiere una atención especial en este sentido. Se espera que el docente desarrolle una nueva estrategia de acción, que en la situación educativa existente resultará en un aumento en el interés de los estudiantes por la música. La obtención de resultados satisfactorios debe verse en el uso de métodos y formas de enseñanza adecuados a la situación y los medios de comunicación dados.

P a l a b r a s c l a v e: educación infantil, docente, música, educación a distancia

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Cloud Computing and Distance Learning in Computer Science

Abstract

This work demonstrates that the use of laboratories for the development of curricular work in the area of information technology exclusively supported by cloud computing technology does not decrease the level of learning and assessment objects on the part of students. This scenario arose from the need to interrupt face-to-face classes in physical laboratories due to the COVID-19 Pandemic.

K e y w o r d s: Cloud Computing, Azure, distance learning, WEB App, Virtual Labs, DevOps.

The Context

In everyday language Cloud Computing (CC) is a set of computational resources made available to a group of users, remotely, taking the form of services. And like any service today, electricity, water, gas, etc., they are always available for both individual and business use. This is possible because throughout the second half of the 20th century, the technical industry adopted a set of standard models from different sources and technological platforms. CN works as a universal, paid service, but is always available to users/customers who need it, in the same way that they

have the electricity service. The main principle that supports this technology and this model is the provision of computing, storage and software as a service. Cloud is a distributed and parallel computing system, consisting of a collection of virtualized and interconnected computers that are presented as a set of dynamic and unified resources, based on Service Level Agreement (SLA) established between the service provider and the end customer. With the crisis caused by the pandemic of COVID-19, almost all universities had to change the model of classroom classes to a model of distance classes. The paradigm is radically different. In certain scientific and technical areas, the transition was more straightforward. However, in the case of laboratory classes the process became more complicated or even impossible. In the specific case of computer network laboratories which were based on computers and servers installed at universities' on-premise infrastructures, the process was almost impossible and these laboratory classes had to be postponed, or complex processes had to be created so that students could go to the labs. This work intends to develop a demonstration of a model that can allow to simulate the teaching of the development and operation of computer networks through a laboratory created by the teacher in a Cloud Computing system – in this case, in Azure.

The main objective of this work is to verify if the use of cloud computing laboratories (in this case in Azure) for curriculum development in substitution of physical laboratories on university campuses, due to the mandatory interruption of classroom classes in the context of COVID-19, had an impact on learning and what is the effect on school success, namely on assessments. The second objective of this work is to compare if the school objectives and the evaluation between two different curricular units obtained the same performance standard or, in case of divergences, this second objective helps to validate whether the method used based on laboratories in cloud computing is successful or not. This study is contextualized in the area of information technology and, specifically, in the area of a master's degree in computer science.

Main objectives may be encapsulated as follows:

- to compare the evaluation made in the pre-Covid-19 period and the evaluation during the first phase of Covid-19;
- to analyze whether the use of online laboratories had a negative impact on the evaluation.

At the beginning and during the first phase of the Covid-19 pandemic, more than 90% of teachers were not familiar with distance learning. In a record period of two months, they had to adapt to a new paradigm. The adaptation was made essentially with self-study by the teachers. In the case of students there was an identical situation, they were also not familiar with distance learning. They had always taken classes exclusively face-to-face.

History of Cloud Computing

The concept of CC arises from another idea that was called time-sharing, and which implied sharing, by several entities at different times, the same computing equipment. However, today, there are substantial differences between the concept of computational time-sharing and CC. At the time of computational time-sharing, the services or machines that held them could only be used by one operator at a time, that is, they were divided according to portions of time and not portions of accommodation space; today the question of time-sharing does not exist, it pays according to the service that is obtained or the space that the information occupies, but not according to the time that this resource is being used. But the basic idea is very similar – it is to provide a computing service remotely and not locally. Using daily and straightforward concepts by analogy, we can say that both the computational time-sharing system and the DC system can be seen as a service that is made available in the same way as electricity or water, that is, they are available when we need them, we pay for that availability and its use. For example, if we use Office 365 we pay for its use as when we consume electricity, but we can also pay for the accommodation of the documents produced by it, as we pay if we want to have a storage system for reserve energy. Initially, in the sixties of the 20th century, computer systems were in large rooms with powerful and expensive cooling systems and a high consumption of electricity. Besides, they could only be used locally. The next step was to change this situation through a system that would allow remote access to a central computer; it is from here that we can talk about time-sharing.

Organizations could buy time to use a computer system, without having to have it in their facilities, and without having to worry about its maintenance and administration. Microcomputers started to appear when the concept of time-sharing was already popular. Microcomputers were smaller than mainframes and were significantly cheaper. Microcomputers quickly became more sophisticated than the old mainframes, but more importantly, microcomputers had multitasking capabilities, allowing for time-sharing. The concept of time-sharing and microcomputers quickly led to the creation of a new idea, that of distributed systems.

Fundamentals of Cloud Computing

Definitions

The term cloud computing (CC) has become somewhat of a sensational term, almost everyone in the industry has its definition of CN, in this paper we adopted the definition of CC assumed by the National Institute of Technology and Standards (NIST, 2020):

> Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics (On-demand self-service, Broad network access, Resource pooling, Rapid elasticity, Measured Service); three service models (Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS)); and, four deployment models (Private cloud, Community cloud, Public cloud, Hybrid cloud). Key enabling technologies include fast wide-area networks, powerful, inexpensive server computers, and high-performance virtualization for commodity hardware. The Cloud Computing model offers the promise of massive cost savings combined with increased IT agility. It is considered critical that government and industry begin adoption of this technology in response to difficult economic constraints. However, cloud computing technology challenges many traditional approaches to datacenter and enterprise application design and management. Cloud computing is currently being used; however, security, interoperability, and portability are cited as major barriers to broader adoption. The long-term goal is to provide thought leadership and guidance around the cloud computing paradigm to catalyze its use within industry and government. NIST aims to shorten the adoption cycle, which will enable near-term cost savings and increased ability to quickly create and deploy enterprise applications. NIST aims to foster cloud computing systems and practices that support interoperability, portability, and security requirements that are appropriate and achievable for important usage scenarios. (Mell, 2011)

In everyday language, Cloud Computing (CC) is a set of computational resources made remotely available to a group of users, taking the form of services. And like any service today, electricity, water, gas, etc., are always available for both individual and business use. This is possible since throughout the second half of the 20th century, the technological industry adopted a set of standard models from different sources and technical platforms. CC works as a universal, paid service,

but always available to users/customers who need it, in the same way that they have the electricity service. However, CC is a term that has many meanings, but an effort has been made in the last ten years to establish common denominators in these meanings, to create a more objective definition. This effort has mainly been made through the publications of the Information Technology Infrastructure Library (ITIL), which is a library of good practices to be applied in infrastructures, operations and maintenance of information technology services, having been developed by the Central Computer and Telecommunications Agency (CCTA), today under the Office for Government Commerce (OGC) in England. In the most generic form, and following the ITIL concept, a service is a relationship between a consumer and a provider, in which the provider makes available and delivers to the consumer a value (service) and the consumer avoids the risks and investments in providing it with this value (service) itself, currently the CC is also inserted in this context. For example, the simple storage and database management services of a retail store on the Web, if they are using the CC, are always available to the store owner, as well as to his customers, without the said owner having to worry about maintaining those services, and don't have to bear the investment risks of purchasing a complex platform. If the business does not go well, it merely cancels the services, having had no losses associated with the investment of fixed technological assets (CSIAC, 2020).

Main characteristics of cloud computing technology

- On-demand self-service services: a consumer can unilaterally provision computing resources, such as server time and storage network, as needed automatically, without requiring human interaction with each service provider.
- Broad network access: resources are available on the network and accessed through standard mechanisms that promote use by thin or thick heterogeneous client platforms (e.g. cell phones, tablets, laptops, and workstations).
- Pooled resources: the provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to the consumer's requirements. There is a sense of location independence, as the customer generally has no control or knowledge about the exact location of the resources provided, but may be able to specify the location at a higher level of abstraction (for example, country, state or data-center). Examples of resources include storage, processing, memory and network bandwidth (Soundarjan, 2015).
- Rapid elasticity: resources can be provisioned elastically and made available, in some cases automatically, to scale out and in quickly, according to the needs. To the consumer, the resources available for provisioning generally appear to be unlimited and can be appropriated in any quantity and at any time.

- Services with metrics, cloud systems automatically control and optimize the use of resources, leveraging a metering resource at levels of abstraction appropriate to the types of services (for example, storage, processing, bandwidth and active user accounts). The use of resources can be monitored, controlled and reported, providing transparency to the provider and the consumer of the services used (Brandao, 2019).

Service Model

Currently, cloud computing technology has three service models (Figure 1):

- Infrastructure as a Service (IaaS): the user can implement and execute software arbitrarily, which can include operating systems and applications. The user does not administer or control the underlying cloud infrastructure, but has control over operating systems, storage, deployed applications and limited control over some network components, for example, host firewalls. The services offered by this delivery model include: hosting servers, Web servers, storage, computing hardware, operating systems, virtual instances, load balancing, Internet access and bandwidth provisioning.
- Platform as a Service (PaaS) allows a cloud user to implement a product created or purchased by the consumer as applications using programming languages and tools supported by the service provider. The user has control over the implemented applications and, possibly, the settings of the hosting environment. He/she does not administer or control the underlying cloud infrastructure, including network, servers, operating systems or storage. This model is not particularly useful when: the application must be portable; proprietary programming languages are used; hardware and software must be customized to improve application performance (Carlyle, 2016).
- The service provider provides software as a service only. The user does not administer or control the underlying cloud infrastructure or the resources of individual applications. Services offered include business services, such as workflow management, groupware and collaboration, supply chain, communications, digital signature, customer relationship management (CRM), desktop software, financial, geospatial and research management. Web 2.0 applications, such as: metadata management, social networks, blogs, Wiki services and portal services. It is not suitable for real-time applications or for those where data cannot be hosted externally. Examples: Office 365, Salesforce.com, Gmail (Voorsluys, 2011).

Implementation Models

There are four models for implementing cloud computing technology:

- Private Cloud: the cloud infrastructure is provisioned for exclusive use by a single organization, composed of several consumers (for example, business

units). It can be owned, managed and operated by the organization, third parties or a combination of them, and it can exist on or off the premises (Armbust, 2009).

- Community Cloud: the cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that share concerns (for example, mission, security requirements, policy and compliance considerations). It can be owned, managed and operated by one or more community organizations, by third parties or a combination of them, and it can exist on or off the premises (Page, 2012).
- Public cloud: the cloud infrastructure is provisioned for open use by the general public. It may be owned, administered and operated by a company, academic or governmental organization, or some combination thereof. It exists on the premises of the cloud provider.
- Hybrid Cloud: the cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community or public) that remain unique entities, but are united by standardized or proprietary technology that allows the portability of data and applications (for example, cloud augmentation for load balancing between clouds).

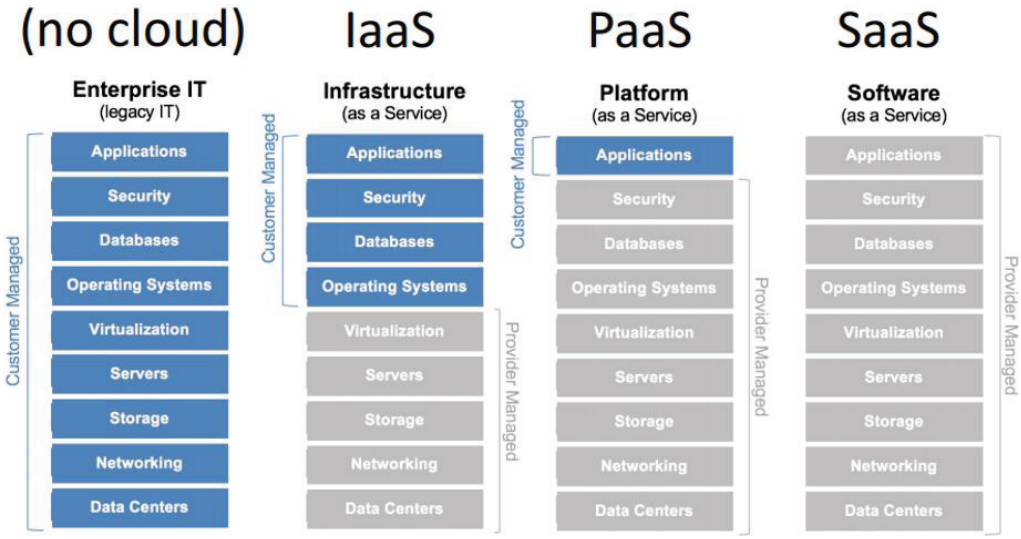

Figure 1. Models of Cloud Computing Services. Source: own work

DevOps

Azure DevOps consists of a mixture of development (Dev) and operations (Ops) – DevOps is the union of people, processes and technology to deliver applications quickly and safely. DevOps gives way to functions that previously worked in silos – development, IT operations, quality engineering and security coordinate and collaborate to produce better and more reliable products. By adopting a culture of DevOps and DevOps practices and tools, teams gain the ability to better respond to development needs and increase confidence in the applications they create as well as achieve their goals faster. The students who used DevOps did so in the context of a curricular unit for developing applications for mobile devices. The methodology followed in curriculum development and application development was as follows:

1. Plan. In the planning phase, the DevOps teams devise, define and describe the features and capabilities of the applications and systems they are going to create. They track progress through high and low levels of granularity, from tasks for individual products to cross-cutting tasks for multiple products. Some of the ways in which DevOps teams plan with agility and visibility include creating to-do records, monitoring errors, managing agile software development with Scrum, using Kanban boards and viewing progress with dashboards.
2. Develop. The development phase includes all aspects of programming – writing, testing, revising and integrating the code by the team members – as well as compiling that code into compilation artefacts which can be implemented in various environments. DevOps teams seek to innovate quickly without sacrificing quality, stability and productivity. To do this, they use highly productive tools, automate mundane and manual steps and iterate in small increments through automatic testing and continuous integration.
3. Distribute. The delivery consisted of the process of implementing applications in production environments consistently and reliably. The delivery phase also includes implementing and configuring the entirely governed base infrastructure that makes up these environments. At this stage, the teams define a launch management process with exact manual approval steps. They also define automatic limits that move applications between phases until they are made available to customers. The automation of these processes makes them scalable, repeatable and controlled. Thus, teams that follow DevOps can frequently deliver with ease, confidence and tranquility.
4. Operate. The operation phase involves the maintenance, monitoring and troubleshooting of applications in production environments. Teams, when adopting DevOps practices, work to ensure the reliability of systems and high

availability and aim for no downtime, while reinforcing security and governance. DevOps teams seek to identify problems before they affect the customer experience and mitigate them quickly before they occur. Maintaining this surveillance requires advanced telemetry, actionable alerts and full visibility to applications and the underlying system.

The research methods

The main techniques and tools used for gathering research data include the following quantitative methods:

- Observation. This involved counting the number of times that a specific event occurred or encoding observational data to translate them into numbers. In this case, the difficulties in completing the laboratories were requested for the evaluation.
- Screening of assessment documents – obtaining numerical data from the evaluation forms and counting of unrealized events that were considered mandatory objectives for evaluation.
- Comparative experimentation – testing hypotheses in laboratories, testing cause and effect relationships, through experience in the development of network laboratories, comparing the results in terms of performance between laboratories developed in person before the COVID-19 crisis and the performance in the development of network labs in a 100% cloud computing environment.
- Hypotheses. One of the leading hypotheses presented is that the transition from a classroom model to a fully online class model does not affect the students' performance and learning level, nor does it provide a lower level of evaluative success in the area of information technology information. As a second hypothesis, it is expected that precisely in the area of information technology, the results will be even more positive in the case of curriculum development done in online laboratories, in particular via cloud computing.

Laboratory to teach how to create a WEB App

The plan for creating a WEB App follows the exact indications advised by Microsoft in its teaching plan for the development of these solutions in Azure (Microsoft, 2020).

If you want to build a website for a new business, or you are running an existing web app on an old on-premises server, you can do it in 15 minutes. Setting up a new server can be challenging. You need appropriate hardware, likely a server-level

operating system, and a web hosting stack. Hosting your web application using Azure App Service makes deploying and managing a web app much easier when compared to managing a physical server. In this module, we will implement and deploy a web app to App Service.

Learning objectives:

- use the Azure portal to create an Azure App Service web app;
- use developer tools to create the code for a starter web application;
- deploy your code to App Service.

Using the Azure portal, you can easily add deployment slots to an App Service web app. For instance, you can create a staging deployment slot where you can push your code to test on Azure. Once you are happy with your code, you can easily swap the staging deployment slot with the production slot. You do all this with a few simple mouse clicks in the Azure portal.

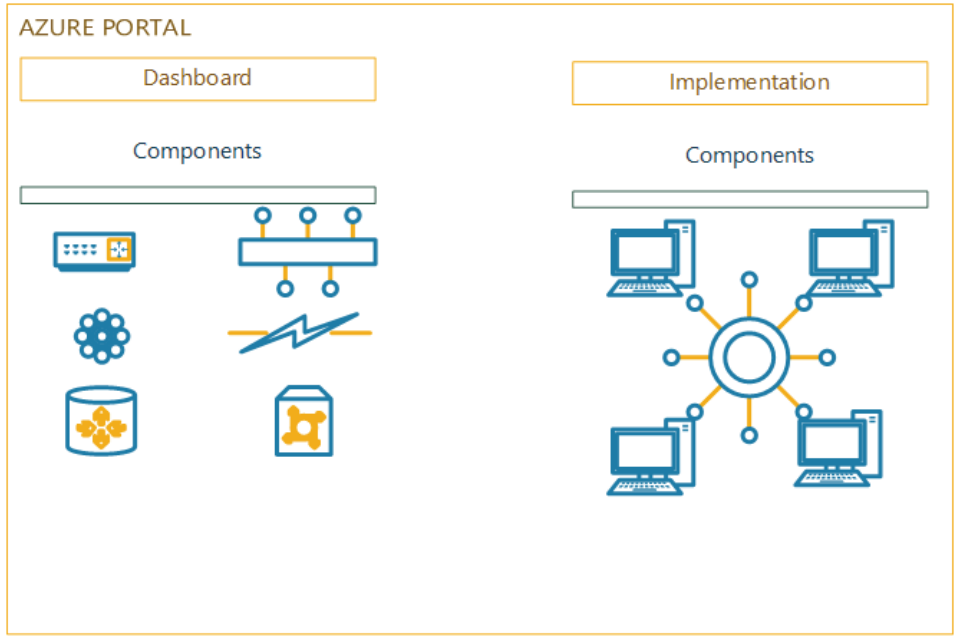

Figure 2. Azure Portal. Source: own work

When you are ready to run a web app on Azure, you visit the Azure portal and create a Web App resource. Creating a web app allocates a set of hosting resources in App Service, which you can use to host any web-based application that is supported by Azure, whether it be ASP.NET Core, Node.js, Java, Python, etc.

If you are deploying your app as code, many of the available runtime stacks are limited to one operating system or the other. After choosing a runtime stack, the toggle will indicate whether you have a choice of operating system. If your target runtime stack is available on both operating systems, select the one that you use to develop and test your application. If your application is packaged as a Docker image, choose the operating system on which your image is designed to run. Selecting Windows activates the Monitoring tab, where you have the option to enable Application Insights. Enabling this feature will configure your app to automatically send detailed performance telemetry to the Application Insights monitoring service without requiring any changes to your code. Application Insights can be used from Linux-hosted apps as well, but this turnkey, no-code option is only available on Windows. An App Service plan is a set of virtual server resources that run App Service apps.

A plan's size (sometimes referred to as its Sku or pricing tier) determines the performance characteristics of the virtual servers that run the apps assigned to the plan and the App Service features that those apps have access to. Every App Service web app you create must be set to a single App Service plan that runs it.

A single App Service plan can host multiple App Service web apps. In most cases, the number of apps you can run on a single plan will be limited by the performance characteristics of the apps and the resource limitations of the plan. App Service plans are the unit of billing for App Service. The size of each App Service plan in your subscription, in addition to the bandwidth resources used by the apps deployed to those plans, determines the price that you pay. The number of web apps deployed to your App Service plans does not affect your bill.

You can use any of the available Azure management tools to create an App Service plan. When you create a web app via the Azure portal, the wizard will help you to create a new plan at the same time if you do not already have one. The Azure Portal provides a wizard to create the solution with the following options: subscription, resource group, App name, publish, runtime stack, operating system, region and App service plan.

To create the WEB App, the steps below must be followed (Figure 2):
On the Azure portal menu or from the Home page, select Create a resource. Everything you create on Azure is a resource. The portal navigates you to the Marketplace page. From here, you can search for the resource you want to create or select one of the popular resources that people create in the Azure portal. Select Web > Web App to display the web app creation wizard. Fill out the wizard with the following values: Subscription (Concierge), Resource Group (Sandbox resource group), Name (enter a unique name), Publish (Code), Runtime stack (.NET Core 3.1 – LTS), Operating System (Linux), Region (chose the close to you), SKU and Size (F1). Then select Review and Create.

The Analysis

The investigation focused on the analysis of the results of school progress, including the final assessment of 21 students in a master's degree course in Information Technology.

We present two hypotheses to verify: first, whether or not there was a decrease in school results in the period of confinement caused by the Pandemic of COVID-19; second, check if there is any correlation between the evolution of the evaluation results between different curricular units, in the referred period. Both hypotheses considered referring to contexts of curriculum development through Cloud Computing systems.

The participants were the students of the first year of the master's degree. Both classes needed to use the same laboratories for curriculum development work.

One of the curricular units, Digital Systems Architecture, was run from the first semester, that is, from a pre-COVID-19 period. In this period the laboratory work was performed in person, that is in the laboratories of the university. The other curricular unit was Private Cloud Computing, already developed in the period of COVID-19, without face-to-face classes. It is important to consider that our university closed all face-to-face classes at the beginning of March – unlike many other countries, Portugal was one of the first countries to close schools and universities. The law of university autonomy in Portugal allows university directors to establish autonomous contingency plans, this is what happened at our institution.

In the confinement phase, students only took online classes, Google Classroom taught asynchronous classes, synchronous classes by Google Meet. In the case of this master's degree in computer science, the part of technological laboratories migrated entirely to Microsoft Azure. The laboratories developed by this class were all implemented in the area of computational infrastructure.

Analysing the evolution of the curricular unit of the first semester, Digital Systems Architecture, it was found that the average of the evaluations obtained was 16 values (on a scale from 0 to 20), it was also found that the standard deviation was 2.718 (Figure 3).

Laboratory work in the first semester was only completed in the last week of that semester. Not all students were able to finish the laboratories on time, mainly because they were working students and did not have the necessary time to dedicate to the face-to-face laboratories, as well as the fact that they had to miss classes for different reasons. The teacher had to extend classes for over a week for everyone to finish their work.

On the other hand, the Private Cloud Computing Course Unit, was taught in the confinement period of COVID-19, all took place through distance learning, that

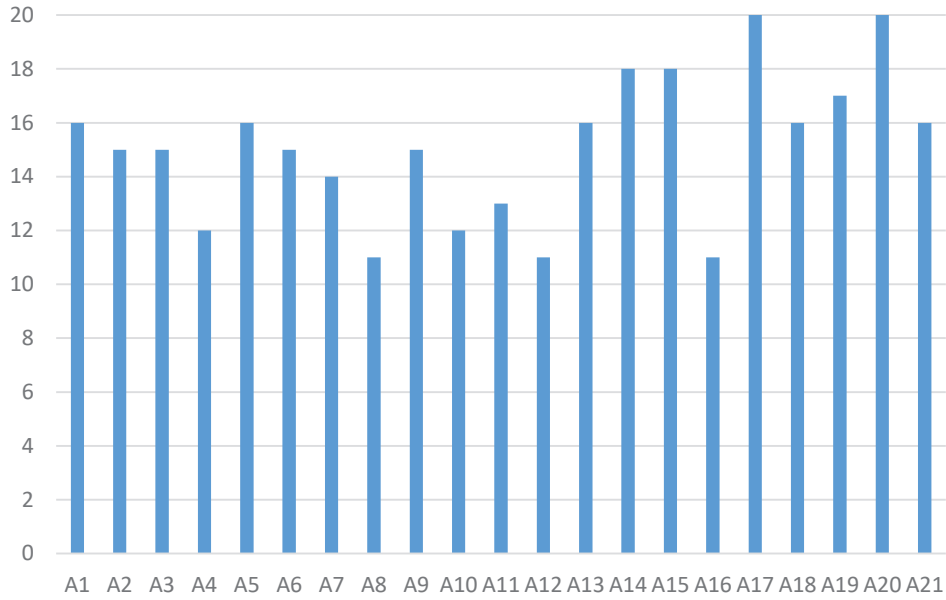

Figure 3. Result of the final evaluation of Private Cloud Computing – Pre-COVID-19. Source: own work

is, online, the curriculum development works in the laboratory were all installed in Microsoft Azure infrastructure.

The results obtained from the analysis to the evaluation and performance of the students were genuinely superior to what happened in the first semester, curricular unit.

The average of the final evaluation was 18 values, and the standard deviation was 1.590 (Figure 4). This is a significantly higher average – the fact that the general population and students were experiencing a period of enormous emotional stress, which did not occur in the first semester should be considered here) – yet in spite of this, they obtained higher ratings. Another aspect to note are the differences in standard deviation between the two scenarios. The standard deviation of the second-semester assessment is lower, which indicates that the general consolidation of objectives and learning, in addition to being more elevated, is more consistent and more students improved their performance.

The average difference between the results of the assessment obtained before confinement and the results obtained during the confinement period for similar curricular units (represented in Figures 3 and 4) is two values; in the confinement period, the students on average obtained a superior evaluation in two values, on an evaluative scale of zero to twenty values.

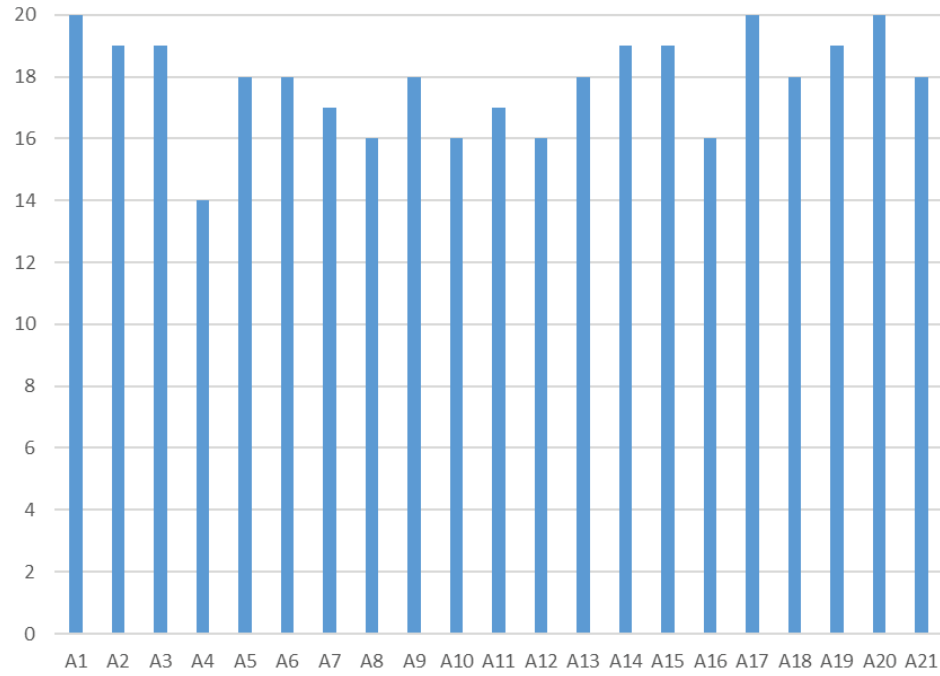

Figure 4. Result of the final evaluation of Digital Systems Architecture – confinement – COVID-19. Source: own work

It was also found that all students finished laboratory work before the deadlines with fewer doubts about the contents to be developed. This is not a quantitative aspect, but I consider it relevant. It is the opinion expressed by all students that the fact that the laboratories are in cloud computing allowed them to work at any time and repeat the tests and learning in a more straightforward way. They were able to review all the work easily. In technical terms, these labs also allowed students to reset any development errors as they were using virtual machines which, due to their characteristics, allow easy to create reverse images.

Advantages of Cloud-based E-Learning

We believe that there are many advantages in laboratory teaching based on Cloud Computing for some technical-scientific regions of Computer Sciences (Riahi, 2015), we also recognize that this model does not adapt so well to other areas.

However, some advantages of Cloud-based E-Learning should be summarized:

1. Low cost; e-learning computer users need not configure up for e-learning applications. They can cloud applications via PC, mobile phone, tablet with an Internet connection to run with minimal configuration (Maskarade, 2014).
2. Improved performance; since cloud-based applications for e-learning run with super-strength, super-source software is automatically updated. So, students always received updates (Viswanath, 2012).
3. Direct benefits for students; they can take online courses, take the exam online, received feedback about the coaches, and post projects and assignments online through their teachers (Patel, 2014).
4. Cybersecurity; cloud computing providers supply some major security benefits for individuals and companies that are using e-learning solutions (Mohammed, 2014). All the information is more secure.

We carried out the same type of study for two other curricular units in an area other than that of the Azure infrastructure. In this case, we compared two curricular units for the development of applications for mobile devices, one taught in the pre-COVID-19 period, the other taught at the peak of the COVID-19 pandemic in which students only had classes through online technologies, and in this case through Azure DevOps.

In the curricular unit Web and Multimedia Programming, taught before the COVID-19 period, always in face-to-face classes in the classroom and with the use of development software existing on students' computers or in the classroom, the results were average (Figure 5).

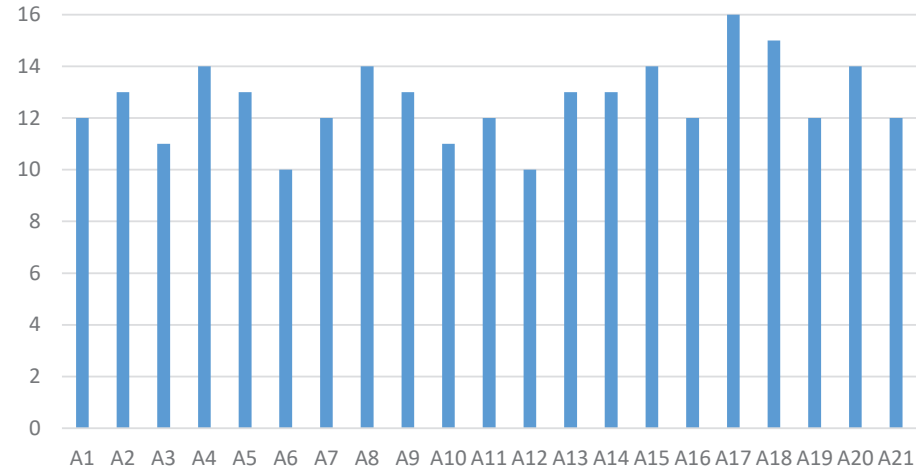

Figure 5. Result of the final evaluation of Web and Multimedia Programming – pre-COVID-19 (the vertical axis represents the assessments and the horizontal axis represents the students). Source: own work

On the other hand, in the curricular unit Development for Android Platforms, taught during the COVID-19 period, always in online classes, and still using the Azure DevOps ceiling, the students obtained, on average, much higher final evaluation results. We also received direct information from students who much appreciated this method of corrective development, as they could efficiently work at their own pace and easily correct errors without jeopardizing the work already done. We recognize that these curricular areas are easily adapted to the use of these technologies; however, the results in terms of the evaluation were outstanding in the generality of the pool of students analyzed. We can even consider the assessment as excellent (Figure 6).

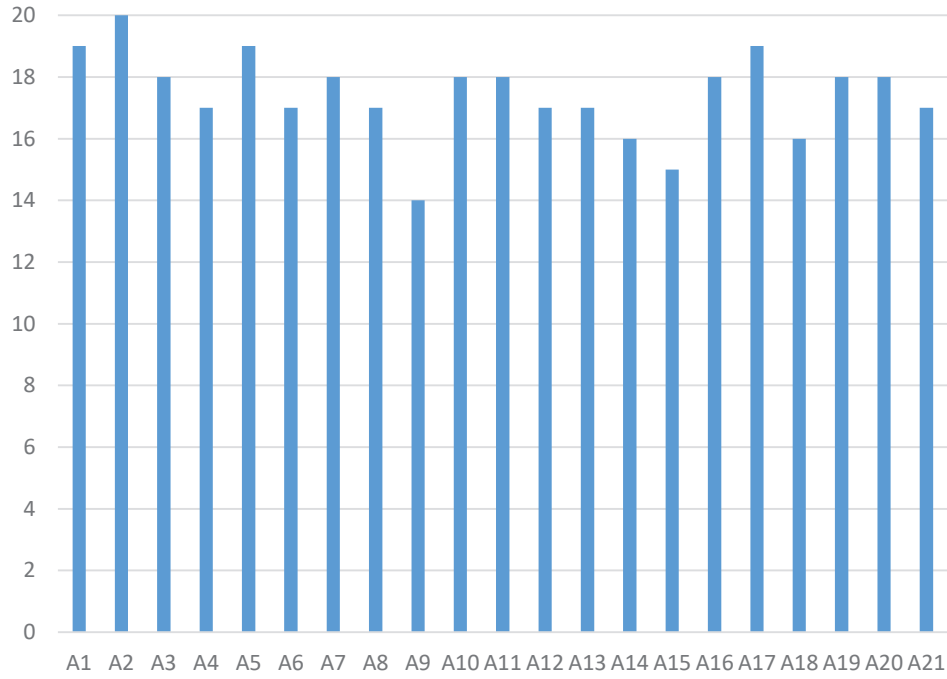

Figure 6. Result of the final evaluation of Development for Android Platforms – pre-COVID-19 (the vertical axis represents the assessments and the horizontal axis represents the students). Source: own work

In the analysis of the second hypothesis, that is, when comparing the results of well-differentiated curricular units, in which they used types of curriculum development tools other than the Azure infrastructure, the results obtained would also have a pattern during the period of confinement comparable to the pattern obtained with the results shown in Figure 1 and 2. In the teaching scenario which

employed DevOps, the average difference between the results of the assessment obtained before confinement and the results obtained during the confinement period for similar curricular units and represented in Figures 5 and 6, is five values – in the period of the confinement, the students obtained on average a much higher evaluation of five more values. On an evaluative scale of zero to twenty values, the difference is even higher than that obtained in an identical scenario in the Azure infrastructure curriculum. On the other hand, the results of standard deviations demonstrate that students learned and had better evaluations.

The value of the standard deviation for the results of the assessment in the pre-confinement period and shown in Figure 5, is 1.5275; the standard deviation value for the evaluation results during the period of confinement, shown in Figure 6, is 1.3989. The latter value is lower, which means that the assessment obtained by students during the period of confinement, using Cloud Computing tools and taking classes exclusively online was much higher in the entire group of students studied.

Conclusion

In a new paradigm in which online education or combined teaching, both online and classroom, must be considered, having technologies which allow a correct teaching/learning process that achieves the objectives of obtaining skills through laboratories is a fundamental requirement.

The use of cloud computing technology allows today to give laboratory classes in the area of computer science entirely via online. As demonstrated, we can create an online laboratory on Azure and demonstrate/teach students how to develop a WEB application. On the other hand, students can use the same online infrastructure to build their project and put the acquired knowledge into practice. One can easily set up and provide on-demand access to preconfigured virtual machines (VMs) to support one's scenarios. One can teach a class, train professionals, run a hackathon or a hands-on lab, and more. Simply define your needs, and the service will roll the lab out to your audience. Users access all their lab VMs from a single place. For this reason, cloud computing laboratories solve problems of not accessing laboratories where students must be in person. From the study carried out using a mainly quantitative method, comparing the school results of two curricular units that had the need to use computational laboratories, in which one had access to on-site laboratories and others had only access to laboratories in Cloud Computing, it was found that the results of evaluation, performance, and easiness in reaching the objectives was more positive in the use of the laboratories in Cloud Computing,

showing that all this teaching activity was carried out under enormous social and psychological pressure, due to the context of COVID-19. Another conclusion that we can also draw is that the most favourable results obtained through the use of Cloud Computing platforms are identical in totally different curricular units. That is why there is a correlation between the good results obtained in the use of Cloud Computing for laboratories in Azure and the application development platform (DevOps). However, if a second wave of COVID-19 occurs, this study should be repeated this year to increase the validation of the results now obtained.

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Pedro Ramos Brandao

Chmura obliczeniowa i kształcenie na odległość w informatyce

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

Z niniejszej pracy wynika, że wykorzystanie laboratoriów do opracowywania zajęć dydaktycznych w zakresie technologii informatycznych wspomaganych wyłącznie technologią przetwarzania w chmurze nie obniża poziomu uczenia się i poziomu oceniania studentów w ramach kształconych przedmiotów. Ten scenariusz powstał z potrzeby przerwania bezpośrednich zajęć tradycyjnych w laboratoriach fizycznych z powodu pandemii COVID-19.

S ł o w a k l u c z o w e: Cloud Computing, Azure, nauczanie na odległość, WEB App, Virtual Labs, DevOps.

Педро Рамос Брандао

Облачные вычисления и дистанционное обучение в информатике

А н н о т а ц и я

Эта работа демонстрирует, что использование лабораторий для разработки учебных программ в области информационных технологий, исключительно поддерживаемых технологиями облачных вычислений, не снижает уровень объектов обучения и оценивания со стороны студентов. Этот сценарий возник из-за необходимости прервать традиционные занятия в физических лабораториях из-за пандемии COVID-19.

К л ю ч е в ы е с л о в а: облачные вычисления, Azure, дистанционное обучение, веб-приложение, виртуальные лаборатории, DevOps.

Pedro Ramos Brandao

Computación en la nube y aprendizaje a distancia en informática

R e s u m e n

Este trabajo demuestra que el uso de laboratorios para el desarrollo del trabajo curricular en el área de tecnología de la información apoyado exclusivamente en la tecnología de computación en la nube no disminuye el nivel de aprendizaje y objetos de evaluación por parte de los estudiantes. Este escenario surgió de la necesidad de interrumpir las clases presenciales en los laboratorios físicos debido a la Pandemia COVID-l9.

P a l a b r a s c l a v e: Computación en la nube, Azure, aprendizaje a distancia, Aplicación WEB, Laboratorios virtuales, DevOps.

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Online Collaborative Learning to Enhance Educational Outcomes of English Language Courses

Abstract

With various aims and objectives, syllabi of e-learning, blended learning and web-enhanced courses meant for a particular group of undergraduates or postgraduates, may vary substantially. However different they are, they are likely to show behaviourist ideas embodied in instructional design. A plethora of online tools (text based, image based, multimodal production and collaborative ones) can increase students' learning experiences, as they offer opportunities for interactions that are not available in a traditional, instructivist classroom setting. Thus, a university language course with web-enhanced components offers more versatile learning options than face-to-face classes, which may result in students becoming more competent and competitive workers in the years to come. By using online tools such as *ThingLink*, *mural*, *quip*, *easel.ly, infogram* and *venngage* to collect and critically analyse data, they learn in a new active way, in a more genuine environment. This way of engaging students helps them to achieve learning outcomes structured around communication, teamwork, media literacy and language skills. These ideas are supported by students' opinions and attitudes expressed in the surveys conducted at Gdańsk University of Technology in the years 2017–2019.

K e y w o r d s: web-enhanced language learning, online tools, hard and soft skills, e-learning, university education, collaborative project

Engaging students in various interactions, of which resulted from student exposure to a range of multi-purpose tasks, both online and blended, can help educators achieve the desired educational outcomes. Developing both hard and soft skills in an e-leaning environment enriches students' learning experience, because they have an increasingly greater number of opportunities to engage in educational activities. University courses are more likely to arouse interest, stimulate involvement and lead to satisfactory outcomes when they are developed in environments structured around pedagogical methodologies based on active learning and collaborative achievements (Kołodziejczak et al., 2015).

Problem-based learning results in an increase in complex skills, especially when it is supported by web tools (Issa et al., 2016). Having the capacity for versatile interactions, online programmes that target collaborative achievements allow their users, both teachers and students, to develop more competencies than traditional ones based on the same subject matter. They can better satisfy the needs, expectations and learning styles of Generation Z (Beall, 2016). Moreover, they can enable educators of previous generations to improve their skills to emulate the majority of their students who have been raised in a technology-rich environment. Not only do Internet-based tasks provide access to a vast number of up-to-date resources, but they also make use of different tools and their functionalities, thus giving plenty of opportunities to increase learning and teaching experiences. Academics can engage their students in more genuine interactions than those available in a traditional, face-to-face setting, and they can increase their scope of educational methods and techniques (Kołodziejczak et. al, 2017; Kemp & Grieve, 2014).

The paper aims to show how to achieve course outcomes, which are a required element of a syllabus, through creating a project-based environment that can raise students' interest and increase their satisfaction, and how to engage both teachers and students in an active and collaborative development of various competencies. Furthermore, it attempts to investigate how effectively undergraduates involved in e-learning tasks can focus on developing hard and soft skills. The presented hypotheses are supported by survey results, analyses of students' behaviour during online activities, follow-up tests and tasks, as well as educators' opinions presented in the literature.

Behaviourism and its Impact on the Wording of Aims, Objectives and Outcomes

Behaviourism, being one of the most influential learning theories, started in the first half of the 20th century with research carried out by Edward Thorndike, John Watson and Ivan Pavlov into changes in animals' and people's behaviour which resulted from them having been subjected to a series of stimuli. Behaviourist scientists discovered that an animal or a child presented for some time with conditional stimuli associated with unconditional ones responded in the same way to the conditional stimuli even when they were not accompanied by the unconditional ones. This lasted for a certain period of time and eventually resulted in the "extinction" of the behaviour. They also noticed a positive role of awards (Thorndike, 1911) and reinforcers (Skinner, 1938), which strengthened a stimulus-response bond. According to neo-behaviourists, observable changes in behaviour are not only caused by conditioning, classical or operant, but also by some elements of cognition. They perceive personality, motivation and habit to be important reinforcers (Bishop et al., 2016).

The influence of behaviourism can be seen in how educators understand learner behaviour inside and outside the classroom (Jordan et al., 2008, pp. 27–31). Bloom's taxonomy of learning with its later modifications (Bloom, 1956; Bloom & Krathwohl, 1956) classifies three domains which show hierarchical sets of behaviours. The cognitive domain, which is the most important from the educational point of view, identifies six levels related to intellectual abilities, showing the progress from Knowledge – the lowest level – to Evaluation – the highest level, through Comprehension, Application, Analysis and Synthesis. All these stages do not have to occur in the educational process, however, in order to enter any of the higher ones, one has to pass through the previous ones. Self-directed learners must reach the last one if they want to effectively use their acquired knowledge.

The hierarchy was slightly modified by Anderson and Krathwohl (2001), and supplemented with a new top level, that is, the level of Creating, which shows that people are able to create new knowledge after evaluating what they have learnt so far. The affective domain is used to categorise attitudes. From the lowest level labelled Receiving, which indicates that first people are aware of a situation, then through responding, valuing, organising and conceptualising they eventually reach the highest stage, that of Characterising by Value or Value Concept (Krathwohl et al., 1964). After passing the last stage, students have the system of values internalised. It enables them to work independently and in teams, and apply the attitudes and values they hold to problem-solving (Clark, 2004). The third domain, which

is called the psychomotor, concerns skills. Research into it was started by Bloom, and later completed by Dave (1975), who suggested the following hierarchical levels: Imitation, being the lowest one, Manipulation, Precision, Articulation and Naturalisation, being the highest one. All the stages show how finally, entering one after another, learners achieve the mastery of skills, and the highest level of expertise required to construct, design or create new things.

The behaviourist understanding of learner actions expressed in Bloom's Taxonomy is visible in the way course developers prepare tasks. The wording of instructions shows that they are based on behaviours described in the cognitive domain. When passing through the first level, i.e. Knowledge, learners preparing, e.g., infographics, reports, specifications, are asked to define the scope, to outline the problems found in the literature, to identify the aim and objectives, and to quote external sources by making references in an appropriate way. In the next parts, they have to describe the relevant theories, materials, equipment or machinery used, as well as to show the methods employed. When comparing, contrasting and interpreting data and facts in the Results and Findings part, they reach Bloom's levels of Comprehension and Application. They need to use the acquired knowledge to solve problems, examine and measure outcomes, calculate results, classify findings in tables, and finally illustrate them with graphs. The behaviours found in the last three stages of the original cognitive domain, i.e., Analysis, Synthesis, Evaluation, are also visible in the teacher's recommendations on how to prepare assignments.

The wording of course objectives used by developers of different e-learning programmes (Heriot-Watt University, 1999) exhibits associations with behaviourist principles (Mokwa-Tarnowska, 2017a). Objectives are often written in a learner-centred format which indicates what behaviours students will display after finishing the course, e.g. "You will be able to use formal English in writing," "You will be able to apply coherence and cohesion devices when writing a technical text," "You will be able to make a presentation," "You will be able to work in an international team." Syllabi of e-learning, blended learning and web-enhanced courses may vary substantially and may depend on various aims and objectives. They may also be meant for a particular group of undergraduates or postgraduates. However different they are, they are likely to show behaviourist ideas embodied in instructional design.

In order to measure learning outcomes, specified by means of course aims and objectives phrased in a behaviourist way, one can apply formative assessment (Cowie & Bell, 1999, pp. 101–116; Crooks, 2001), whose purpose is to provide students with continuous feedback, which helps them increase knowledge and benefit the most from the course. This form of assessment better encourages and motivates learners during an online course or module than summative assessment (Scott, 2003; Atkin et.al, 2005) – it can be treated as positive reinforcement.

From the behaviourist perspective, feedback referring to underperformance has to be constructive, it must not be phrased by means of negative words. If a task is delivered online and supervised by a tutor, formative assessment plays a crucial role in developing self-directed learning, and in building learners' self-confidence. Students can learn how to assess their skills and knowledge, and what to do to improve their learning experience, which is very important if they are to become lifelong learners. Positive evaluation of progress and achievements can function as a highly motivating factor, which contributes to students feeling autonomous in self-education.

Web 2.0 Tools to Support Language Learning and Attainment of Learning Outcomes

There is a variety of Web 2.0 tools to enhance language classes for university students attending traditional courses (Mokwa-Tarnowska, 2017b). Text based tools, image based tools, multimodal production tools and collaborative tools can increase learning experiences. With their various functionalities, they offer different opportunities for teachers who can engage their students and themselves in interactions that are not available in a traditional, instructivist classroom setting (Kołodziejczak et al., 2017; Mokwa-Tarnowska et al., 2018). They can stimulate collaborative learning by doing and help students improve both hard and soft skills. This, in turn, can result in meeting university course aims and objectives, most of which in the case of learning languages focus on developing competencies that enable teamwork in the work context. Presented in a behaviourist format, learning outcomes that university education is supposed to lead to, refer to knowledge, skills, and social competence, and are divided into cognitive and behavioural ones (Austin 2012, pp. 46–47). The former identify what students will know after completing a course, and the latter what students will be able to do. In the Polish education system, learning outcomes are expressed in terms of aims and/or objectives, with the choice depending on the course. The intended results, when expressed in Polish, are thus mistakenly understood to be the achieved ones, which is seen in the choice of words. However, they are only likely to be attained, and the prediction of what will have been reached is stated in the curriculum preparation phase, and then visible in the course syllabus.

Course aims and objectives that target soft skills are difficult to fulfil, and employers across the world constantly complain that university graduates are not

equipped well enough with the competencies that they are looking for (NACE, 2019). Poor soft skills have been reported to be the reason why young workers have difficulty adapting to a new work environment. Thus, to prepare students for future challenges in the labour market, universities should change their course curricula to increasingly focus on the development of various competencies, not only the hard ones that are obviously of the utmost importance in university education (Mathur, 2017; Rima et al., 2017). By expanding the scope of language classes to include soft skill-based experiences, educators can create an environment that will allow them to meet goals far beyond the four fundamental language skills that contribute to one-to-one and one-to-many communication (Widła, 2019). The verification criteria chosen to check if students' achievements fulfil the requirements can refer both to traditional and online activities, combined to achieve a synergistic effect. With its tools and their functionalities, synchronous and asynchronous modes and other affordances, an e-learning environment can help educators ensure that learning outcomes meet the aims, their own needs and those of their students.

Traditional Language Courses at GUT Enhanced with Online Tools

The author of this paper uses online components to enhance her students' learning opportunities. They supplement traditional classes and focus on English for Specific Purposes (ESP) and academic English. Their goal is to introduce novelty into teaching and learning, prepare students for blended programmes and self-directed learning. They aim to create an environment suitable for the development of different hard and soft skills. Their objectives differ and depend on the subject matter and skills they target. They range from hard skills such as the writing skill and the reading skill to soft competencies, e.g. collaborative skills, time management skills, managerial skills, analytical skills and critical-thinking skills.

The last few years have seen the emergence of different Web 2.0 tools, which has resulted in a growing interest to use them in university education (Noskova et al., 2017). Due to their functionalities, they can support the development of different hard and soft competencies. So far the following tools have been tested during language courses offered by Gdańsk University of Technology (GUT) to understand how well they can support students of science and engineering: website creation and data publishing technologies such as the Moodle wiki tool, ThingLink, mural, quip, easel.ly, infogram and venngage. They have been selected to support short and long collaborative, project-based tasks.

Research Design and Implementation

Since October 2016 slightly over 300 students of different GUT's faculties have developed online materials using the Web 2.0 tools mentioned above – 260 have completed questionnaires on their attitudes towards the web-enhanced classes they have participated in. As many as 180 students participated in longer, i.e., three-week, online collaborative projects, most of whom, i.e., 161, completed surveys. An analysis of the answers to selected questions is presented in this paper. It is supported by findings collected during qualitative research based on observation and answers to open-ended questions.

In the first semester of the academic year 2016/2017, two groups of students attended collaborative, web-enhanced classes, first using ThingLink and then Moodle wiki (Mokwa-Tarnowska, 2017c). The students produced a multimedia poster in the first project, later presented in class as a springboard for discussion. The second project involved compiling specifications of an apparatus or equipment invented by the students themselves to be advertised in class. Both one-week tasks entailed shifting control over the learning process to the participants. Their experience showed that one-week projects cannot effectively target the development of collaborative skills through online activities because students meet at an English class in a traditional classroom setting once a week and attend faculty lectures and seminars every day. Thus, they can discuss their duties during face-to-face meetings. Moreover, one-week projects resemble typical homework that can be done by a group of people on one computer.

Since the second semester of the academic year 2017/2018 longer, usually three-week projects have been carried out to enhance English classes. They require a substantial amount of involvement and effort – they are more intensive than the previously assigned online and traditional ones. With more duties, students are likely to work online on their own at intervals, and not together doing everything in one sitting in front of one computer. In the first phase of the research, the collaborative tools the students were asked to choose were mural, quip, and easel.ly, to be followed in the second phase by infogram and venngage, which target the collaborative creation of infographics in particular – all of which were easy to use for technically-mined undergraduates.

Research Questions and Methods

The qualitative and quantitative research into the nature of web-enhanced language classes at GUT and their impact on an increase in student competencies, both hard and soft ones, was initiated four years ago. Students' opinions and motivations shown in comments presented in class as well as answers to open-ended questions have helped to uncover some trends to be further tested in the next research phases. Two basic tools have been used so far to produce a qualitative

analysis: direct observation and group discussions. The quantitative research in each phase involved a paper survey. The research questions targeted in the second phase were as follows:

– What are the students' attitudes to online collaborative work during longer projects?
– How effective can online collaborative work which enhances traditional classes be in terms of learning outcomes?
– How can an online environment created to enhance traditional classes help develop hard and soft skills?
– How does an online environment affect learning outcomes?

It can be assumed that the composition of each study group was homogeneous with respect to many factors: age, intellectual capacity, interest in science and engineering, undergraduate course participation and B2–C1 level of English according to the Common European Framework of Reference for Languages. The only major difference was that both first-year and second-year students participated in the survey, which could have had an impact on their perception of collaborative work. It might be easier for second years as they are better acquainted with university requirements, have more experience related to working in teams, which is required in many subjects usually taught at a later stage, and they better know each other. Moreover, students of the third and fourth semesters of an English course usually have more experience in doing ESP tasks, including online ones. Thus, they are likely to find them easier. The data collected during the research are presented as medians, mean values or percentage, as appropriate. The comparison of groups (categorical data) was analysed with the $\chi 2$ test. All the results were considered significant at $p<0.05$. The statistical analyses were performed with STATISTICA 12.0 (StatSoft Inc.)

Quantitative research – Results and Discussion

The survey targeted the students who had participated in longer online projects, usually of 3-week duration. The respondents who participated in the projects in the second semester of the academic year 2017/2018 used mural, quip and easel.ly, their number amounted to 72, out of whom 61 completed questionnaires (17 students of Mechanical Engineering, 18 students of Telecommunication and Electronics, both groups in the first year of their English course, and 26 students of Automation and Robotics, and Medical Engineering in the second year of their English programme). Data from answers to two questions are presented in figures 5 and 6.

The cohort doing infographics in the second semester 2018/2019, using infogram and venngage, consisted of 125 students, of whom 100 completed questionnaires (14 Physics and Maths students, 16 Mechanical Engineering students, 13

Civil Engineering students and 23 Architecture students in the first year of their English course, as well as 17 Civil Engineering students and 17 Architecture students in the second year of their English course).

Most of the students who participated in the latest phase of the research, in the academic year 2018/2019, stated that the task allowed them to improve their data analysis skills (Figure 1). More than half of the students attending the first year of a two years' course of English were satisfied with their progress and rated it as good or acceptable (students of Physics and Mathematics: 92.85%, students of Mechanics: 75%, students of Civil Engineering 1: 61.54%, students of Architecture 1: 86.96%). The students in year two of their English course assessed their data analysis skills in a similar way (students of Civil Engineering 2: 64.7%, students of Architecture 2: 94.12%). The Architecture students' positive opinions may have resulted from being accustomed to analysing visual data, and from having had to develop a spatial imagination over the years, instrumental in architectural design. The most dissatisfied students were those of year one from Mechanical and Civil Engineering faculties, 18.75% and 15.38% respectively, for whom this was a new experience.

The students were asked to assess their contribution to the teamwork (Figure 2). A majority contributed substantially but there were a number of students who had not put enough effort into the task. Over half of the first year students in Civil Engineering considered their contribution to be substantial. All the other students who chose the same answer ranged between 30.43% and 47.07%. In three groups, there were students who made no contribution (12.5% of the students of Mechanics, 7.69% of the students of Civil engineering 1 and 11.76% of Civil Engineering 2) – they did not provide any explanation why they were inactive. When asked in class about the work all the team members had done, no student complained about their classmates being unwilling to participate in the project or not providing any support.

The students' perception of an increase in their language skills was also addressed in the survey (Figure 3). A substantial number of the respondents regarded their hard competencies as better after the task completion. They learnt new vocabulary and practiced writing IELTS style descriptions they had not attempted before. Thus, it is not surprising that a large proportion of the students noticed an improvement in their language skills. The participants who had not contributed to the projects stated that the task had not added to their competence – there is a consistency in understanding a correlation between work effort and involvement and skill improvement. However, the number of negative answers was significantly higher, which means that also some of the students who stated that they had contributed to the overall result were dissatisfied with their language skills (6.25% of the students of Mechanical Engineering, 15.38% of Civil Engineering

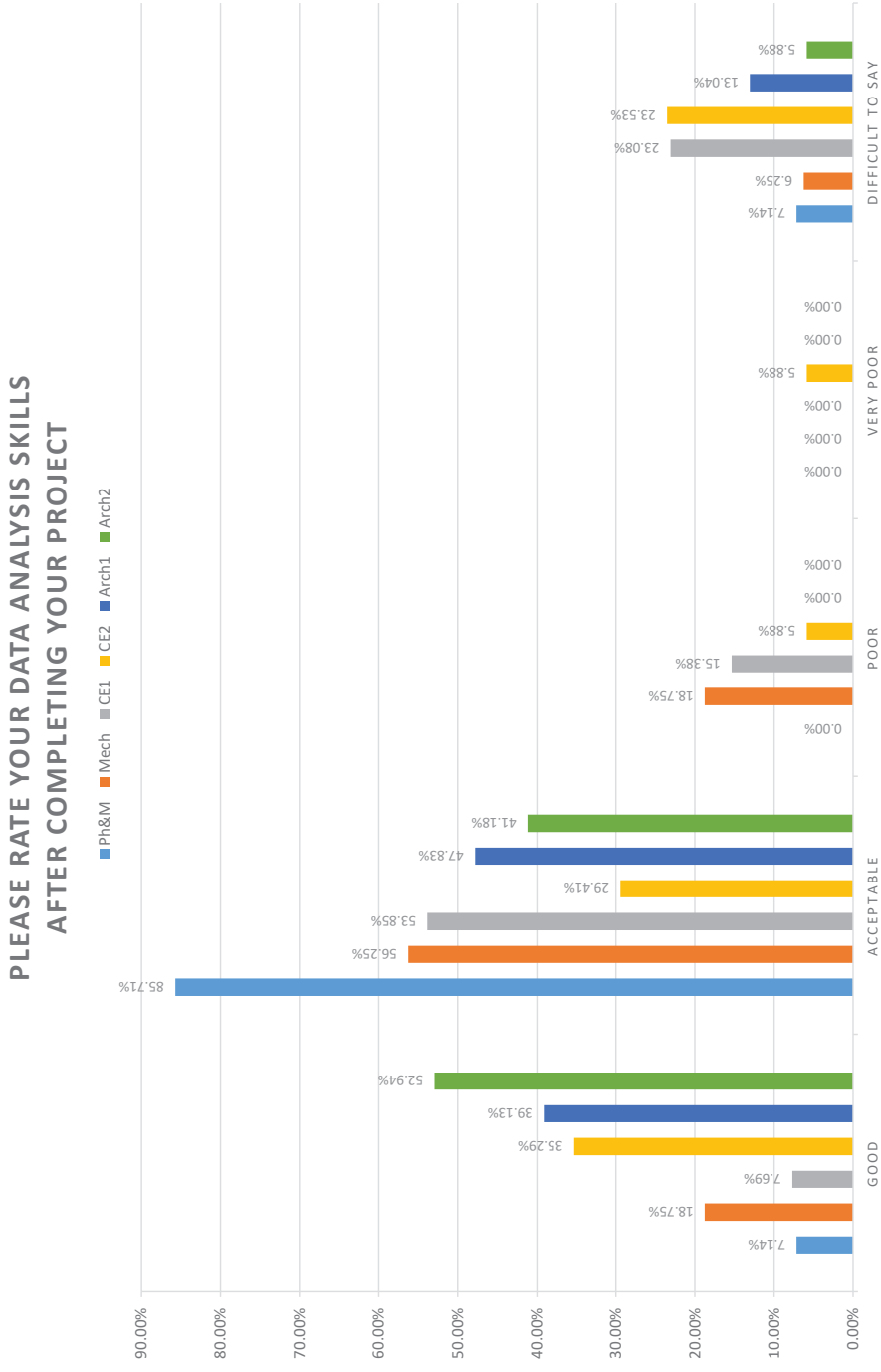
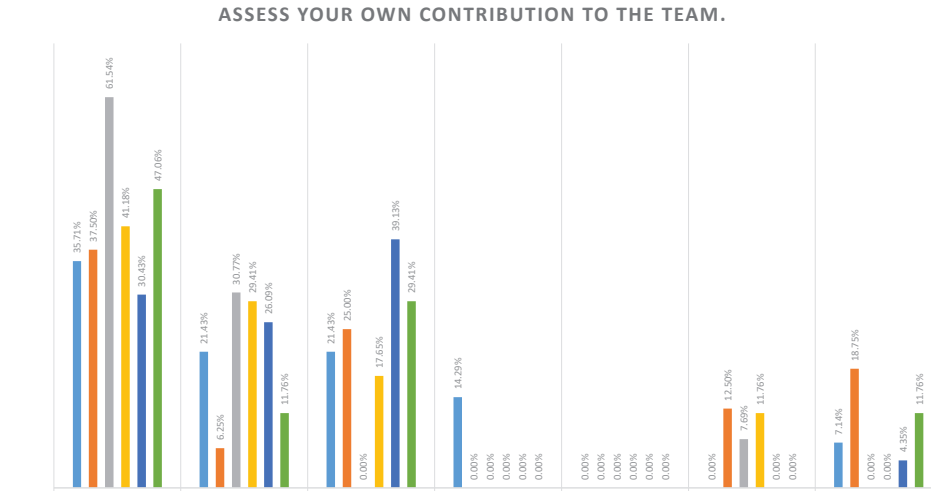


Figure 1. Data analysis skills.



	A1	A2	A3	A4	A5	A6	A7
Ph&M	35.71%	21.43%	21.43%	14.29%	0.00%	0.00%	7.14%
Mech	37.50%	6.25%	25.00%	0.00%	0.00%	12.50%	18.75%
CE1	61.54%	30.77%	0.00%	0.00%	0.00%	7.69%	0.00%
CE2	41.18%	29.41%	17.65%	0.00%	0.00%	11.76%	0.00%
Arch1	30.43%	26.09%	39.13%	0.00%	0.00%	0.00%	4.35%
Arch2	47.06%	11.76%	29.41%	0.00%	0.00%	0.00%	11.76%

Figure 2. Contribution to team work.
N o t e: A1. My contribution was substantial. A2. I worked a lot but I should have done more. A3. My contribution was average but other team members made no complaints about it. A4. I did what I was assigned to do but other team members were not satisfied with my contribution. A5. I did too little and other team members were dissatisfied with my contribution. A6. I did nothing. A7. I have no opinion.

1, 11.77% of Civil Engineering 2, 8.7% of Architecture 1 (plus 21.74% of those undecided)).

Figure 4 shows the respondents' opinions regarding online collaborative tasks being a part of university curriculum. Over half of the students in every group stated that traditional language classes should be supplemented with teamwork carried out in an e-learning environment (64.28% of Physics and Mathematics students, 56.25% of Mechanics students, 76.92% of Civil Engineering 1 students, 52.94% of Civil Engineering 2 students, 86.96% of Architecture 1 students, 94.12% of Architecture 2 students). It seems that if students are accustomed to working in teams in a classroom setting, like students of Architecture, they are more inclined towards online efforts as well. It must be emphasised that one third of the students of Physics and Mathematics, the students of Mechanical Engineering and the students of Civil Engineering in year 2 would not like to learn in an active collaborative environment.

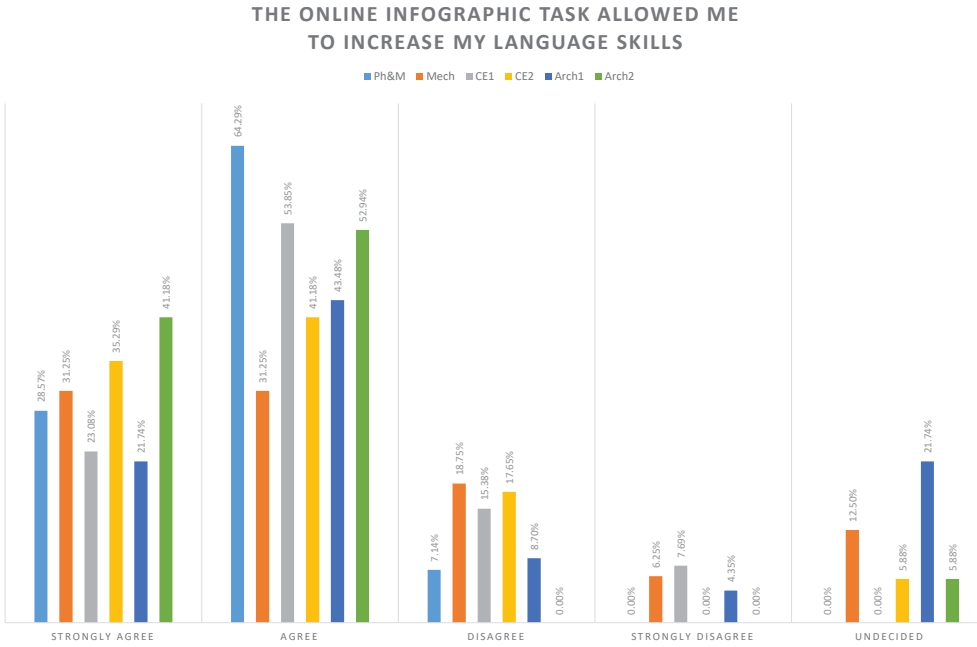


Figure 3. Increase in language skills.

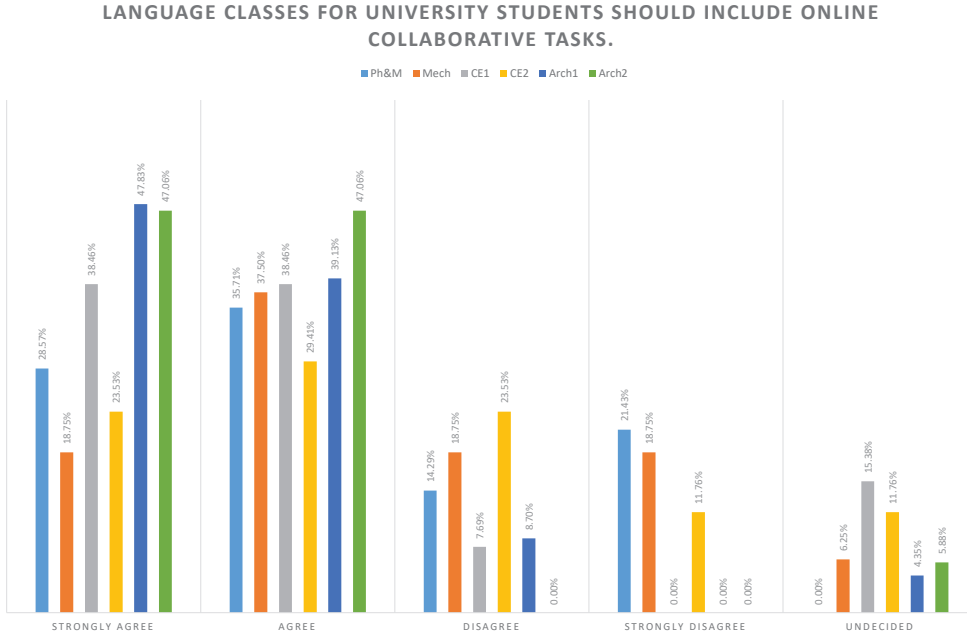
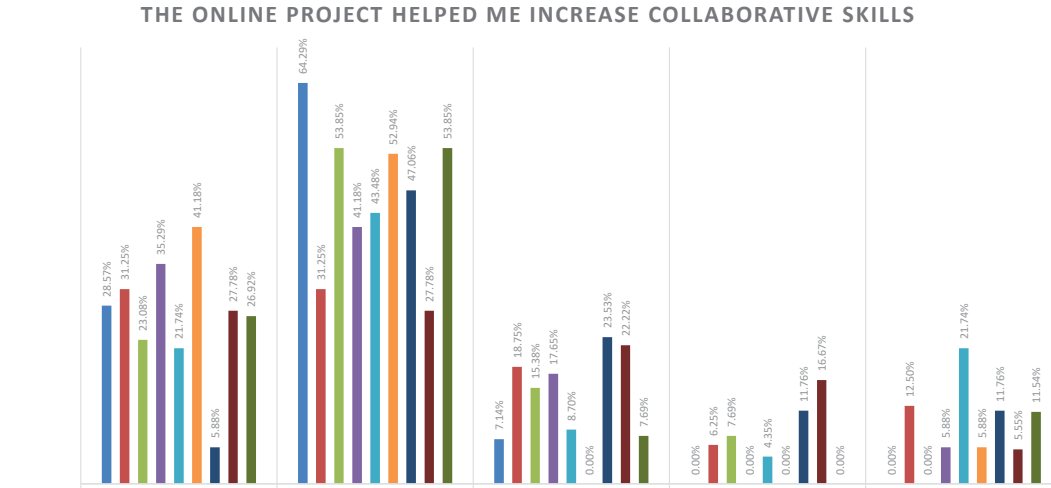


Figure 4. Willingness to participate in online collaborative language classes.

Not only the respondents who participated in the data visualisation tasks but also the ones who were involved in developing interactive posters in the previous stage of the research noticed an increase in their soft skills, namely in the collaborative one. Figure 5 shows the data collected in two phases of the research – the latest one in which the students made infographics and the previous one that focused on presenting critically analysed data and specifications. A statistical comparison of the two groups shows that more than half the students appreciated being engaged in online teamwork – the mean in the data visualisation group and in the interactive poster one equals 78.02% and 63.09% respectively, with the medians being 76.7% and 55.56%. There is a statistically significant difference between the responses in both groups ($p=0.039$, $p<0.05$). However, if there were more respondents in the second group (61 students completed the questionnaire) than in the first one (100 students), an analysis could show no statistically significant difference.



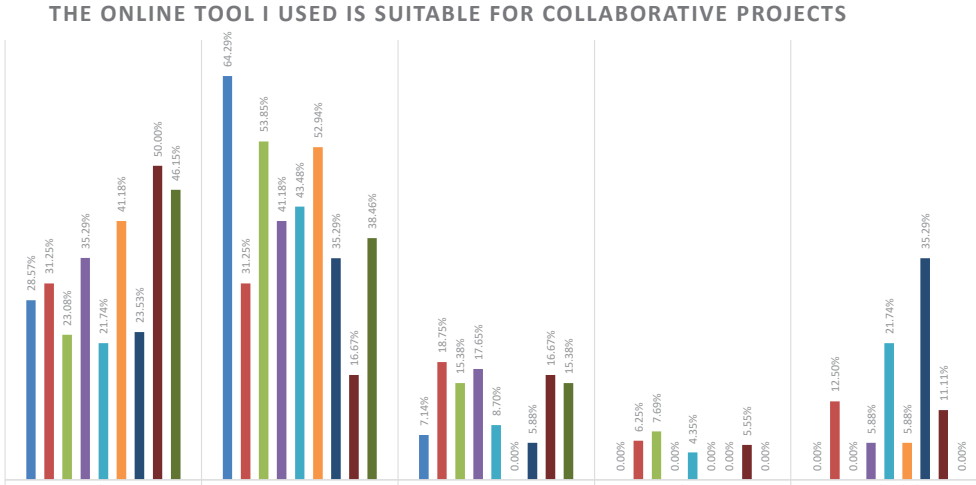
	Strongly Agree	Agree	Disagree	Strongly Disagree	Undecided
Ph&M	28.57%	64.29%	7.14%	0.00%	0.00%
Mech	31.25%	31.25%	18.75%	6.25%	12.50%
CE1	23.08%	53.85%	15.38%	7.69%	0.00%
CE2	35.29%	41.18%	17.65%	0.00%	5.88%
Arch1	21.74%	43.48%	8.70%	4.35%	21.74%
Arch2	41.18%	52.94%	0.00%	0.00%	5.88%
Mech IP	5.88%	47.06%	23.53%	11.76%	11.76%
Tele IP	27.78%	27.78%	22.22%	16.67%	5.55%
AR&ME IP	26.92%	53.85%	7.69%	0.00%	11.54%

Figure 5. Impact of online projects on collaborative skills.

The respondents used different tools, which might have affected their experiences. All of them were easy to use, free and did not require any technologically advanced knowledge. However, those which were applied to create infographics

– infogram and venngage – had more functionalities and their affordances were more varied and sophisticated. The respondents had also a wide range of templates to choose from, so they were supported pre-emptively by the tool's authors. The mural, quip, easel.ly tools do not provide users with so many possibilities to create advanced projects as the ones used to build infographics.

As can be seen in Figure 6, no matter which tool was applied and then evaluated, every one contributed to the development of collaborative skills from the point of view of the respondents. A majority of the students regarded the tool they had chosen as suitable for online teamwork (92.86 of Physics and Maths students,



	Strongly Agree	Agree	Disagree	Strongly Disagree	Undecided
Ph&M	28.57%	64.29%	7.14%	0.00%	0.00%
Mech	31.25%	31.25%	18.75%	6.25%	12.50%
CE1	23.08%	53.85%	15.38%	7.69%	0.00%
CE2	35.29%	41.18%	17.65%	0.00%	5.88%
Arch1	21.74%	43.48%	8.70%	4.35%	21.74%
Arch2	41.18%	52.94%	0.00%	0.00%	5.88%
Mech IP	23.53%	35.29%	5.88%	0.00%	35.29%
Tele IP	50.00%	16.67%	16.67%	5.55%	11.11%
AR&ME IP	46.15%	38.46%	15.38%	0.00%	0.00%

Figure 6. Suitability of online tools for collaborative projects.

62.5% of Mechanics students, 76.93% of Civil Engineering 1 students, 76.47% of Civil Engineering 2 students, 65.22% of Architecture 1 students, 94.12% of Architecture 2 students vs. 58.82% of Mechanics students, 46.67% of Telecommunication students, 84.61% of Automatics, Robotics and Medical Engineering students). The mean values for both groups are 78.02% (median for 100 participants equals 76.7%) and 63.37% (median for 61 participants equals 58.82%).

The first research phase showed that there was a significant correlation between the students' evaluation of the wiki tool, which has only basic functionalities, and soft skills development ($p<0.05$) – the higher the respondents rated the Moodle tool, the better they evaluated an increase in their collaborative skills (Mokwa-Tarnowska et al., 2018, p. 459) The comparison of the answers given by the two groups, of which each worked with different tools, the first one with more advanced than the second one, shows that all the tools can be used to deliver collaborative projects but there is no correlation between the complexity and sophistication of the tool and an increase in collaborative skills. Like in the previous comparative analysis across groups based on data in Figure 5, the result is considered statistically significant ($p=0.044$, $p<0.05$). However, the p-value is near the significance threshold of 0.05, so tests on a larger sample size must be repeated.

Conclusions

The qualitative research based on the observation of students' behaviour in class during project discussions, in-class presentations of the infographics and posters created during online collaboration, as well as answers to closed-ended questions with "other (specify)" responses and open-ended questions has revealed that the students enjoyed online collaborative work because it was conducted in an e-learning environment (dos Reis et al., 2018, p. 12), which was a new experience for most of them. The majority noticed an improvement in their hard competencies.

The productions that the students submitted for formative assessment included well-contextualised vocabulary and adequate grammar structures, as well as showed innovative solutions, particularly seen in the specifications in interactive posters. Thus, the work they had done added to an increase in the knowledge of different issues related to their specialisms. Additionally, they increased language fluency in the range of choice of lexis and grammar used in academic English, appropriateness of discourse, as well as digital literacy, which appear in national curricula and are needed for academic success and future work challenges.

The learning outcomes were particularly satisfactory in terms of the writing skill development, which was seen in follow-up paper-based tests. The average score was higher by 15% compared to the one in the tests that covered the same range of material, which were introduced in a traditional classroom setting and practiced during coursebook-based activities. The evidence comes from the latest phase of the research in which the students were asked to produce infographics

and write a description of a graph or a table based on the work. Thus, an online, active and student-centred environment had a more profound impact on an increase in the ability to use specialist vocabulary than traditional classroom teaching, which is more instructionist and much less interactive. This way of engaging students helped them to achieve the learning outcomes structured around communication in an academic environment and in the workplace, as described in the GUT's undergraduate course curriculum for all courses taught across the university.

They also had a chance to practice and increase different soft skills, such as analytical and critical thinking ones, as they were engaged in a critical analysis of data when working with authentic materials (Kołodziejczak et al., 2017). This is in line with the wording of another course outcome, central to TUG's language course curriculum, which states that during a first degree course, students are able to obtain and process information related to their field of study and an academic environment in a foreign language (Mokwa-Tarnowska et al., 2018). A positive attitude expressed by more than two thirds of the respondents results from their understanding of the possibilities of the online learning environment they used. They were involved in analysing data collected in Internet research and critical discussion. This, in turn, also led to their increased media literacy skills, as the majority of the data they studied came from films, documentaries, interactive poster presentations and infographics.

Both the qualitative and quantitative research, based on the observation of the students' behaviour during all project stages and their answers to the survey questions, prove that a web-enhanced academic English course should include online collaborative learning to satisfy various needs, including the authorities' needs related to outcomes.

It is also worth stressing that the students lacked sufficient practice as far as collaboration was concerned, some of them asked to be allowed to work individually at the commencement of their project. The reason they gave was that they did not like working in groups. They found it difficult to get along with others. This reveals that collaborative activities, including online ones, should be included in the syllabus of each university course. The presented research shows that educational programmes supplemented by web-based tasks, online group assignments in particular, may stimulate better engagement in course activities (Woo et al., 2007). They encourage students to explore up-to-date topics related to their study area, and motivate them to develop various hard and soft skills.

The participants of the projects improved their collaborative, analytical and critical thinking competencies and the writing skill in particular. It can also be assumed that the survey itself helped the students develop their reflective skills. After analysing their performance and responding to the questions, their meta-

awareness of the learning process increased, which should result in them being able to better self-direct their education in the future. The instructional design of the language courses they attended contributed to meeting the learning outcomes, central to the mission of the university.

Final Remarks

By participating in online collaborative language tasks, students can learn how to overcome different problems they may face in the future when working both in national and international teams, which is what students are expected to learn in a modern university course, and which is difficult to achieve in a traditional monolingual classroom, where there is a lack of genuine interactions and students feel forced to participate in artificially induced activities. With its affordances, a web-enhanced setting creates more opportunities for the development of adequate knowledge and soft skills. Its complex and versatile nature allows educators to address the students' expectations more explicitly and directly, and helps them achieve learning outcomes structured around key curricular concepts: creativity, communication, teamwork, media literacy and digital competencies.

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Iwona Mokwa-Tarnowska

Zadania grupowe online wzmacniające efekty uczenia się na zajęciach z języka angielskiego

Streszczenie

Istnieje wiele typów zajęć e-learningowych, blended learningowych i wspomaganych komponentami online. W zależności od nauczanych przedmiotów, kierunku i stopnia studiów, mają one zaspakajać zróżnicowane cele główne i szczegółowe zapisane w sylabusach. Bez względu na założenia konstrukcyjne, w każdym kursie internetowym lub wspomaganym narzędziami online widać inspiracje ideami behawiorystycznym. Mają one duży wpływ na sposób formułowania celów i język instrukcji, a w szczególności na konceptualizację efektów uczenia się. Widoczne jest to również w zapisach dotyczących tradycyjnych zajęć prowadzonych w sali wykładowej, seminaryjnej i laboratorium. Wykorzystanie licznych narzędzi online, oferujących różnorodne funkcjonalności, przyczynia się do znacznego zwiększenia możliwości interakcyjnych, niedostępnych w tradycyjnym, instrukcjonistycznym środowisku uczenia się i nauczania. Zajęcia z języka angielskiego przeznaczone dla studentów szkół wyższych, wykorzystujące komponenty e-learningowe, mogą stymulować do nauki poprzez aktywności skutkujące rozwojem wielu umiejętności potrzebnych w przyszłej pracy – kompetencji zarówno twardych, jak i miękkich. Dzięki wykorzystaniu narzędzi online do prowadzenia projektów grupowych można stworzyć bardziej autentyczne środowisko edukacyjne, przypominające sytuacje mające miejsce w życiu codziennym i zawodowym. Ułatwi ono studentom osiągnięcie zapisanych w sylabusach kursów językowych efektów uczenia

się, ukierunkowanych na nabycie przez nich umiejętności komunikacji, pracy zespołowej, korzystania z mediów oraz na rozwinięcie kompetencji językowych. W niniejszym artykule zaprezentowano wyniki badań nad efektywnością nauczania online, w których poddano analizie opinie studentów Politechniki Gdańskiej wyrażone w ankietach przeprowadzonych w latach 2017–2019.

S ł o w a k l u c z o w e: uczenie się języka angielskiego w szkole wyższej, narzędzia online, umiejętności twarde i miękkie, e-learning, projekty zespołowe

Ивона Моква-Тарновска

Совместное онлайн-обучение для улучшения результатов обучения на курсах английского языка

А н н о т а ц и я

Различные цели и задачи программы электронного обучения, смешанного обучения и веб-курсов, которые предназначены для определенных групп студентов или аспирантов, могут существенно различаться. Какими бы разными они ни были, они могут демонстрировать бихевиористские идеи, воплощенные в учебном дизайне. Множество онлайн-инструментов (текстовых, графических, мультимодальных и совместных) могут улучшить учебный опыт учащихся, поскольку блфгодаря им предлагаются возможности для взаимодействия, недоступные в традиционной, инструктивистской концепции классе. Таким образом, университетский языковой курс с веб-компонентами предлагает более универсальные возможности обучения, чем очные занятия, что может привести к тому, что студенты станут более компетентными и конкурентоспособными сотрудниками в ближайшие годы. Используя онлайн-инструменты, такие как ThingLink, фрески, шутки, easel.ly, инфограммы для сбора и критического анализа данных, они учатся по-новому, в более реальной среде. Такой способ заангажирования студентов помогает им достичь результатов обучения, основанных на общении, командной работе, медиаграмотности и языковых навыках. Эти идеи подтверждаются мнениями и отношением студентов, выраженными в опросах, проведенных в Гданьском технологическом университете в 2017–2019 годах.

К л ю ч е в ы е с л о в а: изучение языков через Интернет, онлайн-инструменты, твердые и мягкие навыки, электронное обучение, университетское образование, совместный проект

Iwona Mokwa-Tarnowska

Aprendizaje colaborativo en línea para mejorar los resultados educativos de los cursos de idioma inglés

R e s u m e n

Con varios propósitos y objetivos, los programas de aprendizaje en línea, el aprendizaje combinado y los cursos mejorados por la web destinados a un grupo particular de estudiantes universitarios o posgraduados pueden variar sustancialmente. Por diferentes que sean, es probable que muestren ideas conductistas incorporadas en el diseño instruccional. Una plétora de herramientas en línea (basadas en texto, basadas en imágenes, producción multimodal y colaborativas) pueden aumentar las experiencias de aprendizaje de los estudiantes, ya que ofrecen oportunidades para interacciones que no están disponibles en un aula instructivista tradicional. Por lo tanto, un curso universitario de idiomas con componentes mejorados en la web ofrece opciones de aprendizaje más versátiles que las clases presenciales, lo que puede hacer que los estudiantes se conviertan en trabajadores más competentes y competitivos en los próximos años. Al utilizar herramientas en línea como ThingLink, mural, quip, easel.ly, infogram para recopilar y analizar datos de manera crítica, aprenden de una manera nueva y activa, en un entorno más genuino. Esta forma de involucrar a los estudiantes les ayuda a lograr resultados de aprendizaje estructurados en torno a la comunicación, el trabajo en equipo, la alfabetización mediática y las habilidades lingüísticas. Estas ideas están respaldadas por las opiniones y actitudes de los estudiantes expresadas en las encuestas realizadas en la Universidad Tecnológica de Gdańsk en los años 2017–2019.

P a l a b r a s c l a v e: aprendizaje de idiomas mejorado por la web, herramientas en línea, habilidades duras y blandas, e-learning, educación universitaria, proyecto colaborativo

II. Innovative Methods and Technology in Education

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Application of Computer Mathematical Tools in University Training of Computer Science and Mathematics Pre-service Teachers

Abstract

The requirements for the training of mathematics and computer science teachers to use specialized mathematical software in professional activities are substantiated in the article. Among them: the ability to creatively choose the forms and methods of teaching for the use of specialized software; ability to find non-standard or creative mathematical problems; ability to make an informed choice of specialized software; ability to see possible ways to check the result obtained by the pupil; the ability to eliminate common mistakes when pupils use computer tools, etc. The specialized mathematical software, which is used today in mathematical training of mathematics and computer science teachers in Ukraine, has been specified. The specialized mathematical software which is used today for teaching mathematics in schools of Ukraine is given. The analysis of computer tools used by the teacher in the most common mathematical software is carried out. The most urgent problems faced by mathematics teachers in their professional activities are

highlighted. The experiment with ninth-grade pupils proved the positive impact of using dynamic geometry software and appropriate mathematical tools on the level of pupils' mathematical training, which is reason to talk about the importance of computer science and mathematics pre-service teacher training to involve such tools in professional activities. Prospects for further research in the direction of developing methods for using computer mathematical tools in a research-based learning environment are presented.

K e y w o r d s: computer mathematical tools; dynamic geometry software; computer algebra system; pre-service teacher of mathematics; pre-service teacher of computer science; university education

The professionalism of a modern teacher of computer science and mathematics is not only their competence in various fields of mathematical knowledge and computer science, their high qualifications, which are the key to successful work. Teachers of computer science and mathematics are required not only to use traditional forms and methods of education but also innovative ones, related in particular to digital technologies. Considering that a significant content of education at the University of computer science and mathematics teachers is occupied by mathematical disciplines, the problem of training teachers for the use of specialized software deserves attention. In our opinion, this problem can be considered along the following lines:

- clarification of specialized software for mathematics, which is now used in mathematical training of computer science and math teachers;
- finding out the problems faced by math teachers in their professional activities, even if they are familiar with specialized mathematical software;
- clarification of the list of knowledge and skills required by computer science and math teachers for use in professional activities of specialized mathematical orientation Program Soft.

Literature Review

Analysis of scientific publications in the field of mathematics gives grounds to talk about the use of certain types of specialized software: computer algebra systems (CAS) and dynamic geometry software (DGS). The former include such

programs as Maple, Mathematica, Maxima, and others, the latter – GSP (The Geometer's Sketchpad), GeoGebra, GRAN, DG, and others. Among the first type of programs, there are none offered by Ukrainian developers, which is explained by objective circumstances of lack of sufficient funding for such projects. Among the second type of programs, we note the Ukrainian GRAN and DG, which were once recommended for use in Ukrainian schools, but also stopped improving due to lack of funds.

Analysis of scientific and methodological publications on the specialized software use in the field of mathematics gives grounds to talk about the active use of the second type programs (DGS). Thus, Semenikhina and Drushlyak described some aspects of such programs use in the schools of Ukraine (Semenikhina & Drushlyak, 2015). Henseruk characterized the professional competence of a teacher, where the component is digital competence, which, among other things, involves the teacher's ability to use specialized software (Henseruk, 2019).

Stols and Kriek examine the influence of mathematics teachers' beliefs on their intended and actual usage of dynamic mathematics software in their classrooms. The theory of planned behavior, the technology acceptance model, and the innovation diffusion theory was used to examine the influence of teachers' attitudes, subjective norms, and perceived behavioral control on their intention to use dynamic mathematics software in their classrooms (Stols & Kriek, 2011). Hohenwarter and Preiner describe a study aimed to identify the most common impediments related to the introduction of an open-source mathematical software package GeoGebra. The study identified the challenges participants face during workshops and evaluated the difficulty levels of GeoGebra tools (Hohenwarter & Preiner, 2007). Saha, Ayub, Tarmizi investigated the peculiarities of using GeoGebra in the learning of coordinate geometry among students classified as high visual-spatial ability students and low visual-spatial ability students. The results of the study show that the use of GeoGebra enhanced the students' performance in learning coordinate geometry (Saha, Ayub & Tarmizi, 2010). Similar positive results were obtained in the study of Zengin, Furkan, Kutluca, which determined the effects of dynamic mathematics software GeoGebra on student achievement in the teaching of trigonometry (Zengin, Furkan & Kutluca, 2012).

Botana, Hohenwarter, Yanichich and others identified a number of GeoGebra features (integration of computer algebra, dynamic geometry, spreadsheet, etc.), that allow student experiments, in particular, in the context of proving theorems (Botana, Hohenwarter, Yanichich, et al. 2015). Dubrovskyi substantiated the basic principles of using the program Mathematical Constructor (Dubrovskyi, 2016). Morozova and Myroshkina presented methodological principles of work with the program Living Mathematics, which is a Russian equivalent of GSP (Morozova & Myroshkina, 2013).

Also noteworthy are studies on innovative teaching methods, in particular mathematics and computer science. Let us turn to the work "Innovative Pedagogical Methods in the Digital Era," which presents the following methods: Blended Learning, Flipped Learning, Problem Based Learning, Inquiry Based Learning (Dziabenko, 2020).

At the same time, our analysis of the scientific literature allowed us to establish that the issue of training pre-service teachers of mathematics and computer science to use specialized mathematical software in professional activities remains insufficiently researched. The development of software and its constant updating determine the new requirements for mathematics and computer science teachers' knowledge and skills in the field of using specialized Program Soft, the development of mathematical competence through e-learning, which is emphasized in the study of Heba, Kapounova, Smyrnova-Trybulska (Heba, Kapounová & Smyrnova-Trybulska, 2014).

The Aim of the Article

The aim of the article is to determine the requirements for the training of math and computer science teachers to use specialized mathematical software in professional activities.

The goal led to the solution of several tasks:

1) clarification of specialized mathematical software, which is currently used in mathematical training of math and computer science teachers in Ukraine;
2) clarification of specialized mathematics software, which is currently used for teaching mathematics in schools of Ukraine;
3) analysis of computer tools used by teachers in the most common mathematical software;
4) clarification of the problems faced by mathematics teachers in their professional activities;
5) clarification of the list of knowledge and skills required for mathematics and computer science teachers to use specialized mathematical software in professional activities.

Methodology of Research

To solve the first and second tasks, a survey was used, which consisted in the study of answers to the questions: "What mathematical software is used in teaching the following disciplines: mathematical analysis, linear algebra, analytical geometry, projective geometry, differential equations, differential geometry and topology, mathematical modeling, linear programming, group theory, probability theory and mathematical statistics, complex analysis, teaching methods"; "What mathematical software is used in teaching algebra and the beginnings of analysis, plane geometry, stereometry."

The sample for the first task consisted of 13 lecturers who had the experience of teaching a given discipline for at least five years, and numbered by discipline: mathematical analysis – 11, linear algebra – seven, analytical geometry – five, projective geometry – three, differential equations – 11, differential geometry and topology – three, mathematical modeling – four, linear programming – five, group theory – three, probability theory and mathematical statistics – three, complex analysis – five, teaching methods – three.

The sample for the second task was 73 teachers who had the experience of teaching senior classes for at least three years. Based on the results of first and second tasks, the most popular software type was selected. For this type, the analysis of available computer tools was carried out and the list of the most popular ones in the work of mathematics and computer science teachers was compiled.

To solve the fourth task, an expert survey was conducted: "Specify the problems faced by teachers of mathematics and computer science when using specialized mathematical software." The experts were teachers-methodologists and teachers of the highest category with a total number of five people.

The consistency of experts' opinions was assessed by the Kendall concordance coefficient. According to the results of the examination, the concordance coefficient W was determined by the formula:

$$W = \frac{12\sum_{j=1}^{n} d_j^2}{m^2(n^3-n)-m\sum_{i=1}^{m} T_i}, d_j = S_j - \frac{\sum_{j=1}^{n} S_j}{n}, S_j = \sum_{i=1}^{m} R_{ij}, T_i = \sum_{l=1}^{L}(t_l^3 - t_l)$$

R_{ij} – rank, assisted by the i expert to the j problem;
m – the number of experts, n – the number of problems;
l – the number of the same (related) ranks groups;
T_i – the number of related ranks in each group.

If the value of the concordance coefficients is close to 1, then obtained data indicate a high degree of experts' agreement.

The fifth task was solved by systematizing and summarizing the results of previous tasks.

The work was performed within the scope of scientific topics: “Theoretical and practical aspects of the use of mathematical methods and information technology in education and science” (registration number 0116U004625) Department of Computer Science and Mathematics, Borys Grinchenko Kyiv University and “Use of information technology in education” (registration number № 0111U005734) Department of Computer Science, Makarenko Sumy State Pedagogical University.

Results of Research

The results of task 1 are summarized in Table 1. It is worth noting that each respondent could indicate any number of the proposed software.

Table 1.
The results of the lecturers survey (%)

	Mathematical analysis	Linear algebra	Analytical geometry	Projective geometry	Differential equation	Differential geometry	Mathematical simulation	Linear programming	Group theory	Probability theory	Complex analysis	Methods of mathematics, computer science
Maple	0.18	0.14			0.18	0.33	0.25	0.2				
Mathematica												
Maxima	0.27	0.29			0.27			0.2				
R	0.09	0.43			0.09							
Mathlab	0.45	0.29	0.4		0.45	0.33						
Geogebra			0.6	0.33			0.25			0.33		0.66
Mathkit												0.66
GSP												0.33
other												0.33

According to the results of the survey, there are specific reasons to talk about the popularity of the first type of specialized mathematical software: Maple, Maxima, Mathlab, as well as program of the second type. The reasons are, as follows: the choice of Maple powerful tools, a wide range of tasks that the program helps to solve; the choice of Maxima by free distribution and sufficiently powerful tools for solving mathematical problems of the university course of mathematics for teachers; Mathlab's choice of toolkit power and significant prevalence among universities; Geogebra's choice of free distribution, specificity and constant updating of tools, which allows expanding the range of mathematical problems.

It should be noted that as the result of the training, mathematics and computer science teachers will be familiar with the mentioned programs and will be able to solve a range of mathematical problems based on their tools. The results of task 2 are presented in Table 2.

Table 2.
The results of teachers survey (%)

	Algebra and the beginnings of analysis	Plane geometry	Stereometry
Maple	0.11		
Mathematica			
Maxima	0.11		
R			
Mathlab			
Geogebra	0.73	0.73	0.82
Mathkit	0.62	0.62	
GSP		0.25	0.55
Cabri		0.07	0.07
Gran	0.44	0.44	0.44
DG		0.3	
other			

According to the results of the survey, the second type of software is popular in teaching mathematics at school, with Geogebra and Mathkit being the most popular, followed by Gran. We explain this by their free distribution, convenient and clear interface, as well as sufficient tools for solving school problems. Also, the use of Geogebra and Mathkit tools is often provided by educational programs for pre-service teachers of mathematics and computer science, in particular when studying teaching methods – this could be another reason for their popularity in teacher work.

Note that a survey of a similar kind was conducted by us in 2014, so the results were expected (Semenikhina & Drushlyak, 2015).

According to the results of the surveys, the most common in the educational and professional activities of mathematics and computer science teachers are the second type of software – programs Geogebra and Mathkit.

We will now discuss the results of task 3. In accordance with the results of the analysis of computer tools for dynamic mathematics, a list was created (Table 3).

Table 3.
Computer tools embedded in the DGS

Tool available from the panel or menu	DG	Gran 1	Gran2D	Gran3D	Cabri	Cabri 3D	GeoGebra	GeoGebra 5.0	Living Mathematics	Mathematical constructor
1	2	3	4	5	6	7	8	9	10	11
1. Calculator	+	+	+	+	–	–	+	+	+	+
2. Construction of a point, line, ray, segment, circle	+	–	+	–	+	+	+	+	+	+
3. Construction of the middle of the segment, bisector	+	–	+	–	+	+	+	+	+	+
4. Construction of an arc	+	–	+	–	+	+	+	+	+	+
5. Construction of a sector, segment	–	–	–	–	+	–	+	+	–	+
6. Construction of a perpendicular or parallel line	+	–	+	–	+	+	+	+	+	+
7. Division of a segment or angle into parts	–	–	–	–	+	–	–	–	–	+
8. Determination of length, angle, area	+	–	+	+	+	+	+	+	+	+
9. Construction of a polygon	+	–	±	–	+	+	+	+	+	+
10. Construction of a tangent to a curve	–	–	±	–	–	–	+	+	–	+
11. Construction of a function graph given explicitly and implicitly	–	+	–	+	–	±	׀	׀	±	+
12. Construction of a function graph given parametrically	–	+	–	–	–	–	׀	׀	±	+
13. Construction of an interpolation polynomial	–	+	+	–	–	–	+	+	–	+

1	2	3	4	5	6	7	8	9	10	11
14. Convert function graphs	–	–	–	–	–	–	–	–	–	+
15. Actions on sets	–	–	–	–	–	–	–	–	–	+
16. Construction of a polyhedral	–	–	–	+	–	+	–	+	–	–
17. Spatial objects management	–	–	–	±	–	+	–	+	–	–
18. Construction of a plane, a half-plane, a selection of a face of a polyhedron, construction of a cylinder, a cone, a sphere	–	–	–	±	–	+	–	±	–	–
19. Calculation of definite integrals, solving equations and inequalities of different types, their systems	–	+	–	±	–	–	±	±	–	–
20. Statistical processing of results	–	+	–	–	–	–	+	+	–	±

This list is sufficient to solve the typical problems of the school course of mathematics. We also analyzed the methodological tools provided by the developers of the second type of programs (Table 4).

Table 4.
Methodical methods provided in DGS

Characteristic	DG	Gran 1	Gran2d	Gran3d	Cabri	Cabri 3d	GeoGebra	GeoGebra 5.0	Living Mathematics	Mathematical constructor
Step-by-step animation	*	–	*	–	*	*	*	*	*	*
Creating of own tools	*	–	*	–	–	–	*	*	*	*
Setting marks on the object	–	–	–	–	–	–	*	*	–	*
Image restrictions	–	–	–	–	–	–	–	–	–	*
Built-in demonstrations	–	–	–	–	–	–	–	–	–	*
Set the type and color of objects	*	*	*	*	*	*	*	*	*	*
Installing buttons	–	–	–	–	*	*	*	*	*	*
Hiding objects	*	*	*	–	*	*	*	*	*	*
Organization of control	–	–	–	–	–	–	–	–	–	*
Dynamic trail	*	–	*	–	*	*	*	*	*	*

As can be seen from Table 4, the MathKit program provides the greatest methodological support for teachers, as it allows enhancing the effect of learning by creating your tools, setting marks on the object, the ability to restrict images, use built-in demonstrations, set buttons, hide objects and organize automated control over mathematical solutions – these functions are not always avaliable in other programs.

To perform task 4 of our study, the results of an expert survey provided the following list of problems which mathematics and computer science teachers face or may face when using the second type of specialized software.

1. The use of DGS requires *rethinking of forms and methods of training by a teacher*. The traditional solution to the problem from the textbook with the help of software is not always advisable. As an example, problems for the transformation of expressions require an understanding of formulas, geometric problems for proof require additional initial training, a large number of tasks involves simply practicing a particular skill (counting, simplifying, calculating). At the same time, if the teacher plans to involve a computer, it is worth using tasks that provide some research without reference to specific data numbers.

Thus, the study of the sine theorem may not be conducted through direct proof of this theorem, but rather through the empirical study of the sides and angles of a triangle: "In a triangle opposite a smaller angle lies always a smaller side, etc." Pupils should record the results of twenty studies in a table (Table 5) for each type of triangle (equilateral, isosceles, versatile obtuse, versatile acute) and draw the appropriate conclusions. Empirical results must then be proved mathematically, but as practice shows, empirically obtained results are better mastered.

Table 5
Table of research result

Triangle parameter	Side a	Angle A	Side b	Angle B	Side c	Angle C	Smallest angle (letter)	Smallest side (letter)
Experiment №1								
Experiment № 2								
Experiment № 3								
…								
…								
Experiment № 20								

2. *The DGS use requires the search for non-standard and creative tasks.* This is because modern pedagogical theory and practice promote the development of the creative abilities of pupils, including the use of ICT. It is known that one of the components of creative thinking is intuition. It is the content of mathematical problems that determines its development. Scientists claim that solving problems best promotes the development of observation, the ability to apply visual thinking, and other faculties.

We have also noted that the realization of interdisciplinary connections contributes not only to the formation of skills to model objects of different nature but also to the better assimilation of the subject and increased knowledge of the subject. In particular, it is proposed to visualize molecules and atoms of substances, whose structure is subject to symmetry laws or to model the water movement in a garden hose under the influence of gravity.

3. *The problem of environment-rational choice.* Our observations have shown situations when the problem is solved using a computer tool which is not optimal. However, this problem is easy to solve when you already have experience with such tools and identify opportunities for their use in maths lessons. Thus, it is not always appropriate to involve the program *Gran3d* to solve stereometry problems, because its limited tools (creation of basic stereometric objects, parallel transfer, and rotation) does not allow for operatation with equations of objects and their transformations (the program *Cabri 3D* does not provide for the assignment of objects by their equations either). Instead, *GeoGebra 5.0* will successfully assist in solving problems set analytically.
4. *To check the results of solving the problem using a computer program*. It is important to understand the pupil's approach to creating a solution. Thus, the problem of constructing a square can be solved in several ways, not all of which will be correct (for example, the construction of lines which are visually perpendicular to each other, but do not retain this property with a dynamic change of design).
5. *Standard errors when using computer tools.* Such errors include incorrect command syntax, incorrect use of the tool, lack of understanding of the result of the tool's impact on the object, inability to explain the obtained solutions following the use of the tool, and so on.

Typical errors are not limited to those given above. Focusing on them adds confidence that pre-service teachers will be able to avoid the same mistakes. Therefore, it is extremely important to have a clear presentation of the training material, a well-chosen system of exercises, recommendations which prevent the implementation of incorrect actions.

So, the list of problems which mathematics and computer science teachers face or may face when using specialized software of the second type, includes the following: the need to rethink the established forms and methods of teaching by

the teacher, the problem of a constant search for non-standard and creative tasks, the problem of software rational choice; the problem of checking the obtained computer's result, the problem of common errors in the use of computer tools. The assessment of the experts' consistency opinions was based on the Kendall concordance coefficient and amounted to 0.75 (Table 6).

Table 6
Distribution of expert's opinions

	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6
Problem 1	1	1	1	1	1	2
Problem 2	2	3	2	2	2	1
Problem 3	4	5	4	4	4	4
Problem 4	3	2	3	3	3	3
Problem 5	5	4	5	5	5	5

Since the value of the coefficient is more than 0.5, there is reason to speak about the consistency of experts' opinions on several problems faced by teachers in order to rationally and prudently approach the involvement of specialized software in professional activities. Testing the hypothesis on the significance of the concordance coefficient according to Pearson's criterion (H_0: the value of the concordance coefficient is random; H_1: the value of the concordance coefficient is significant) also confirms these conclusions (the value χ^2 empirical is 11.714, which is more than χ^2 critical 11.07 for the significance level of 0.05 and $6 - 1 = 5$ degrees of freedom). These problems can be eliminated provided that mathematics and computer science teachers are prepared for the creative choice of forms and methods of teaching, the ability to find non-standard or creative mathematical problems, the ability to make an informed choice of specialized software, a vision of possible ways to check the computer result obtained by the pupil and typical errors in the use of computer tools.

It should also be noted that conducted expert analysis was taken into account to improve the educational programs for the training of mathematics and computer science pre-service teachers. In particular, we have expanded the content of the course "Teaching Methods" with a separate module "Teacher's problems when using specialized software." In addition, we have developed and proposed a elective special course "The use of computers in teaching mathematics." One of the tasks in the formation of mathematics and computer science pre-service teachers is the ability to rationally choose dynamic geometry software to solve certain classes of mathematical problems and the development of creative skills in reformulating textbook problems.

To perform task 5 to clarify the list of skills required for mathematics and computer science teachers to use specialized mathematical software in professional activities, an extended analysis of the mathematics school course topics in a primary school was conducted to support them with computer-aided mathematical tools, identified during the analysis of the relevant environments. Such an analysis, along with the study of mathematical education standards, revealed that the requirements for the training of specialists are formulated too "broadly." In particular, the level of standard for pre-service mathematics teachers in the use of special computer programs is defined only as an ability to select and use ready-made software (mathematical application packages) for symbolic, graphical, numerical analysis of mathematical models of real objects. There is no clarification of the computer tools list or their types, methods of their study, or methods of use at the task level of quantitative content or competence.

This led to further research in the direction of clarifying the computer tools list which should be in the arsenal of modern mathematics teachers from the standpoint of state requirements for teacher training.

Clarification of the computer mathematical tools list necessary for a modern mathematics teacher was implemented by us in the typical tasks of the school mathematics course, existing mathematical software, requirements for primary school graduates and educational standards of higher education (Mathematics. State standard of basic and complete secondary education. Educational branch "Mathematics," 2004).

Therefore, the generalization of our previous research, as well as the analysis of educational standards for higher education and secondary schools, curricula for computer science and mathematics teachers allowed to specify and harmonize the requirements of the pedagogical education standard, the need for school mathematics and a list of teacher skills in using specialized software (Table 7).

The described analysis and refinement of standards allow to single out those educational tasks whose solution will ensure the formation of computer science and mathematics pre-service teachers the ability to use computer mathematical tools in professional activities:

– formation of competence for solving standard problems of the school algebra and geometry course with the use of computer mathematical tools;
– formation of integral computer mathematical tools as one of the teaching aids;
– formation of skills taking into account the chosen method of training to choose the expedient computer mathematical tool;
– formation of skills to choose the best of the available computer mathematical tools for the implementation of various tasks.

Table 7
Skills of math and computer science teachers

Standard requirement	Clarification of the requirement in the context of the study
Be able to select and use ready-made software tools (mathematical application packages) for symbol-formula, graphic, numerical analysis of mathematical models of real objects	Be able to use specialized software of the second type (DGS). Be able to choose the best of the available mathematical computer tools to visualize the condition, step-by-step demonstration of the solution, accelerate the result, check the answer
Possess the use of computer, numerical and graphic information processing systems, subject-oriented application systems	Possess the tools of programs of DGS
Be able to compose programs for solving typical educational problems	Be able to solve typical problems of school mathematics course topics with the use of computer tools
Be able to choose tools and methods of teaching using computer technology	Be able to choose the appropriate computer tool, taking into account the chosen method of teaching
Be able to use computer-oriented systems of teaching disciplines in their specialty	Be able to use a computer tool and teach students to use it independently Be able to creatively choose the forms and methods of teaching for the use of specialized software Ability to find non-standard or creative mathematical problems Ability to make an informed choice of specialized software Be able to see possible ways to check computer result obtained by the pupil Ability to correct common mistakes when pupils use computer tools

Discussion

In the previous works of the authors of this study, V. Proshkin and O. Semenikhina, it was established that in the system of Ukrainian mathematical education there is terminology which characterizes its informatization. Among them is mathematical software, by which are meant tools whose functionality is focused on solving certain classes of mathematical problems, and pedagogical software, which

means a kind of electronic educational resources that requires the involvement of certain types of computer technology (computer, smartphone, tablet, etc.), is used for a specific pedagogical purpose and serves to support the educational process (Astafieva, Bodnenko & Proshkin, 2019; Semenikhina, Drushlyak, Shishenko & Zigunov, 2018). One of the important characteristics of pedagogical software is interactivity, which is the direct response of the system to user actions. Given this, some mathematical software which allows you to organize an interactive research process or interactive visualization of analytical or geometric properties of a particular mathematical object or structure can be considered pedagogical and should be used in mathematical training.

A review of the scientific methodological literature in the field of teaching mathematics shows that two classes of mathematical software are studied in general, although at the same time software developers offer a wide range of narrowly oriented programs (graph plotters, mathematical statistics systems, etc.). The first class includes computer algebra system (Maple, MatLab, Maxima, etc.). These systems are especially effective in solving a variety of applied problems, especially problems of mathematical modeling in science and technology. The second class includes programs of dynamic geometry software (DGS), which provide not only the ability to draw accurate figures, build various graphs, find the roots of equations, inequalities, and their systems, etc., which is difficult without the environment, but also the possibility of dynamic changes of mathematical construction, the study of its numerical characteristics or their relations in the dynamics: GeoGebra, Mathkit or Mathematical Constructor, DG, Gran, Cabri, Living Mathematics, etc. (Althoen, 2009; Hohenwarter, 2008).

The interfaces of the mentioned programs and their principles are very similar: through the use of the mouse and the toolbar mathematical objects such as functions and graphs can be represented, calculations can be done, certain geometric objects (points, lines, segments, circles, as well as their constructions) can be created, dynamic changes can be made, certain properties fixed to calculate values of lengths, angles, areas, etc. It should be noted that the analysis of the existing scientific and methodological bank revealed some terminological limitations regarding the designation of software actions (the available terms being ”service,” “tool,” “team,” “means”). There is no correlation between these concepts in the works of scientists, so in the context of our study, we define the essence of a computer mathematical tool: we consider a computer tool as a certain virtual algorithm (a mechanism), which can be separate or in the environment of a computer program. It can be used to affect the object to obtain the desired result.

Mathematical tools are tools used to analyze various objects (phenomena), investigating their numerical or geometric characteristics. They are usually used in the process of calculating, measuring, or constructing various geometric shapes.

The given definitions allow us to specify the term "computer mathematical tool" as a virtual algorithm (a mechanism) of a computer program (the program itself), used to develop and study mathematical objects (their components) through different numerical and geometric characteristics of existing objects.

Taking into account the above given definition, we have analyzed several computer algebra systems to identify their computer mathematical tools. We strongly believe that these programs are computer mathematical tools and also perform the functions of a specific environment, where there is a subset of different computer tools.

Our research additionally raised the question of the minimum number of computer mathematical tools sufficient for the professional activity of computer science and mathematics teacher. The experts suggested to proceed from the analysis of typical problems in a school mathematics course, whose solution requires a certain list of computer mathematical tools, analysis of available tools in DGS, teachers' experience in using DGS in mathematics teaching, and, taking into account the results of students' achievements, re-service computer science and mathematics teachers. The results of this analysis showed the need to master various tools. Note that many of them are embedded in the DGS Living Mathematics, which is not very popular with both students and teachers because of the ascetic interface, from which we conclude that there is an excess stock of computer mathematical tools in all other DGS.

It is worth noting that the developers of information products are modernizing them in the context of expanding opportunities to solve various problems, as well as providing procedures to simplify the implementation of the educational process. Such modifications include a step-by-step demonstration and the ability not to show individual objects and texts. A modern version of several programs, Mathematical Constructor for example, also provides test control of knowledge.

Let us list and outline the methodical features of the application of computer mathematical tools. They include:

– the ability to change the pattern in the dynamics, observation of the trajectories of points. This allows for a better organization and implementation of research activities of the educational process (pupils have some tools for mathematical discovery, the teacher has a pedagogical way which contributes to a high-quality understanding of the mathematical idea);
– the ability to expand the set of tools for constructing the middle of a segment, parallel to a line or perpendicular, the installation of tools which have already been used. As practice shows, this simplifies the construction process;
– the computer helps the computer science and mathematics teacher to verify the correctness of difficult constructions. It is interesting that in some computer

systems, for example, at Mathematical Constructor, the check is performed automatically.

We see the solution to erroneous problem solving with the use of DGS in the introduction of such learning technology, which would allow to verify the result, in particular when using multiple DGS, parallel involvement of analytical methods, as well as when using tasks with insufficient, redundant data, contradictions, as well as creative and exploratory tasks.

Therefore, the appropriate preparation of teachers for the effective use of computer mathematical tools is especially important. It is important to define each task and tools for solving, but also to arrange the selected tasks in such a sequence that they are initially simple and feasible for most pupils and their complexity gradually increases. The practice has shown that if a pupil feels that the task is too complex, he moves on to solving simpler problems, including those in another virtual environment.

We implemented the clarification of the computer mathematical tools list required for computer science and mathematics teachers in the typical tasks from school mathematics course, the current mathematical software tools, the requirements for primary school graduates, and the educational standards of higher education. We also identified a list of topics for the appropriate use of computer mathematical tools, indicated the programs where these tools are provided, indicated the availability of computer tools for individual programs in studying school mathematics courses (also gave the conditions of typical problems).

An interesting result of our study was an experiment related to the study of the impact of DGS on the level of pupil's achievement. It was conducted by pre-service computer science and mathematics teachers after mastering a special course related to the study of computer mathematical tools.

During the 2018–2019 academic year, fourth-year students majoring in mathematics at Makarenko Sumy State Pedagogical University proposed as a diploma project to lead a student academic society whose main purpose was to solve mathematical problems in DGS environments. Students developed the program of the circle, selected problems of different complexity levels and according to their preferences one could choose the DGS. It was necessary to investigate whether the use of computer mathematical tools affected the level of pupil achievement.

This level was checked by the tasks of the SFE at the beginning of the circle's activity and once it ceased.

Pupils of 9th grade of schools in the Sumy region took part in the experiment. The total number was 72 people.

The pupils were asked to answer the test questions at the beginning and at the end of group meeting, the list of tasks and answers was positively assesed by

experts in the mathematic field. The test was positioned as one which checks the level of 9th-grade pupils' mathematical training.

The maximum number of test scores was 25.

The general level of academic achievement and its dynamics was monitored by students. Since the scale of names had two positions correct/incorrect, the results of each sample members were dependent, but as the results between the sample members were mutually independent we used the criterion of signs to process the overall results.

The null hypothesis is that the work of the circle does not affect the quality of pupils' mathematical training. Alternative – the quality of mathematical training will change.

At the significance level, 0,05 is the critical value of statistic *Gcrit*.=28.

Table 8 shows the test results.

Table 8
Pupils' test results

№ resp.	Type of change	№ resp.	Type of change	№ resp.	Type of change	№ resp.	Type of change	№ resp.	Type of change	№ resp.	Type of change
1	0	13	5	25	-2	37	-1	49	0	61	0
2	2	14	3	26	-2	38	-2	50	4	62	0
3	4	15	2	27	-1	39	-4	51	2	63	2
4	-1	16	6	28	6	40	-2	52	3	64	-2
5	-3	17	-4	29	2	41	3	53	1	65	-1
6	0	18	-1	30	5	42	3	54	1	66	-3
7	-2	19	0	31	6	43	0	55	1	67	-1
8	0	20	-2	32	3	44	2	56	-1	68	2
9	-1	21	-1	33	-2	45	0	57	-2	69	2
10	2	22	6	34	-3	46	3	58	2	70	-1
11	3	23	2	35	-1	47	3	59	2	71	-1
12	2	24	3	36	-1	48	0	60	2	72	2

According to the rules of decision-making, we have that *Gemp*.= 27. Since the empirical value is less than critical, an alternative hypothesis is accepted about the impact of the group work on the quality of pupils' mathematical training, and this impact is positive because the number of positive shifts (35 respondents increased) exceeds the number of negatives (27 respondents showed a decrease in overall score test).

In other words, there is a reason to speak about the positive impact of DGS use and relevant mathematical tools on the level of schoolchildren's mathematical

training, and therefore there is a reason to talk about the importance of training pre-service computer science and mathematics teachers to involve such tools in their professional activities.

Conclusions

A survey of university lecturers and school teachers in Ukraine established that the most common specialized software for teaching mathematics are Maple, Maxima, Mathlab (CAS) and Geogebra, and Mathkit (DGS). The factors influencing the popularity of using these programs in teaching mathematics were highlighted. This made it possible to analyze the available computer tools and compile a list of computer tools which are most in-demand in the work of mathematics and computer science teachers. Methodological receptions that were provided by developers of DGS programs were analyzed.

As a result of an expert survey of teachers-methodologists, the most pressing problems faced by mathematics and computer science teachers when using DGS were identified. The assessment of the experts' opinions consistency is based on the Kendall concordance coefficient. This allowed us to identify the requirements for the training of mathematics and computer science teachers to use specialized software for mathematics in professional activities. These include the ability to creatively choose the forms and methods of specialized software, the ability to find non-standard or creative mathematical problems, the ability to make an informed choice of specialized software, a vision of possible ways to check the computer result obtained by the pupil, skills to eliminate the common mistakes when pupils use computer tools.

To clarify the list of skills required for mathematics and computer science teachers to use in professional activities of specialized mathematical software and to support them with computer mathematical tools, the analysis of the school mathematics course topics of primary school has been carried out. The list of computer tools that should be in the arsenal of a modern mathematics and computer science teacher was specified.

As a result of an experiment related to the study of DGS influence on the level of pupils achievement, a positive effect of DGS use on the level of schoolchildren mathematical training has been established (using the G-criterion of signs). This determines the importance of preparing pre-service computer science and mathematics teachers to use DGS in professional activities.

We see the prospect of further scientific research in the development of methods for using computer mathematical tools in a learning environment based on research. We also consider it appropriate to analyze the application of computer mathematical tools in university training of computer science and mathematics pre-service teachers in different countries.

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Zastosowanie komputerowych instrumentów matematycznych w przygotowaniu przyszłych nauczycieli informatyki i matematyki na uniwersytetach

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

W artykule uzasadniono wymagania stawiane kształceniu nauczycieli matematyki i informatyki w kontekście wykorzystania specjalistycznego oprogramowania na kierunku matematycznym w działalności zawodowej. Wzięto pod uwagę: umiejętność twórczego doboru form i metod nauczania obsługi specjalistycznego oprogramowania; umiejętność znajdowania niestandardowych lub kreatywnych problemów matematycznych; umiejętność dokonania wyważonego wyboru specjalistycznego oprogramowania; możliwość zobaczenia sposobów sprawdzenia wyniku uzyskanego przez ucznia; umiejętność eliminowania typowych błędów przy korzystaniu z narzędzi komputerowych itp. Doprecyzowano specjalistyczne oprogramowanie kierunku matematycznego, które jest obecnie wykorzystywane w kształceniu matematycznym nauczycieli matematyki i informatyki na Ukrainie. Przedstawiono specjalistyczne oprogramowanie kierunku matematycznego, które jest dziś używane do nauczania matematyki w ukraińskich szkołach. Dokonano analizy narzędzi komputerowych wykorzystywanych przez nauczyciela we wspólnym oprogramowaniu kierunku matematycznego. Zwrócono uwagę na najpilniejsze problemy, z którymi borykają się nauczyciele matematyki w swojej działalności zawodowej. W wyniku eksperymentu z uczniami klas 9 wykazano pozytywne uwarunkowanie stosowania dynamicznych układów geometrycznych i odpowiednich narzędzi matematycznych na poziom przygotowania matematycznego uczniów, co jest podstawą do rozmowy o znaczeniu przygotowania przyszłych nauczycieli informatyki i matematyki do wykorzystania takich narzędzi we własnej działalności zawodowej. Przedstawiono perspektywy dalszych badań naukowych w kontekście opracowania metodologii wykorzystania komputerowych narzędzi matematycznych w uczeniu się opartym na badaniach.

S ł o w a k l u c z o w e: komputerowe narzędzia matematyczne; dynamiczne oprogramowanie geometryczne; systemy algebry komputerowej; przyszły nauczyciel informatyki; przyszły nauczyciel matematyki; edukacja w uniwersytecie

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Применение компьютерных математических инструментов в университетской подготовке будущих учителей информатики и математики

Аннотация

В статье обоснованы требования к подготовке учителей математики и информатики в контексте использования специализированного программного обеспечения математического направления в профессиональной деятельности. Среди них: умение творчески выбирать формы и методы обучения использования специализированного программного обеспечения; умение находить нестандартные или творческие математические задачи; умение осуществить взвешенный выбор специализированного программного обеспечения; умение видеть возможные пути проверки полученного учеником результата; умение устранять типовые ошибки при применении учеником компьютерных инструментов и т.д. Уточнено специализовананое программное обеспечение математического направления, которое сегодня используется в математической подготовке учителей математики и информатики в Украине. Представлено специализированное программное обеспечение математического направления, которое сегодня используется для обучения математики в школах Украины. Осуществлен анализ компьютерных инструментов, используемых учителем в распространенного программного обеспечения математического направления. Выделены наиболее актуальные проблемы, с которыми сталкиваются учителя математики в профессиональной деятельности. В результате эксперимента с учениками 9-х классов доказано положительное влияние использования динамических геометрических систем и соответствующего математического инструментария на уровень математической подготовки школьников, ято является основанием говорить о важности подготовки будущего учителя информатики и математики к использованию такого инструментария в собственной профессиональной деятельности. Представлены перспективы дальнейших научных поисков в контексте разработки методики использования компьютерных математических инструментов в условиях обучения, основанного на исследованиях.

Ключевые слова: компьютерные математические инструментарии; динамическое геометрическое програмное обеспечение; системы компьютерной алгебры; будущий учитель информатики; будущий учитель математики; университетское образование

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Aplicación de instrumentos matemáticos informáticos en la formación universitaria de futuros profesores de informática y matemáticas

A n o t a c i ó n

El artículo fundamenta los requisitos para la formación de profesores de matemáticas e informática en el contexto del uso de software especializado en la dirección matemática en actividades profesionales. Entre ellos: la capacidad de elegir creativamente las formas y métodos de enseñar el uso de software especializado; la capacidad de encontrar problemas matemáticos creativos o no estándar; la capacidad de realizar una elección equilibrada de software especializado; la capacidad de ver posibles formas de comprobar el resultado obtenido por el alumno; la capacidad de eliminar errores típicos cuando un estudiante usa herramientas informáticas, etc. Se ha aclarado el software especializado de la dirección matemática, que se utiliza actualmente en la formación matemática de profesores de matemáticas e informática en Ucrania. Se presenta el software especializado de la dirección matemática, que se utiliza hoy para enseñar matemáticas en las escuelas ucranianas. Se realiza el análisis de las herramientas informáticas utilizadas por el docente en el software común de la dirección matemática. Se destacan los problemas más urgentes que enfrentan los docentes de matemáticas en sus actividades profesionales. Como resultado del experimento con estudiantes de 9 grado, se comprobó la influencia positiva del uso de sistemas geométricos dinámicos y las herramientas matemáticas correspondientes en el nivel de formación matemática de los escolares, que es la base para hablar sobre la importancia de preparar un futuro. profesor de informática y matemáticas para utilizar dichas herramientas en sus propias actividades profesionales. Se presentan las perspectivas de futuras investigaciones científicas en el contexto del desarrollo de una metodología para el uso de herramientas matemáticas informáticas en el aprendizaje basado en la investigación.

P a l a b r a s c l a v e: herramientas matemáticas informáticas; software de geometría dinámica; sistemas informáticos de álgebra; futuro profesor de informática; futuro profesor de matemáticas; educación universitaria

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Using the Application Friendly Schedule on a Tablet to Promote Independence in Children with Autism Spectrum Disorder

Abstract

The prevalence of autism spectrum disorder (ASD) has increased in recent decades. The need to provide evidence-based practices in the field of ASD is also growing. The Institute for Child Development (IWRD) in Poland is offering science-based intervention to children with autism, based on the model developed initially by McClannahan and Krantz (1993) in the Princeton Child Development Institute, USA. Their research and clinical experience show that activity schedules are very effective in teaching people with autism many new skills. However, activity schedules in the "traditional" paper version could lead to stigmatization while used in the social environment. It is essential to give people with autism spectrum disorder socially acceptable tools, which can help them to function more independently. The intensive development of modern technologies as well as an easy access to various types of mobile devices inspired us to implement tablets into our treatment. Friendly Schedule is an application for children and youth with autism and related disorders, which was developed as a joint initiative of the Gdańsk University of Technology and the Institute for Child Development. The application was created as a "non-profit" project. The data from our research show that manual prompts

are very effective in teaching children with autism to follow activity schedules on a tablet. All of our participants learned to use the application Friendly Schedule to complete five tasks independently. In the IWRD program the application Friendly Schedule is used to teach students with autism a variety of new skills, including verbal and social behaviours.

K e y w o r d s: autism, activity schedules, application, assistive technology, manual prompts, independence

Autism Spectrum Disorder

Autism was described for the first time 75 years ago by Leo Kanner. There is no brain scan, blood test, or any other objective test which can diagnose autism. The diagnosis must rely on observations of a person's behaviour. The definitions and diagnostic criteria for autism have changed many times over the years. The latest changes made by the American Psychiatric Association are very broad. The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM; APA, 2013) included autism within the neurodevelopmental disorders. DSM-5's classification also changed the diagnostic name to "autism spectrum disorder" (ASD) to emphasize that the level of functional independence among individuals with autism can differ from very mild to severe. Individuals with ASD show varying degrees of severity of major symptoms: difficulties in social communication, restricted and repetitive behaviour, and sensory abnormalities (De Groot & Van Strien, 2016). The prevalence of autism is still growing. The data from 2016 published by the Centers for Disease Control and Prevention (Maenner et al., 2020) estimate autism's prevalence as 1 in 54 children aged eight years. A strong male bias in autism spectrum disorder (ASD) prevalence has been observed – the combined male to female prevalence ratio was 4.3 to 1. The first symptoms of autism appear before the child reaches the age of three. Deficits in social reciprocity are the most significant factor for autism. People with ASD have difficulties with a normal back-and-forth conversation; they very often fail to initiate or respond to social interactions and rarely share their interests or achievements with others. For some people with autism, the development of spoken language will be delayed, and others will have no spoken language. Difficulties in verbal communication are not compensated by nonverbal communication. People with autism can show marked impairment in the use of eye contact, facial expressions, or body postures. They also have deficits in understanding and using gestures during social interaction

(APA, 2013). Limited communication and inability to express personal needs may result in unwanted behaviours such as tantrums or aggression. In the diagnostic criteria of ASD, there are also listed restricted, repetitive, and stereotyped patterns of behaviour, interests, and activities. People with autism can show inflexible adherence to specific, non-functional routines or rituals. They can engage in different types of stereotyped or repetitive motor movements. In ASD, developmental deficits are very extensive and limit a person's ability to function properly in many different areas of life.

Applied Behaviour Analysis

Although no cure for autism is known, there are well-documented treatment approaches which can address some of the challenges associated with ASD. Behavioural approaches have been recognized by many researchers and practitioners as the most effective treatment methods (Green, 1996; Howard et al., 2005; Eikeseth et al., 2007; Peters-Scheffer et al., 2011). In these approaches, treatment procedures are based on the principles of applied behaviour analysis. Applied behaviour analysis (ABA) is the data- and research-based application of behavioural principles to socially significant behaviour (Cooper et al., 2007). The best results for children with autism can be achieved by a long-term, comprehensive ABA intervention. Positive effects can be observed in intellectual functioning, language development, and adaptive behaviour of people with autism. More evident results can be achieved in verbal IQ, receptive and expressive language than in non-verbal IQ or independent social functioning (Virués-Ortega, 2010).

Through decades of research, applied behaviour analysts have developed many teaching procedures. These procedures are very effective in increasing deficit behaviour and reducing problem behaviour. ABA techniques can be used for children with autism to develop their social, communication, play, and self-care skills, as well as the ability to manage their own behaviour.

Activity Schedules

People with ASD may get fixated on one activity and have problems in independent transitioning between different tasks or performing a complex chains of behaviours (Clarke et al., 1999). The ability to learn sequential tasks is also impaired in high-functioning individuals with ASD. Promoting independent functioning of people with disabilities is one of the main goals in educational and vocational settings. Independent functioning and reduction of prompt dependency is necessary for the successful inclusion of students with autism to the society. Children with autism can complete a variety of activities but very often depend on prompts to switch from one activity to another (McClannahan & Krantz, 2010). Dependency on prompts and verbal cues from others is a significant problem for

students with disabilities, because in many educational institutions or intervention programs whole learning process is built on teachers' cues and assistance (MacDuff et al., 1993), thus running the risk that the students will not respond to natural stimuli.

A well-known and scientifically documented instructional strategy which demonstrated multiple benefits for students with autism, including transitional skills and promoting independence, is an activity schedule. McClannahan and Krantz (2010) defined an activity schedule as a set of photographs, pictures or words which cues a person to complete a sequence of activities. The most important benefit of an activity schedule is that stimulus control can be transferred from a parent or teacher to a visual cue (Copeland & Hughes, 2000). When people with autism learn to respond to picture cues, these cues can guide their behaviour in the absence of supervising adults. Activity schedules usually consist of notebooks depicting a series of photographs, symbols, and/or words which are presented sequentially to cue a chain of responses (McClannahan & Krantz, 2010). There is much research supporting the use of activity schedules to teach and promote functional independence in children with autism. The research also indicates that schedule-following may have positive correlation with reductions in stereotypic or disruptive behaviours (Krantz et al., 1993; Koyama & Wang, 2011). Schedules may be used with preschoolers, teenagers, and adults at different levels of functioning. Activity schedules can be used to teach students with autism independent play, communication skills, daily living skills and on-task behaviours (Krantz et al., 1993; Banda et al., 2009).

Modern Technologies

Over the last few years, we could observe modern technologies becoming more popular in special education. The amount of research done in this area is growing. The results are very promising, with a clear conclusion that modern technologies can be very effectively used in the daily treatment of people with disabilities.

> These technologies allow support and learning to occur at all times of the day, whether at home or at school; they also permit self-management and self-instruction. A stunningly great feature of these devices is the fact that they are now so commonplace in our society that they can provide a less stigmatizing method for supporting and teaching students with disabilities (Silton, 2014, p. XIX).

The review of studies and literature showed that students with a moderate to mild intellectual disability and/or with autism can use technological aids to learn

academic, communication, employment, and leisure skills (Kagohara et al., 2013; Den Brok & Sterenburg, 2015; Valencia et al., 2019). New skills are acquired through prompting, interaction with devices, and also practicing in realistic virtual environments. iOS based devices can be used also to increase independence for the persons with autism, so the assistance of an adult can be reduced (Carlile et al., 2013). The research also indicates that therapists should use science-based teaching techniques and generalization procedures during introducing modern technologies in the treatment to achieve better outcomes for people with ASD (Hong et al., 2018).

Friendly Applications Project

Friendly Schedule (Przyjazny Plan) is an application for children and youth with ASD, which was developed in Poland as a joint initiative of the Gdańsk University of Technology (GUT) with the coordinator A. Landowska, PhD, and the Institute for Child Development (IWRD) with A. Budzińska, PhD, and I. Ruta-Sominka as the coordinators. The goal was to create an application which would allow therapists or parents to create activity schedules on a tablet and give them the opportunity to add audio scripts and use the scripts and script fading technique to develop social and verbal behaviours in children with autism. From the beginning, the project was based on a non-profit principle – the application is available for free, and the software code is open for anyone willing to develop the application (Landowska et al., 2016). The application is dedicated for tablets with an Android operating system.

Friendly Schedule consists of two separate programs:

1. Friendly Schedule Manager – a mobile application for the therapist or parent, which enables the teacher to prepare or modify the schedules that the child can use later on his or her application;
2. Friendly Schedule – an application for the student, which cues him or her to engage in a sequence of activities and/or interactions.

The application Friendly Schedule Manager allows the therapist to adjust the schedule for the child's individual needs (Landowska et al., 2016; Landowska et al., 2017). When preparing the first activity schedule, the teacher must know the student's current abilities. For beginners, the schedule can be prepared as a slide show with one activity per "page" (Figure 1). The therapist could decide which type of visual stimuli is the best for his or her student to put on the slide: a photograph of a real object or a symbol. He or she can also add written cues to the picture. If the schedule is used to teach the child to initiate interactions with others, the therapist could add audio scripts (a sound, word, or sentence), so the child could listen to the script on the device and repeat it to the conversational partner.

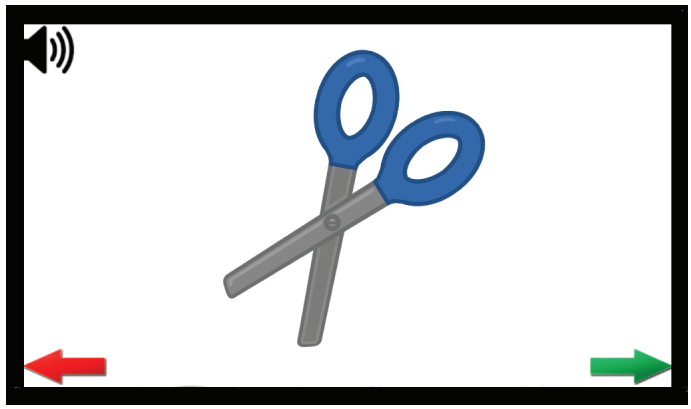

Figure 1. A screenshot from the application Friendly Schedule (Przyjazny Plan) on Samsung Galaxy 7" tablet, showing the activity schedule as a slide show with one activity per page.

N o t e: Friendly Schedule is an open-source application created by the Gdańsk University of Technology and the Institute for Child Development with the symbol added by authors (the source of the drawing: own work).

For more advanced students, the teacher can create the schedule as a sliding list with colour coding. In this type of schedule, the teacher can also add symbols and/or audio scripts to the written cues.

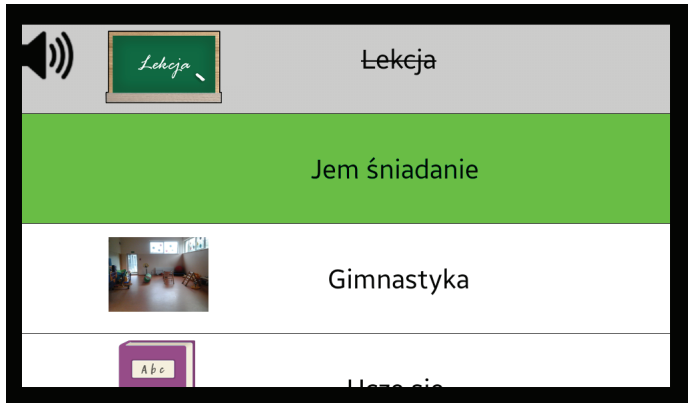

Figure 2. A screenshot from the application Friendly Schedule (Przyjazny Plan) on Samsung Galaxy 7" tablet, showing the activity schedule in the form of a sliding list with colour coding and the task already completed by the student, which was automatically crossed out.

N o t e: Friendly Schedule is an open-source application created by the Gdańsk University of Technology and the Institute for Child Development with symbols added by authors (the source of the photo and drawings: own work).

Friendly Schedule is an application that is intended to be very accessible and easy to use for people with autism, but full success is possible only when the teacher or parent knows how to teach the student with ASD to use the schedule on a tablet. This was the main subject of our study.

Teaching Children with Autism to Follow an Activity Schedule on a Tablet Using the Application Friendly Schedule

Even a properly prepared schedule on a tablet will not be a useful tool for a person with autism if the therapist does not teach him or her how to use it. Teaching people with ASD can be a real challenge, so every teacher should use only those teaching techniques whose effectiveness has been scientifically proven. The study shows the use of the application Friendly Schedule and graduated manual guidance in teaching three boys with autism to follow an activity schedule on a tablet. The target behaviour was to teach the students to independently complete five tasks, following an activity schedule on the tablet without any prompts from the teacher.

Participants and Settings

Three boys with autism at preschool age participated in the study. All met the ICD-10 criteria for childhood autism (WHO, 1992) – the classification of mental and behavioural disorders which was obligatory in Poland at that time. All participants have been receiving four and a half hours of therapy daily at the Institute for Child Development (IWRD) in Gdańsk, Poland. At the time of the study, one of the boys has been a student at IWRD for 25 months and the other two for 13 months. All the students have acquired all needed prerequisite skills and could match identical objects, as well as distinguish a picture of an object from the background. All the boys also accepted manual guidance (McClannahan & Krantz, 2010). All of the participants had prior experience in using tablets to play simple games or watch cartoons. Before we started the study, all our participants had previous experience with activity schedules on paper and they could follow different activity schedules in the form of a notebook or a daily activity schedule in the form of a written list with small pictures. All of the participants have mastered various simple tasks, such as stacking puzzles, colouring simple pictures, completing simple tracing worksheets, matching pictures or words, etc. They had no experience with following any type of activity schedules on a tablet.

The setting was a preschool and a research center for children with autism (IWRD). Baseline, intervention, and ongoing generalization probes were conducted in a typical classroom furnished with desks, chairs, and bookcases. The tablet was placed on a small table, near the shelves where all the materials were located. The chair and the table for the student were in the same room. Generalization sessions were all held in this same setting but with different teachers.

Materials

We selected five basic categories of tasks which could be done independently by our students: stacking puzzles, tracing pictures, building with blocks, matching pictures, and completing simple worksheets for preschoolers. All the tasks had a clear ending, so the participants did not need a timer to stop the activity. For each participant, we selected 15 simple tasks, with three different tasks for each category. All the tasks have already been mastered during one-to-one sessions with the teacher. For one session, only five tasks were selected, and the remaining ten activities were used for the subsequent sessions.

Each participant had his own Samsung Galaxy Tab A 7.0" tablet with the application Friendly Schedule. Individualized activity schedules were embedded into the devices.

The schedule on each tablet consisted of a list of five written cues with small pictures (Figure 3). After all five activities were completed, the symbol "Koniec" ("Finished") was automatically presented on the screen. The tasks in the schedules

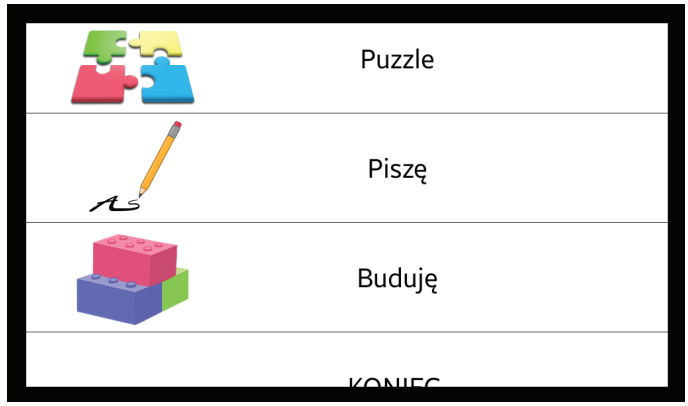

Figure 3. A screenshot from the application Friendly Schedule (Przyjazny Plan) on a tablet, showing written cues with small pictures on the left in an individualized activity schedule.

N o t e: Friendly Schedule is an open-source application created by the Gdańsk University of Technology and the Institute for Child Development with symbols added by authors (the source of the drawings: own work).

were presented in a variable order for every session. All the materials for the tasks were placed on the shelves. Materials for each task were placed in separate baskets or folders. Each basket or folder was marked with one written cue and a picture, the same as in the schedule.

Experimental Design and Measurement Procedures

In multiple baseline designs, the intervention is introduced sequentially to different clients, behaviours or settings (Morgan, 2009). In multiple baseline designs a single transition from baseline to intervention (AB) is introduced at different times across multiple subjects. Multiple baseline designs eliminate the need to return to baseline and therefore are particularly suitable for evaluation of intervention when a long-term effects are expected (Krasny-Pacini & Evans, 2018).

In our research, a multiple-baseline across participants design was used to assess the effects of prompting procedures. Data were presented as the percentage of correctly completed components in the chain in the activity schedule. The interobserver agreement (IOA) conformity test was conducted during every session and data were collected to determine whether the data recorded by two independent observers were congruent. Percentage interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. Mean interobserver agreement on the occurrence of correct responses was 100%.

Independent Variables

During the study, graduated manual guidance was used as the teaching procedure. Manual prompts were defined as manual assistance in displaying the desired response. In the literature (MacDuff et.al., 2001), graduated guidance has been described as providing physical prompts as needed and fading them immediately (within a session) as the student begins to respond correctly. The fading is not systematically planned and relies on the student's responding during the sessions. Fading can apply to the location of the prompt on the student's body (e.g., hand, forearm, upper arm), and/or the intensity (e.g., pressure, force) of the prompt. The practitioner should shadow the student's movements, allowing for immediate corrections as necessary. In graduated guidance, the instructor provides manual prompts to complete an action, and then fades these prompts by changing their intensity or locations" (MacDuff et.al., 2001, p. 42).

Dependent Variables

Task analysis was used to identify the components required to complete the chain of activities. The student is following the activity schedule on the tablet

during independent tasks when he completes independently all the components of the chain:
– turns on the screen on the tablet (if it is black);
– touches the correct written cue with a picture on the tablet;
– takes materials;
– completes the task and puts the materials away;
– returns to the tablet.
The application Friendly Schedule has already been opened for the student.

Baseline

Prior to teaching, baseline measures of target responses were obtained. During the baseline phase, the therapist did not use any prompts or rewards; he could only give one verbal instruction at the beginning, "check your schedule." Baseline sessions were terminated if the participant did not start to follow the activity schedule on the tablet during the first 30 seconds or stopped completing the components of his activity schedule for 30 seconds.

Intervention

The sessions occurred three times per day; five days per week. At the beginning of the single session the researcher gave a short instruction, such as "check your schedule," in the presence of a corresponding activity schedule on the tablet and all tasks located on the shelf. If the participant did not follow the activity schedule on the tablet, the teacher manually guided him to complete the chain correctly. The consistent time delay for prompting was five seconds. If an error occurred, a behaviour rehearsal trial was conducted, in which the teacher provided manual prompts to correct the error. Manual prompts were gradually faded when the child correctly performed any component of the chain. Prompts were faded in frequency and intensity as rapidly as possible (Cooper et al., 2007).

At the beginning of the teaching, edible rewards were delivered by the teacher after every correctly performed component of the chain. When the data showed that the participant had 50% (or higher) of correct components, reinforcement was thinned. The edible rewards were delivered after the child correctly performed the whole chain for a single task and at the end of the whole schedule.

Generalization

Generalization data were collected prior to and after the teaching. When the criterion of 100% of correct components of schedule following was met, the generalization was checked in the same place but in the presence of a new person. There were no verbal or manual prompts or rewards during the testing of generalizations.

The new person could give only one verbal instruction at the beginning, "check your schedule."

Results of Research

During the baseline measurements, two students did not complete any schedule component; for one participant – student 2 – the mean percentage of correctly completed components during the baseline was 2%. When manual prompts and reinforcement were introduced, our students learned to use the application correctly. The first student's percentage of correctly completed components increased

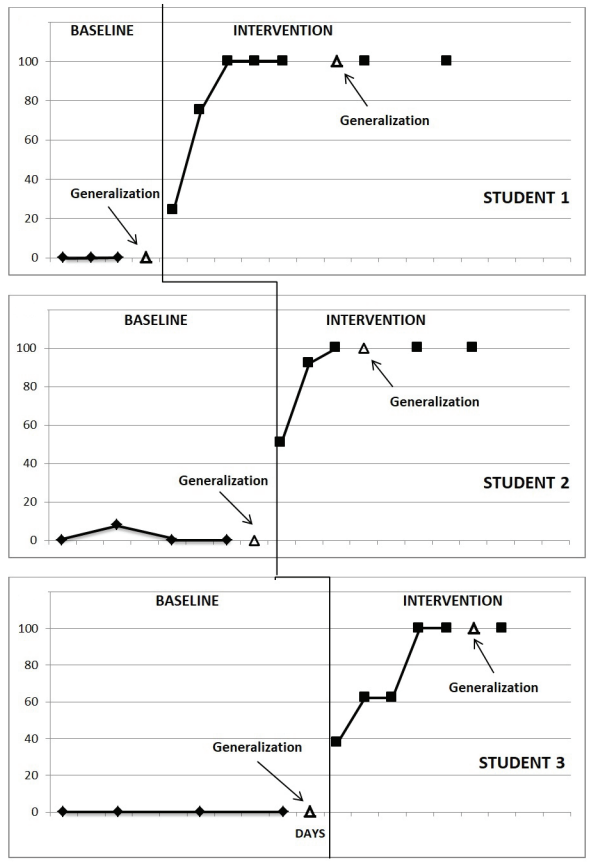

Figure 4. Percentage of correctly completed components during baseline and intervention with generalization probes for three participants.

N o t e: Solid diamonds represent the percentage of correctly completed components during the baseline measurement. Solid squares represent the percentage of correctly completed components during the intervention. Open triangles represent the percentage of generalization (the source: own research).

to a mean of 66% (range: 24–100%) during the intervention, with mastery of all the schedule components occurring within seven sessions. The second student's percentage of correctly completed components increased to a mean of 81% (range: 51–100%) during the intervention, with mastery of all the schedule components occurring within seven sessions. The third student's percentage of correctly completed components increased to a mean of 60% (range: 38–100%) during the intervention, with mastery of all the schedule components occurring within ten sessions.

The generalization was assessed with a person who did not participate in the teaching; all of the students scored 100% of correctly completed components (Figure 4).

We can conclude that graduated manual guidance was a very effective procedure in teaching the students to follow activity schedules on a tablet. Another conclusion is that the application Friendly Schedule is a great tool which can be used to prepare activity schedules for students with ASD.

Maintenance data were not collected, because all our students were continuously using Friendly Schedule on a tablet during their daily treatment and we introduced the application to other educational programs to develop a variety of deficit behaviours.

Discussion

Based on the results of our research, we can conclude that the application Friendly Schedule is a very useful tool which can be used to prepare activity schedules for students with ASD. We can also conclude that graduated manual guidance is an effective procedure in teaching the students with ASD to follow activity schedules on a tablet. In our research, a multiple-baseline across participants design was used to assess the effectiveness of intervention strategies. The main reason for choosing this design was that we did not have to return to the baseline. It was not ethical to remove the effective intervention and return to the baseline, as required in ABA design, because after the teaching phase all the participants began to continuously use the application in the kindergarten, as well as during their home-programming. We are aware that the number of participants was small, but the multiple-baseline design allowed for prediction, verification and replication. In our research, we can observe the same pattern across all the participants to prove the effectiveness of the intervention. However, because only three students with autism participated in the study, we can admit that our results cannot be generalized. However, our results

are an important indication that it should be worthwhile to verify the effectiveness of the application and the teaching procedure with a larger group of participants to confirm the results. Given that all the participants had some prior experience using activity schedules on paper, we can presume that this had an impact on the acquisition of the target behaviour. More research is needed to examine the use of Friendly Schedule with children who did not have previous experience with any type of activity schedules. Teaching children with autism to use the Friendly Schedule application on tablets has an important social validity, because this method can be considered more natural, and the child with autism should be less stigmatized in the social environment.

We are continuously using the application Friendly Schedule at the Institute for Child Development in Gdańsk, and we have noticed some limitations for wider use of the application. One is that new users – teachers or parents – cannot use it effectively without instructions from an experienced person who would explain how to use the application to prepare the schedules and, also, how to teach the student with ASD to follow the activity schedule on the tablet in a proper way.

Our data from daily treatment shows that the application can have a much wider use (Landowska et al., 2016). We are using the application to develop new playing skills, such as building with blocks or drawing, and to develop self-help skills such as dressing oneself. By adding audiotaped scripts to an activity schedule, we can also teach children with autism new verbal and social behaviours, such as conversations or making requests. More research can be done to show the effectiveness of using the application Friendly Schedule to develop other deficit skills in children with ASD.

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Iwona Ruta-Sominka, Anna Budzińska

Wykorzystanie aplikacji Przyjazny Plan na tablecie do rozwijania samodzielności u dzieci z zaburzeniem ze spektrum autyzmu

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

Częstotliwość występowania zaburzeń ze spektrum autyzmu (ASD) znacząco wzrosła w ostatnich dziesięcioleciach. Wzrasta również potrzeba zapewnienia osobom z ASD terapii opartej na badaniach naukowych. Instytut Wspomagania Rozwoju Dziecka (IWRD) w Gdańsku oferuje dzieciom z autyzmem terapię wzorowaną na modelu opracowanym przez dr McClannahan i dr Krantz (1993) w Princeton Child Development Institute w USA. Ich badania i doświadczenie kliniczne pokazują, że plany aktywności są bardzo skuteczne w uczeniu osób z autyzmem wielu nowych umiejętności. Jednak plany aktywności w „tradycyjnej" papierowej wersji mogą prowadzić do stygmatyzacji osoby z autyzmem w środowisku społecznym. Istotne jest, aby dać osobom z ASD społecznie akceptowane narzędzia, które pomogą im w jak najbardziej niezależnym funkcjonowaniu. Intensywny rozwój nowoczesnych technologii, a także łatwy dostęp do różnego rodzaju urządzeń mobilnych zainspirowały nas do wdrożenia tabletów do codziennej terapii.

Przyjazny Plan (Friendly Schedule) to aplikacja dla dzieci i młodzieży z autyzmem i zaburzeniami pokrewnymi, która została opracowana dzięki wspólnej inicjatywie Politechniki Gdańskiej i Instytutu Wspomagania Rozwoju Dziecka. Aplikacja na tablet została stworzona jako projekt „non-profit". Dane z naszych badań pokazują, że podpowiedzi manualne są bardzo skuteczne w uczeniu dzieci z autyzmem korzystania z planów aktywności na tablecie. Wszyscy uczestnicy badania nauczyli się korzystać z aplikacji Przyjazny Plan podczas samodzielnego wykonania

ciągu złożonego z pięciu zadań. W IWRD aplikacja Przyjazny Plan jest obecnie wykorzystywana do uczenia uczniów z autyzmem różnych nowych umiejętności, w tym zachowań werbalnych i społecznych.

S ł o w a k l u c z o w e: autyzm, plany aktywności, aplikacje, technologia wspomagająca, podpowiedzi manualne, samodzielność

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Использование приложения Дружественный план (Przyjazny plan) на планшете для развития самостоятельности у детей с расстройством аутистического спектра

А н н о т а ц и я

Заболеваемость расстройствами аутистического спектра (РАС) значительно возросла за последние десятилетия. Также возрастает потребность в проведении научно-исследовательской терапии для людей с РАС. Институт поддержки развития ребенка (IWRD) в Гданьске предлагает детям с аутизмом терапию, смоделированную по модели, разработанной доктором МакКланнэн и доктором Кранц (1993) в Принстонском институте развития ребенка в США. Их исследования и клинический опыт показывают, что планы действий очень эффективны в обучении аутичных людей многим новым навыкам. Однако планы деятельности в «традиционной» бумажной версии они могут стигматизировать человека с аутизмом в социальной среде. Важно дать людям с РАС социально приемлемые инструменты, которые помогут им действовать максимально независимо. Интенсивное развитие современных технологий, а также легкий доступ к различным типам мобильных устройств вдохновили нас на внедрение планшетов для ежедневной терапии. Дружественный план (Przyjazny plan) – приложение для детей и подростков с аутизмом и связанных с ним расстройств, который был разработан благодаря совместной инициативе Гданьского технологического университета и Института поддержки развития ребенка. Приложение для планшетов было создано как «некоммерческий» проект. Данные нашего исследования показывают, что мануальные подсказки очень эффективны в обучении аутичных детей использованию планов действий на планшете. Все участники исследования научились использовать приложение Дружественный план (Przyjazny plan) при самостоятельном выполнении последовательности из пяти задач. В IWRD приложение Дружественный план (Przyjazny plan) в настоящее время используется для обучения учеников с аутизмом различным новым навыкам, включая вербальное и социальное поведение.

К л ю ч е в ы е с л о в а: аутизм, планы действий, приложения, вспомогате технологии, мануальные подсказки, самостоятельность

Iwona Ruta-Sominka, Anna Budzińska

Uso de la aplicación Horario Amigable en una tableta para promover la independencia en niños con trastorno del espectro autista

Resumen

La prevalencia del trastorno del espectro autista (TEA) ha aumentado en las últimas décadas. También está creciendo la necesidad de proporcionar prácticas basadas en evidencia en el campo de los TEA. El Instituto de Desarrollo Infantil (IWRD) en Polonia ofrece una intervención científica para niños con autismo, basada en el modelo desarrollado inicialmente por McClannahan y Krantz (l993) en el Instituto de Desarrollo Infantil de Princeton, Estados Unidos. Su investigación y experiencia clínica muestran que los horarios de actividades son muy efectivos para enseñar a las personas con autismo muchas habilidades nuevas. Sin embargo, los horarios de actividades en la versión impresa "tradicional" podrían llevar a la estigmatización cuando se utilizan en el entorno social. Es esencial brindar a las personas con trastorno del espectro autista herramientas socialmente aceptables que puedan ayudarlas a funcionar de manera más independiente. El intenso desarrollo de tecnologías modernas como también el fácil acceso a varios tipos de dispositivos móviles nos inspiró a utilizar tabletas en nuestro tratamiento. Horario Amigable es una aplicación para niños y jóvenes con autismo y trastornos relacionados, que se desarrolló como una iniciativa conjunta de la Universidad Tecnológica de Gdańsk y el Instituto de Desarrollo Infantil. La aplicación fue creada como un proyecto "sin fines de lucro". Los datos de nuestra investigación muestran que las indicaciones manuales son muy eficaces para enseñar a los niños con autismo a seguir los horarios de actividades en una tableta. Todos nuestros participantes aprendieron a usar la aplicación Horario Amigable para completar cinco tareas de forma independiente. En el programa IWRD la aplicación Horario Amigable se utiliza para enseñar a los estudiantes con autismo una variedad de nuevas habilidades, incluidos comportamientos verbales y sociales.

Palabras clave: autismo, horarios de actividades, aplicación, tecnología de asistencia, indicaciones manuales, independencia

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Padlet as a Modern Form of E-learning in the Context of Sugata Mitra's Research – a New Model of Education

Abstract

The aim of this article is to present the results of surveys concerning Padlet tool. The authors analyze contemporary trends in education, legal regulations and research, which are part of the new model of education. The text contains descriptions of research results from 230 surveys conducted on students in relation to three categories. The first category presents the results of the evaluation of Padlet as a tool for content segregation, the second category concerns the evaluation of Padlet in terms of the function of group work, and the third category concerns the functionality and comparison of Padlet tool with other similar tools. In the current educational situation caused by the global coronavirus pandemic SARS-Cov-2 causing the disease COVID-19, evaluation and presentation of research results related to distance learning tools and methods is very necessary.

K e y w o r d s: Padlet, ICT tools, e-learning, new model of education, Sugata Mitra, SARS-Cov-2, COVID-19, distance learning.

A New Model of Education

The term "new model of education" is very problematic because over the last 200 years it has been difficult to determine what it really means (Walat, 2010; Kopciał, 2010; Field, 2000). For example, should we consider as a model the pragmatism of John Dewey, who as the main objective saw introducing thought-provoking, action and movement enhancing activities and, in particular, activities dealing with problem situations created by teachers and the environment? Similar considerations can be made, for example, with regard to the creative attitude based on the freedom of action described by Maria Montessori (2013), or the model of education based on the cognitive development of Jean Piaget including the term of assimilation, as a mechanism for attaching new concepts to those already known to us, and the term of accommodation, i.e. the process of modifying the terms already known in order to adapt them to the environment (Richmond, 2013).

Similar doubts arise in the case of the classification of Ken Robinson's theory that school kills children's creativity (Resnick & Robinson, 2017) and Seymur Papert's constructivism which consists in the creation of various artefacts by children in order to present their ideas rather than using those proposed by the system or the teacher (Papert, 1993).

A recent example of a proposal for a new model in education presented in literature that is worth considering is Sugata Mitra's experiment known as "hole in the wall," which provides rather controversial conclusions that in the absence of supervision or formal education, children can teach each other and learn from each other if they are motivated by their peers' curiosity and interest in an experiment (Mitra, 2003). How different is Dewey's pragmatic model from Papert's constructionism? The creative freedom of a child according to M. Montessori from the killing of creativity and focusing on art according to Ken Robinson? And cannot the "hole in the wall" experiment be seen only as a well-presented model of J. Piaget's assimilation and accommodation mechanisms? The authors leave the reader with these questions, as there would be plenty of arguments for and against. However, there is one factor that differentiates these approaches. It is the ubiquitous technology with its approach to information. Currently in education, the lack of knowledge of a given topic is not as paralysing as the lack of possibility to find information on a given topic on the Internet (Morze, Spivak, & Smyrnova-Trybulska, 2014).

Today's "new model of education" is mainly based on ICT solutions (Information and Communication Technologies, including personal computers, digital television, e–mail, educational robots. Thus, ICT is about the storage, retrieval, manipulation, transmission or reception of digital data.) Therefore, children, pupils, students and adults function on two levels: the real world and the online world (Fu,

2013). The primary objective of teaching is to develop key skills in the modern world such as communication skills, teamwork, problem solving and analytical thinking. More broadly, these goals are included in the area of the use of computer thinking (Brennan & Resnick, 2012). Teaching seen as a process, not just an effect, must focus on those subjects and topics which are important to the modern world, in order to ensure that these skills are achieved. Moreover, teachers should use appropriate tools which are, on the one hand, close to the learner, i.e. understandable and acceptable to him/her, and, on the other hand, effective and contextual. It should be emphasized that in modern education a great role is played by the science of coding, programming, and above all, the science of effective search for information, such as appropriate competences convergent with Google hacking (Long, Gardner, & Brown, 2011), which are the basis for the competence of the modern human being (Noskova, Pavlova, Yakovleva, Smyrnova-Trybulska, & Morze, 2016).

The need for changes in the education system is particularly noticeable today. The global coronavirus SARS-Cov-2 pandemic, which causes the disease COVID-19, has painfully proven this. As a result of the closure of Polish primary and higher education schools, it has become necessary to switch to the remote teaching system. Unfortunately, it was not possible to do this immediately in all cases. Most of the educational institutions did not have procedures and IT systems in place that would allow for the transition to remote teaching to the extent and at the level comparable to traditional teaching. In many cases, very provisional solutions were introduced. This problem also affects many other countries of the European Union or the world in general. This confirms the validity of the research undertaken and the need to verify the current teaching system, together with the possibility of introducing new teaching tools. So that, in case of similar events in the future, it would be possible to react to them effectively and immediately.

Legal Background for the Creation of a New Model of Education

The following are the legal recommendations formulated by the European Parliament and the Council of the European Union in 2006 and its subsequent amendments. They are reflected in the emerging new model of education. In 2006, the European Parliament and the Council of the European Union adopted a document (Recommendation of the European Parliament and of the Council of December 18, 2006 on key competences for lifelong learning) which deals with key competences for lifelong learning. The Recommendation, in its subsequent amendments, invites

Member States to "develop the provision of key competences for all as part of their lifelong learning strategies, including a strategy to achieve universal literacy and to use the document": Key Competences for Lifelong Learning – A European Reference Framework (Council Recommendation of May 22, 2018). Since its adoption, the Recommendation has been one of the key reference documents for the development of competence oriented education, training and learning.

At the same time, international research, such as that carried out by the Organisation for Economic Cooperation and Development (OECD, 2016) as part of the Programme for International Student Assessment (PISA, 2015) or the Programme for the International Assessment of Adult Competencies (PIAAC, 2016) carried out by the same organisation, shows that there is a persistently high proportion of teenagers and adults with insufficient basic skills. In the 2015 PISA survey, one in five pupils had serious difficulties in achieving sufficient levels of literacy in reading with understanding, mathematical thinking or understanding of natural phenomena. In some countries, even one in three adults is able to understand and produce information and mathematical reasoning at the lowest possible level.

Overall, 44% of the EU population has little or no digital competence (19%) (OJ C of June 4, 2018), despite the significant impact of the pace of technological and digital change on our economies and societies. The rapid digital transformation of the economy means that today almost all jobs – and participation in society in general – require certain digital skills. Digital literacy is now just as important as literacy and mathematical reasoning, and Europe needs people with digital competences, who are not only able to use these technologies, but are also able to innovate and play a leading role in them.

The above document, i.e. Key Competences for Lifelong Learning – A European Reference Framework, established eight key competences: comprehension and information creation competences, multilingualism competences, mathematical competence and competence in science, technology and engineering, digital competence, personal, social and learning to learn competences, civic competences, entrepreneurial competences and cultural awareness and expression competences.

All key competences are considered equally important; each contributes to a successful life in society. Competences can be used in many different contexts and combinations. Their scope overlaps and is interlinked: aspects necessary in one field support competences in another. Skills such as critical thinking, problem solving, searching for information become universal competences for today's citizen of the world.

In summary, the documents on EU education adopted by the European Parliament recommend that reference be made to these documents in order to ensure that

young people receive initial education and training which would enable them to develop key competences so as to equip them for adult life and that adults should be able to develop and update their key competences throughout their lives. Poland adopted the concept of development only in 2013, supporting it with the preparation of a programme basis which took into account the key competences. It was not until 2017 that the core curriculum aimed at promoting mathematical and logical thinking at all levels of education from kindergarten to secondary school came into force under the Regulation of the Minister of National Education of February 14, 2017, which resulted in many significant educational implications, including those related to a greater promotion of areas of knowledge related to mathematics, logic, algorithms and programming.

The Context of Sugata Mitra's Research in Relation to the New Model of Education

Sugata Mitra conducted a project called "a hole in the wall" for 12 years. It started with an experiment in Kalkaji, New Delhi when he placed a computer in the wall, which was located on one of the streets of the city with Internet access and had a few running programs. Within a very short time, the computer was besieged by children from the nearby slums, who learned how to use it, surf the Internet and use the available programs on their own. The experiment was repeated in many places in India, Africa and also Europe, with very similar results. The main documented conclusion of the experiment is the discovery of the incredible self-learning ability of children working in small groups. Mitra called the groups of children working together a self-organized learning environment (SOLE). The experiment showed how children's learning processes take place, how their consciousness develops, and pointed to a fascinating process of building methods and ways of reaching information and constructing knowledge on one's own. The author himself was so proud and convinced of the significance of the results of his experiment, that in the introduction to one of his monographs he wrote: "I finished writing this book on the rainy day of August 15, Independence Day. However, I would like to talk about yet another day of independence: the day when we will achieve independence from an education system that is more than 2 500 years old. It's time to start this journey." (Mitra, 2013).

Mitra conducted his experiment with information technology. However, the context of its use and exploitation was different from the ways in which technology was usually introduced to schools. First of all, Mitra assumed that ICT learn-

ing does not have to take place at school, under the care of adults. Secondly, the experiment recognised that technology is, per se, transparent for children, and constitutes only a means and in no way an obstacle to learning, while learning in itself is the most important thing. Knowledge is not the result of hours spent at school and passive submission to the process of transmission of ready-made packages of information, described in detail in the curriculum. As I. Illich rightly pointed out, "learning is in fact the kind of human activity that requires the least interference from others." (Zaldívar, J. I., 2015). Knowledge is the result of taking responsibility for one's own learning, in an environment which supports students in their own development and helps them make decisions. Digitisation, on the other hand, understood as the use of technology in the learning process, is a natural consequence of creating an adequate working environment for the acquisition of information, an ability that will become a competence.

At the time when the Internet was still in its infancy, only 6% of world cultural material was digitised. Today, within a quarter of an hour, the Internet is growing by an average of 20 billion bits of data. An analogous equivalent of this number would be all the works that make up the canon of world literature. Without a shadow of exaggeration, we can therefore describe our times as "data epochs." (Zikopoulos & Eaton, 2011, p. 43).

At the beginning of the 1990s, the bandwidth of the Polish Internet was only 9600 bits per second. Currently, thanks to the investments made in recent years, the information sent via the Internet travels between Warsaw and any other city in Poland in just 2.5 milliseconds. It takes 5–10 milliseconds to get to another country in Europe and 70–90 milliseconds to get to the city on the east coast of the United States. (W. Raghupathi, & V. Raghupathi, 2014). Therefore, there is a lot of pressure from the decision-makers to create elements of a digital school. With such a large escalation of the problem of big data, diversity of presented content and information and education based on SOLE, it becomes clear that there is a need to use tools which would help us to control the segregation and reorganization of online content. One of the most common tools is Padlet, which is a kind of internet board which allows the necessary internet resources to be collected in a more systematic way.

Padlet (www.padlet.com) is an easy-to-use tool which can serve as an information board or workspace for students and teachers to collaborate on digital content. It is successfully used in gathering collections, as a place for discussion, conducting simple competitions, brainstorming, editing common stories, receiving feedback, or submitting posts and comments. And these are only a few examples of its use. On the whiteboard, you can place any multimedia files, texts, films, website addresses, pictures and photos (downloaded from one's own computer, from the Internet or taken directly from a camera).

Research Problems

Since 2015, most universities in Poland have moved to the implementation of a description of qualifications adjusted to international standards. The system is named the National Qualifications Framework (NQF) and aims to provide a clear description in the national and international context (Chmielecka, 2013). A number of changes have been implemented as a result of its introduction. One of the most significant is the requirement for the student to achieve specific qualifications through the implementation of modular and area effects in given subjects. Modular and area effects are realized by means of knowledge, skills and personal and social competences. One of the most frequently repeated competences is the ability to search for information and present it in a multimedia form.

An interesting solution to the above issues concerning NQF implementation could be the use of Padlet as a tool to perform the assumptions outlined above. It would be beneficial if the proposed solution, tool and method of working with it involved the use of the ICT platform, thus becoming a part of the "new educational model."

All questions for the test were extensively discussed by active experts on the use of teaching applications. Taking into account all the issues mentioned in this article, the following research question may be raised: Can Padlet be treated as a tool for a self-organised learning environment (SOLE)? The auxiliary questions for such a formulated research problem will include: evaluation of Padlet as a tool by users on Likert's linear scale from 1 to 5, where a higher note indicates a higher level of usefulness. A quantitative assessment prepared this way will be included in the following questions helping in the evaluation of Padlet as a tool:

1. How do you evaluate the usefulness of Padlet as a tool for gathering information available in various places on the Internet? Linear scale, e.g. from 1 (not useful at all) to 5 (very useful).
2. How do you evaluate the usefulness of Padlet as a tool for collecting various types of data (texts, photos, videos, links)? Linear scale, e.g. from 1 (not useful at all) to 5 (very useful).
3. How would you rate the usefulness of Padlet as a tool for taking notes? Linear scale, e.g. from 1 (not useful at all) to 5 (very useful).
4. How do you evaluate the usefulness of Padlet as a tool to support your learning process? Linear scale, e.g. from 1 (not useful at all) to 5 (very useful).

The next question area concerns issues related to competences in cooperating in a group:

5. Rate your willingness to use virtual whiteboards created by others. Linear scale, e.g. from 1 (I am not interested) to 5 (I would be very happy to use it).

6. Rate your willingness to share your virtual whiteboards. Linear scale, e.g. from 1 (I do not intend to share) to 5 (I am very happy to share it with others).
7. Rate your satisfaction with the fact that other people could add materials to your virtual whiteboard. Linear scale, e.g. from 1 (I am displeased, this is an unnecessary option) to 5 (I am very happy about this possibility).

The following detailed questions are related to the area of "functionality" of the use of Padlet as a tool:

8. According to your experience so far, what features are missing in Padlet's environments? Own answer.
9. According to your experience so far, what function is unnecessary in Padlet? Own answer.
10. Suggest a different use of Padlet than the one you learned in the classroom. Own answer.

The last set of detailed questions involve an evaluation of the padlet by means of questions which compare the tool with other tools used by the respondent.

11. Padlet is as intuitive/not intuitive (delete as appropriate) as:....
12. Padlet is as complicated/easy (delete as appropriate) as:...
13. A tool which is used in a traditional way that Padlet reminds me of most is the:...
14. Which other tool that you are currently using would you exchange for Padlet?

The questions formulated this way will help answer the main question: Can Padlet be treated as a tool for a self-organised learning environment (SOLE)? All respondents had previously used Padlet as a tool to supplement a topic on subjects related to the use of technology in teaching at full-time study courses.

Apart from the research questions, the questionnaire included sociometric data such as: age, gender, place of residence, subjective assessment of the respondent's financial situation, subjective assessment of IT skills, assessment of the inclination to use traditional and digital information sources. All the detailed questions have a high Alpha Cronbach level of internal consistency, which averaged at $\alpha = 0.8125$.

Sample Characteristics

Questionnaire data collection was conducted electronically through Google forms. Statistica 10 was used to compile the obtained data. The relationships between the socio-demographic questions and the relevant questions were developed using the student's T-test for dependent groups. The survey was a one-time survey.

The questionnaire consists of seven closed questions and eight open questions, including two information questions on a topic which was realized with the use of Padlet and six questions of a socio-demographic type. All respondents were made familiar with the handling of Padlet before starting the survey. The selection of the surveyed group was random.

The survey was conducted on a sample of 250 students of different levels of education. The surveyed group consisted of 250 students aged 20–22 years (M = 21.35; SD = 0.63), including 55.2% of women, N = 138 and 44.8% of men, N = 112. The survey was conducted at the University of Technology and Humanities in Bielsko-Biała and the University of Silesia in the period from 02.02.2019 to 02.03.2019 in Poland. 20 questionnaires were not fully completed, therefore they were not compiled statistically. A total of 230 questionnaires was accepted for statistical analysis.

The study was conducted on adults, with their consent. The division concerning the place of residence was as follows: areas up to five thousand inhabitants (N = 50, 21.7%), areas up to 50 thousand inhabitants (N = 90, 39.1%), areas up to 100 thousand inhabitants (N = 30, 13%), areas up to 200 thousand inhabitants (N = 50, 21.7%), areas above 300 thousand inhabitants (N = 10, 4.3%). There were affirmative answers N = 50, 21.7% to the question on preference in obtaining information in the traditional way (book, press, notes), while some N=180, 78.3% preferred digital downloading. As for the subjective assessment of the subjects' material status, N=0, 0% rated it as very low, N=0, 0% as low, N=110, 47.8% as moderate/sufficient, N=110, 47.8% as good, N=10, 4.3% as very high. The subjective assessment of competences in the use of information technologies was as follows: N=0, 0% insufficient, N=40, 17.4% permissible, N=90, 39.1% satisfactory, N=90, 39.1% as good, N=10, 4.3% as very good.

Research Results

In the assessment on the five-stage scale (Likert 1–5) Padlet was positively evaluated as a tool in the field of collecting digital information from the Internet.

The Likert scale was used, which is a symmetrical scale containing the same units on both sides of the scale. A large number of 230 respondents took part in the study. The obtained distribution of answers was normal, no significant diagonality of the distribution of answers to any of the questions was noted. We believe that a large number of respondents and a normal distribution of answers to the questions cause that measuring the significance of the difference with the use of the parametric test will not give a falsified result of the examined intergroup differences.

Due to the large number of respondents and the obtained distribution of responses, it was decided to use the parametric test to study intergroup differences.

A score of 3 was given by N=60, 26.1% respondents, 4 by N=100, 43.5% respondents, 5 by N=70, 30.4% respondents. Therefore, about three quarters of the respondents (N=170, 74%) rated the applications as good and very good. In the first question concerning the subjective evaluation of Padlet as a tool, a correlation between good and very good ratings and the place of residence was found. Respondents from cities up to 5,000 inhabitants rated Padlet as a tool more poorly D(1.3118)=83.585, p=0.0000. A similar relation with a bilateral distribution concerned subjects from areas up to 50,000 inhabitants and over 50,000 inhabitants D(1.4102)=103.55, p=0.0000. It is worth noting that none of the respondents rated Padlet negatively, i.e. 1 or 2 on the Likiert scale. At the same time, male respondents more frequently rated Padletpositively , i.e. over 3 points on the Likiert scale D(1.4118)=109.90, p=0.0000 than their female counterparts, who mostly marked 3 points D(1.2118)=73.585, p=0.0000 on the scale.

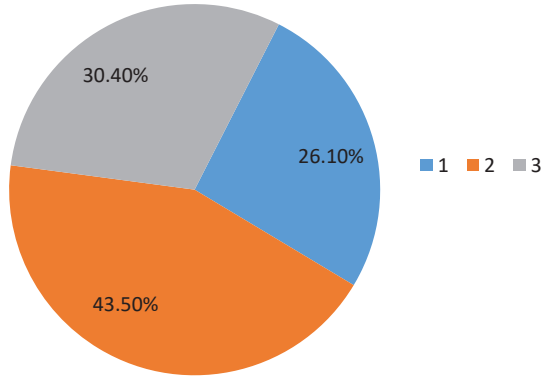

Figure 1. Assessment of Padlet as a tool for collecting resources from the Internet (Likert scale 1–5).

N o t e: 1 – Obtained result for grade 3 on the Likert scale; 2 – Obtained result for grade 4 on the Likert scale; 3 – Obtained result for grade 5 on the Likert scale.

The evaluation of Padlet as a tool for collecting digital content such as films, photos, texts, links, etc. was also high. Among the respondents N=30, 13% gave Padlet 3 points, N=120, 52.2% 4 points, which was the most frequent rating, while N=80, 34.8% gave it 5 points.

There was only one statistically significant correlation in this question, namely between the financial status of very good and the 5 point rating D(1.1251)=53, p=0.0000. It is worth noting that in this question none of the respondents gave Padlet 1 or 2 points.

The third question concerned using Padlet as a tool for taking notes. Here, the results were more dispersed on the Likiert scale: 2 points (N=20, 8.7%), 3 points (N=60, 26.1%), 4 points (N=60, 26.1%), 5 points (N=90, 39.1%). It is worth noting that the highest score of 5 was the most frequently chosen value, while 1 was not recorded. No statistically significant correlation was found in this question.

The fourth question was the last question concerning the subjective evaluation of Padlet and concerned the use of the tool as a learning aid. The result distribution in the evaluation was as follows: 2 points (N=10, 4.3%), 3 points (N=60, 20.1%), 4 points (N=90, 39.1%), 5 points (N=70, 30.4%). The lowest score of 1 was not recorded in this question. There were also no statistical correlations between socio-demographic questions and the relevant questions.

Another set of questions concerned working in a group using Padlet as a tool to perform tasks in this area (group work). The first question concerned using the tool to view tables created by other users in the group, i.e. an element related to the collection and viewing of data prepared by other people. The highest value recorded was 5 points (N=100, 43.5%), followed by 4 points (N=80, 34.8%), and 3 points (N=50, 21.7%). It is worth noting that scores 1 and 2 were not recorded in this question. In the questions concerning the evaluation of Padlet as a tool for group work, a significant statistical correlation was observed between the subjective evaluation of the subjects' own IT competences and the tendency to give a high score i.e. from 4 to 5. In the questions concerning the use of Padlet as a tool for group work, this correlation was D (1.3118)=83.185, p=0.0000) for the score of 4, while for the score of 5 it was (1.4118)=91.485, p=0.0000), respectively.

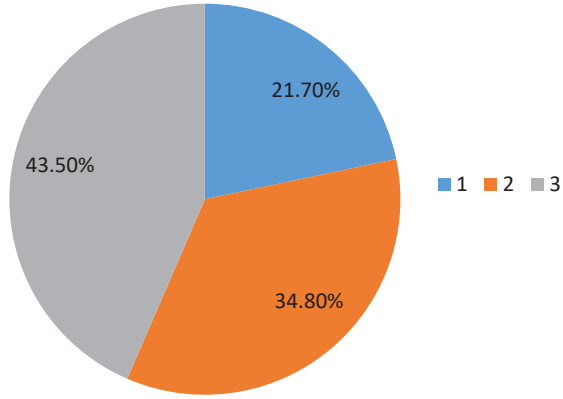

Figure 2. Assessment of Padlet as a tool for group tasks (Likert scale 1–5).

N o t e: 1 – Obtained result for grade 3 on the Likert scale; 2 – Obtained result for grade 4 on the Likert scale; 3 – Obtained result for grade 5 on the Likert scale.

The next question concerned the sharing of resources created by means of Padlet. The question, therefore, aimed to determine the tendency to share materials with the use of the tool. The lowest rating of 1, expressing a lack of willingness to share materials, was given by N=10.4.3% respondents, 2 points were given by the same number of respondents (N=10.4.3%), 3 by N=40, 17.4%, 4 by N=90, 31.9%, 5 by N=80, 34.8%, which overall gives a result of 8.6% for negative responses, 17.4% for neutral responses, and 74% for positive responses.

In the question on the respondents' opinions concerning the possibility of receiving materials for their board from other people, around 3/4 of those surveyed rated such a possibility of cooperation equally highly and positively. The distribution of responses on a scale of 1–5 was as follows: for the score of 1 (N=10, 4.3%), 2 (N=20, 8.7%), 3 (N=50, 20.7%), 4 (N=80, 34.8%) and 5 (N=70, 30.4%).

The next block included open questions about the functionality of Padlet or lack thereof. The respondents provided their proposals as responses to open questions. The answers included numerous suggestions such as: the ability to use a font of choice, sending private messages, or the ability to scale windows. These proposals, however, remained within 0.86%, therefore cannot be considered statistically significant. The largest number of responses concerned the impossibility of creating a visual side of the board (N=50, 22%).

When asked which function of Padlet is not useful, most replied that there is no function that would have to be removed (N=130, 57%). The rest of the answers were within the range of 0.86%, i.e. outside the statistically significant data range.

In the question about using Padlet for purposes other than as a multimedia board, the respondents most often mentioned such uses as: a diary, a blog on a given subject (N=130, 57%), a place for discussions and sharing materials for exams (N=50, 22%), reports from events (N=22, 10%). Other answers were statistically insignificant, i.e. within 0.86%.

The next question concerned the intuitiveness and simplicity of Padlet, which the respondents answered as follows: Padlet is a very intuitive tool (N=150, 65%), a moderately intuitive tool (N=70, 30.4%), not very intuitive (N=10, 4.3%). It is worth noting the very high value for the first answer (N=150, 65%), which correlates with the high percentage of answers from the first pool of questions, where the average of positive scores of 4 and 5, was given by an equally high percentage of respondents (N=180, 78%).

In comparison with other tools of this type in terms of simplicity and intuitiveness of use, Instagram scored (N=16, 7%), Pinterest (N=46, 20%), PowerPoint (N=49, 21%) while Prezi (N=120, 52%) in open questions. This question is open-ended and despite a number of other insignificant statistical tools such as Trello, Linoit, Pearltrees, Mind24, Mindomo, the students did not mention the competitive Moodle platform, even though everybody used it in their first year of studies.

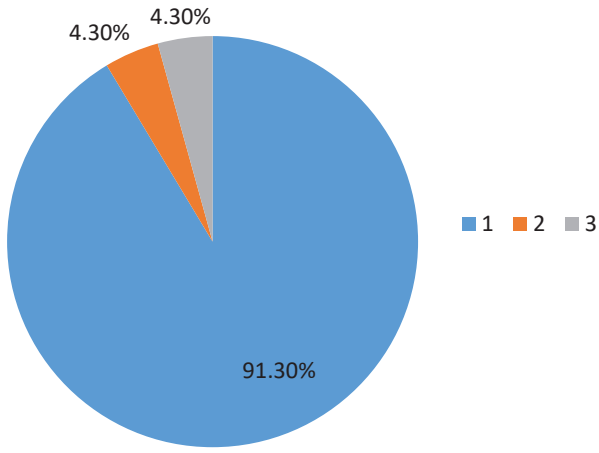

Figure 3. Assessment of Padlet's useability level (descriptive scale).
N o t e: 1 – High level of useability; 2 – Medium level of useability; 3 – Low level of useability.

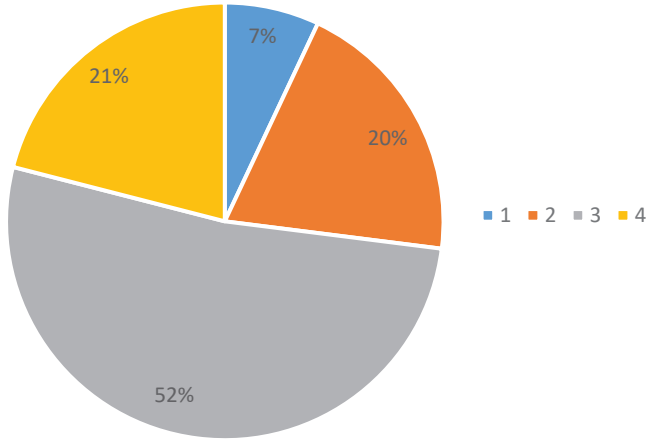

Figure 4. Comparison of Padlet useability to other tools (descriptive scale).
N o t e: 1 – Instagram; 2 – Pinterest; 3 – Prezi; 4 – Power Point. In the question concerning the simplicity of the Padlet as a tool, almost the majority of the respondents stated that Padlet is easy to use (N=210, 91.3%), complicated (N=10, 4.3%), while N=10, 4.3% claimed it is difficult to say.

The second to last question referred to the respondents' associations between Padlet as a tool and traditional analogue tools, to which the following answers were given: corkboard (N=110, 48%), notepad (N=92, 40%), binder (N=27, 125%).

The last question concerned the possibility of replacing a tool already in use with Padlet. The respondents were ready to replace their previously used tools with Padlet. These tools included: Blog (N=20, 9%), Google Disc (N=30, 13%),

Google Presentation (N=38, 17%), One Drive (N=64, 28%), Pinterest (N=70, 30%). It would appear from the results that the tools most commonly used to segregate and organize knowledge are Pinterest and Google tools. Other answers, such as Notepad, Prazi or Word, were not statistically significant, i.e. around 1.3%.

Discussion

At the beginning of the discussion, it should be noted that there are many different tools which help in the segregation and preparation of digital information. In order to assess the possibilities of such an approach, researchers had to choose one of many on the basis of the respondents' recommendations. Multimedia boards should not be treated as the main and only tool in the educational process, but the problem of the excessive amount of "Big Data" information forces the recipient to segregate and collect data, in the form of, for example, simple links redirecting to a given topic (Pedrycz & Chen, 2014).

In Polish literature there is only one publication which tries to describe Padlet as a tool with a certain potential to be used for work in higher education (Wawrzyniak-Guz, 2016). In this work, Padlet has been well evaluated both as a place to segregate and organize work and as a remote, collaborative, easy to use work environment forstudents. However, the previous study consisted in a qualitative assessment based on the direct verbal descriptions of the respondents. The author of the work did not undertake to present a quantitative approach to this issue. English language journals include many more such studies, the most frequently quoted include the work by Fuchs, B. (2014). This article is an introductory text, as it contains a general description of Padlet as a tool for educational purposes based on the example of classroom work. The author describes the tool by recommending it, but does not perform any qualitative or quantitative analysis. In other publications concerning Padlet we find a qualitative approach, which very positively assesses the role and use of Ppadlet in work at a university (Lowe & Humphrey, 2018). A quantitative approach, on the other hand, was taken up in research conducted by D. Dewitt and D. Alias (Dewitt, Alias, & Siraj, 2015). The authors present Padlet as a tool for joint learning based on the example of a debate. This study confirms its usefulness in acquiring new knowledge and joint learning in a group. In addition, students were interviewed to collect feedback on the use of the tool, and the results indicate that it is perceived positively. Another article that shows positive results in terms of its application in the learning process is a text by Q. Zhiand, M. Su (2015), which presents the results on the basis of two case studies. The

results show that Padlet can complement teaching and learning activities, help instructors to facilitate learning and pupil participation and to improve pupils' motivation and performance. From the available publications, it can be concluded that Padlet as a working tool has received high recommendations.

Conclusions

The authors of this text performed their analysis by providing a quantitative presentation of the tool in three separate contexts, i.e.: subjective evaluation of the tool, evaluation of teamwork (sharing of resources) and comparative evaluation of the tool compared to other selected tools.

In the first area of the subjective evaluation, almost 3/4 of respondents positively evaluated the padlet as a tool for sorting and collecting data. It is worth noting that in four evaluation questions the rating of 1 never appeared, while 2 occurred as a low percentage value (8.7%). This shows that the tool is very "user friendly" and shows a high level of "usability." There was a sociodemographic correlation in these questions, where residents of larger towns and cities and males provided more positive responses than other respondents.

In the second area concerning teamwork, Padlet as a tool received equally high marks as in the subjective evaluation, i.e. 4 and 5 (74%) and a very low percentage of marks 1 and 2 (8.6%), which points to the tool's usefulness in teamwork.

The last element of the evaluation involved comparing Padlet with other known tools. Here, it was also very highly rated as a tool that has many uses and which can replace the already used and popular tools such as Google Drive or Pinterest. The open questions contained in the last block of the survey confirm to a high degree (65%) the excellent functionality and intuitiveness of Padlet compared to many other popular tools which the respondents had previously used.

To summarize the above argumentation and to answer the research question posed at the beginning, it is concluded with a high level of confidence that Padlet can be considered a useful tool for a self-organised learning environment. Its potential can be successfully used and developed especially in the present times, when it has become necessary to verify the existing methods of education and seek new solutions. Assuming extended duration and wide extent of the effects of the SARS-Cov-2 coronavirus pandemic, it seems that this issue will remain relevant.

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Tomasz Kopczyński, Kamil Szpyt

Padlet jako nowoczesna forma e-learningu w kontekście badań Sugaty Mitry – nowy model edukacji

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

Artykuł ma na celu prezentację wyników badań ankiet dotyczących narzędzia padlet. Autorzy dokonują analizy współczesnych trendów edukacyjnych, przepisów prawnych oraz badań, które wpisują się w nurt nowego modelu edukacji. Tekst zawiera opisy z wyników badań zebranych z 230 ankiet przeprowadzonych na studentach w odniesieniu do 3 kategorii.

Pierwsza kategoria prezentuje wyniki ocen padletu jako narzędzia służącego do segregacji treści, druga kategoria dotyczy oceny padletu pod kątem funkcji pracy w grupie, oraz trzecia kategoria dotyczy funkcjonalności i porównania narzędzia padlet z innymi podobnymi narzędziami. Obecna sytuacja w edukacji spowodowana światową pandemią koronawirusa SARS-Cov-2 powodująca chorobę zwaną COVID-19 pokazuje słuszność ewaluacji i prezentacji wyników badań związanych z narzędziami i metodami do nauczania zdalnego jest bardzo potrzebna.

S ł o w a k l u c z o w e: padlet, narzędzia ICT, e-learning, nowy model edukacji, Sugata Mitra, SARS-Cov-2, COVID-19, nauczanie na odległość

Томаш Копчиньский, Камил Шпит

Падлет как современная форма электронного обучения в контексте исследования SugataMitra – новая модель образования

А н н о т а ц и я

Целью данной статьи является представление результатов опросов, касающихся инструмента падлет (padlet). Авторы анализируют современные тенденции в области образования, правовые нормы и исследования, которые являются частью новой модели образования. Текст содержит описание результатов исследований 230 опросов, проведенных среди студентов по 3 категориям. Первая категория представляет результаты оценки работы модуля как инструмента разделения содержания, вторая категория касается оценки инструмента с точки зрения функции групповой работы, а третья категория – функциональности и сравнения инструмента падлет (padlet) с другими аналогичными инструментами. В нынешней образовательной ситуации, вызванной глобальной коронавирусной пандемией SARS–Cov–2, вызывающей болезнь под названием КОВИД–19, оценка и представление результатов исследований, связанных с инструментами и методами дистанционного обучения, весьма необходимы.

К л ю ч е в ы е с л о в а: планшет, средства ИКТ, электронное обучение, новая модель образования, Sugata Mitra, SARS–Cov–2, COVID–19, дистанционное обучение

Tomasz Kopczyński, Kamil Szpyt

Padlet como una forma moderna de e–learning en el contexto de la investigación de Sugata Mitra – un nuevo modelo de educación

Resumen

El objetivo de este artículo es presentar los resultados de los estudios sobre el instrumento de paleta. Los autores analizan las tendencias contemporáneas en la educación, las regulaciones legales y la investigación, que forman parte del nuevo modelo de educación. El texto contiene descripciones de los resultados de la investigación de 230 encuestas realizadas a estudiantes en relación con 3 categorías. La primera categoría presenta los resultados de la evaluación del padlet como herramienta para la segregación de contenidos, la segunda categoría se refiere a la evaluación del padlet en cuanto a la función del trabajo en grupo, y la tercera categoría se refiere a la funcionalidad y comparación de la herramienta de padlet con otras herramientas similares. En la actual situación educativa causada por la pandemia mundial de coronavirus SARS–Cov–2, causante de la enfermedad denominada COVID–19, la evaluación y presentación de los resultados de las investigaciones relacionadas con los instrumentos y métodos de aprendizaje a distancia es muy necesaria.

Palabras clave: padlet, herramientas de TIC, e–learning, nuevo modelo de educación, Sugata Mitra, SARS–Cov–2, COVID–19, aprendizaje a distancia

III. Theoretical, Methodological and Practical Aspects of ICT and E-learning in Education

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The Role of Information Technology in Ecological Education in the Context of Cooperation between High Schools from Poland, Austria and the Czech Republic

Abstract

Contemporary ecological problems of the world can not only be studied as a survey of knowledge, opinions and attitudes, but also as a project designed to stimulate society from an early age towards responsibility for the environment and to increase individual ecological awareness. The article is a summary of the work carried out during the project of three cooperating schools representing Poland, Austria and the Czech Republic. The aim of the project was to consider the importance of ecology at the level of participating secondary schools in selected countries and the use of technology to implement this project. International project coordinators were interviewed. The questions concerned: application of technology in an international school project, summary of the effects of the Polish school's cooperation

with foreign schools and new challenges in the digital school. A qualitative study was carried out. The project was also analyzed in terms of activities included, and the effects were presented. The main issue raised in the project is environmental protection and ecology. Attention was paid to the problems of the Earth, the common home of all people. The role of education in shaping a possible international dialogue on cooperation in the field of ecology was also emphasized. Real environmental protection, as the activities of school students from three countries described in the article show, is a new style of education, a new approach to ecology, which is a call to the right relationship of man to the world around him.

K e y w o r d s: environmental protection, sustainable development, educational innovations, ecology, information technology

From the beginning of the human race, there has been a mutual interaction between man and nature. In the distant past, all the damage caused to the environment by human activities was local and the nature itself was able to compensate for it. Currently, human intervention which introduces harmful changes in the environment, is so intense that a worldwide ecological crisis has been created – a crisis which everybody should be aware of. Ecological awareness is identified with beliefs about reality, and its positive feature is the criticism of the anti-ecological character of the modern world (Sobczyk, 2003, pp. 19–21).

The competences belonging to the ecological imagination undoubtedly include three skills: prediction of the ecological effects of the actions undertaken, the ability to see and integrate the connections between human and natural processes and designing activities with the requirements of ecological knowledge (Marek-Bieniasz, 2004, pp. 17–19).

Ecological education means creating conditions, transferring values, evoking respect and admiration for nature so that a young man subjected to this education, creating new communities and wanting to survive and protect civilization, can respect the laws of nature, can use its goods wisely and exist in balance with the biocenosis of the surrounding environment. In order to form the desired pro-ecological attitudes in a person, it is necessary to include ecological education in the general educational process of a young person. One cannot treat individual areas of life separately and fragmentarily. If the educational system is to be effective, it must be implemented as a whole. A significant violation of the natural and climate balance can lead to a threat and, consequently, to the disappearance of human civilization. That is why formal and informal education should raise and expand the awareness of complex environmental, social and other connections, in

which every educational institution always participates (Brożek & Gawlik, 2011, pp. 10–33).

Schools are usually equipped with sets of teaching aids needed to implement projects and digital equipment such as laptops/computers, projectors, cameras. It is important that teachers from partner schools cooperate with each other during and after the project. To achieve this, networking meetings are held regularly, and daily contact provided by the Moodle platform. Only such material components are needed and the cost of their use is even lower than if the project were to be carried out in real terms on an exchange basis. Above all, what is necessary is willingness. Three Schools: Poviat School Complex No. 2 in Pszczyna, Albrechtova Stredni Szkoła in Český Těšín and Bundesrealgymnasium Purkersdorf in Austria jointly carried out projects which were supported by technologies. The Poviat School Complex No. 2 in Pszczyna conducted many stationary activities for the benefit of ecology, therefore it was the leading partner in this project (Ruman, 2018, pp. 110–117).

In the 2018/2019 school year, a project was carried out between selected secondary schools in three countries: Poland, Austria and the Czech Republic. 17 students participated from the Polish school, 11 students from the Austrian school, and 20 students from the school in the Czech Republic. The aim of the project was: to improve the quality of school work, develop proper relationships with peers (primarily in English), to raise awareness of the importance of ecological activities in your life, as well as to expand knowledge about the proper and reasonable use of the Internet. The project was carried out as part of additional extracurricular activities. The program of the project provided for two hours of classes per week, although sometimes the meetings took place on a significantly extended basis.

Students willingly participated in the classes, took active part in them, the attendance was very high. They showed creative attitude, inquisitiveness and perseverance needed to achieve the goal.

Authors conducted interviews with teachers from three schools who coordinated the ecological project. Regardless of the group's characteristics (three countries – Poland, Austria and the Czech Republic), a permanent element of the project was the use of technology, which was the basis of communication. Thanks to multimedia tools, it was possible to create an interesting e-book that described intra-project activities that can serve as an inspiration for other schools or kindergartens. The e-book contains examples of scenarios of ecological meetings for children in kindergarten, ecological games with puzzles.

Background of Research and Literature Review

Many articles have already been published on the subject of technologies used in various projects. Several are especially valuable for teachers interested in such project activities, as they may function as models or inspiration. An example is the text by Tavernise and Bertacchini, 2017. The article is devoted to designing virtual foundations for learning history, where the NetConnect project is presented on the topic of new educational strategies in the modern digital environment, which is still developing and is an important element of education at every level (Smyrnova-Trybulska et al., 2016). In schools, there are more and more innovations that, inspired by the changing demand in the work environment, force the adaptation of students' education as potential employees. To improve their education, it is also necessary to use information technologies, as shown in the article on the direction of new education in the field of fashion design, where the science of virtual prototyping using electronic textiles is shown (Han et al., 2020). Technologies primarily support learning at school (Skubała & Smyrnova-Trybulska, 2014), also through homework, which will significantly improve reading and writing skills among high school students (Magalhães et al., 2020). An interesting study is also an article on the impact of online activities on the development of students' media competence (Simonova et al., 2017). In addition to media competences, language skills are significant abilities which a student must acquire in the education process. Language and communication skills of bi- and trilingual students and the importance of IT tools as a method of improvement are the topic of the article by three Russian authors: Guzhelya, Kurilenko and Biryukova (2019). However, the project on sustainable development in education carried out between schools in Poland and Austria can serve as an example of environmental and ecological activities (Ruman & Kubiak, 2018).

About Ecological Education – Preliminary Considerations

The problem of nature protection has a significant social dimension. Natural resources should serve primarily to satisfy basic human needs. Both the benefits and costs of civilization and technical development should be equally distributed. You cannot charge next generations, leaving them with the heritage of devastated environment. True environmental protection is not an action aimed at completely stopping man's interference into nature and preserving it in an absolutely intact

state, but a harmonious coexistence and joint development of a man together with the world around him. It is, above all, a new lifestyle, solidarity between people and the resulting new attitude towards nature (Peacocke, 1991, pp. 147–149).

As long as human beings exist, there is a mutual interaction between man and nature. In past centuries, all the damage caused to the environment by human activities was local and the nature itself was able to compensate for it. Currently, human intervention, introducing harmful changes in the environment, is so intense that a worldwide ecological crisis has been created, of which everybody must be conscious from an early age. Ecological awareness is identified with beliefs about reality, and its positive feature is the criticism of the anti-ecological character of the modern world (Michalik, 2002, p. 444).

The competences belonging to the ecological imagination undoubtedly include three skills: prediction of the ecological effects of the actions undertaken, the ability to see and integrate the connections between man and natural processes and designing activities with the requirements of ecological knowledge (Papuziński, 1998, pp. 210–222).

It is known from experience that knowledge about sustainable development is not enough – this one is disseminated, and has been in the core curriculum for many years. Sustainable development would have to become a value that people will manage as well as feel responsible for strengthening. Achieving this requires systematic, consistent and careful educational activities, involving development of morality and responsibility for one's own actions and actions of others. In various areas of activities related to shaping attitudes that protect the environment, goals are set. In the area of general goals, attention is paid to the expected effects of educational activities such as:

- ecological lifestyle,
- harmonious relationship between man and nature,
- preparation to take joint actions in defense of the Earth and future generations (Kulik, 2008, p. 183).

The most important rules of ecological teaching accompanying the goals of educational activities are the principle of regularity and the principle of linking theory with practice (Sobczyk, 2003, pp. 26–28).

Education for Sustainable Development

The following definition of sustainable development applies in Polish legislation: sustainable development is a socio-economic development in which the process

of integrating political, economic and social activities takes place, preserving the natural balance and sustainability of basic natural processes, in order to guarantee the ability to meet the basic needs of individual communities or citizens of both the modern generation and future generations (Sztumski, 2006, pp. 73–76). It is important to sensitize young people to the needs of the natural environment, to enrich their knowledge of its dependencies, to indicate the beauty and diversity of nature, to make them aware of how much depends on human beings. Knowledge about sustainable development requires systematic, consistent and careful educational activities, involving the development of morality and responsibility for their actions and others (Krzysztofiak, 2009, pp. 239–243).

However, the school has educational tasks in addition to the transfer of knowledge. Its tasks include supporting the intellectual and moral self-development of students, so that their potential creative possibilities and shaping responsibility for the state of the natural environment can be triggered. Young people should be characterized by a pro-ecological attitude, i.e. love of nature and all forms of life with a human being at the forefront. Environmental protection has real meaning only when people act according to beliefs which are deeper than those dictated by reason or market laws. The formation of the pro-environmental attitude was reflected in the record included in the International Strategy on Environmental Education: "Environmental education cannot be one more item added to the existing grid of hours. It should be included in the programs of all subjects regardless of the age of the learners [...]. Its content should penetrate into the components of school education programs" (Kowalak, 2009, pp. 313–314).

Ecological security is the state of counteracting the social consequences of the transformation of the surrounding environment. It is connected with elimination of the threats to health and life of people, which originate from the natural environment or reducing such threats to a minimum. It is a set of conditions protecting people and the environment against ecological threats and shaping natural and social relations in the Earth's biosphere, which creates proper living conditions for all humanity, without undermining the basis of life on our planet. This is achieved mainly through the implementation of innovative methods and implementation of the concept of sustainable development (Łebkowski, 2008, p. 16).

Ecological safety is a durable and continuous process aimed at achieving the desired ecological status, securing the peaceful and healthy existence of all elements of the ecosystem, using various measures consistent with the principles of internal coexistence of the state and the international community (Zacher, 1991, p. 98).

The current concept of growth is an idea based on the philosophy of sustainable development. This also applies to the transmission of cultural heritage, due to its supra-regional significance for society and the environment. Sustainable develop-

ment is aimed at the sustainable quality of life of present and future generations, through integration and shaping the right proportions between the goals: spiritual, economic, ecological, social, institutional and spatial. The problems of the present day, such as socio-economic and cultural changes, also concern the preservation of identity and cultural heritage and should be the subject of broad scientific discussions (Piontek, 2002, p. 27).

The school development program should be oriented towards the systematic improvement of the conditions of its implementation and thus towards the development of students and the professional development of teachers whom it will create in the following years. It should meet various expectations of the local community. It is not only students and teachers who undertake many activities to improve the functioning of the school and contribute to its development, but also cooperating entities. Cooperating with local government, various institutions in the community and county, the school should invite their representatives to important ceremonies which take place and show the effects of school work visible at concerts, performances and exhibitions.

School achievements, the successes and the involvement of its pupils should be included in the local press and the Internet portals, and such activities should be treated as a form of school promotion, which is characterized by a special prosocial involvement in relation to spiritual values.

The main task of the school is to implement an educational program which promotes sustainable development, to combine ecological education of students with moral education. The school is an institution supporting development on two levels: social and individual. Social level is connected with growing in culture, taking over patterns of functioning and finding a place in the world. The individual level concerns shaping the personality, increasing self-awareness, enriching forms of self-realization. "Learner's happiness" is regarded as the goal of teaching. The teacher plays a huge role in the education process, models behaviours for students and provides them an example to follow.

Cooperation with other schools, the need for meetings of their representatives is a help and inspiration for effective implementation of education for sustainable development in schools. During such meetings, it is possible to exchange views, to reinterpret teaching content and to evaluate the methodology of teachers. These are different ways of understanding eco-development as the implementation of the global activities for sustainable development, as the improvement of education, its scientific and didactic workshop.

Partnership is characterized by interaction and communication. The educational community is a huge space for communication and meaning, in which actors – teachers, parents and children – continue to send messages through a variety

of channels. Thanks to this, a convenient source of inspiration and development, interaction, and encounters between men are created.

Educational activities aimed at gaining experience and understanding reality, "use of living," making social changes and constant attempts to understand oneself and others create conditions for better development and creativity of students. At the same time, they enable implementing thoughtful and conscious actions, using the strength and power of authorities and values creating national and international culture.

Education for sustainable development shows its religious-ethical-philosophical dimension in starting well-thought-out and sustainable organic work at home, at the foundation, for the benefit of their own "small homeland" and their rightful citizens.

Detailed Description of the Design of the Three Schools

In this part of the article activities at the Karol Miarka County School Complex no. 2 in Pszczyna (from the School Chronicle) will be reviewed. The following are selected examples of integral ecological activities carried out in the project together with foreign schools:

- Students participated in monitoring of wild dumps. An observation was made concerning kind of waste that was found in the landfill and its quantity, and also the impact of this waste on the environment was assessed. Students wondered why landfills in wild areas are formed and what can be done to prevent people from creating them. The students of each of the partner schools completed the task in their own country and presented the results through a remote meeting.
- Students took part in the workshop "Modern methods of waste management," learned the way of waste from home to landfill and how to segregate waste. They invited a specialist from the Czech Republic who led the meeting, connecting with young people via the Internet.
- At the CHP plant, students learned where heat is coming from, how it is transported, why the pipes are cold although there is hot water flowing in them and how the heat plant differs from the CHP plant. The meeting was also held remotely, the effect was surprising, because by means of webcam, an employee at the Polish Pszczyna CHP Plant showed their place of work to curious youth, who connected via multimedia from Poland and abroad.

Together, young people also interviewed children in selected kindergartens in their surrounding area about the importance of ecology in their lives. The result of

the analysis was surprising, because in all the studied countries children are aware of the importance of ecological activities. They believed in:

- respect for animals and plants, not trimming grass as a pro-ecological attitude;
- leading clean life through not producing pollution and too much waste;
- ecology which means eating fruit and vegetables;
- ecology which is about how to breathe fresh air and have clean water;
- ecology as life, there is no life without it.

Students from three countries also created inventions that in the future would help protect the environment. The inventions largely included technological equipment which would indicate the exact place of littering in the mountains, would give the sensor a sign that someone threw a trash bag in the forest, or indicated dripping taps loose in school and other institutions. The ideas were diverse, creative, and above all future-oriented.

These mini-projects were carried out remotely, but the effects of their implementation are valuable in the education of young people in each country participating in this project, as confirmed by the guardians.

Representatives – coordinators commented on the validity and validity of projects that are implemented using only technology as follows:

Opinion of the youth guardian from Austria, Stephan Sampt:

> At first I was skeptical about such a project, I did not know if its effect would be visible. I have extensive experience in stationary projects, where we cooperate for several months and then present the effect of the work. What are we going to do here? However, I saw the enthusiasm of young people, they had a desire to do something new. At the same time, they were happy that they would be the first, practically not moving from school, they would do something. As a teacher, of course, I remember that the goals of the partnership are part of the concept of improving the quality of school work. I read that there is a principle of mutual commitment, which means that both partners should equally involve their time and skills in the partnership. I thought that the students and teachers of each partner school would contribute as much as possible to the realization of jointly defined goals. Everyone will do it to the best of their abilities and taking into account any restrictions. Full access to all information on partnerships by both interested schools is also important. Traveling is not an option, especially at the beginning of cooperation. Virtual contact often has to be enough for us. That is why information and communication technologies (ICT) are extremely important during the implementation of the partnership – they allow us to communicate quickly and efficiently. I was surprised, but despite my abilities and knowledge, young people

> know technology better than teachers. By the way, we – the elders – can learn something more and observe. I am very pleased with the cooperation and recommend such solutions to other schools. Through multimedia, we connect once a week and discuss a selected topic related to ecology. This is obviously a social problem that bothers us, we help the partner school find a solution and they help us. In addition to the fact that we can expand language knowledge (we speak English), we also see ourselves through the webcam. At the end of the mini-project, we have fun together, hold an e-learning party. We play music, dance, play puns. It works out best for us. There is simply time for entertainment after hard work (S. Sampt, application of technology in an international school project, October 11, 2019).

The guardian of Polish youth, Jarosław Kinalski:

> We are glad that we, as a school, could participate in such an innovative project. We see the same benefits: greater motivation to learn foreign languages and faster progress in learning, stimulation and development of imagination, a chance to make new acquaintances, practical application of information and communication technologies. It is primarily an openness to people representing other cultures, activities for a sustainable lifestyle, an increase in knowledge about school reality in a partner country. Despite the great skills demonstrated by students in this area, it is worth ensuring the support of an IT teacher. I took up this challenge and I'm happy. The technologies in such a project enable easy and quick communication with a partner from a distant country, motivate to work independently and raise competences in the field of using ICT, as well as affect the dissemination of information through a website. Thanks to this, students will learn about the new use of computers and the Internet, going beyond the basic methods of communication. Most of the meetings took place in this one room, because without a computer room in the project, we would never move forward. Therefore, it is worth determining from the very beginning what principles groups will work on. The advantage is that the partnership encourages students to apply the acquired knowledge about e-mail, internet forums, websites, etc. in practice. Our youth have started keeping electronic diaries, like their colleagues from Austria. And this is now a novelty among our students, and a cause of admiration in others. Thanks to the partnership, our students can acquire skills important in today's world, use and build an attitude of openness and actions. The partnership is part of our school's daily work, as it manages to focus on education

> (J. Kinalski, summary of the effects of the Polish school's cooperation with foreign schools, September 16, 2019).

The guardian of the Czech youth, Zdenek Mruzek:

> The development of technology makes its mark on the functioning of students. Some time ago, I remember it was enough to be prepared at the level of computer literacy. Rapid changes in technology have forced the expansion of literacy into proficiency in the use of information and communication technologies. And dealing with computer help in problem situations caused interest in computational thinking. At the beginning of the development of IT education, it was enough for students and teachers to be able to use the office package and to communicate via the network. This basic preparation is not enough today. The purpose of equipping schools with the latest technology is to familiarize students with technology in times of its extremely rapid development and to prepare them for functioning in the information society. Why not use the possibilities of projects for this? If there are schools willing to cooperate without payment, if there are passionate teachers, then why not? Currently, computer and information technologies are integrated into almost every field. School graduates are expected to be well prepared to use these technologies. Thanks to such projects, our students have learned to think creatively and critically and are fluent in communicating and establishing relationships. It makes you happy. By doing projects, young people try to learn about their culture and customs. It opens to otherness and diversity. Thanks to such meetings, of course with an element of science, students develop skills in critical thinking and formulating their position (Z. Mruzek, new challenges in the digital school, September 3, 2019).

The main benefits of using new technologies in environmental education that the respondents mentioned were the low costs of carrying out this project and enabling meetings without the need to travel to other countries between participants. During the presented interview, the coordinators were very pleased with the results, because students, in addition to joint participation in ecological workshops, could compare the ecological awareness of people in their countries. They also highlighted the creativity of young people and their ideas. This exchange of thoughts inspires even better action for the benefit of our environment.

As part of the project, three teachers exchanged ideas on how to better use ICT tools at work during class. Everyone agrees that the project brought only benefits. The subjects concerned ecological activities, which, as it turned out in all three

schools, despite the differences in state, are important and one should talk about ecology from an early age. Students eagerly connecting via multimedia, carried out joint ventures, exchanged ideas, and gathered the effects of their work together in an e-book. It turns out that projects do not have to be based on exchanges and trips. The project showed an innovative idea – through using technological equipment, it was possible to carry out several activities performed by young people who connected via the Internet. Each of the parties boasted their ecological activities, and at the same time improved their level of English. The most important element were low project costs. The teachers also emphasized that the project allowed them to learn new opportunities to use technology in education, watching young people. Polish students began to create their electronic diaries, like their foreign new friends.

A Summary

The issue of climate change is undoubtedly the current topic for discussion. Climate change is a fact and often the discussion about its causes hardly contributes to the real solution to the problem. A reliable debate on climate protection, as well as state fulfillment of international commitments undertaken in this area can contribute to the problem solution.

Social changes taking place in the world cause changes in lifestyle. Health care at home and the environment is becoming more and more important, and families are developing initiatives to raise children in an active respect of the environment and shape the ecological sensitivity from an early age. This ecological education has a great chance to change the existential attitude of a nation, which consists in treating life as an opportunity to experience pleasure (Bołoz, 1995, pp. 33–37).

One of the major problems of the modern world is the so-called "Ecological crisis," or a serious disturbance of the natural balance between man and his environment. This situation results from the disordered use and plundering of natural resources by human activities. Often, man does not realize that threatening his environment, he is threatening himself. Unfortunately, humankind, despite of the fact of being completely dependent on nature, unfavourably influences the existing balanced interaction between organisms and the environment. As a result, the entire ecology of the earth, thoroughly changes. Therefore, the human mission to the world can be described by three verbs: transform, serve and protect. Nature is not a completely self-renewing resource, therefore man cannot take a gladiatorial attitude towards it; we are not the only or the last generation, hence we cannot

leave our land devastated. Today, ecology is a call to the proper attitude of man towards the world around him (Krawczyk, 1986, pp. 13–23).

Keep in mind that: "The basic idea is that students, who will come of age in the 21st century, need to be taught different skills than those learned by students in the 20th century, and that the skills they learn should reflect the specific demands that will be placed upon them in a complex, competitive, knowledge-based, information-age, technology-driven economy and society" (Morze et al., 2016, p. 42). The essence of computer science is solving problems with the help of a computer. Students are struggling with problems and tasks from various subjects, and quite often a computer is the right tool to use. The problem is a situation where a student is to present a solution and steps leading to it, on the basis of what he knows but without any prior knowledge how to do it. The problem is generally of some difficulty, it is not a routine task. Schools should develop their students' IT competences more and more. The presented project of three schools from three different countries showed the importance of the described activities. Technology should increasingly be used during projects in order to enrich them.

It should be remembered that the use of technology can also take place during extracurricular activities, as well as projects that bring only benefits (such as shaping language and IT competences, as well as preparing students to international cooperation and developing their).

The use of technology in projects requires specific workload of coordinators and participants as a part of clearly defined activities, tasks and assigned roles. Using IT also helps in conducting the evaluation at the end of a project more efficiently. Thanks to such undertakings as the project described, schools will have the opportunity to train students' skills in working in international groups, prepare for independent search of information, also on the Internet, and improve the ability to select important information.

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Rola technologii informacyjnej w edukacji ekologicznej w kontekście współpracy szkół średnich z Polski, Austrii i Czech

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

Współczesne problemy ekologiczne świata mogą być badane nie tylko jako sondaż wiedzy, opinii i postaw, ale także jako projekt mający na celu stymulowanie społeczeństwa od najmłodszych lat do odpowiedzialności za środowisko, zwiększenie indywidualnej świadomości ekologicznej. Artykuł stanowi podsumowanie prac przeprowadzonych w ramach projektu trzech współpracujących szkół reprezentujących Polskę, Austrię i Czechy. Celem projektu było rozważenie znaczenia ekologii na poziomie szkół średnich w wybranych krajach uczestniczących w tym projekcie oraz wykorzystanie technologii do realizacji tego projektu. Międzynarodowi koordynatorzy projektów przeprowadzali wywiady. Pytania dotyczyły: zastosowania technologii w międzynarodowym projekcie szkolnym, podsumowania efektów współpracy polskiej szkoły ze szkołami zagranicznymi i nowych wyzwań w cyfrowej szkole. Przeprowadzono również badania jakościowe. Projekt został także przeanalizowany pod kątem uwzględnionych działań i zaprezentowano efekty. Główną kwestią poruszoną w projekcie jest ochrona środowiska i ekologia. Zwrócono uwagę na problemy Ziemi jako wspólnego domu wszystkich ludzi. Podkreślono także dialog o współpracy w dziedzinie ekologii. Prawdziwa ochrona środowiska, jak pokazują opisane w artykule działania uczniów z trzech krajów, to nowy styl edukacji, nowe podejście do ekologii, co jest wezwaniem do właściwej relacji człowieka z otaczającym go światem.

S ł o w a k l u c z o w e: ochrona środowiska, zrównoważony rozwój, innowacje edukacyjne, ekologia, technologia informacyjna

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Роль информационных технологий в экологическом образовании в контексте сотрудничества между вузами Польши, Австрии и Чехии

Аннотация

Современные экологические проблемы мира можно изучать не только как обзор знаний, мнений и взглядов, но и как проект, направленный на стимулирование общества с раннего возраста к ответственности за окружающую среду, повышение индивидуальной экологической осведомленности. Статья представляет собой резюме работы, выполненной в рамках проекта трех сотрудничающих школ, представляющих Польшу, Австрию и Чешскую Республику. Целью проекта было рассмотреть важность экологии на уровне средних школ в отдельных странах, участвующих в этом проекте, и использование технологий для реализации этого проекта.

С международными координаторами проекта были проведены собеседования. Были затронуты следующие вопросы: применение технологий в международном школьном проекте, краткое изложение результатов сотрудничества польской школы с иностранными школами и новые вызовы в цифровой школе. Качественное исследование было проведено. Проект также был проанализирован с точки зрения деятельности, включенной в него, и были представлены результаты.

Основными вопросами, затронутыми в проекте, являются охрана окружающей среды и экология. Внимание было уделено проблемам Земли, общему дому всех людей. Была также подчеркнута роль образования в формировании возможного международного диалога о сотрудничестве в области экологии. Реальная защита окружающей среды, о чем свидетельствует деятельность студентов из трех стран, описанная в статье, – это новый стиль образования, новый подход к экологии, который является призывом к надлежащим отношениям человека с окружающим его миром.

Ключевые слова: охрана окружающей среды, устойчивое развитие, образовательные инновации, экология, информационные технологии

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El papel de la tecnología de la información en la educación ecológica en el contexto de la cooperación entre escuelas secundarias de Polonia, Austria y la República Checa

Resumen

Los problemas ecológicos contemporáneos del mundo pueden estudiarse no solo como una encuesta de conocimiento, opiniones y actitudes, sino también como un proyecto destinado a estimular a la sociedad desde una edad temprana a la responsabilidad por el medio ambiente, aumentando la conciencia ecológica individual. El artículo es un resumen del trabajo realizado en el marco del

proyecto de tres escuelas cooperantes que representan a Polonia, Austria y la República Checa. El objetivo del proyecto era considerar la importancia de la ecología a nivel de escuelas secundarias en países seleccionados que participan en este proyecto y el uso de tecnología para implementarlo.

Se entrevistó a coordinadores de proyectos internacionales. Las preguntas se referían a: aplicación de tecnología en un proyecto escolar internacional, resumen de los efectos de la cooperación de la escuela polaca con escuelas extranjeras y nuevos desafíos en la escuela digital. Se realizó un estudio cualitativo. El proyecto también se analizó en términos de actividades incluidas en él, y se presentaron los efectos.

Los principales problemas planteados en el proyecto son la protección del medio ambiente y la ecología. Se prestó atención a los problemas de la Tierra, el hogar común de todas las personas. También se hizo hincapié en el papel de la educación en la configuración de un posible diálogo internacional sobre cooperación en el campo de la ecología. La verdadera protección del medio ambiente, como lo demuestran las actividades de los estudiantes de los tres países descritos en el artículo, es un nuevo estilo de educación, un nuevo enfoque de la ecología, que es un llamado a la relación adecuada del hombre con el mundo que lo rodea.

P a l a b r a s c l a v e: protección del medio ambiente, desarrollo sostenible, innovaciones educativas, ecología, tecnología de la información

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Using Moodle as a Solution to Interdisciplinary E-collaboration Issues

Abstract

Rapid technological development in recent years has contributed to numerous changes in many areas of life, including education and communication. Establishing interdisciplinary collaboration brings many benefits, it is, however, often associated with numerous problems and inconveniences, as well as the need for constant improvement, lifelong learning, professional development (CPD) and finding an effective way of information transfer. Living in a constant rush makes the logical order of information transfer become a key aspect, as more and more operations are being done chaotically, using multiple online tools. Although collaboration happens to be complicated even for colleagues specializing in different aspects of the same profession, establishing cooperation between specific groups of interdisciplinary specialists, such as engineers and physicians, has a significant impact on modern diagnostics and medical treatment development. Based on some selected case studies investigated at Gdańsk University of Technology and Medical University of Gdańsk, supported by an overview of available education and collaboration tools, a solution based on the Moodle LMS platform has been proposed, implemented, and analyzed.

K e y w o r d s: Moodle, interdisciplinary collaboration, e-collaboration, medical engineering

Interdisciplinary Collaboration Issues

Lifelong learning and the direct application of a relatively new field called interdisciplinary collaboration is now required to apply broad knowledge from various fields which are not always related. In interdisciplinary projects, active consulting with the use of appropriate and efficient collaboration tools is an extremely important factor which abounds in many benefits (Augustine, 2018).

It has been researched and proven that even the mere possibility of conducting consultations positively affects the creation process, while teamwork increases the sense of security, reduces stress and allows for the exchange of ideas which can lead to novel solutions. Active collaboration increases the awareness of mistakes and opens people's minds to perceive the subject from a completely different angle, which is extremely important in interdisciplinary projects (Howard, 2015).

Establishing such cooperation brings many benefits. However, it is often associated with numerous technical problems and inconveniences, as well as the need for changes in the adult education model, constant improvement, and continuous professional development (CPD). The time constraints of the modern day are compounded by the need for projects to be consulted at every step. Moreover, the problems of distance, delays and the high cost of traveling make conventional consultations prohibitively expensive and ineffective. Yet, effective consulting does not require being in the same room. The key objective is to communicate and share information effectively. With time increasingly being of the utmost importance, more and more projects are conducted over the Internet using multiple online tools instead of organizing long and often inefficient office meetings (Kozłowska, 2017).

Despite many advantages of online collaboration, there are those who are still concerned about certain aspects of online projects and interdisciplinary work in general. Is it overconfidence and a sense of rivalry which makes some think that they can do everything by themselves and resent anybody looking over their shoulders or criticizing their work, or, is it a completely different reason? Misunderstandings between specialists of different fields often discourage them from working together. The problem is that a lack of consultation may lead to dangerous and even harmful situations, whose effect might become apparent only after some time. Is the illusion of independence worth risking human safety? Definitely not! We need different specialists to pay attention to different parameters and consider factors not strictly associated with their field. One professional may identify problems another would never consider. Communication problems can also occur between specialists of different fields of the same scientific discipline, where differences in terminology and procedures cause serious misunderstandings, even

when the same native language is spoken by all involved. Interdisciplinary collaboration requires much patience and mutual respect.

Engineers and Physicians – How It All Started

Establishing interdisciplinary cooperation between engineers and physicians brings many benefits and has a significant impact on modern diagnostics and treatment development. However, engaging in such cooperation often causes many problems and inconveniences. Medical engineering requires a great sense of responsibility. Even a small mistake may cause serious consequences. Proper and effective collaboration between different specialists who are focused on different aspects is a significant factor with regard to the patient's safety and recovery (Morschauser, 2014).

It all started with an engineering diploma thesis which was carried out at Gdańsk University of Technology, Faculty of Mechanical Engineering. As a graduate engineering student of Mechanical-Medical Engineering, I was assigned to a project to design a device for children learning to walk (an improved baby walker). A few years earlier, a similar project was carried out and produced a baby walker which received great media success and a patent. However, subsequent research revealed that the baby walker concept in general was, in fact, extremely harmful to toddlers. Based on collected publications, research results, statistical analysis, and legal regulations, it was established and proven that baby walkers are harmful and do not hasten the learning process of walking.

In some countries, such as Canada, they are now classified as illegal. Using, producing, buying, or importing baby walkers in Canada is forbidden by law. Moreover, baby walkers seriously delay a child's physical development. They can cause lumbar spine deformation, balance disorders, flat feet and other health issues. Based on professional literature, the required mechanism of a child learning to walk was illustrated. On the basis of the collected data and consultations with doctors and physiotherapists, the dangers of placing children in baby walkers were described. It was also explained how baby walkers can hinder the child's development. The harmfulness of walkers has been analyzed in the context of general development, orthopedics, and neurology. It was concluded that baby walkers have no positive effect on the child's process of learning to walk. Furthermore, they are harmful and can lead to many developmental disorders that may stay undisclosed and asymptomatic for many years and suddenly appear in adulthood or even in one's old age, such as the lack of proper safety reactions when falling, which can result in serious bone fractures (Kozłowska, 2016).

The mechanical parameters of baby walkers fulfill basic mechanical requirements regarding, for instance, robustness and durability, which are the main preoccupations of a mechanical engineer. Yet, if it had not been for the multidisciplinary

approach to the subject matter and consultations with physicians, another harmful device would have been designed.

Another issue connected with the collaboration between engineers and physicians is the time-consuming and inconvenient need for constant mutual supervision. Medical device designing requires a wide range of expertise in various fields of medicine and engineering, including the rapid development of technologies used in diagnosis, implantology, rehabilitation, etc. Moreover, collaboration should be consistent because it is usually most effective when it is carried out throughout the entire designing process.

An example of the consequences of the lack of collaboration is the rehabilitation robot Renus-1 (Dunaj, Klimasara, & Piłat, 2017). Renus-1 was designed by an engineer, based on his own rehabilitation experiences. The designing process was carried out without any participation of a medical specialist or an institution. Although a prototype of the robot has been built, it cannot, unfortunately, be used for any rehabilitation purposes. The problem is the lack of collaboration in the designing process, which resulted in many complications during the implementation. First, it is very difficult to obtain the approval from the ethics committee for tests on patients. Moreover, the control system designed by engineers was not intuitive for non-technical staff. The presence of a medical specialist in the project group would have helped in overcoming of many barriers.

E-Collaboration Issues

Interdisciplinary collaboration takes time and, apart from knowledge, requires a lot of patience, dedication, and involvement. Since conducting consultations is usually associated with long waiting periods in hospital corridors and sometimes entails frequent appointment rescheduling, transferring the collaboration aspect to a wisely chosen online tool saves time and also protects project participants from health hazards of hospital premises.

Naturally, there are always some cultural differences, individual habits or personality differences which may cause numerous misunderstandings. Well-organized online work also needs a good schedule and a set of rules which every team member clearly understands. The key aspect is selecting the most appropriate tools to meet the specific requirements of the project.

First, one needs to determine what programs are to be used, the deadlines for each stage of work and the communication procedures between participants. Let us imagine a situation when member A uses only e-mail messages to get in touch with member B, who checks his mailbox only once a week but keeps calling member C to get information about the progress, which C does not have because he is not on A's mailing list. One is an early bird while all the others are night owls and always get angry when forced to answer an early morning call. Moreover, one

participant uses a special program which is not compatible with any of the others' operation system. Even worse, a discussion which is important to the whole group is conducted between individual members using various platforms and messaging tools at various times. At one time, they might be communicating via Facebook Messenger or WhatsApp, at another writing SMS messages or e-mails (with or without the proper use of a "reply to all" button or using it only sporadically), and then again they might be communicating via group chat or video conferencing. The multitude of electronic channels of communication can later cause problems with retrieving or referring to important data. This does not facilitate collaboration but rather sows disorder, which leads to frustration (Kozłowska & Howard, 2019).

It should also be clearly defined how often the email box should be checked, what time and day is usually convenient for live sessions, how often a progress report is to be submitted, what kind of software is going to be used and what types of files are compatible with everybody to share and work on. Roles and tasks should be allocated to the members in accordance with their specific skills, competences and availability. All to maintain the appropriate pace of work.

Another important issue is that of cultural differences. Some cultures prefer long descriptions and expressions of courtesy, while others appreciate communication which is straight to the point. The commanding tone of communication in one culture could seem offensive to somebody from another culture. This should also be considered.

Implementing Moodle As a Solution

Based on an overview of various programs and platforms supporting online collaboration and education, a comparison of the most suitable of the available cooperation tools has been made and a solution based on the Moodle LMS platform has been proposed.

Moodle (Modular Object-Oriented Dynamic Learning Environment) is a Learning Management System (LMS) used for e-learning projects, mostly in schools, universities, and workplaces. Customizable management features make it a good tool for creating private websites with online courses for educators and trainers. Moodle allows for extending learning environments using community sourced plug-ins. The software also allows instructors to hold live online meetings. Features include a private online Learning Room with document, audio, and video files (Stanley, 2014). Various integrated Moodle tools, such as Forum, Wiki, Glossary and Choice, make collaboration well-organized.

Forum can be used for general announcements but also for discussions and evaluations. It is possible to create many different fora in sections of the course.

Wiki helps in collaborative writing of papers. It registers all the changes made by individual team members. It also saves all the previous versions of a document as a backup, which provides greater control of the writing process.

Using Glossary is an essential part of any interdisciplinary project. Collecting definitions and explanations of the specific terms used prevents misunderstandings and improves communication between the team members.

Choice is a simple decision maker. A simple question can be asked and a few options are provided to choose from. Depending on the activity settings, one or more answers can be chosen. The disclosure of the results can be regulated.

Moodle is a particularly good repository. It also has a reporting system that shows all the activities of each participant.

Case Studies

To check the suitability and correctness of the chosen solution in practice, cooperation with representatives of technical, medical, and business environments has been established and an experimental group of volunteers, including students, teachers and entrepreneurs has been created. The information gathered was used to prove that using Moodle along with clearly specified technical programs makes interdisciplinary work faster and much more efficient.

Engineers, Physicians and Entrepreneurs – Erasmus+

Without doubt, one of the best inducements for universities to collaborate with each other occurs when they receive a grant or become involved in a major project. Some interdisciplinary projects have resulted from inter-academic cooperation between Gdańsk University of Technology (GUT) and Medical University of Gdańsk (MUG) with the support of the SP4CE ERASMUS+ program.

Erasmus+ is a European Union programme for education, training, and sport in Europe. The ERASMUS+ project SP4CE (Strategic Partnership for Creativity and Entrepreneurship) directly addressed the aims and needs of enhanced European cooperation in vocational education and training. SP4CE was a response to needs identified in the "Bruges Communiqué on Enhanced European Cooperation in Vocational Education and Training for the period 2011 – 2020." (Cedefop, 2010). To implement a SP4CE portal, WordPress and Moodle were used. The WordPress page (http://sp4ce.eu/en/) provides information and training materials in five languages: English, Greek, Polish, Slovak and Hungarian. The Moodle platform

(http://sp4ce.moodle.pl/) allows for the collaboration of consultants, teachers and students from different universities using the concept of Learning Rooms.

Learning Rooms are an on-line space on a dedicated Moodle platform created to work on one project. It usually consists of a discussion forum, a set of tools such as built-in links, books and pages working as a materials repository, and also some activities, such as Wiki, assignments, surveys or voting tools. Moodle offers many external plug-ins, like PoodLL, Skype, Facebook or different webinar platforms which can engage the participants and diversify the collaboration. The work can be both synchronous or asynchronous, depending on the conditions, time zone differences and personal preferences.

All the project results and project actions were connected with promoting the adoption of innovative practices in education and training by supporting personalized and collaborative learning approaches, as well as critical thinking, strategic use of Information and Communication Technologies (ICT), Open Educational Resources (OER), virtual mobility and other innovative learning methods (Grabowska, Czaja, Kozłowska, & Pałasz, 2016).

The aim of the SP4CE project was to develop information and organizational solutions which would enable professional training aimed at an effective collaboration between all project target groups during the learning process. The SP4CE project supported collaboration between project partners by exchanging modern educational solutions and developing innovative tools to facilitate communication and collaboration between students, schools, and businesses.

The SP4CE project used the experience and results of two lifelong learning projects, OpenInn and HIG. The project consortium consisted of six partners from four EU countries. The project coordinator, PIAP (Poland), is a research institute with long-established cooperation with the industry and educational institutions. PRO-MED (Poland) is a private company which has experience in developing innovative approaches to teaching and learning with e-learning and blended learning methodologies. TUKE (Slovakia) is a technical university fostering links with institutions in the private and public sectors, while ASTRA (Slovakia) is a training company which has significant experience in conducting manager training. TREBAG (Hungary) has rich experience in the development of innovative training materials and methodologies, including e-learning and implementation of technology, and IDEC (Greece) has consulting experience in developing quality management systems (Grabowska, Urbancikova, Słowikowski, & Zieliński, 2015).

SP4CE portal provided the space for:

- problems to be solved, questions to be answered,
- creating teams, which wanted to work towards finding solutions to problems,
- mentoring & coaching,

- presentation of developed solutions,
- publishing of solutions.

It was dedicated to three main target groups:

- coaches from companies who formulated and submitted the problem.
- students from various universities who chose problems, looked for solutions and submitted short proposals.
- teachers who were allocated in accordance with the proposed solution to students in Learning Rooms and assisted in the problem-solving process.

To achieve good online collaboration between all target groups, volunteers from Gdańsk University of Technology and Medical University of Gdańsk have been trained to use the appropriate software.

Participants of the SP4CE project took part in some open Moodle courses, starting from a Massive Open Online Course, Moodle MOOC 7, run by dr. Nellie Deutsch on the Integrating Technology Moodle4Teachers platform (Deutsch, 2015). Experience gathered by both students and teachers during those Moodle MOOCs was implemented in the project. Short training videos relating to Moodle tools and the operation of Learning Rooms were created as part of the training and used for future educational purposes. Numerous Learning Rooms were created for students to be used for university group projects, med-tech consulting, research, paper writing and much more.

Even though during the Moodle MOOCs and individual training numerous different webinar tools were tested (e.g. WizIQ, BigBlueButton, Zoom, ClickMeeting), none of them were selected to be included in the Learning Rooms as recommended.

After the professional training of some of the project leaders, a free two-day workshop for students and teachers from Gdańsk University of Technology and Medical University of Gdańsk was organized as part of SP4CE implementation and Autodesk Fusion 360 Designation world online event. Among the 31 participants who finished the whole course, 10% were students of medical faculties, 13% were PhD students, 16% were academic teachers and the remaining 61% were engineering students of Gdańsk University of Technology faculties of: Electronics, Telecommunications and Informatics; Electrical and Control Engineering; Applied Physics and Mathematics; Mechanical Engineering and Management and Economics. The Moodle platform created for the purpose of the SP4CE project (http://sp4ce.moodle.pl/) allowed participants from different institutions to join a dedicated Learning Room without formal obstacles.

One of the most successful projects, carried out and completed online with the use of a Moodle platform and the new CAD cloud designing program Autodesk Fusion 360, was a collaborative mandible implant design created by two students of mechanical-medical engineering at Gdańsk University of Technology, working

online with a student of dentistry from the Medical University of Gdańsk. As a result, they not only prepared the design and material selection, but also produced a prototype based on an individual computer tomography examination of a real patient after bone resection, and a reconstruction with the usage of CAD programs and 3D printing (Halman & Etmańska, 2017).

Based on this case study, a structural outline consisting of the following steps was prepared for future use:

- diagnosis,
- X-ray and/or Multidetector Computed Tomography (MDCT),
- MDCT evaluation,
- sharing the results on Moodle,
- consultations between physicians in different medical centers,
- more medical tests, if needed,
- final diagnosis,
- planning the surgical treatment based on MDCT,
- consultations between physicians and engineers during the process of CAD designing,
- 3D printing or milling of a prototype,
- evaluation,
- 3D printing or milling of surgical template,
- 3D printing or milling custom implant,
- surgical template and custom implant sterilization,
- surgical procedure,
- postoperative control using MDCT or Magnetic Resonance Imaging (MRI).

For the purpose of visual presentation of the collaboration process, a simplified flow chart (Figure 1) was created as an additional resource, which can be used as an simplified instruction and an explanation of the recommended cooperation contrivance for future collaborative implant designing projects.

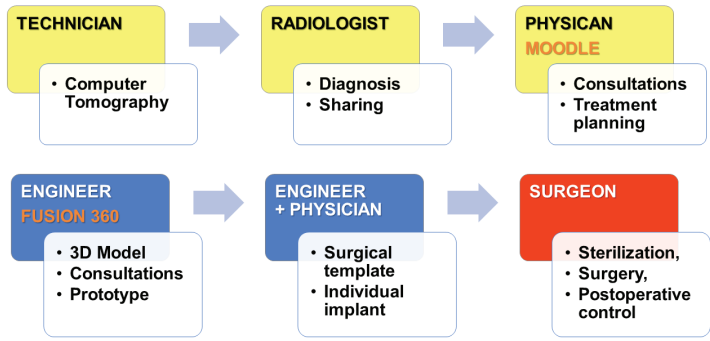

Figure 1. Engineer-Physician collaborative e-designing contrivance.

Thanks to the new technology, all the collaborative designing process was conducted strictly online (Grabowska et al., 2016).

By the end of the project, there were over 500 registered users working in 124 Learning Rooms. These users were from Austria, Belgium, Brazil, Bulgaria, Croatia, France, Germany, Greece, Hungary, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Spain, Sweden, and the UK.

Although the SP4CE project is officially finished, many Learning Rooms are still being used and more are being created after the acceptance of the final report by the European Union Commission, which is the evidence of the project's sustainability.

Interdisciplinary PhD Dissertation – on Moodle?

Collaboration appears to be complicated even for colleagues specializing in different aspects of the same profession. An ongoing interdepartmental PhD research project can be given as an example. The subject matter, connected with heat transfer, material sciences and surface modification, required collaboration between the Department of Energy and Industrial Apparatus, and the Department of Materials Engineering and Bonding. Both are part of Gdańsk University of Technology, Faculty of Mechanical Engineering. Because of some prosaic inconveniences, the work had been going slowly, mostly because of the lack of proper information exchange.

The main problem was an inconsistent application of communication tools. Email exchanges were mixed with phone calls which were usually impossible to record and hard to remember. Moreover, teachers from both departments used to contact only the PhD student and ask what the other scientists had decided or hurried them up without talking to each other. Meetings at the university were repeatedly postponed because of poor time management or conflicting schedules. It all resulted in almost a year of planning without undertaking any action.

After the great success of many interdisciplinary engineer-physician projects carried out as a part of the SP4CE program and a Moodle-conducted master's thesis, it was decided to continue PhD research and consultations on Moodle. Once the research had moved to a Moodle working area (Figure 2), communication rapidly improved, which resulted in a better understanding of the subject and, therefore, an increase in research efficiency.

However, after a few weeks, work slowed down again. The main PhD supervisor took the position of an observer and, therefore, left others confused about who was taking on the leadership position. It is a cultural custom that in some countries, university social status makes interpersonal relations more distanced. In other words, if a student took control over the project and started issuing commands, it could be considered rude. As long as it is done in a polite way, with respect and

clear explanation, it is acceptable to have one rule bent or even broken for the purpose of general improvement.

In this case, it was the PhD student who had to take over and put some pressure on other team members, otherwise, the research and experiment would have gotten stuck at a dead end due to procrastination.

It also turned out that some of the university teachers, mostly elderly ones, would never admit that they did not feel comfortable enough in the online col-

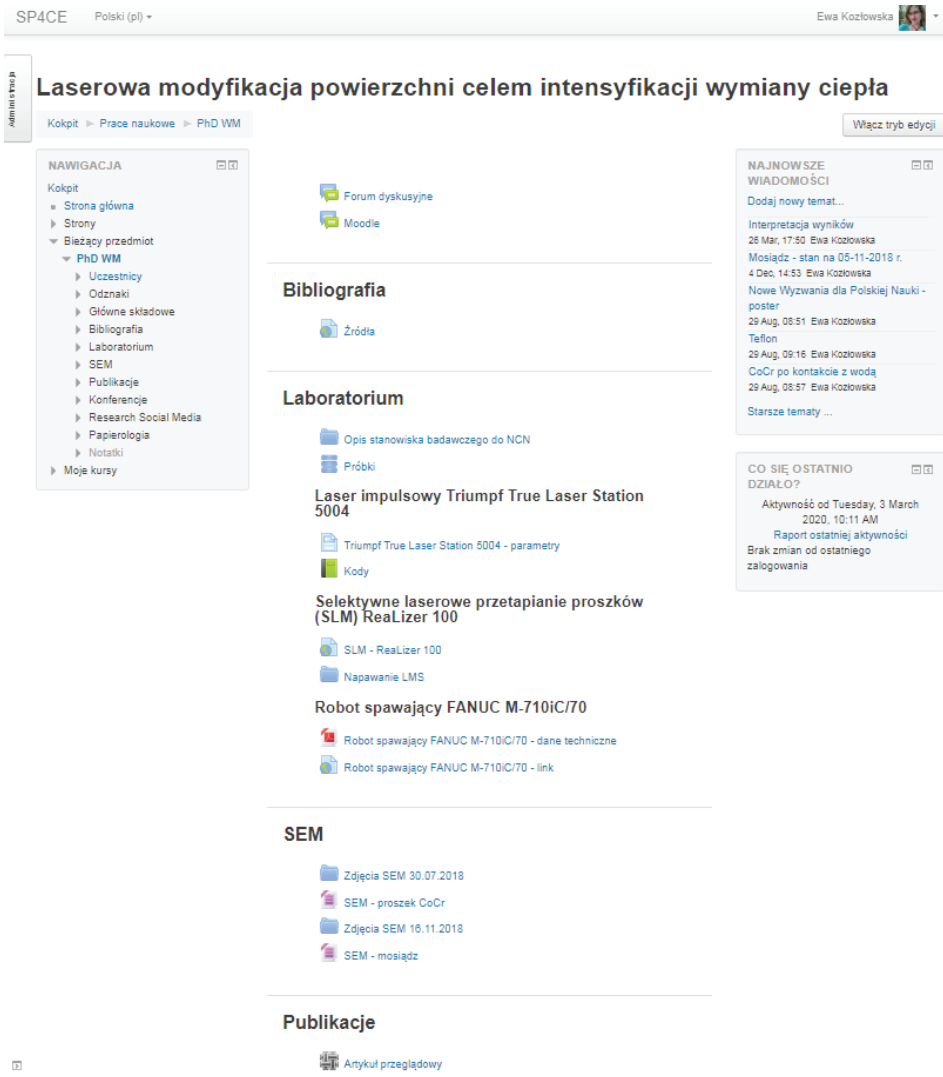

Figure 2. Moodle working area created to carry out a PhD research (in Polish)

laboration environment. Although their lack of some basic digital skills excluded them from proper participation in the project, it was too embarrassing for them to ask for help. It could have been the differences between the former and modern deportment that adversely affected the integral endeavor.

The solution was to implement personalized training for teachers, which was carried out in a way that their authority remained intact. Human habits, attitude, abilities, and willingness should always be taken into consideration as an important factor determining the success or failure of a proposed solution.

Conclusions

Constant communication between professionals specialized in different disciplines has a positive effect on the whole designing process. Interdisciplinary cooperation between all the multidisciplinary team members reveals the possibilities and limitations of each medical and technical solution from both points of view. It makes the results more credible. Jointly developed solutions are more sustainable and much safer. Using the right e-collaboration tool makes interdisciplinary work faster, safer, and more efficient.

Transferring the collaboration contrivance to the universities' Moodle platforms causes many concerns over some formal obstacles such as scientists, project participants and researchers from outside the university logging into the university platform. Gdańsk University of Technology has its own Moodle platform – eNauczanie (https://enauczanie.pg.edu.pl/moodle/), which is integrated with the general university portal MojaPG (https://moja.pg.edu.pl/). The system allows people from outside of the university to access the Moodle platform after going through a registration and verification process.

LMS Moodle supports online collaboration in multiple ways. The variety of available tools allows for many adaptations of the working area to meet the needs of different projects in diverse disciplines. Working online with Moodle saves time, money and saves participants from unnecessary frustration.

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Ewa Kozłowska

Moodle jako rozwiązanie problemów interdyscyplinarnej e-współpracy

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

Szybki rozwój technologiczny w ostatnich latach przyczynił się do licznych zmian w rozmaitych dziedzinach życia, w tym w edukacji i komunikacji. Nawiązanie współpracy interdyscyplinarnej przynosi wiele korzyści, jednak często wiąże się z różnymi problemami i niedogodnościami, a także potrzebą ciągłego doskonalenia, uczenia się przez całe życie, rozwoju zawodowego (CPD) i znalezienia skutecznego sposobu przekazywania informacji. Życie w ciągłym pośpiechu sprawia, że czas staje się kluczowym aspektem, ponieważ coraz więcej operacji jest wykonywanych prawie wyłącznie przy użyciu różnorodnych narzędzi online. Mimo że w wielu przypadkach współpraca bywa skomplikowana nawet dla osób specjalizujących się w różnych aspektach tego samego zawodu, nawiązanie współpracy między konkretnymi grupami interdyscyplinarnych specjalistów, takimi jak inżynierowie i lekarze, ma znaczący wpływ na nowoczesną diagnostykę i rozwój leczenia. Na podstawie wybranych studiów przypadków zbadanych na Politechnice Gdańskiej i Gdańskim Uniwersytecie Medycznym, popartych przeglądem dostępnych e-narzędzi wspierających edukację i współpracę, zaproponowano rozwiązanie oparte na platformie LMS Moodle, które następnie wdrożono i przeanalizowano.

S ł o w a k l u c z o w e: Moodle, współpraca interdyscyplinarna, e-współpraca, inżynieria medyczna

Using Moodle as a Solution to Interdisciplinary E-collaboration Issues

Эва Козловска

Moodle – решением проблем междисциплинарного электронного сотрудничества

Аннотация

Быстрое технологическое развитие в последние годы способствовало многочисленным изменениям в различных сферах жизни, включая образование и комуникацию. Установление междисциплинарного сотрудничества приносит много преимуществ, но часто связано с различными проблемами и неудобствами, а также с необходимостью постоянного совершенствования, обучения в течении всей жизни, профессионального развития (НПР) и поиска эффективных способов передачи информации. Жизнь в постоянной спешке делает время важным аспектом, поскольку все больше и больше операций выполняется почти исключительно с использованием различных онлайн-инструментов. Несмотря на то, что во многих случаях сотрудничество иногда затруднено даже для людей, специализирующихся в разных аспектах одной и той же профессии, установление сотрудничества между определенными группами междисциплинарных специалистов, такими как инженеры и врачи, оказывает значительное влияние на развитие современной диагностики и лечения. На основе избранных тематических исследований, изученных в Гданьском технологическом университете и Гданьском медицинском университете, а также на основе обзора доступных электронных инструментов, поддерживающих образование и сотрудничество, было предложено решение на базе платформы LMS Moodle, которое затем было реализовано и проанализировано.

Ключевые слова: Moodle, междисциплинарное сотрудничество, электронное сотрудничество, медицинская инженерия

Ewa Kozłowska

Usando Moodle como solución de e-colaboración de materias interdisciplinarias

Resumen

El rápido desarrollo tecnológico de los últimos años ha contribuido a numerosos cambios en muchas áreas de la vida, incluidas la educación y la comunicación. Establecer una colaboración interdisciplinaria trae muchos beneficios, sin embargo, a menudo se asocia con numerosos problemas e inconvenientes, así como con la necesidad de mejora constante, aprendizaje permanente, desarrollo profesional (DPC) y encontrar una forma efectiva de transferencia de información. Vivir con prisa constante hace que el orden lógico de la transferencia de información se convierta en un aspecto clave, ya que cada vez se realizan más operaciones de forma caótica utilizando múltiples herramientas en línea. Aunque la colaboración resulta complicada incluso para los colegas que se especializan en diferentes aspectos de la misma profesión, el establecimiento de la cooperación entre grupos específicos de especialistas interdisciplinarios, como ingenieros y médicos, tiene un impacto

significativo en el diagnóstico moderno y el desarrollo de tratamientos médicos. Sobre la base de algunos estudios de casos seleccionados investigados en la Universidad Tecnológica de Gdańsk y la Universidad Médica de Gdańsk, respaldados por una descripción general de las herramientas de educación y colaboración disponibles, se ha propuesto, implementado y analizado una solución basada en la plataforma Moodle LMS.

P a l a b r a s c l a v e: Moodle, colaboración interdisciplinaria, e-colaboración, medicina

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The Interactive Board – an Indispensable Device in Upper Secondary Education

Abstract

In the face of dynamic social transformations and the lives of modern children and young people, the school should use modern educational technologies to a greater extent than ever before. One of the great opportunities to increase the attractiveness of the school for students is to use, for example, an interactive board that offers greater opportunities for interactive lessons. Children and young people are living in the world of multimedia, which have taught them to demand surprises and new ways of presenting information at an ever faster pace; therefore, they have different expectations from their teachers than previous generations. To use modern technologies in lessons, it is necessary to prepare and motivate teachers. The article presents the educational values of this type of teaching aid, and explores their use by teachers in upper secondary school.

K e y w o r d s: information technology, interactive board, digital school, media competence of teachers

Introduction

Nowadays, teaching is enriched with many new interactive media, thus increasingly referred to as "multimedia." Today, this term is reserved primarily for computer applications. Interestingly, in the past its meaning was completely different, and meant the simultaneous use of several teaching aids (Nocny, 2007). The development of modern technologies makes it necessary to constantly adapt to new conditions, which allows introducing modern forms of teaching to the educational system. The Ministry of National Education in Poland places an increasing emphasis on the digitization of schools, which aims to ensure that all school classes have interactive boards. An interactive board is an indispensable teaching tool in a modern school. This touch screen, which works with a multimedia projector and computer, enables the teacher to display graphic or multimedia materials. We can provide students with websites, movies and other educational materials, through the use of the interactive board. On the board a teacher can write, underline and work like on a traditional board, but they are also able to save and print the content of what can be seen on the screen. The interactive board is a 21st century school board and makes it very easy for the Polish teacher to conduct interactive lessons (Kupisiewicz, 2013).

Accordingly, it may be argued that students who are raised in the era of the ubiquitous access to computers and whiteboards absorb the knowledge much faster and easier. These devices activate and stimulate their concentration. What is more, teachers can spend less time preparing for their classes and return to a previous topic at any time during the lesson.

In this way, it can help to recollect, reuse and consolidate existing material. The functioning of the European Multimedia Education Center proves the importance of interactive education. Interactive education is choosing a learning process that maximizes participation in the lesson and gives the student the opportunity to choose their own methods and ways of learning. It ensures the effectiveness of teaching, increases the level of motivation and satisfaction of students (Surowaniec, 2007). This center mainly trains school principals who are interested in introducing the newest technology into their institutions. By demonstrating "good practices" from foreign schools which have introduced multimedia tools during lessons, Polish principals, through the training become the precursors and main motivators of the newest technology in their schools.

The Interactive Board in the Practice of the Learning Process

The interest of children and young people who have daily contact with television, computer games and the Internet is becoming an increasingly difficult task for teachers using static teaching methods; mainly because students become bored quite quickly with traditional methods of teaching. Interactive boards are a great solution for these types of contemporary problems. There are more and more "white boards" in Polish schools. It should be emphasized, however, that they first became particularly popular in British schools. Using an interactive whiteboard has many benefits – above all, it increases the interest and activity of students during classes. Lessons become more attractive. They provide the opportunity to use rich multimedia resources and didactic programs. Moreover, they stimulate classroom discussion, enable interaction with teaching material and motivate to learn (Majewska, 2013).

There are many interesting articles on the use of interactive whiteboards in lessons. These articles deal with such topics as: multimedia help during the preparation of passing mathematics exams (Heba, Smyrnova-Trybulska, & Kapounová, 2017), showing the use of an interactive whiteboard during English lessons (Serowy, 2011), how to work correctly and effectively on a multimedia board (Zbisławska, 2010; Sęczawa, 2008), or the use of this equipment during geography lessons (Rolf-Murawska & Podgórski, 2010). These articles can serve as inspiration for teachers who are starting their adventure with multimedia aids.

The interactive whiteboard belongs to new media that allow the use of digital recording and algorithmic processing techniques to process and send any large amount of data in the shortest possible time (Ruman, 2018). Thanks to the use of an interactive whiteboard during the lesson, the teacher does not provide students with information and ready-made ways to solve problems, but directs their work so that they independently search for answers by performing exercises specially prepared for this purpose. The many advantages are also visible in class with the varying pace of work. When writing examples of exercises on a traditional board, at some point, the teacher must erase the record. The interactive whiteboard gives you the opportunity to return to specific content at any time. Thanks to this, students who work faster can be asked to perform another task, and students with a slower pace of work can return to previous messages and the teacher can calmly explain its content.

It should be mentioned that the interactive whiteboard is multisensory. Parallel impact on many senses allows for quick and effective assimilation of knowledge and longer retention of knowledge. The student may experience learning in many ways. During the use of the board, young people become the co-creators of the

image, notes, choice of colors, themes and ways of writing. The student may feel that the lesson is not only reproduced by the teacher, but that they are actively involved in it (Miernik & Piasta-Siechowicz, 2008/2009). Keep in mind that: "The basic idea is that students, who will come of age in the 21st century, need to be taught different skills than those learned by students in the 20th century, and that the skills they learn should reflect the specific demands that will be placed upon them in a complex, competitive, knowledge-based, information-age, technology-driven economy and society" (Morze, Makhachashvili, & Smyrnova-Trybulska, 2016, p. 42). Information education is education preparing students for life in an information society. Today's students are tomorrow's teachers – they will be teaching other people (Ruman, 2017).

Thanks to such a board, the teacher controls the course and pace of the lesson by explaining the harder parts without interrupting the application. Furthermore, they have the ability to use ready-made multimedia materials and the students' independent handling of the board ensures their active participation in the lesson. The interactive whiteboard also has drawbacks. First of all, the time to prepare materials for the board is very long, and the markers quickly break down. What is more, often launching a whiteboard takes a lot of valuable lesson time, the board freezes and does not offer as much writing space as a traditional blackboard. It can also be unreliable when launching websites or programs. Continuous use of the board can cause students to become accustomed to it and thus discourage them from traditional working methods. Despite the wide possibilities of the interactive whiteboard, the teacher should use a traditional whiteboard so that students do not forget how to write on it (Sałasińska-Andruszkiewicz, 2015).

There are several factors that affect the efficiency of using a multimedia whiteboard. This includes a high level of blackboard use skills, ensuring constant training depending on the individual needs of teachers, preparing their own materials for the board, cooperation between teachers and an exchange of experience in using the board. Administrators should also pay attention to the proper assembly of the board and technical support to quickly eliminate any problems. There are several types of interactive whiteboards:

- touch – these boards have a matt surface resistant to reflections and ensure a high quality of reading. They are controlled by means of a pointer or finger and are also resistant to damage;
- electromagnetic – these are operated using precise electronic pens. They allow simultaneous use by several people and can be treated as dry-wipe boards;
- infrared – the boards of this type are equipped with a matt surface that guarantees resistance to mechanical damage. Even in the case of defects they will work properly;

- capacitive – this kind of board is characterized by the ability to be operated by several people at the same time. The properties they have include high resolution and control with a finger or a pointer (Mamroł, 2018). There are many models equipped with special programs for schools that have work tools adapted to different subjects.

A teacher who works with an interactive whiteboard should also read the pages of the instruction manual that are useful in the course proposal, as well as tips from other teachers that are related to their particular field of expertise. There are materials related to various topics and subjects at http:/www.scholaris.pl. There are also pages where teachers share entire lessons with their own outlines. Such materials can be found at http://exchange.smarttech.com. Publishers have also proposed e-books and multibooks for interactive boards that would be helpful to the teacher in preparing their lessons. The first suggestion is a repetition of textbooks that can be used to guide students as to which page of the textbook they are working at a given moment to avoid unnecessary confusion. Multibooks are very interesting tools – they are also textbooks, but supplemented with songs, texts read by celebrities, films, interactive exercises and more (Sałasińska-Andruszkiewicz, 2015).

The fact that an interactive whiteboard is a very universal teaching aid is demonstrated by its use at many levels of education. For example, Mirosława Iwasiewicz showed that one should not be afraid of using the blackboard even when discussing a work of art – a painting by Jan Matejko, *Jan Kochanowski over the dead body of his daughter, Urszulka*. Among other activities, students marked and labelled which elements of the image indicate the funeral mood of the work (Iwasiewicz, 2011/2012).

Collecting and preparing multimedia materials for the lesson is unfortunately time consuming and requires considerable skills from the teacher. It is easier to use ready-made applications from the whiteboard resources or take advantage of ready-made multimedia lessons published on the Internet. The new generation of educational computer programs and interactive charts can be purchased from many specialist publishers and can also be found on the Internet, e. g. at the School and Pedagogical Publishers website. The texts, images, sounds and animations collected at www.wsipnet.pl, often obtained from foreign resources, can easily be adapted by the teacher to meet their individual needs. The board significantly facilitates the use of feeding methods (e. g. stories, lectures, talks or descriptions), as it enables enriching the verbal message with films, animations or static images, e. g. photos, drawings, tables, diagrams, diagrams and other source materials. On the board a teacher can display important information, definitions and formulas. This helps the teacher in conducting the lesson, because they do not have to use notes during the lesson, as everything is pre-prepared (Wojtanowicz, 2013).

Czesław Banach, analyzing the challenges and tasks of Polish education for 2012–2025, states that one of the priorities is, among others, preparing learners for effective social and professional functioning and "lifelong learning" in the information society (Banach, 2012). Therefore, taking this concept into account, the interactive whiteboard advances the adaptability of students to learn in a multimedia environment while also advancing the idea of "lifelong learning" among teachers who are unfamiliar with new technologies.

The types and characteristics of multimedia teaching aids are presented by H. Noga, who believes that the general division of multimedia resources includes multimedia devices, e. g. projector, screens and software, as well as e. g. multimedia applications, multimedia proprietary systems and multimedia presentation systems (Noga, 2010). The factors determining the use (functions) of multimedia teaching aids are as follows: education, including distance learning, multimedia presentations, interactive television, communication (multimedia mail), hypermedia (browsers, the Internet), digital film editing and production systems, computer simulations and virtual reality (Kołodziejczak & Zieliński, 1995). These devices are used at schools in the following way:

- computers – online translations, educational games, creating multimedia presentations, writing essays, searching for information on the Internet, printing documents;
- interactive boards – writing, watching presentations, watching educational films, drawing, making class quizzes, enlarging materials, etc.;
- smartphones – online translations, educational games, quick information search, conversations about absence from school;
- digital cameras – taking photos for an educational project, a school's Facebook account;
- MP4 players – listening to music tracks learned in class, e. g. during lessons on culture and/or religion.

The Use of Interactive Boards by Upper Secondary School Teachers – Own Research

Research carried out at the Marzano Research Laboratory in 2009 shows how valuable of a multimedia aid a whiteboard is. The research results indicate that the use of an interactive whiteboard in 75–80% of the class increases the knowledge acquired by students by 29%. The blackboard should not be used too much

(85–95%), because the results of the research indicate that the acquired knowledge of the students is then lower (Majewska, 2012).

In the Powiat School Complex No. 2 in Pszczyna, all teachers who were employed full-time at school, i.e. 112 people, participated in the multimedia project. Thanks to their participation in training and workshops, teachers expanded their skills, which they later used when conducting classes in the field of introducing technology during lessons. The school received equipment (multimedia boards, projectors and speakers) that were used by teachers and students. In order to create the article, the authors conducted a survey among willing teachers, as well as an interview with the principal of the institution.

The research, the results of which are presented below, was conducted at the Karol Miarka Powiat School Complex No. 2 in Pszczyna during the 2018/2019 school year. Each teacher spoke about the use of an interactive whiteboard in their lessons. The research group consisted of 84 people, including 57 women and 27 men. 28 respondents came from a rural environment and 56 from an urban environment. They were teachers who expressed their willingness to participate in these studies, and were selected from a group participating in a school project on technology where the overall number of participants was 112.

The main problem that this work examines is the question: do teachers use technological aids (such as a multimedia board) in their work? The main problem was supplemented by specific questions closely related to the concept of technological tools that can support school work. These questions were answered by teachers of the Powiat School Complex No. 2 in Pszczyna. The questions are:

- How often do teachers use the interactive whiteboard in their lessons?
- Do they support their work through multimedia aids?
- What knowledge do teachers have about the various possibilities of an interactive board?
- How do they know about the use of technology in school?
- What are the benefits of using an interactive board in the educational process?

The participating teachers were told the following: “polling can take the form of a survey or interview depending on how you respond – in writing or orally.” The researchers were then dealing with one of the techniques: a survey or an interview, as well as the adequate research tools related to them, i.e. questionnaires and an interview.

For the purposes of this study, a questionnaire for teachers and an interview questionnaire were constructed, which was addressed to the school’s principal. It consisted of four open-ended questions.

Unfortunately, the question regarding supporting the teacher at work with technologies other than a multimedia board during school activities was omitted by 81 respondents, only two men and one woman answered as follows:

> I am not afraid to ask students to find information and definitions on the Internet on their smartphones, during practical classes, this way the work is much faster. In the process, they will see their new messages (e. g. on Facebook), which they would read anyway in the classroom, only secretly, leaving the class or becoming distracted from the topic of the lesson. On smartphones, they have a lot of handy applications, which are also needed in class, a smartphone is like a portable board in their pockets, we can work in groups more efficiently. Of course, students know what the smartphone should be used for during the lesson, so that they do not record or photograph themselves, but rather follow the rules and want to learn in this way (Vocational teacher).

> The board is so multifunctional that in principle you do not need any other help, although of course if it malfunctions, I can teach the classes without any problem. I don't use any other technological aids (Math teacher).

> In addition to the interactive whiteboard, I use a platform that supports testing and uses e-textbooks (Geography teacher).

The next research topic explored concerned how often the teachers use the interactive whiteboard in their lessons and whether they have knowledge of its various possibilities. The respondents' answers show that more than half of the teachers (55%) use it "often," 25% "very often," 10% "from time to time" and 10% declared "rarely."

70% of respondents defined the level of their knowledge about interactive boards as "high," while 15% indicated an "average" level. Only four people (5%) declared the level as "very low" and the same number chose "very high" level because of their profession – an IT teacher.

Many teachers (60%) obtained their knowledge through courses and training organized by various institutions such as the Voivodship Center of Information Technology Development and the Regional Center for the Development of Education, and also participated in trainings organized at the school. Mostly, however, teachers instructed each other on how to use the board. A significant proportion of teachers also searched for information using the Internet (35%).

All teachers agreed that the use of an interactive whiteboard in the educational process allows for the greater motivation and participation of students. This view is expressed by 85% of respondents. They admitted that:

- greater involvement of students in the lesson can be seen;
- an interactive whiteboard helps in transferring knowledge;
- it is helpful in checking students' knowledge;

- it enriches the lessons with books, it is a "stepping stone";
- it is easier to prepare for the lesson.

Examples that illustrate the enrichment of lessons thanks to the board are presented below.

- After a trip on November 28, 2018 to the Museum of the History of Computers and Computer Science in Katowice, students from the IT Technician classes prepared multimedia presentations that they presented on the class forum using interactive boards.
- There was a cyclical competition for garden design by students of the Landscape Architecture Technician classes in teams, using technological assistance.
- Math teachers sent out classroom notes by email on the interactive whiteboard, so students had more solved examples in class because they did not waste time rewriting them.
- In biology and nature lessons, the gradual disclosure of fragments of the message allowed students to focus on content relevant for the given moment and fragmentary approximation.

Despite many positive results, many teachers believe that even greater knowledge and skills are necessary for the full use of the boards, and also non-technical problems related to both the operation of the board itself and the functioning of the Internet, from where the appropriate lesson materials are downloaded. It is important that teachers had no main concerns with using interactive whiteboards. Almost everyone uses them and believes that they are a helpful didactic tool.

The use of multimedia aids by teachers during the classes depends on the purpose of the lesson. Sometimes, teachers use computers as an element of integrating and teaching students to collaborate, then they assign several students to one computer. During the selected lessons, students have access to websites and Internet portals, where they have the opportunity to do exercises in the online system. Tasks which are compatible with the blackboard are the most popular among students. Teachers' observations show that multimedia boards add variety to standard lessons, in particular for students with learning disabilities.

Unfortunately, fewer teachers claim to use ICT during extra-curricular classes to develop students' talents, or to level the students' knowledge. In these classes, the only introduced approach is the traditional method of teaching students. This however may by the result of the teachers' unwillingness in participating in any form of workshops, courses or training dedicated to ICT methods.

In addition, an interview was conducted with the principal of the Powiat School Complex No. 2 in Pszczyna, MSc. Eng. Piotr Cygan, on the usefulness of interactive boards in class work, as well as the importance of new technology in Polish schools. The principal, when asked about the need of introducing technology into the classes, presented the following reflection:

> Technology certainly enriches the current workshop of the teacher, no matter what subject he/she teaches. A condition for the success and effective use of new tools is to orient teachers' improvement on developing their substantive and methodological competences, so that they can find their place in the digital reality. This, of course, is not so simple, it requires workshops and training, during, for example, pedagogical councils. New technologies mean that the teacher plans and prepares didactic classes, aids, and collects materials differently. What is more, I see that students are much more likely to come to such a lesson, they are more interested and this is our goal above all. (P. Cygan, Technology to support teachers, February 3, 2019)

The difference between the students' natural digital environment in which they are immersed outside of school and the traditional school environment creates a tension that some students find difficult to overcome. The problem is not the school equipment itself or its lack, but the teachers' reluctance to use modern technological methods, including whiteboards, during their classes.

The next issue was the question about the effectiveness of using interactive whiteboards at school. The headmaster broaches the subject as follows:

> The school must equip students with competences that will facilitate their life in the future, i. e. the ability to solve problems, search for and manage information and process ideas. To achieve this goal, the use of new technologies in teaching should consist of changing the role of the student from an observer into an active multimedia user that he/[she] can use during the learning process. It's such a digital revolution in science. Interactive boards and other modern IT tools that work effectively in school curricula around the world create a completely new model of school teaching. It is focused on the active acquisition, use and processing of information. The use of modern technologies in the teaching process increases the level of motivation and concentration of students, and, as a consequence, the level of retention and recall, also provides better results. I regret that in the past, we did not have such an opportunity. This potential should be used, students are waiting for lessons to be conducted in this way. (P. Cygan, The effects of using modern technologies at school, February 3, 2019)

The third question concerned the programs in which the teachers were trained by their educational institution. The principal mentioned the whole range:

> None of the teachers would certainly want to, because it is a huge number of hours of training. It is certainly worth mentioning that the teachers have enriched their knowledge of working with a SMART Board interactive whiteboards, working with an e-learning platform, and using IT tools to create interactive teaching aids. The teachers were presented the capabilities of two computer programs: FastStone Capture – a program for screen shots to be used in science and professional subjects, as well as XMind – a program for creating mental maps, which works very well in our school during English and history classes, and is admired by principals of other schools of the Pszczyna powiat, which I am very proud of. (P. Cygan, Description of teacher training on technology, February 3, 2019).

During workshops and trainings, the teachers of the researched school gained knowledge and important skills in the application of modern technologies in teaching, including SMART Board interactive whiteboards, which they can successfully use during school activities.

The last question concerned the teachers' satisfaction with the acquired knowledge gained during the workshops, trainings or courses. The question was addressed to the principal. The reply was as follows:

> Now, after over two years since the introduction of whiteboards in our school, I can definitely say that all the teachers who participated in training, courses and workshops not only feel more comfortable with new technologies but are much more eager to use their knowledge during their classes. However, the process of using this knowledge and skills by the teachers was complex. First, they felt a bit reluctant to use new tools, nevertheless, after some time and some other motivational factors, the teachers overcame their concerns. They are slowly becoming aware of the positive influence of the new methods on learners in the process of teaching and learning. What is more, the students became more interested in the lessons. Of course, this required self-discipline from teachers, and a lot of work input at the beginning to get used to the equipment, but the results are great. Teachers see that thanks to the introduced changes, the pace of work has changed, students can see, understand and assimilate faster. Through the interactive board, the teacher can load notes from the board into the computer's memory and play movies with the possibility of taking notes directly on individual frames. Using the facilities mentioned above, they have the ability to enlarge the image during the visual presentation of phenomena, static elements and details on charts, which is very important in our school, as more and more visually impaired students come to us.

> What more can you say? (P. Cygan, The implementation of the introduction of technology in teaching, February 3, 2019)

Summing up the statements of the school principal of the examined school in Pszczyna, the key challenge was to use interactive boards from a new methodological point of view. This, in turn, has increased the school's educational attractiveness to prospective students. It should be remembered that the use of interactive whiteboards and multimedia devices is the inevitable future of every school. The use of the board in the didactic process is attractive, interesting and makes learning by observing, acting, feeling and thinking more attractive. Learning becomes more effective through a visible increase in student activity. Students are involved in all activities proposed in the classroom, and after completion show a high degree of retention of the knowledge learned and skills acquired.

Advice for Teachers Using an Interactive Board – Summary

In the modern world, students acquire knowledge and skills presented through images. The teacher should meet the expectations of students and conduct lessons in an active way to interest students and encourage them to interact with the intellectual work presented in class, regardless of the level. The interactive whiteboard gives the opportunity to conduct dynamic classes, thereby making lessons attractive.

Chris Betcher and Mal Lec, practitioners who have worked with an interactive whiteboard for many years, created seven valuable tips for teachers who are starting their adventure with the interactive whiteboard:

- "Teacher, be proficient in your art!" – be fluent in the use of a computer.
- "Control the technical organization" – teachers should have control over the location of the interactive whiteboard, the efficiency of the whiteboard, access to external devices, whiteboard and computer software.
- "Teacher, be interactive" – the authors want to remind teachers about the interactive properties of the board when preparing an exercise.
- "Teacher, be flexible in your actions" – learn to use the blackboard in the context of the Internet.
- "Teacher, be constructive" – when working with an interactive board, remember that there are several advantages of multisensory teaching aids.

- "Teacher, have an open mind" – analyze the goals you want to achieve during the lesson and choose the most advantageous option of working with information technology.
- "Teacher, remember to cooperate."

Teachers should remember about the many functions that boards have in their menus and, trying to make their work easier, use as many of them as possible. (Majewska, 2012).

Probably, the teachers who did not have contact with the board wonder whether it is easy to learn how to use it. "Anyone who has mastered computer skills should not have difficulty working on the board. It is a quite simple and intuitive teaching aid. Additional training in this area will allow complete mastery of the device" (Wojtanowicz, 2013, p. 215).

An interactive board is a great teaching aid that should be found in every class. Teachers should constantly find newer and better ways in which students may be motivated during a lesson. If anyone still has doubts, the researchers wanted to quote a sentence that should encourage every teacher to constantly improve. "Who stands still, goes back – so, let's look for the best for students, they are the most important here" (Brewczyńska, 2009, p. 5).

An interactive whiteboard is a great convenience for the teacher because it has a wide range of applications, e. g. in a nature lesson, all that is needed is one microscope, operated by a teacher and connected to the board, where the microscope image can be seen at high magnification, which above all, reduces the time needed for each student to approach the microscope. However, in history, language or Polish language classes, you can move to important places discussed during the lesson, or in a book, which enriches the student's active imagination.

The tools supporting e-learning in upper secondary schools can be divided into two groups:

- facilitating the implementation of the educational process, which can include various types of electronic diaries;
- streamlining the implementation of the teaching process, which includes all programs or environments used to create various types of multimedia teaching aids or entire e-learning courses (Bednarek & Lubina, 2008).

Conclusions

An interactive board is a teaching aid for teachers, which is characterized by simplicity and ease of use. Such a board is a very valuable didactic tool that sup-

ports education and arouses interest in students who have been connected with technology from an early age. An example of the use in education of the interactive whiteboard is certainly the Powiat School Complex No. 2 in Pszczyna. Although it is certainly a challenge for teachers who would not willingly replace traditional methods with newer ones, students do not have to wait long for the effects of their work. The school principal spoke about the correctness and success in the interview mentioned above and provided encouragement to other teachers not to be afraid to introduce interactive boards in their classes.

The presented conclusions may become an inspiration for other upper secondary schools to further improve their teaching staff in the field of information technology. It is optimistic that the participation of students in classes based on multimedia aids is enthusiastic, provides good results, and students, by consolidating knowledge, demonstrate their skills, often surprising the teachers themselves. Teachers should be aware that IT is not a threat to them, but a valuable asset, as it strengthens students' knowledge of using ICT equipment and materials and will certainly observe an increase in the skills of any given subject. The multimedia board, on the other hand, assembles the capabilities of all existing teaching media as a tool that affects many receptors, entertains and teaches, helps in the transmission of material, and accelerates the teaching process. Of course, everything can be done only if the school facility is well equipped with such devices.

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Natalia Maria Ruman, Agata Pokładnik

Tablica interaktywna – niezastąpiona pomoc w edukacji ponadgimnazjalnej

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

W obliczu dynamicznych przeobrażeń społecznych i życia współczesnych dzieci i młodzieży, szkoła powinna w większym aniżeli dotąd stopniu wykorzystywać nowoczesne technologie edukacyjne. Jedną z wielkich szans na zwiększenie atrakcyjności szkoły dla uczniów jest wykorzystanie np. tablicy interaktywnej, która daje duże możliwości w tym względzie.

Młodzież żyjąca w świecie multimediów, która nauczyła domagać się zaskoczenia, nowości, szybkiego tempa, ma inne oczekiwania wobec nauki szkolnej. Do większego zastosowania nowoczesnych technologii w szkole konieczne jest odpowiednie przygotowanie i zmotywowanie nauczycieli. W artykule ukazano walory edukacyjne tego typu pomocy dydaktycznych, ich wykorzystania przez nauczycieli w szkole ponadgimnazjalnej.

S ł o w a k l u c z o w e: technologia informacyjna, tablica interaktywna, szkoła cyfrowa, kompetencje medialne nauczycieli

Наталья Мария Руман, Агата Покладник

Интерактивная доска – незаменимая помощь в старших классах средней школы

А н н о т а ц и я

Перед лицом динамичных социальных преобразований и жизни современных детей и молодежи школа должна использовать современные образовательные технологии в большей степени, чем раньше. Одной из замечательных возможностей повысить привлекательность школы для учащихся является использование, например, интерактивной доски, которая предлагает большие возможности в этом отношении.

Дети и молодые люди, живущие в мультимедийном мире, которые научили их требовать удивления, новостей, быстрого темпа, имеют разные ожидания в отношении школьного образования. Для более широкого использования современных технологий в школе необходимо подготовить и мотивировать учителей. В статье представлены образовательные ценности этого вида учебных пособий, их использование учителями в старших классах средней школы.

The Interactive Board – an Indispensable Device in Upper Secondary Education

Ключевые слова: информационные технологии, интерактивная доска, цифровая школа, медиакомпетентность учителей.

Natalia Maria Ruman, Agata Pokładnik

Tablero interactivo – ayuda insustituible en educación secundaria superior

Resumen

Ante las transformaciones sociales dinámicas y la vida de los niños y jóvenes modernos, la escuela debería utilizar tecnologías educativas modernas en mayor medida que antes. Una de las grandes oportunidades para aumentar el atractivo de la escuela para los estudiantes es utilizar, por ejemplo, una pizarra interactiva que ofrezca grandes oportunidades a este respecto.

Los niños y jóvenes que viven en el mundo multimedia que les han enseñado a exigir sorpresa, noticias, ritmo rápido, tienen diferentes expectativas para la educación escolar. Para un mayor uso de las tecnologías modernas en la escuela, es necesario preparar y motivar a los docentes. El artículo presenta los valores educativos de este tipo de material didáctico, su uso por parte de los docentes en la escuela secundaria superior.

Palabras clave: tecnología de la información, pizarra interactiva, escuela digital, competencia mediática de los docentes.

IV. Reports

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A Report from the International Scientific Conference DLCC2019 in Poland, October 14th and 15th, 2019

The 11th edition of the International Scientific Conference "Theoretical and Practical Aspects of Distance learning" DLCC2019 (www.dlcc.us.edu.pl) was held under the theme "E-learning and STEM Education" from the IRNet project. The conference was held on the 14th and 15th of October in 2019 in Katowice and Sosnowiec. It was organised by the Faculty of Ethnology and Educational Sciences in Cieszyn, Faculty of Computer Science and Materials Sciences in Sosnowiec, University of Silesia in Katowice (Poland).

The Conference was organized under the auspices of the Minister of Science and Higher Education of the Republic of Poland dr Jarosław Gowin, Rector of the University of Silesia in Katowice professor Andrzej Kowalczyk, Dean of the Faculty of Ethnology and Sciences of Education professor Zenon Gajdzica, Director of the Institute of Sciences of Education professor Krzysztof Śleziński, Dean of the Faculty of Computer Science and Materials Science professor Danuta Stróż, Director of the Institute of Computer Science professor Zygmunt Wróbel.

The co-organisers were the University of Ostrava (Czech Republic), the Silesian University in Opava (Czech Republic), the Constantine the Philosopher University in Nitra (Slovakia), the Twente University (The Netherlands), the University of Extremadura (Spain), the Curtin University in Perth (Australia), the Borys Grinchenko Kiev University (Ukraine), the Herzen State Pedagogical University of Russia (Russia), the Dneprodzerzhinsk State Technical University (Ukraine), the Ministry of Science and Higher Education, Poland, the Polish Pedagogical Association, Branch in Cieszyn, Polish Scientific Association of Internet Education, IADIS – International Association for the Development of the Information Society, SEA – Polish Academic E-Learning Association.

The conference included the following range of the topics:

1. E-learning and STEM Education:
   - STEM education trends;
   - Robots and Coding in education;
   - Immersive learning environments. Blockchain;
   - Internet of things. 3D printing.
2. E-environment and Cyberspace:
   - E-environment of the University;
   - SMART Universities. SMART Technology in education;
   - E-learning in a sustainable society.
3. E-learning in the Development of Key and Soft Competences:
   - Effective development of teachers' skills in the area of ICT and e-learning;
   - Key competences in the knowledge society;
   - Use of e-learning in improving the level of students' digital competences;
   - Distance Learning and Lifelong Learning;
   - Self-learning based on Internet technology.
4. E-learning and Intercultural Competences Development 4 in Different Countries:
   - Legal, social, human, scientific, technical aspects of distance learning and e-learning in different countries;
   - Psychological and ethical aspects of distance learning and e-learning in different countries;
   - Collaborative learning in e-learning.
5. E-learning Methodology – Implementation and Evaluation:
   - European and national standards of e-learning quality evaluation;
   - Evaluation of synchronous and asynchronous teaching and learning, methodology and good examples;
   - MOOCs – methodology of design, conducting, implementation and evaluation;
   - Contemporary trends in world education – globalization, internationalization, mobility.
6. ICT Tools – Effective Use in Education:
   - Selected Web 2.0 and Web 3.0 technology;
   - LMS, CMS, VSCR, SSA, CSA;
   - Cloud computing environment, social media, multimedia resources video tutorial design.
7. Alternative Methods, Forms and Techniques 7 in Distance Learning:
   - Simulations, models in distance learning;
   - Networking, distance learning systems;
   - M-learning.

8. Theoretical, Methodological Aspects of Distance Learning:
   - Successful examples of e-learning;
   - Distance learning in humanities and science;
   - Quality of teaching, training programs and assessment;
   - E-learning for the disabled.

DLCC conferences are traditionally organized through international projects and this was a place for the presentation of research results, in particular "E-learning as a road to communicating in the multicultural environment," supported by the International Visegrad Fund (IVF) from 2009. The conferences in 2014–2018 were the essential event to summarise the results of the 4-year long project entitled IRNet "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 project has been conducted in the framework of 7th Framework Program and financed by the European Commission and the Polish Ministry of Science and Higher Education. Professor Eugenia Smyrnova-Trybulska (Faculty of Ethnology and Educational Science) is a coordinator of an international consortium that includes ten institutions from nine countries.

The start of the new international project "FITPED – Work-based Learning in Future IT Professionals Education" (www.fitped.eu), with participation of Constantine the Philosopher University in Nitra, Slovakia (coordinator), the University of Silesia in Katowice, Poland, the Pedagogical University of Cracow, Poland, Mendel University in Brno, Czech Republic, University of Las Palmas de Gran Canaria, Spain, Helix5, Netherland, Teacher.sk, Slovakia was determined by the digitization of the society and the automation of many processes which bring new opportunities and types of jobs. The number of employees employed in the IT sector is continually growing. The employees in the European Union urge that there is an increasing lack of IT specialists, mainly in the field of software development, data analysis and data science. The theme of the conference was: "E-learning and STEM Education."

Experts on STEM and robotics in education from ten countries, Austria, Bulgaria, Czech Republic, Morocco, the Netherlands, Poland, Slovakia, Ukraine, Russia, Turkey reflected on how STEM education is currently viewed and implemented in their respective countries, drawing on legislation and funding focus and using local data to predict how the future will unfold for STEM education. The speakers from the University of Innsbruck (Austria), University of Twente (the Netherlands), the Comenius University in Bratislava (Slovakia), Plovdiv University "Paisii Hilendarski" (Bulgaria), Borys Grinchenko Kyiv University (Ukraine), Gdańsk Technical University (Poland), Herzen State Pedagogical University of Russia, St. Petersburg (Russia), Jagiellonian University (Poland), Warsaw University (Poland),

Silesian University in Opava (Czech Republic), Jesuit University of Philosophy and Education "Ignatianum" Cracow, (Poland), University of Silesia in Katowice (Poland), University of Defence in Brno (Czech Republic), K. Ushynskyi South Ukrainian National Pedagogical University (Ukraine), Maria Curie-Skłodowska University in Lublin (Poland), Lublin University of Technology (Poland), Mykhailo Drahomanov National Pedagogical University, Kyiv, (Ukraine), Kazimierz Wielki University in Bydgoszcz (Poland), Taras Shevchenko National University "Chernihiv Collegium" (Ukraine), Dniprovsk State Technical University (Ukraine), University of Ostrava (Czech Republic), Pedagogical University of Krakow (Poland), University of Social Sciences and Humanities in Warsaw (Poland), Makarenko Sumy State Pedagogical University (Ukraine), Poznań University of Medical Sciences (Poland), Ternopil Volodymyr Hnatiuk National Pedagogical University (Ukraine), Kherson State University (Ukraine), Warsaw University of Technology (Poland), University of Social Sciences and Humanities in Warsaw (Poland), Izmail State University of Humanities (Ukraine), Adam Mickiewicz University in Poznań, (Poland), and other educational institutions delivered lectures providing insights into interesting studies, presented their recent research results and discussed their further scientific work. The authors included experts, well-known scholars, young researchers, highly trained academic lecturers with long experience in the field of e-learning, PhD students, distance course developers, authors of multimedia teaching materials, designers of websites and educational sites. I am convinced that this monograph will be an interesting and valuable publication, describing the theoretical, methodological and practical issues in the field of e-learning in STEM education offering proposals of solutions to certain important problems and showing the road to further work in this field, allowing for the exchange of experiences of scholars from various universities from many European countries and other countries around the world. The guests and conference's members were welcomed by the Vice-Dean of the Faculty of Social Science professor Patrycja Szostok-Nowacka on the first day of the conference. The first day of the conference included two sessions: the plenary and thematic ones and was held in the Hotel Novotel, Roździeńskiego Avenue 16, Katowice. Keynote speakers of the DLCC2020 conference are the best experts in the areas of e-learning, micro learning, robotics in education, big data, multimedia in education and teacher training in the area of digital competences.

Theo Hug, PhD, is professor of educational sciences at the Department of Media, Society and Communication at the University of Innsbruck and coordinator of the Innsbruck Media Studies research group. His areas of interest include media education and media literacy, e-education and microlearning, theory of knowledge, methodology and philosophy of science. He is particularly interested in the interfaces of medialization and knowledge dynamics as well as learning processes.

Some of his recent work focuses on instant knowledge, bricolage and didactics of microlearning (http://www.hug-web.at/). The title of his keynote lecture was "Robots as Friends, Co-Workers, Teachers, and Learning Machines – Metaphorical Analyses and Ethical Considerations."

Piet Kommers, PhD, associate professor in the Faculty of Behavioral Sciences, Department of Media, University of Twente. Professor ICT in Education UNESCO. His actual interest is media, learning and visual communication. From 1990, he has been increasingly involved as partner and coordinator in European research projects based on continuous learning. His role in initiating higher education in Eastern Europe led to his UNESCO chair, followed by the award of honorary doctor by Capital Normal University in Beijing in 2000. Main recent functions: Committee Member for the Academy of Sciences; Communication and Organization, UT; Scientific Board Member for New Learning Projects. Ministry of Education, Singapore; Lector at Fontys University of Applied Sciences for the Integration of ICT in Education; Regular Visiting Professor for Human Factors in Multimodal Communication for the European PhD Academy IMPDET at Joensuu University, Finland; Visiting Professor at the Institute of Educational Multimedia and Telematics; University of Hokkaido, Sapporo, Japan; Member of the UNESCO Board Creative Media Interaction for a Better Future: Trends, Challenges and Priorities. Title of keynote lecture was "Meta-Cognitive Representations for Deep Learning."

Nataliia Morze, dr hab., professor and Vice Rector on IT in 2009–2019 in Borys Grinchenko Kyiv University, Ukraine. State expert of National ICT Program in Education, Elaboration of the National System of In-Service Teacher Training and School Heads Training according to ICT, Elaboration of the Teachers Technological Standards on National Level, Senior Trainer of Word Intel program Teach to the future. Trainer of Microsoft program Cooperation Learning. Elaboration of distance learning courses for teachers and students. Elaboration of State programme of computer science for professionals, high schools and universities. Elaboration of conception of implementation of computer science in education of Ukraine. Teachers' trainer of computer science. Author of more than 300 publications, articles and monographs (70 books on e-learning, critical thinks, interactive methods, IT-teaching). The title of her keynote lecture was "Big Data in Education."

Antonio dos Reis, PhD, retired professor. The Graal Institute Director and scientific coordinator, teacher and consulting adviser in e-learning multimedia projects. Coordinator of the research project "Teacher's skills for the school of the futures." Consulting adviser of the University for the implementation of virtual classrooms. Consulting adviser of WeZupport, Sweden, for e-Campus global project. Move Nations Course, about 3D environments in education. Coordinator of the post-graduation course "Pedagogic and didactic skills in e-learning and multimedia" (2008/09), teacher at Azores University (2007/08). Teacher's

trainer of teacher trainers in Portuguese education Ministry. Distance learning platform, Webmaster and multimedia coordinator in 2006 ISEG UTL (Technical University Lisbon). Scientific Coordinator of pilot project "The school of the future – Today. International conferences key speaker and conference chair at Azores – online learning conference and workshop, 2008/2009. Education website coordinator at www.thegraal.net. More than 500 videos of conferences and pedagogic contents, e-round tables and debates. YouTube contents channel: www.youtube.com/user/antonodreis. Moodle platform administrator: http://thegraal.ccems.pt/. The title of his keynote lecture was "500 years around the world in the road of digital society."

During the first day of the Conference an e-round table debate was held on STEM and STEAM in contemporary education, conducted by Eugenia Smyrnova-Trybulska and Magdalena Roszak (Photo 1, 2). The topics of the E-round table debate conducted face2face and in remote mode via Adobe Connect were:

A. Robotics and STEM in Education.
B. Microlearning – Effective Methods of E-Learning.
C. New Technologies in Personalisation of Education.

The conference event was held with the participation of the following leading experts:

- Theo Hug (Austria),
- Piet Kommers (The Netherlands),
- Antonio dos Reis (Portugal),
- Nataliia Morze (Ukraine),
- Krzysztof Gurba (Poland),
- Tatiana Noskova (Russia),
- Tomayass Issa (Australia),
- Miroslav Hrubý (Czech Republic),
- Todorka Glushkova (Bulgaria),
- Jan Guncaga (Slovakia),
- Xabier Basogain (Spain).

Among the speakers of the Conference Session 1 (Chair: Iwona Mokwa-Tarnowska) were Anna Sajdak-Burska, Marek Kościelniak (Poland), with a presentation "E-Forum Moderation as an Element of Blended Learning Courses for University Students. Conclusions from Action Research," Todorka Glushkova, Stanimir Stoyanov, Irina Krasteva, Veneta Tabakova-Komsalova (Bulgaria), with a lecture "Intelligent School Educational Environment for Distance and Blended Learning," R. Robert Gajewski (Poland) and his report "Computational Thinking: Motivation to Learn in Tertiary Education," Tatiana Noskova, Tatiana Pavlova, Olga Yakovleva (Russia) with a report "Analysis of Students' Reflection on Their Educational Behaviour Strategies Within an Electronic Course: Prospects for the XXI Century

Competences Development," Barbara Kołodziejczak (Poland) presented "The Use of Portals and Learning Environments in Non-Academic Teaching."

In the parallel conference session (Chair: Mariusz Marczak) were seven reports, presented by participants from five countries: Milena Janakova (Czech Republic) "E-learning in Sustainable Society," Mariusz Marczak (Poland) "Successful E-learning: Intercultural Development in GPE's Global Understanding Project," Ján Gunčaga (Slovakia), Tomasz Kopczyński (Poland) "Supporting Mathematical and Digital Competences Useful for Stem Education," Asya Stoyanova-Doycheva, Todorka Glushkova, Vanya Ivanova (Bulgaria) "Application of Subject Domain Ontologies in E-Learning," Olena Kuzminska, Nataliia Morze (Ukraine), Eugenia Smyrnova-Trybulska (Poland) "In The Digital Space: Program Design," Krzysztof Gurba (Poland) "Augmented Reality Learning Environment for Adults and Its Limitations," Ani Epitropova, Alexander Petrov, Stanimir Stoyanov, Asya Stoyanova-Doycheva (Bulgaria) with the project "Inclusive Classroom-Play And Learn – Conception, Design And Software Architecture and Case Implementation," Mateusz Zając (Poland) with "The Modern Business Management Programme."

The short discussion was held after each lecture and every speaker responded to one or two question from the auditorium. The moderators presented some conclusions at the end of sessions and encouraged to continue the discussion in an informal atmosphere and events such as the excursion, lunch, dinner, coffee-break. In the afternoon, an excursion to Nikiszowiec and Katowice was held and in the evening, the conference dinner in the Hotel Novotel Restaurant.

The second day of the conference, 15th October 2019 (Tuesday), was held in Sosnowiec (Ul. Będzińska 39) at the Faculty of Science and Technology. In the beginning of the conference session, the Vice Dean of the Faculty of Science and Technology, dr Katarzyna Trynda (Photo 3) and the Director of the Institute of Computer Science professsor Piotr Porwik (Photo 4) gave a welcoming speech to the participants of the conference.

This day included several events and participants:

- Plenary and conference session according to the conference programme.
- Multiplier event in framework FITPED Project (Photo 7, 8).
- Participation lecturers and PhD students in framework CEEPUS programme from Comenius University in Bratislava, Slovakia and Ostrava University, Czechia. Professor Ján Gunčaga – Vice Dean of the Faculty of Education at the Comenius University in Bratislava. (Slovakia), CEEPUS Slovak team Coordinator. CEEPUS III Central European Exchange Programme for University Studies CEEPUS Network CIII-HU-0028-10-1617 – Active Methods in Teaching and Learning Mathematics and Informatics in the Academic Year 2019/2020. Researchers, academic teachers, PhD students, students, guests from Comenius University in Bratislava, Slovakia, professor Jan Guncaga, professor Lilla

Korenova, professor Veronika Horváthová, dr Peter Ostradický, dr Michaela Gulasova, Hilda Hanobikova, Angelika Sekanova.

- E-round table debate "STEM and STEAM in contemporary education" (Photo 1, 2) and E-round table debate on "The Digital Revolution" (moderated by Antonio dos Reis), which was held at 11.00 a.m. with experts from different countries attending in person and via remote (Photo 5).

The speakers in the second day of the conference in particular were: Nataliia Morze (Ukraine) "Big data in Education," Anna Ślósarz (Poland) "Democratizing the Potential of Distance Learning," Svitlana Skvortsova, Oksana Onopriienko, Tetiana Britskan (Ukraine) "Training in Mathematics of the Future Primary School Teachers by Using Service H5p," Marcin Szwed, Jarosław Krajka (Poland) "Teaching Skills in the Area of Terminology and Terminographic Modelling via E-Learning as Part of Translator Training Programmes," Nataliia Morze (Ukraine), Eugenia Smyrnova-Trybulska (Poland), Mariia Boiko (Ukraine) "The Impact of Educational Trends on the Digital Competence of Students in Ukraine and Poland," Miroslav Hrubý (Czech Republic) "Mentoring as a Significant Tool in Education," Anna Porczyńska-Ciszewska (Poland) "The Use of E-learning in Education for People with Mild Intellectual Disability in the Context of Their Mental Well-Being."

In the E-round table debate 2 on "The Digital Revolution" (moderated by Antonio dos Reis), the experts from different countries who attended in person and via remote mode included: Theo Hug (Austria), Nataliia Morze (Ukraine), Xabier Basogain (Spain), Olga Yakovleva (Russia) (Photo 5).

The participant reports also presented were: Iwona Mokwa-Tarnowska, Viviana Tarnowska (Poland), "Web-Enhanced Secondary and Academic Education Structured around Expectations and Learning Preferences of Generation Z," Maryna Haran, Svetlana Skvortsova, Olena Sagan (Ukraine), "Video of Mathematics in the Primary School as Means of Education for the Mathematical Education Methodology," Anna Czaja (Poland), "Implementing Sp4ce Learning Rooms Concept of a New Generation of Engineers," Katarína Žilková, Edita Partová, Ján Gunčaga, Jana Nemcová (Slovakia), Tomasz Kopczyński, Dominika Zegzuła (Poland), "Development of Geometrical Thinking via Educational Software by Pupils of Elementary School," Jolanta Szulc (Poland), "Models of E-learning Systems Architecture Using AI Components," Agnieszka Gadomska (Poland), "Applying CEFR Descriptors for Mediation for the Design of Moodle Based Materials for TEFL," Veronika Horváthová (Ukraine), "Exploring Addition and Subtraction Strategies with Virtual Manipulatives on Tablet Devices in the Second Grade," Eugenia Smyrnova-Trybulska, Dawid Staniek, Dominika Zegzuła (Poland), "Robotics in Education in Pupils' Opinion. A Survey Report: a Case Study," Svitlana Skvortsova, Yana Haievets, Oksana Onopriienko (Ukraine),

"Electronic Educational and Methodical Textbook. Methods of Teaching to Solve Mathematical Word Problems of Pupils in Grades 1–4," Irena Pulak, Martyna Szczotka (Poland), "Introducing the Youngest to Stem Education Based on the Example of the 'Kitchen Lab For Kids' Project," Nataliia Morze, Viktoriia Vember, Liliia Varchenko-Trotsenko (Ukraine), "How to Create Effective Flipped Learning Sequence in Higher Education," Lyudmyla Khoruzha, Volodymyr Proshkin, Olga Kotenko (Ukraine), Eugenia Smyrnova-Trybulska (Poland), "Digital Competence: Abilities of a Lecturer and Expectations of Students (Ukrainian-Polish Context)," Anastasiia Ishchenko (Ukraine), "Stem Education: Practical Oriented Tools for Teachers of Mathematics," Wojciech Baran (Poland), "Is It Possible to Implement the Law in an Engaging and Effective Manner? A Case Study Based on the Example of the General Data Protection Regulation at the University."

At the end of the conference, Eugenia Smyrnova-Trybulska presented some conclusions and invited everyone to participate in the next edition of DLCC2020 conference.

Photo 1. Participants of the E-round table debate on STEM and STEAM in contemporary education, conducted by Eugenia Smyrnova-Trybulska (right) and Magdalena Roszak: Nataliia Morze (Ukraine), Piet Kommers (The Netherlands), Krzysztof Gurba (Poland), Todorka Glushkova (Bulgaria)

Author: Tomasz Kopczyński

Photo 2. Participants of the E-round table debate on STEM and STEAM in contemporary education, conducted by Eugenia Smyrnova-Trybulska and Magdalena Roszak (left): Antonio dos Reis (Portugal), Theo Hug (Austria), Jan Guncaga (Slovakia), Miroslav Hrubý (Czech Republic)

Author: Tomasz Kopczyński

Photo 3. Second day – 15th October 2019 (Tuesday) Sosnowiec (Ul. Będzińska 39) at the Faculty of Science and Technology. At the beginning of the conference session the Vice Dean of the Faculty of Science and Technology, dr Katarzyna Trynda gave a welcoming speech for participants of the conference.

Author: Katarzyna Wróbel

Photo 4. Second day – 15th October 2019 (Tuesday) Sosnowiec (Ul. Będzińska 39) at the Faculty of Science and Technology. At the beginning of the conference session, the Director of the Institute of Computer Science professor Piotr Porwik gave a welcoming speech for the participants of the conference.
Author: Katarzyna Wróbel

Photo 5. Participants of the E-round table debate on “The Digital Revolution” (moderated by Antonio dos Reis), which was held at 11.00 a.m. Experts from different countries: Theo Hug (Austria), Nataliia Morze (Ukraine), Xabier Basogain (Spain), Olga Yakovleva (Russia) participated in person and in remote mode.
Author: Eugenia Smyrnova-Trybulska

Photo 6. Participants of the DLCC2019 conference
Author: Natalia Ruman

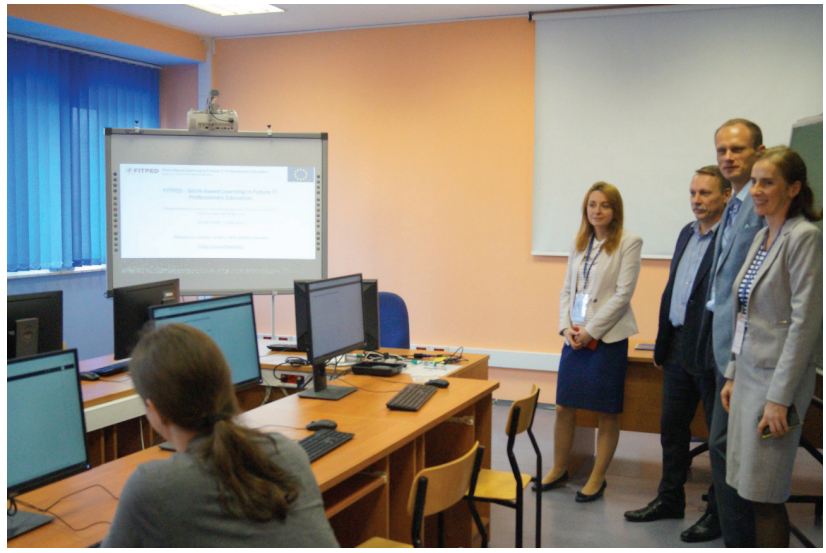

Photo 7. Workshop "Microcourses in programming learning and teaching" conducted by dr hab. Małgorzata Przybyła-Kasperek (C/C++), dr. hab. Beata Zielosko (SQL), MA Kornel Chromiński (Python), (Poland). Multiplier event in framework FITPED Project.
Author: Natalia Ruman

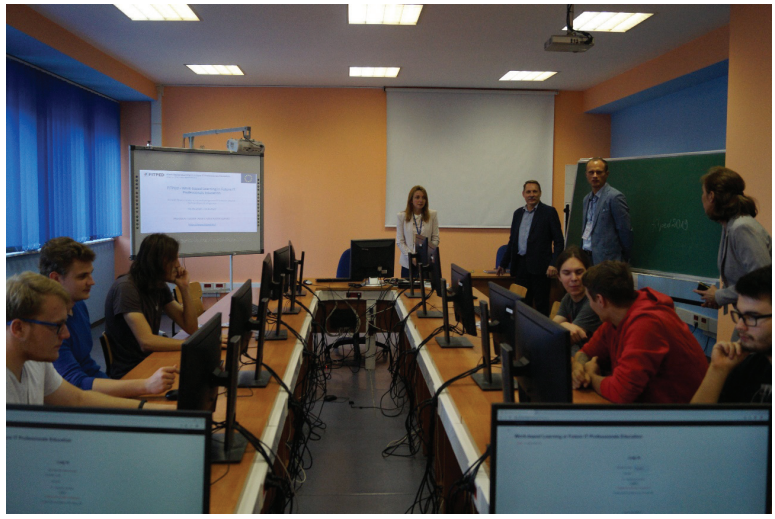

Photo 8. Workshop “Microcourses in programming learning and teaching” conducted by dr. Iwona Polak (HTML/CSS), dr hab. Małgorzata Przybyła-Kasperek (C/C++), dr hab. Beata Zielosko (SQL), MA Kornel Chromiński (Python), (Poland). Multiplier event in framework FITPED Project.

Author: Natalia Ruman

Photo 9. DLCC2019 conference poster

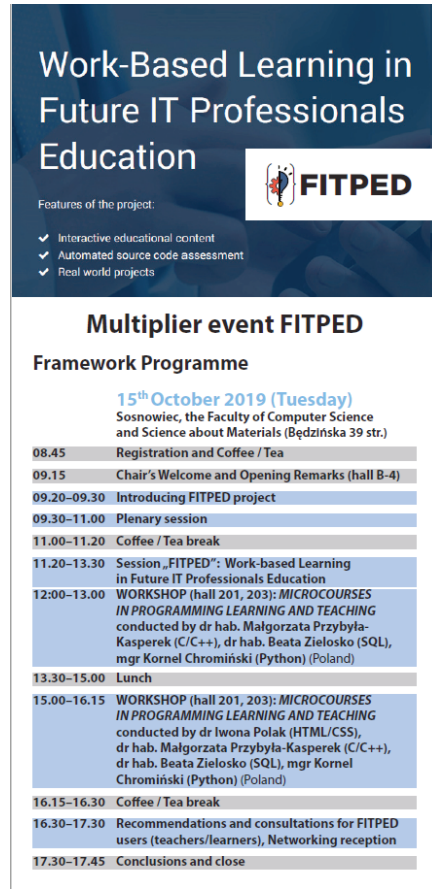

Photo 10, 11. FITPED Project poster and Programme of Multiplier event on 15th October 2019.

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