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8th Workshop on Cloud Technologies in Education: Report

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Abstract. This is an introductory text to a collection of selected papers from the 8th Workshop on Cloud Technologies in Education (CTE 2020) which was held in Kryvyi Rih, Ukraine, on the December 18, 2020. It consists of short introduction, papers' review and some observations about the event and its future.

Keywords: Adaptive Cloud Learning Platforms, Blended Learning, Blockchain in Education, Cloud-based AI Education Applications, Cloud-based E-learning Platforms, Tools and Services, Cloud-based Learning Environments, Competency-Based Education Platforms, Digital Transformation of Education, Educational Data Mining, Emotion AI, Immersive Technology Applications in Education, Mobile Learning, Smart Campus Technologies, Social Analytics in Education

1. Introduction

1.1. CTE 2020: At a glance

Cloud **T**echnologies in **E**ducation (CTE) is a peer-reviewed international Computer Science workshop focusing on research advances, applications of cloud technology in education.

The Workshop occupies contributions in all aspects of educational technologies and cloud-based learning tools, platforms, paradigms and models, functioning programmes or papers

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relevant to modern engineering and technological decisions in the IT age.

CTE topics of interest since 2017 [69, 71, 188]:

- Adaptive Cloud Learning Platforms
- Blended Learning
- Blockchain in Education
- Cloud-based AI Education Applications
- Cloud-based E-learning Platforms, Tools and Services
- Cloud-based Learning Environments
- Competency-Based Education Platforms
- Digital Transformation of Education
- Educational Data Mining
- Emotion AI
- Immersive Technology Applications in Education
- Mobile Learning
- Smart Campus Technologies
- Social Analytics in Education

Figure 1: CTE 2020 logo

This volume represents the proceedings of the 8th Workshop on Cloud Technologies in Education (CTE 2020), held in Ukraine, Ukraine, on December 18, 2020. It comprises 31 contributed paper that were carefully peer-reviewed and selected from 52 submissions (https://notso.easyscience.education/cte/2020/). Each submission was reviewed by at least 3 program committee members. The accepted paper present the state-of-the-art overview of successful cases and provides guidelines for future research.

The volume is structured in seven parts, each presenting the contributions for a particular workshop session.

1.2. CTE 2020 Program Committee

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Leon was born in West Limau, Prabumulih, South Sumatra. He has studied Information Systems, Information Systems Management, and Information Retrieval Systems during his studies. In 2001 he joined as a lecturer at one of the leading private universities in Palembang City. In 2010 he became an Associate Professor (Assoc. Prof.) at the Faculty of Computer Science, Information Systems Study Program (Accredited A). He is currently the coordinator of the enterprise systems research group. Assoc. Prof. Leon A. Abdillah is active as a speaker, author, editor, reviewer, committee on a number of journals, conferences/seminars, books/book chapters, etc. He has included 500 Indonesian scientists (Webometrics, 2015), examiners at Monash University (Group of Eight), Australia, and mentors

at Publons, New Zealand. He also often gets awards for the best undergraduate and post graduate category, the best computer science lecturer, the best reference article, excellent paper, top reviewer, selected article, etc.

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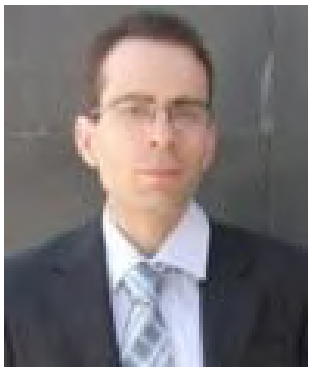

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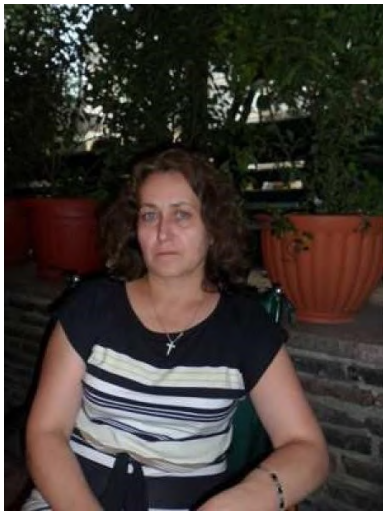

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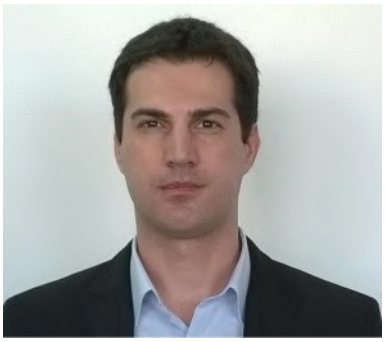

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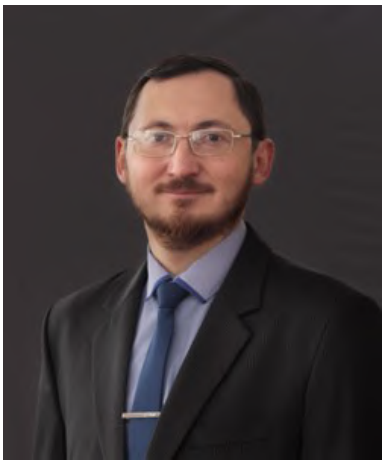

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2. Articles overview

2.1. Session 1: Digital Transformation of Education and Smart Campus Technologies

Andrey V. Pikilnyak, Nadia M. Stetsenko, Volodymyr P. Stetsenko, Tetiana V. Bondarenko and Halyna V. Tkachuk (figure 2) in the article "Comparative analysis of online dictionaries in the context of the digital transformation of education" [167] highlights further research by the authors, begun in [20, 49, 50, 62, 122, 142, 143, 159, 165, 169, 242, 245, 279]. This article is devoted to a comparative analysis of popular online dictionaries and an overview of the main tools of these resources to study a language. The use of dictionaries in learning a foreign language is an important step to understanding the language. The effectiveness of this process increases with the use of online dictionaries, which have a lot of tools for improving the educational process. Based on the Alexa Internet resource it was found the most popular online dictionaries: Cambridge Dictionary, Wordreference, Merriam–Webster, Wiktionary, TheFreeDictionary, Dictionary.com, Glosbe, Collins Dictionary, Longman Dictionary, Oxford Dictionary. As a result of the deep analysis of these online dictionaries, authors found out they have the next standard functions like the word explanations, transcription, audio pronounce, semantic connections, and examples of use. In propose dictionaries, authors also found out the additional tools of learning foreign languages (mostly English) that can be effective. In general, authors described sixteen functions of the online platforms for learning that can be useful in learning a foreign language. Authors have compiled a comparison table based on the next functions: machine translation, multilingualism, a video of pronunciation, an image of a word, discussion, collaborative edit, the rank of words, hints, learning tools, thesaurus, paid services, sharing content, hyperlinks in a definition, registration, lists of words, mobile version, etc. Based on the additional tools of online dictionaries authors created a diagram that shows the functionality of analyzed platforms.

Roman A. Tarasenko, Viktor B. Shapovalov, Stanislav A. Usenko (figure 3), Yevhenii B. Shapovalov, Iryna M. Savchenko, Yevhen Yu. Pashchenko and Adrian Paschke in the article "Comparison of ontology with non-ontology tools for educational research" [228] described the usage of cognitive IT-platform Polyhedron to collect both existing informational ontology-based tools, and specially designed to complement a full-stack of instruments for digital support for scientific research. This article highlights further research by the authors, begun in [198, 199, 202, 203].

The article "A semantic structuring of educational research using ontologies" [204] by Yevhenii B. Shapovalov (figure 4), Viktor B. Shapovalov, Roman A. Tarasenko, Stanislav A. Usenko and Adrian Paschke is devoted to the presentation of the semantic interoperability of research and scientific results through an ontological taxonomy. To achieve this, the principles of systematization and structuration of the scientific/research results in scientometrics databases have been analysed. Authors use the existing cognitive IT platform Polyhedron and extend it with an ontology-based information model as main contribution. As a proof-of-concept we have modelled two ontological graphs, "Development of a rational way for utilization of methane tank waste at LLC Vasylkivska poultry farm" and "Development a method for utilization of methane tank effluent". Also, for a demonstration of the perspective of ontological systems for

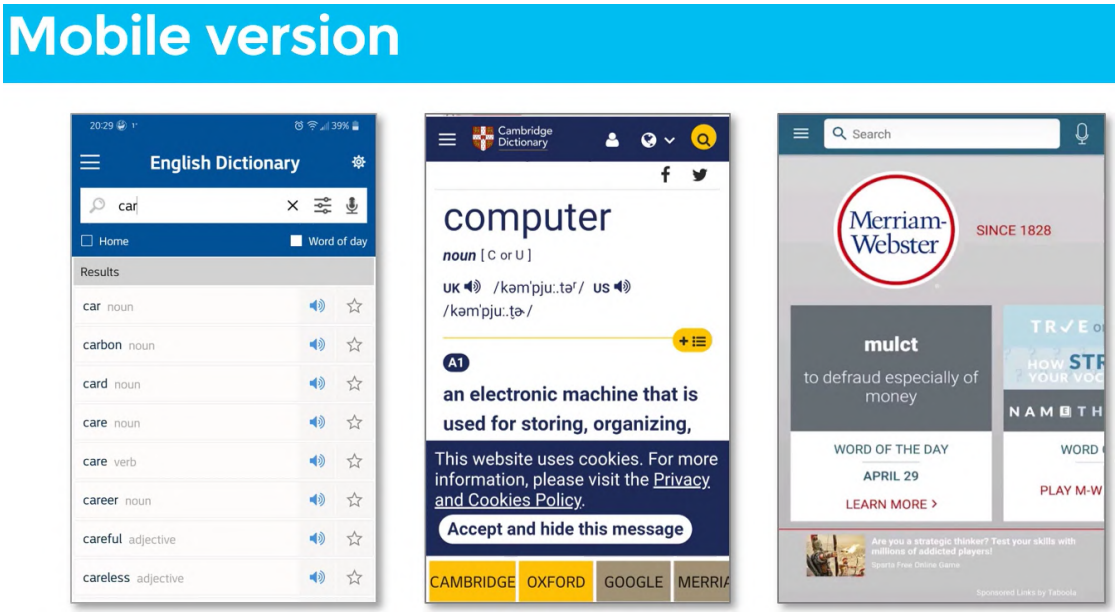

Figure 2: Presentation of paper [167].

a systematization of research and scientific results, the "Hypothesis test system" ontological graph has created.

The article "Applying digital technologies for work management of young scientists' councils" [56] by Anna V. Iatsyshyn (figure 5), Iryna H. Hubeladze, Valeriia O. Kovach, Valentyna V. Kovalenko, Volodymyr O. Artemchuk, Maryna S. Dvornyk, Oleksandr O. Popov, Andrii V. Iatsyshyn and Arnold E. Kiv explores the features of the digital technologies' usage to organize the work of the Young Scientists' Councils and describes the best practices. The digital transformation of society and the quarantine restrictions caused by the COVID-19 pandemic have forced the use of various digital technologies for scientific communication, the organization of work for youth associations, and the training of students and Ph.D. students. An important role in increasing the prestige of scientific activity and encouraging talented young people to participate in scientific projects belongs to the Young Scientists' Councils, which are created at scientific institutions and higher education institutions. It is determined that the peculiarities of the work of Young Scientists' Councils are in providing conditions for further staff development of the institution in which they operate; contribution to the social, psychological and material support of young scientists and Ph.D. students; creating an environment for teamwork and collaborative partnership; development of leadership and organizational qualities; contribution to the development of digital competence. The advantages of using electronic social networks in higher education and research institutions are analyzed, namely: general popularity and free of charge; prompt exchange of messages and multimedia data; user-friendly interface; availability of event planning functions, sending invitations, setting reminders; support of synchronous and asynchronous communication between network participants; possibility of access from various devices; a powerful tool for organizing the learning process; possibility

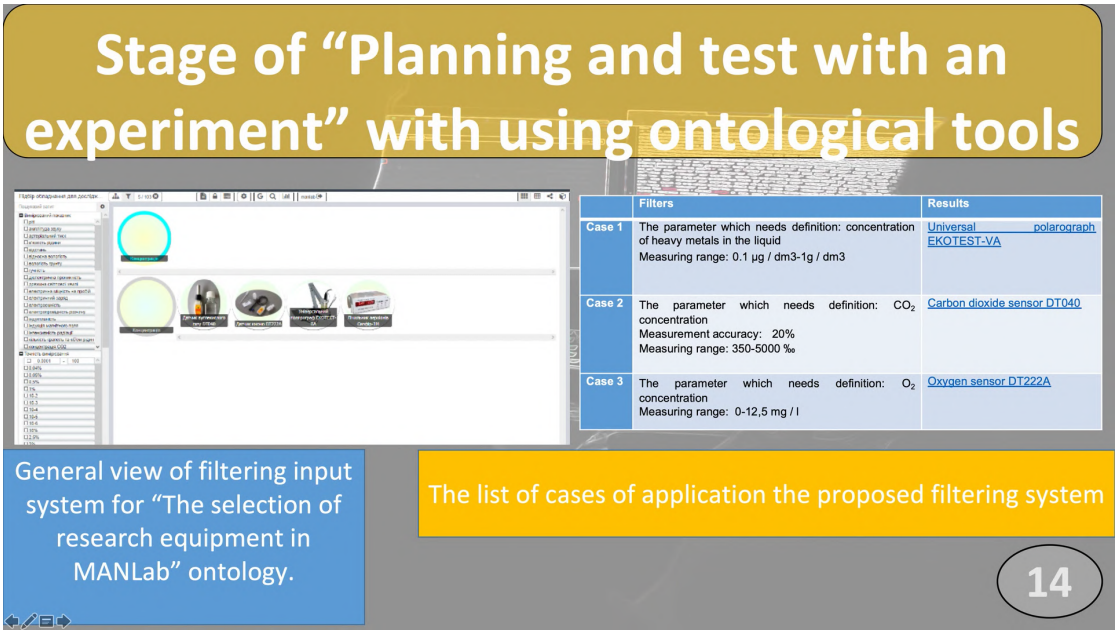

Figure 3: Presentation of paper [228].

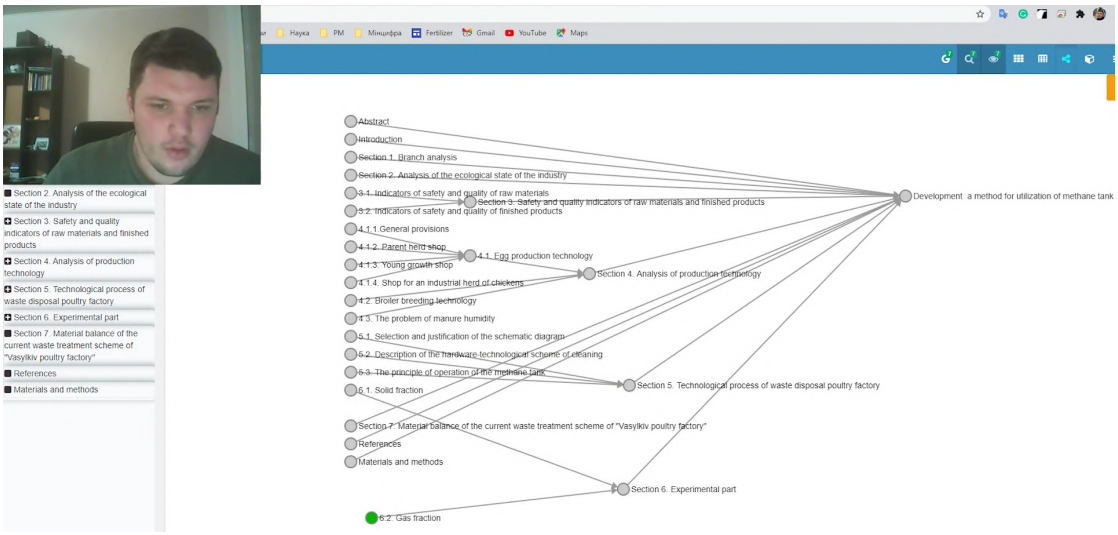

Figure 4: Presentation of paper [204].

of organization and work of closed and open groups; advertising of various events, etc. Peculiarities of managing the activity of the Young Scientists' Council with the use of digital technologies are determined. The Young Scientists' Council is a social system, and therefore the management of this system refers to social management. The effectiveness of the digital technologies' usage to manage the activities of the Young Scientists' Council depends on the

intensity and need for their use to implement organizational, presentation functions and to ensure constant communication. The areas to apply digital technologies for the work managing of Young Scientists' Councils are sorted as the presentation of activity; distribution of various information for young scientists; conducting questionnaires, surveys; organization and holding of scientific mass events; managing of thematic workgroups, holding of work meetings. It is generalized and described the experience of electronic social networks usage for organizing and conducting of scientific mass events. This article highlights further research by the authors, begun in [43, 51–55, 57, 95, 280, 281].

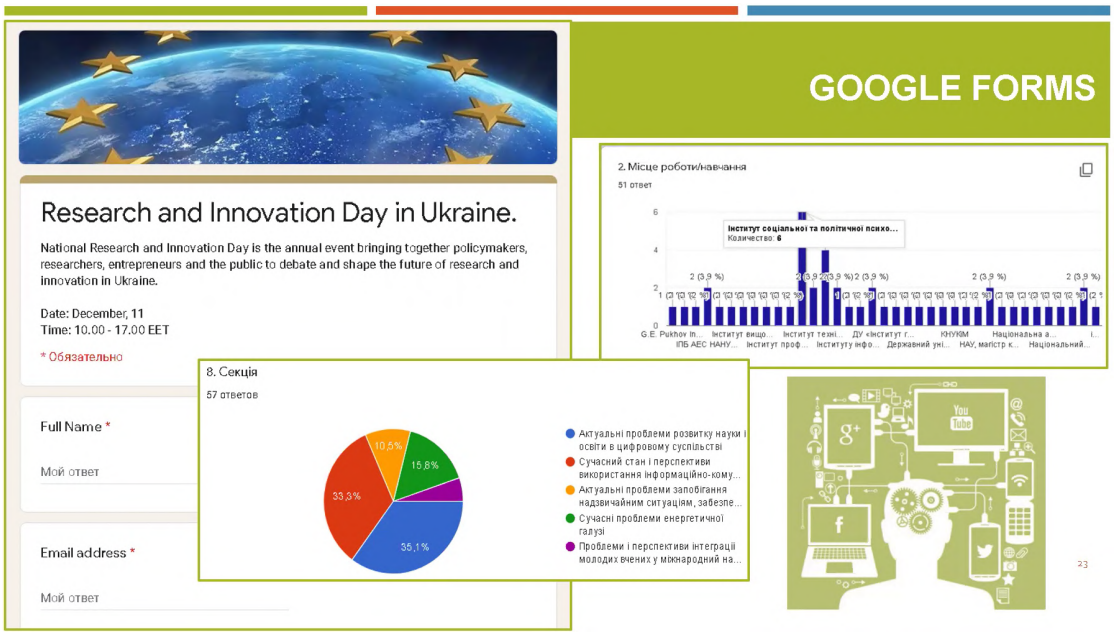

Figure 5: Presentation of paper [56].

The article "The use of cloud computing technology in professional training of future programmers" [150] by Kateryna P. Osadcha and Viacheslav V. Osadchyi (figure 6) provides a brief analysis of the current state of the study of cloud technologies by future software engineers at foreign and Ukrainian universities. The authors' experience in the application of cloud technologies in the training of future software engineers in Ukraine is presented. The application of cloud business automation systems, online services to monitor the implementation of the software projects, Google services for collaboration, planning and productivity while studying professional disciplines and carrying out diploma projects is described. Based on the survey conducted at Stackoverflow, the state of application of cloud technologies by software engineers around the world has been analyzed. The cloud technologies that are not studied at the analyzed universities of Ukraine and those that are not popular with software developers in the world, but studied at Ukrainian universities by future software engineers are outlined. Conclusions are made on the modernization of training programs for future software engineers. Topics for the study of cloud technologies by future software engineers in the content of professional disciplines are proposed. The article highlights further research by the authors, begun in

[26, 27, 82, 141, 149, 151–158, 171, 205, 206, 222–225, 250–252].

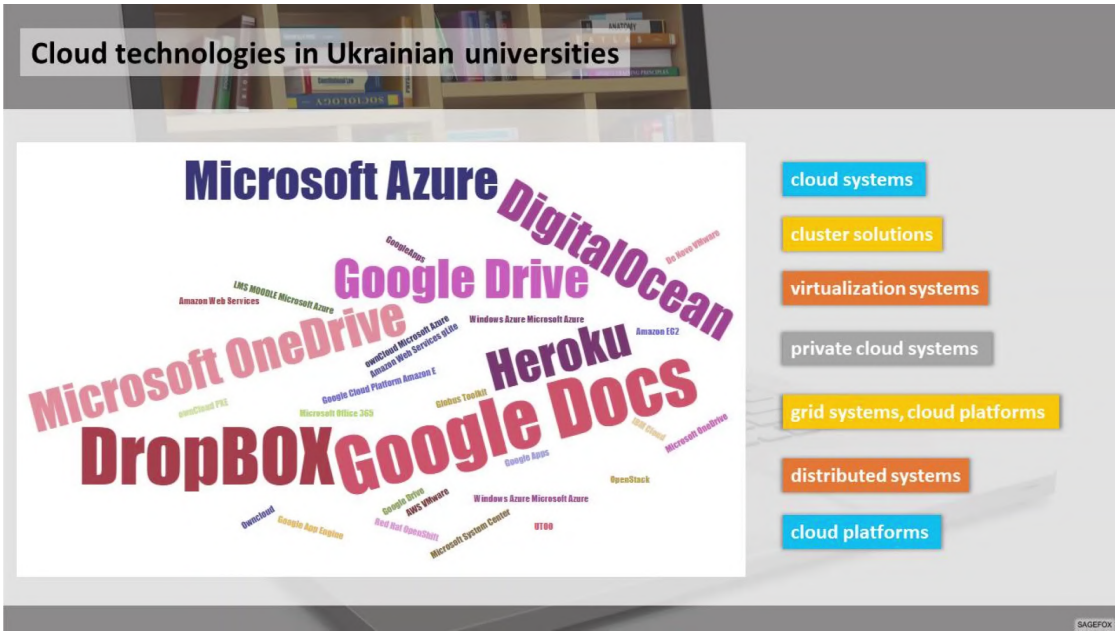

Figure 6: Presentation of paper [150].

The article "Some experience in maintenance of an academic cloud" [147] by Vasyl P. Oleksiuk (figure 7), Olesia R. Oleksiuk, Oleg M. Spirin, Nadiia R. Balyk and Yaroslav P. Vasylenko is devoted to the systematization of experience in the deployment, maintenance and servicing of the private academic cloud. The article contains model of the authors' cloud infrastructure. It was developed at Ternopil Volodymyr Hnatiuk National Pedagogical University (Ukraine) on the basis of the Apache CloudStack platform. The authors identify the main tasks for maintaining a private academic cloud. Here they are making changes to the cloud infrastructure; maintenance of virtual machines (VM) to determine the performance and migration of VM instances; work with VMs; backup of all cloud infrastructure. The analysis of productivity and providing students with computing resources is carried out. The main types of VM used in training are given. The number and characteristics of VM that can be served by a private academic cloud are calculated. Approaches and schemes for performing backup are analysed. Some theoretical and practical experience of using cloud services to perform backup has been studied. Several scripts have been developed for archiving the platform database and its repositories. They allow you to upload backups to the Google Drive cloud service. The performance of these scripts for the author's deployment of private cloud infrastructure was evaluated. The article highlights further research by the authors, begun in [4–10, 144–146, 148, 211–213, 249, 257].

The article "Digitalization of the educational process for the training of the pre-service teachers" [219] by Oksana V. Strutynska, Grygoriy M. Torbin, Mariia A. Umryk (figure 8) and Roman M. Vernydub considers the process of transition from informatization to digitalization in society, implementation of digital support for the educational process in the university, development of the digital educational environment for the training university teachers, and

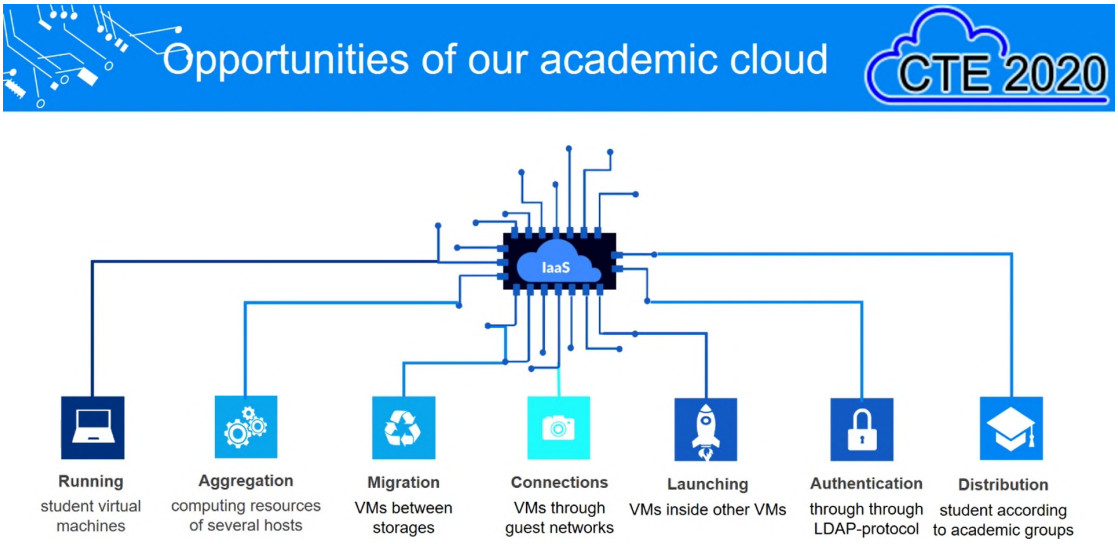

Figure 7: Presentation of paper [147].

proposes the digital tools for such an environment. The authors propose several ways to improve the development level of digitalization of the educational environment in the university. This is to take into account the needs of the digital society and the modern generation of students, provide a high level of the digital literacy formation of university graduates and support the development of a new digital security system of the modern university. Aiming to design the digital educational environment for increasing the of educators' digital literacy level, the authors propose to develop and implement the following computer, multimedia and computer-based learning tools and equipment, which includes blended and distance learning classes, cloud technologies, tools of virtual and augmented reality, tools for gamification of the educational process, educational robotics, tools for learning 3D technologies, MOOCs. The article highlights further research by the authors, begun in [132].

The article "Ways to design a digital educational environment for K-12 education" [131] by Natalia V. Morze and Viktoriia O. Kucherovska (figure 9) is devoted to the description of the concept, components and ways of designing the digital educational environment of a K-12 education institution through the transformation of educational activities. The importance of developing an educational policy of an educational institution in the field of digital technology is described. Authors present the model and the ways of designing the digital educational environment of the K-12 education institution. The necessity of self-assessment of digital technologies usage in the educational process by all its participants is substantiated; the ways of application of the European tool SELFIE for carrying out such self-analysis are described. Based on the adaptation of all components of the tool SELFIE for Ukrainian education, the results of its usage at one of the secondary schools in Kyiv are presented. This article highlights further research by the authors, begun in [41, 90, 91, 129, 130].

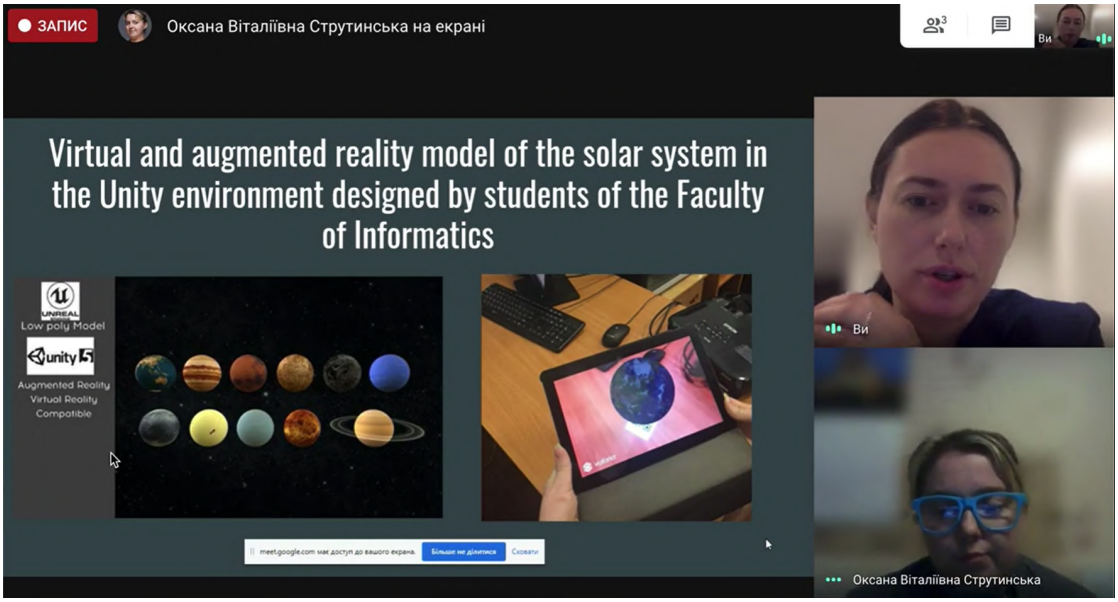

Figure 8: Presentation of paper [219].

2.2. Session 2: Mobile Learning

The article "Integration of chatbots into the system of professional training of Masters" [195] by Tetiana V. Shabelnyk, Serhii V. Krivenko, Nataliia Yu. Rotanova, Oksana F. Diachenko (figure 10), Iryna B. Tymofieieva and Arnold E. Kiv presents and describes innovative technologies of training in the professional training of Masters. For high-quality training of students of technical specialties, it becomes necessary to rethink the purpose, results of studying and means of teaching professional disciplines in modern educational conditions. The experience of implementing the chatbot tool in teaching the discipline "Mathematical modeling of socio-economic systems" in the educational and professional program 124 System Analysis is described. The characteristics of the generalized structure of the chatbot information system for investment analysis are presented and given: input information, information processing system, output information, which creates a closed cycle (system) of direct and feedback interaction. The information processing system is represented by accounting and analytical data management blocks. The investment analysis chatbot will help masters of the specialty system analysis to manage the investment process efficiently based on making the right decisions, understanding investment analysis in the extensive structure of financial management and optimizing risks in these systems using a working mobile application. Also, the chatbot will allow you to systematically assess the disadvantages and advantages of investment projects or the direction of activity of a system analyst, while increasing interest in performing practical tasks. A set of software for developing a chatbot integrated into training is installed: Kotlin programming, a library for network interaction Retrofit, receiving and transmitting data, linking processes using the HTTP API. Based on the results of the study, it is noted that the impact of integrating a chatbot into the training of Masters ensures the development of their professional activities,

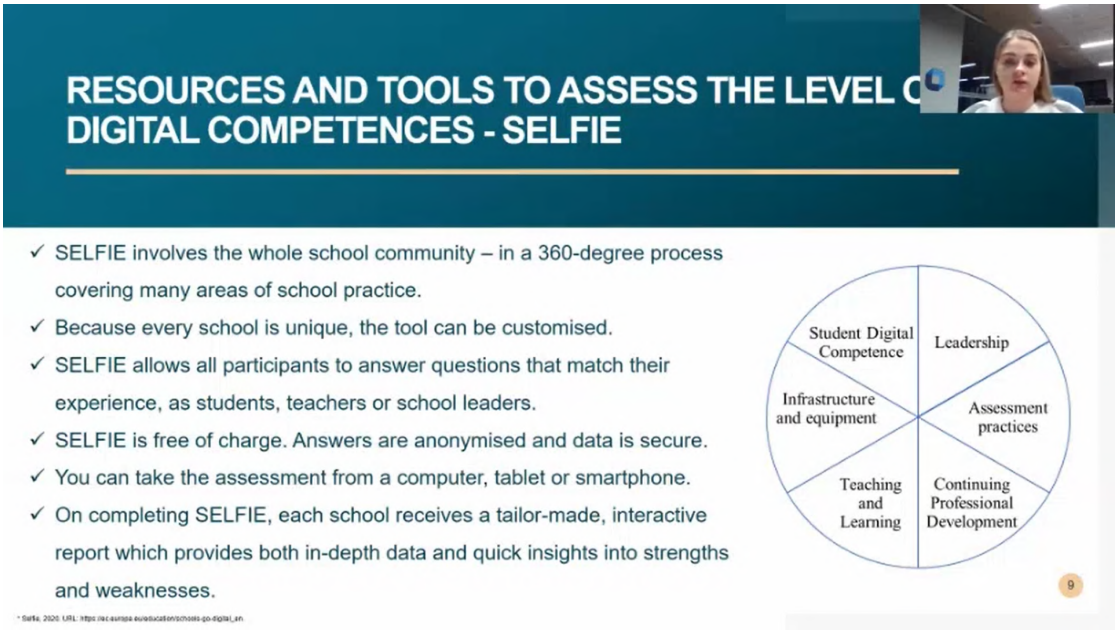

Figure 9: Presentation of paper [131].

which gives them the opportunity to be competent specialists and contributes to the organization of high-quality training. This article highlights further research by the authors, begun in [31, 65–68, 70, 72, 73, 80, 105, 121, 126, 187, 210, 261, 276].

The article "Features of design of digital aids for training students with autistic disorders" [17] by Liudmyla I. Bilousova, Liudmyla E. Gryzun (figure 11) and Nataliia P. Volkova highlights further research by the authors, begun in [13–16, 83, 166, 176, 230, 235–237, 262, 273]. In accordance with the aims of the paper, it is covered essential peculiarities of the design of digital aids for ASD-students. They are distinguished coming from the analysis of common learning and social difficulties inherent to the trainees with autistic disorders; needs for their speaking habits development; advantages of special digital support in terms of facilitating ASD-students' training. The distinguished features essential in the process of the digital aids design are demonstrated on the example of the development of an e-simulator for young ASD-students' speech encouragement. The main stages of its design and functionality are characterised. It is emphasised in conclusion that the developed digital simulator due to its functionality helps to overcome a number of problems faced by young ASD-students.

2.3. Session 3: Blended Learning

The article "Implementation of future agricultural engineers' training technology in the informational and educational environment" [241] by Aleksandr D. Uchitel, Ilona V. Batsurovska, Nataliia A. Dotsenko (figure 12), Olena A. Gorbenko and Nataliia I. Kim highlights further research by the authors, begun in [11, 29, 33, 37, 58, 60, 63, 77, 93, 94, 96, 112, 113, 137, 201], and presents the implementation of future agricultural engineers' training technology in the infor-

Figure 2: Examples of using a working mobile application for making investment decisions

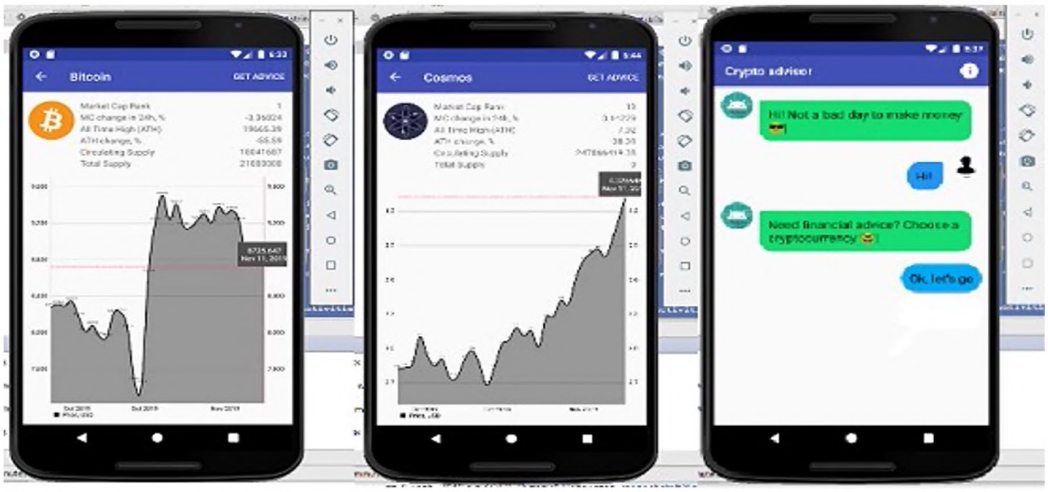

Figure 10: Presentation of paper [195].

mational and educational environment. To train future agricultural engineers, it is advisable to form tutorials for the study of each discipline in the conditions of informational and educational environment. Such tutorials are an assistance in mastering both theoretical material and course navigation, where interactive electronic learning tools are presented to perform tasks in the informational and educational environment. Higher education applicants perform such tasks directly in the classroom with the help of gadgets or personal computers. The final grade is formed from the scores obtained in the classroom and the rating of higher education applicants while studying in the informational and educational environment. The outlined approach is able to help in the quality of learning content. The use of interactive audiovisual online tools allows to get acquainted with the theoretical, practical and experimental provisions clearly, it is important for the training of future agricultural engineers. At the end of the experiment, it can be argued that the developed technology increases the level of motivation and self-incentive to work in the informational and educational environment. The application of the presented technology provides an opportunity to combine the educational process in the classroom with learning in the informational and educational environment, forms analytical abilities and competencies in professional activity. The reliability of the obtained results was checked using the λ Kolmogorov-Smirnov criterion. It is determined that when using this technology in the educational process, the indicators in the experimental group increased, which displays the effectiveness of training bachelors in agricultural engineering in the conditions of informational and educational environment.

The article “Blended learning in the context of digitalization” [25] by Tatyana B. Bykova (figure 13), Mykola V. Ivashchenko, Darja A. Kassim and Vasyl I. Kovalchuk highlights further

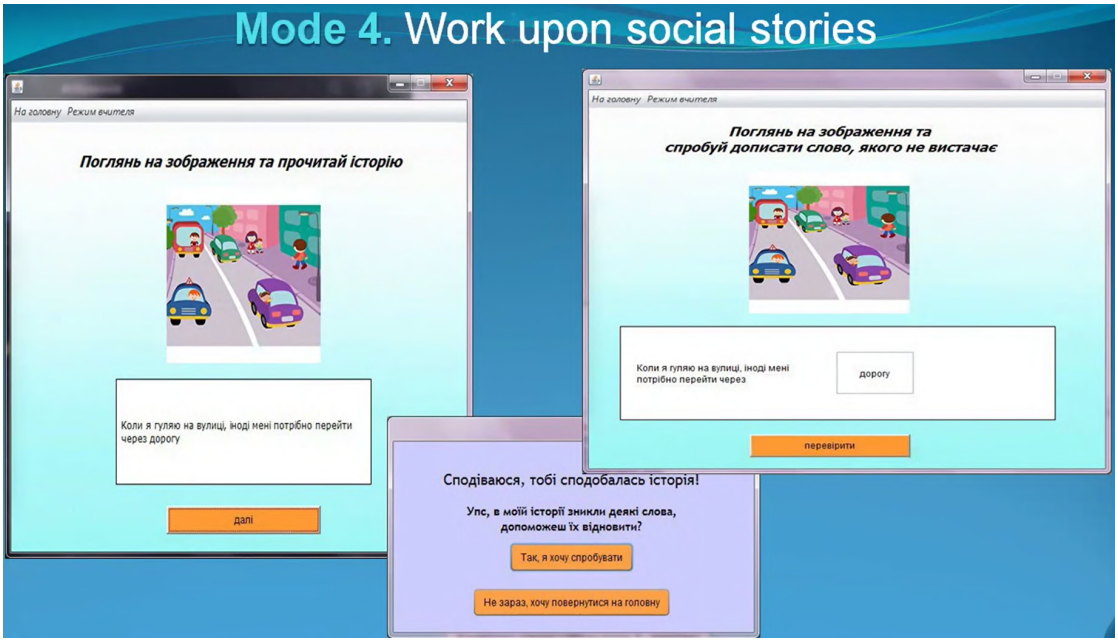

Figure 11: Presentation of paper [17].

research by the authors, begun in [1, 44, 79, 162, 258]. The realities of digitalization require changes in strategies for choosing educational technologies. The modern educational process is not possible without the use of digital technologies. Digital technologies have led to the arising and development of blended learning. However, its effectiveness is determined not only by technology. The human factor receives special attention in this direction. Analysis of the World Development Report 2016: Digital Dividends allows us to identify digital competence as a necessary condition for the successful use of digital technologies, and hence blended learning. Learning interactions designing in the process of implementing blended learning requires timely diagnosis of the level of digital competence. A popular tool for this is the Digital Competence Framework for Citizens. To clarify the peculiarities of its use was made an analysis of the experimental implementation results of blended learning in the industrial training in sewing for intended masters. During the research, it was revealed that the most important digital competence areas for the variable learning establishment in the training of future professionals are Information and data literacy, Communication and collaboration and Problem solving. In addition, competence for area Problem solving conduce to increase the level of competence for all other areas. The level of digital competence of the subjects mainly coincide to the characteristics of basic and secondary levels. The obtained data clarified the reasons for the difficulties, decrease motivation and cognitive activity that occur among students using distance courses-resources learning designed for blended learning. Thus, the use of the Digital Competence Framework for Citizens at the initial stage of implementing blended learning can make a rational choice of strategies for combining face-to-face and distance learning technologies.

The article “Strengthening of e-learning at the leading Ukrainian pedagogical universities in

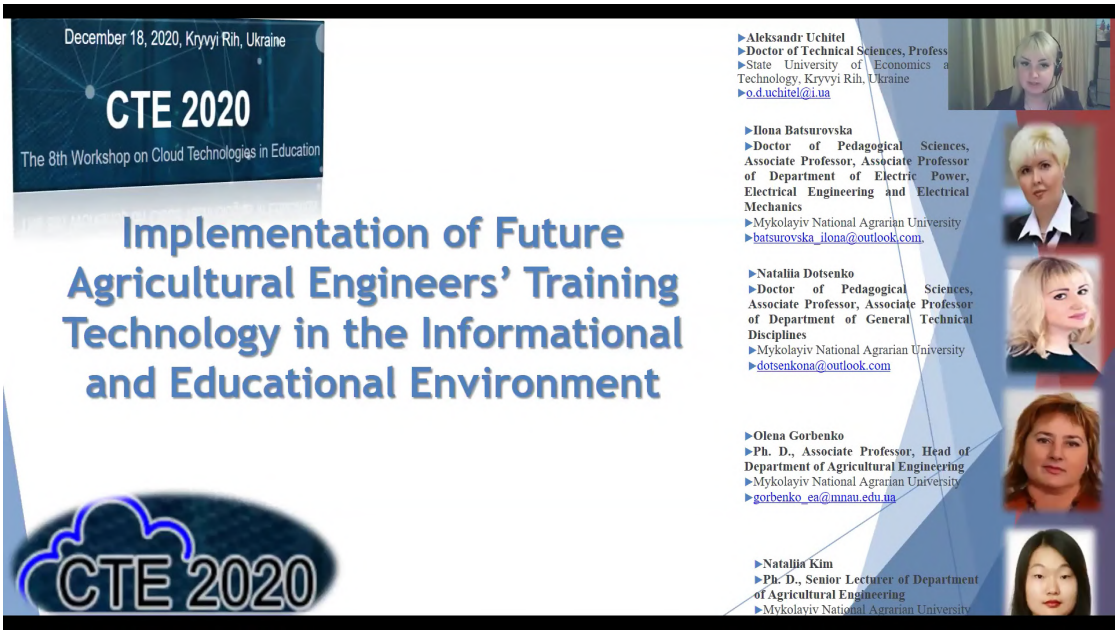

Figure 12: Presentation of paper [241].

the time of COVID-19 pandemic" [38] by Halina I. Falfushynska (figure 14), Bogdan B. Buyak, Hryhorii V. Tereshchuk, Grygoriy M. Torbin and Mykhailo M. Kasianchuk highlights further research by the authors, begun in [231, 275]. Distance education has become the mandatory component of higher education establishments all over the world including Ukraine regarding COVID-19 lockdown and intentions of Universities to render valuable knowledge and provide safe educational experience for students. The present study aimed to explore the student's and academic staff's attitude towards e-learning and the most complicated challenges regarding online learning and distance education. Authors findings disclosed that the online learning using Zoom, Moodle, Google Meet, BigBlueButton and Cisco has become quite popular among the students and academic staff in Ukraine in time of the lockdown period and beyond. Based on the Principal Component Analysis data processing we can conclude that students' satisfaction and positive e-learning perception are in a good correlation with quality of e-learning resources and set of apps which are used while e-learning and distance education. Also, education style, methods, and manner predict willingness of students to self-study. The self-motivation, time-management, lack of practice, digital alienation, positive attitude towards ICT, and instruction strategy belong to the most important challenges of COVID-19 lockdown based on the students and academic staff interviews. Online learning on daily purpose should be used in the favor of strengthening of classical higher education rather than replacing the former. Blended education is the best alternative to face-to-face education, because the communication with mentor in a live environmental even virtual should have ushered the learners to complete online learning and improve its results.

The article "Operation system features and cloud services for lecturer work" [21] by Lesya V. Bulatetska (figure 15), Vitaliy V. Bulatetskyi, Tetyana O. Hryshanovych, Yulia S. Pavlenko,

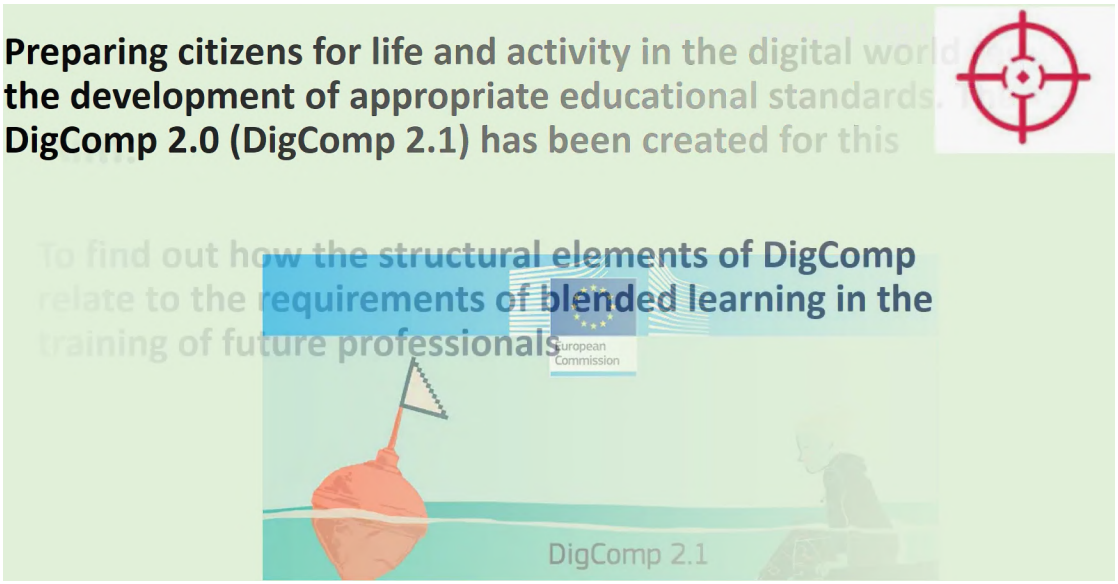

Figure 13: Presentation of paper [25].

Tetyana I. Cheprasova and Andrey V. Pikilnyak proposes a conception of setup and use of teacher's or lecturer's workspace using common software and hardware products. The research object is a system built by using operating system capabilities in conjunction with office suite and public cloud service, as a foundation for teacher's digital workspace. Research is made on how to set up, scale, and operate such a system, by studying the experience of national and foreign scientists and teachers, and using our own experience in educational processes, and working with operating systems and cloud services. As a result, we got a system which is easy to set up, learn, and apply by teachers without significant experience working remote education systems, and could be used for initial learning of remote education principles. It could be used as an initial step before migrating to specialized remote education systems. In the future, the system itself could be improved by adding additional objects into the system and a higher integration level between objects and external subjects.

Online Faculty Development Programs/Webinars are the two buzzing words, which have become viral next to corona among the teaching fraternity during the lockdown period of pandemic situation caused by COVID-19. The article "Research on efficacy of webinars organized for faculty during lockdown of COVID-19" [134] by Krishna Chythanya Nagaraju (figure 16), Karanam Madhavi and Jandhyala N. Murthy intends to throw light on, the reason for the outbreak of FDPs/Webinars, their efficiency and the attitude of the participating faculty during the lockdown period from 16th March to 15th June 20. Information is gathered through an online survey having 31 research questions answered by 683 participants across India. The new found tool of online teaching has become the accepted norm and the urge to lead the bandwagon by each and every stakeholder in the education sector resulted in a sudden spurt of webinars and FDPs in such a short period. Study observed that global reach at no cost plus freedom of working from home spurred many faculty to experiment this mode and 40% from them have

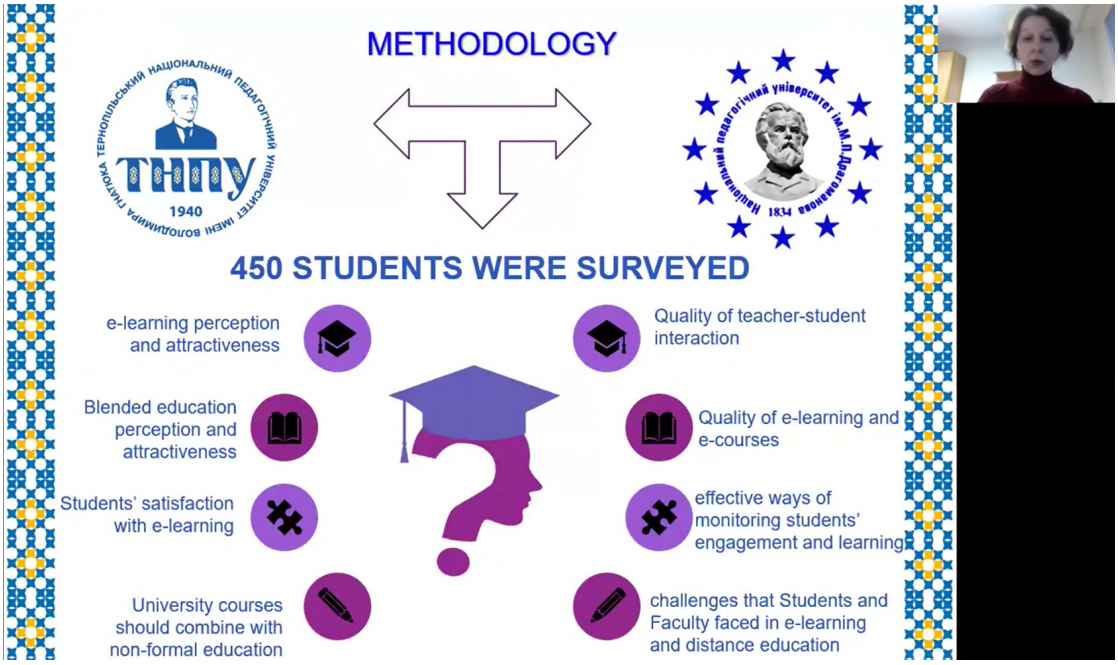

Figure 14: Presentation of paper [38].

been found to be juggling with many courses simultaneously for certificate sake only, 45.1% attended on mandatory instructions and 38% have not even initiated the work. Quizzes and Polls during sessions besides assignments were found to be suitable active learning mechanisms to improve the efficacy of the online knowledge transfer methods.

The article "Cloud resources use for students' project activities" [253] by Nataliia V. Valko (figure 17) and Viacheslav V. Osadchyi and Vladyslav S. Kruhlyk highlights further research by the authors, begun in [42, 88, 89, 214]. The modern educational system proclaims learning aimed at acquiring practical skills and based on the activity approach. Educational research projects are the necessary component of curricula in physics, computer science, biology and chemistry. There is a problem of specialized equipment and facilities using for the implementation of such projects in distance learning. Therefore, the issue of cloud resources using for distance learning organization in robotics is relevant. The article presents a brief overview of the current state of projects development in Ukrainian schools and approaches used in foreign educational institutions in teaching robotics distantly. The article describes the stages of robotics projects development such as organizational, communicative, project work, summarizing. The peculiarities of the stages in distance learning and the possibilities of cloud technologies in robotics are also considered. The authors' experience in projects developing in this environment for students and future teachers is described.

The training of pre-service mathematics teachers is a complex process due to the specifics of the field. Informatization of education affects all the areas, and pre-service mathematics teachers can not be left out. The article "The support of the process of training pre-service mathematics teachers by means of cloud services" [259] by Vladyslav Ye. Velychko and Elena H. Fedorenko

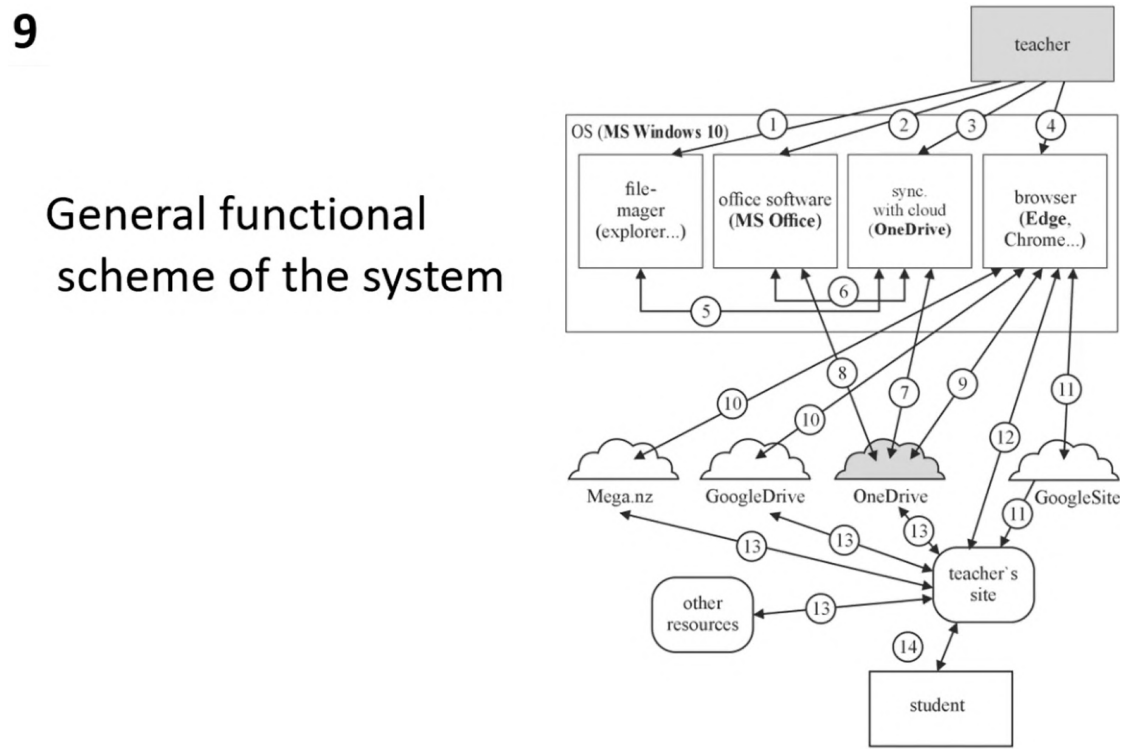

Figure 15: Presentation of paper [21].

and Nataliia V. Kaidan (figure 18), Vladimir N. Soloviev and Olga V. Bondarenko is devoted to the problem of supporting the process of professional training of pre-service mathematics teachers by means of cloud services. Examples of the use of cloud technologies are given. The analysis of a survey of pre-service mathematics teachers on the use of information and communication technologies in the training process is done. This article highlights further research by the authors, begun in [39, 40, 74–76, 85, 114, 115, 136, 183, 185, 194, 209, 227, 232, 244, 260, 278].

2.4. Session 4: Competency-Based Education Platforms

The matter of building an optimal model of managing the online platform "Higher School Mathematics Teacher" is considered in the article "Management of online platform development and support process" by Kateryna V. Vlasenko, Sergii V. Volkov (figure 19), Iryna V. Lovianova, Olena O. Chumak, Irina V. Sitak and Dmytro Ye. Bobyliev [272]. This article highlights further research by the authors, begun in [18, 161, 207, 263–271]. The existing researches on the management of online platform development and support process have been analyzed in this paper. The model developers described the process of building an online platform according to the Software Development Lifecycle rules. The researchers described an online course platform creation and functioning process that corresponds to a five-stage pedagogical ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) of online course preparation. The research describes the roles and objectives of online platform team members. These results

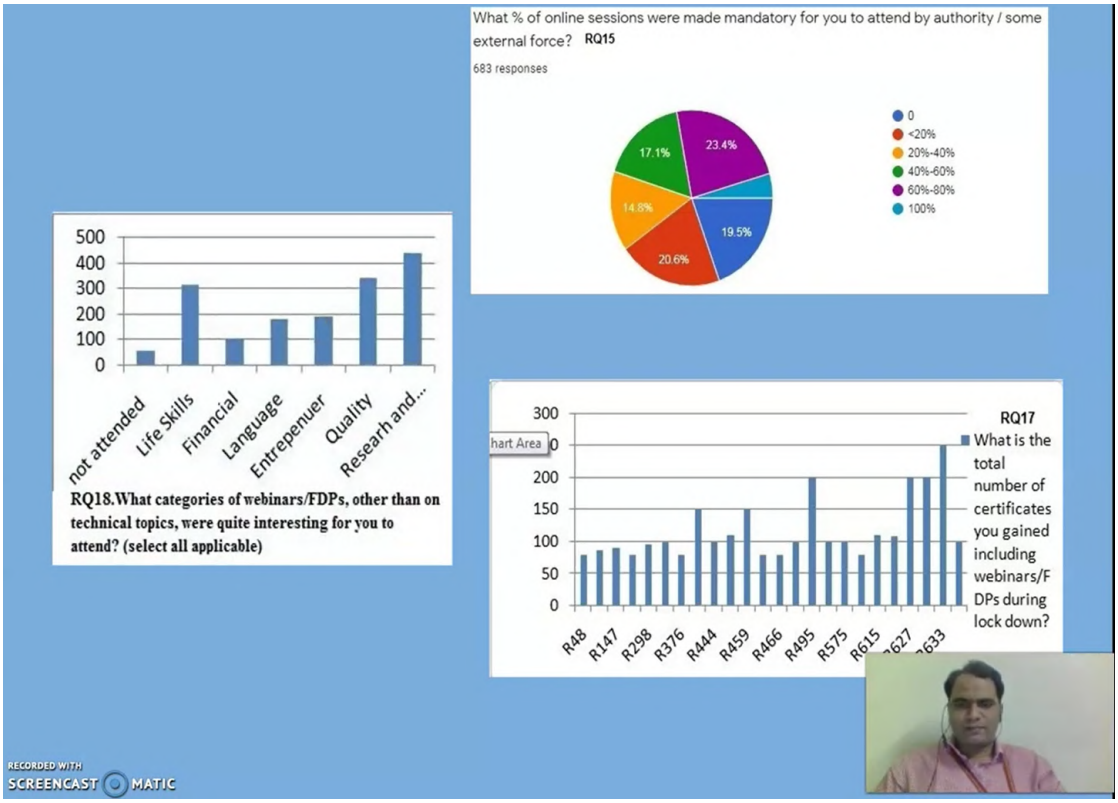

Figure 16: Presentation of paper [134].

allowed the authors of the article to model the organizational structure of online platform management. The method of survey among the team members of the online platform "Higher School Mathematics Teacher" and its participants was used to prove the efficiency of the offered model. The results allowed us to confirm the actuality of the research in the management of educational platforms, the convenience of teamwork in online platform management, and successful model implementation.

Researches and publications on using Google Classroom web service for lecturers of higher educational establishments under pandemic conditions are analysed in the article "The potential of Google Classroom web service for lecturers of higher educational establishments under pandemic conditions" [221] by Leila Yu. Sultanova, Oksana P. Tsiuniak, Liudmyla O. Milto, Maryna O. Zheludenko (figure 20), Lyudmyla M. Lyktei, Larisa M. Petrenko and Aleksandr D. Uchitel. The current state of higher education under pandemic conditions is characterised. Features of Google Classroom web service have been identified. The methodical development for lecturers of higher educational establishments "Potential of using Google Classroom web service" is described. Criteria and levels of using Google Classroom web service are defined. Initial diagnostic of the levels of using Google Classroom web service was conducted. During the diagnostic was revealed that most respondents have insufficient levels of theoretical knowledge and practical skills. In order to increase the level of using Google Classroom web service, the

Figure 17: Presentation of paper [253].

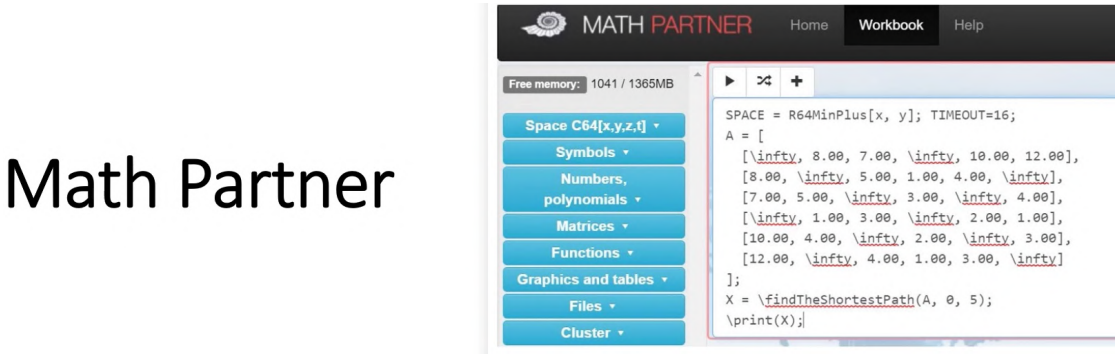

Figure 18: Presentation of paper [259].

methodological development was implemented. As a result, positive dynamics in the levels of theoretical knowledge and practical skills of using Google Classroom web service was revealed. The effectiveness of the obtained results was confirmed by Fisher's criterion. This article highlights further research by the authors, begun in [164, 220].

The article "Formation of informational and digital competence of secondary school students in laboratory work in physics" [110] by Oleksandr O. Martyniuk (figure 21), Oleksandr S. Martyniuk and Ivan O. Muzyka deals with the formation of informational and digital competence of high school students. First and foremost, the existing digitalization strategies for society already approved in the world and in Ukraine, including the implementation of STEM education and the Digital Agenda, are considered. On the other hand, attention is paid to the inconsistency

Figure 19: Presentation of paper [272].

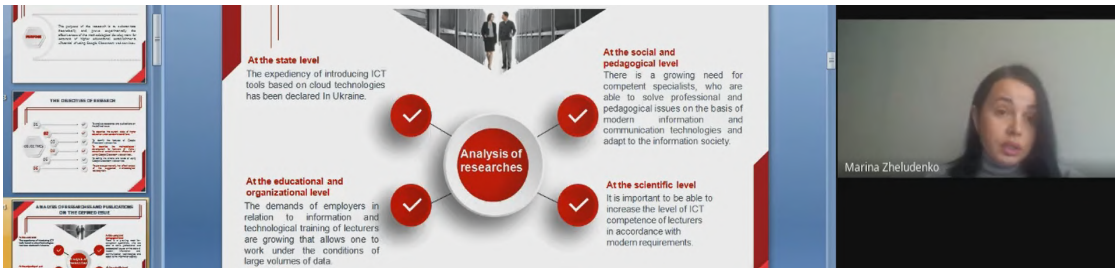

Figure 20: Presentation of paper [221].

of the level of ownership and frequency of use of digital technologies with the requirements of these initiatives. The concept of informational and digital competence is analyzed in detail. Existing publications identify key components, skills and competencies required to achieve this competence. A survey is conducted to better understand the current situation. One of the tasks is to determine the level of use of digital information in the classroom by teachers and in students' preparation at home. The second task was to show how developing students' informational and digital competence can be done by active introduction of existing software and hardware in the educational process in physics, in particular, a laboratory workshop. The example of laboratory work carried out in educational institutions shows how modern software can be used to analyze the movement of bodies and determine the physical characteristics of this movement. The concrete ways of performing laboratory work, analyzing its results and drawing conclusions are given. It is in the combination of existing teaching practices with modern gadgets, specialized and general programs that the basic way of forming informational

and digital competence is seen. Further ways of modernization and improvement of described methods for increasing the level of information and digital competence are proposed. This article highlights further research by the authors, begun in [86, 87, 160, 196, 200].

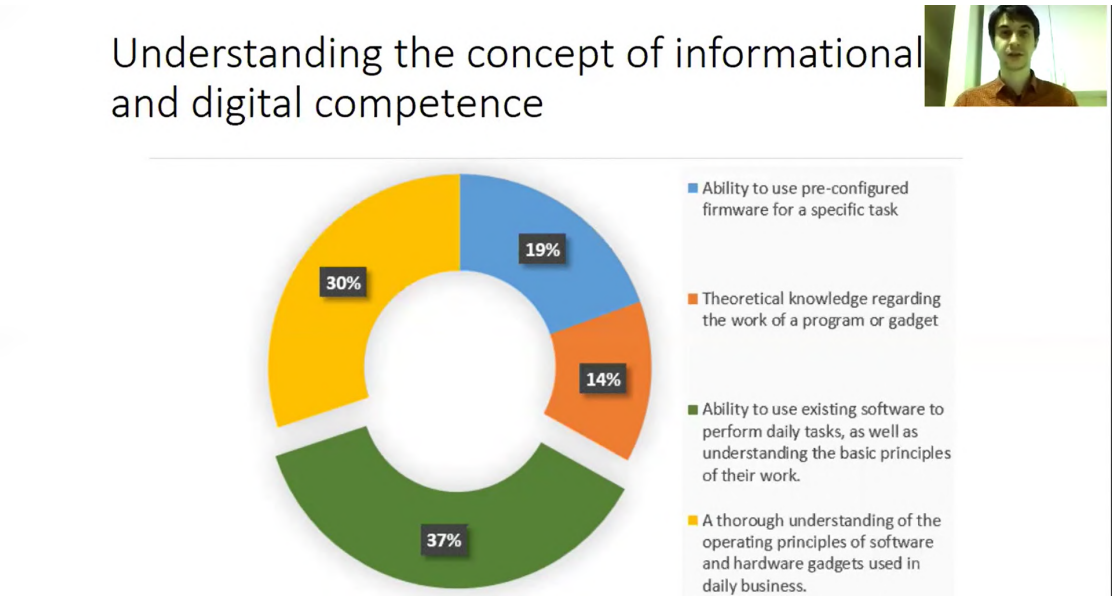

Figure 21: Presentation of paper [110].

2.5. Session 5: Adaptive Cloud Learning Platforms

The article "The selection of cloud services for ER-diagrams construction in IT specialists databases teaching" [248] by Tetiana A. Vakaliuk (figure 22), Olha V. Korotun and Serhiy O. Semerikov highlights further research by the authors, begun in [2, 28, 64, 84, 92, 108, 109, 124, 127, 128, 139, 168, 170, 184, 192, 193, 217, 218, 229, 243, 246, 247, 254]. One of the main aspects of studying databases in higher education institutions by future IT specialists is database design and software product development. This, in turn, is the most important problem of the developer's interaction with the customer. To facilitate the process of database design, ER-diagrams are used, which are based on the concepts of "Entity" and "Relationship". An ER diagram allows you to present a database in the form of visual graphical objects that define a specific subject area. The article considers the available cloud services for the construction of ER-diagrams for learning databases of future IT specialists and their selection the method expert evaluation. For this purpose, the criteria and indicators for the selection of cloud services for the construction of ER-diagrams of databases by future information technology specialists have been determined. As a result, it was found that the cloud services Dbdesigner.net and Lucidchart are the most convenient to learn. It is determined that for a teacher of a higher education institution the use of cloud services is an opportunity to use licensed software in education without additional costs.

The article "Approaches to the choice of tools for adaptive learning based on highlighted

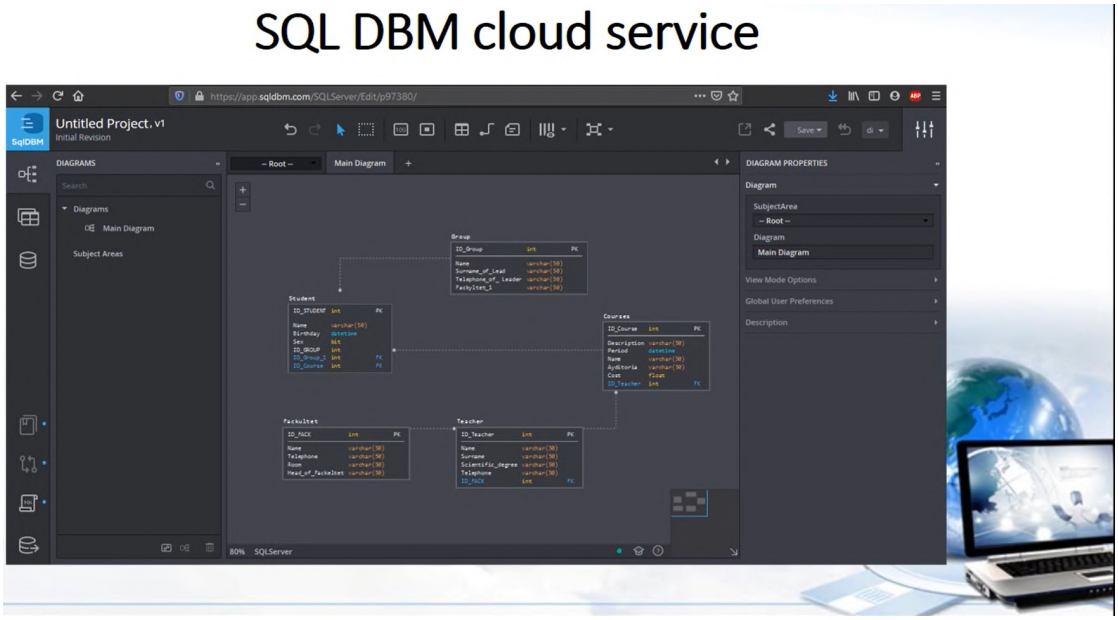

Figure 22: Presentation of paper [248].

selection criteria" [208] by Yaroslava B. Sikora (figure 23), Olena Yu. Usata, Oleksandr O. Mosiiuk, Dmytrii S. Verbivskyi and Ekaterina O. Shmeltser substantiates the relevance of adaptive learning of students in the modern information society, reveals the essence of such concepts as "adaptability" and "adaptive learning system". It is determined that a necessary condition for adaptive education is the criterion of an adaptive learning environment that provides opportunities for advanced education, development of key competencies, formation of a flexible personality that is able to respond to different changes, effectively solve different problems and achieve results. The authors focus on the technical aspect of adaptive learning. Different classifications of adaptability are analyzed. The approach to the choice of adaptive learning tools based on the characteristics of the product quality model stated by the standard ISO / IEC 25010 is described. The following criteria for the selecting adaptive learning tools are functional compliance, compatibility, practicality, and support. By means of expert assessment method there were identified and selected the most important tools of adaptive learning, namely: Acrobatiq, Fishtree, Knewton (now Wiliy), Lumen, Realize it, Smart Sparrow (now Pearson). Comparative tables for each of the selected tools of adaptive learning according to the indicators of certain criteria are given. This article highlights further research by the authors, begun in [59, 61, 78, 104, 120, 138, 274].

The article "Computerized adaptive testing in educational electronic environment of maritime higher education institutions" [32] by Olena S. Diahyleva, Igor V. Gritsuk, Olena Y. Kononova and Alona Y. Yurzhenko (figure 24) is devoted to the organization of modern learning process, namely the use of innovative technologies – computerized adaptive testing in educational electronic environment of maritime higher education institutions. This article highlights further research by the authors, begun in [36]. The example of educational electronic environment is

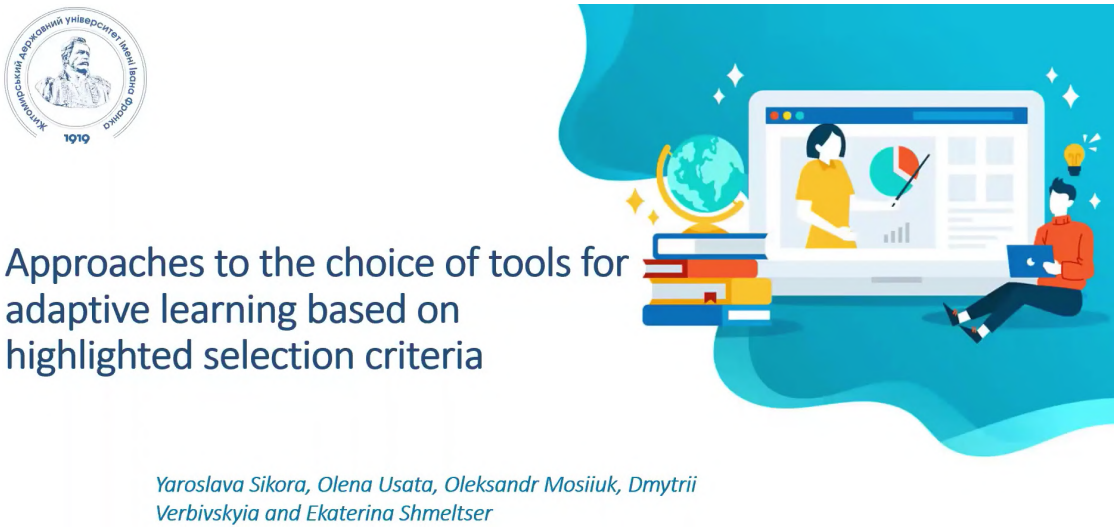

Figure 23: Presentation of paper [208].

presented in the article on LMS Moodle. The provided new technological and methodological opportunities are a priority in the developed methods of control and testing of knowledge, skills and abilities of students. Comparative characteristic of using computerized adaptive testing in educational electronic environment is given in the article according to different criteria: the role of tests in the learning process; methods of training; equipment; presence of the problems in educational process; level of its control and learning outcomes. The paper also presents examples of activities to form communicative competency of future maritime professionals. Types of adaptive tests are listed in the paper. The research activities were done by second year cadets of ship engineering department of Maritime College of Kherson State Maritime Academy. The experiment was devoted to the formation of communicative competence with the help of electronic environment of maritime higher education institution. The results of experiment proved positive impact of computerized adaptive testing on communicative competence of future ship engineers. Further investigation of adaptive testing can also be done for learning system of maritime education establishments using simulation technologies of virtual, augmented and mixed realities.

The ways of providing comprehensive efficiency increase in communication facilities of the academic space are given by Tetyana V. Neroda, Lidia V. Slipchyshyn (figure 25) and Ivan O. Muzyka in the article “Adaptive toolkit of branch-oriented workshop environment for enlargement the cloud-based e-learning media platform” [140] with regard to stipulated methods of managing distributed network resources. Selected the user interfaces types are distinguished according to user actions in the studied subject area, which made it possible to justify and hierarchically organize the categories of adaptive toolkit of the branch-oriented workshop environment by the classes of components declared in the project, which are closely related to the scheme of learning experiment and are basic means for simulating transients. The analytical models of classes of components of the virtual laboratory stand are compiled, the elements of which represent the properties and methods for visualization and further processing

Figure 24: Presentation of paper [32].

of interacting instances of the basic locations of the subject area, while ensuring system stability and controllability by clear distribution of functionality. Finally, the unification of component set template properties of the subject area is implemented, which greatly extending the targeted destination of virtual platform and increasing number of educational disciplines of academic course covered by the designed media resource. The results of the pedagogical verification showed an increase in the students' performance in mastering the subject area by means of presented branch-oriented workshop environment.

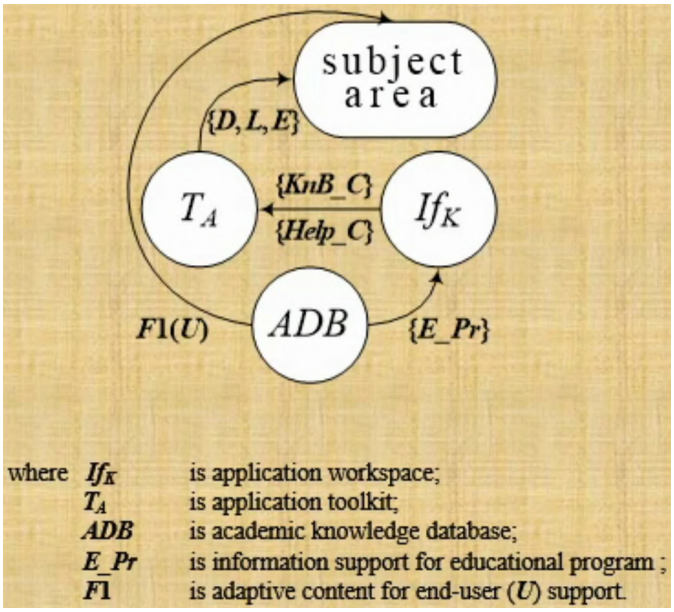

Figure 25: Presentation of paper [140].

2.6. Session 6: Cloud-based AI Education Applications

Rasmus Munk (figure 26), David Marchant and Brian Vinter in the paper "Cloud enabling educational platforms with corc" [133] is shown how teaching platforms at educational institutions can utilize cloud platforms to scale a particular service, or gain access to compute instances with accelerator capability such as GPUs. Specifically at the University of Copenhagen (UCPH), it is demonstrated how the internal JupyterHub service, named Data Analysis Gateway (DAG), could utilize compute resources in the Oracle Cloud Infrastructure (OCI). This is achieved by utilizing the introduced Cloud Orchestrator (corc) framework, in conjunction with the novel JupyterHub spawner named MultipleSpawner. Through this combination, we are able to dynamically orchestrate, authenticate, configure, and access interactive Jupyter Notebooks in the OCI with user defined hardware capabilities. These capabilities include settings such as the minimum amount of CPU cores, memory and GPUs the particular orchestrated resources must have. This enables teachers and students at educational institutions such as UCPH to gain easy access to the required capabilities for a particular course. In addition, we lay out how this groundwork, will enable us to establish a Grid of Clouds between multiple trusted institutions. This enables the exchange of surplus computational resources that could be employed across their organisational boundaries.

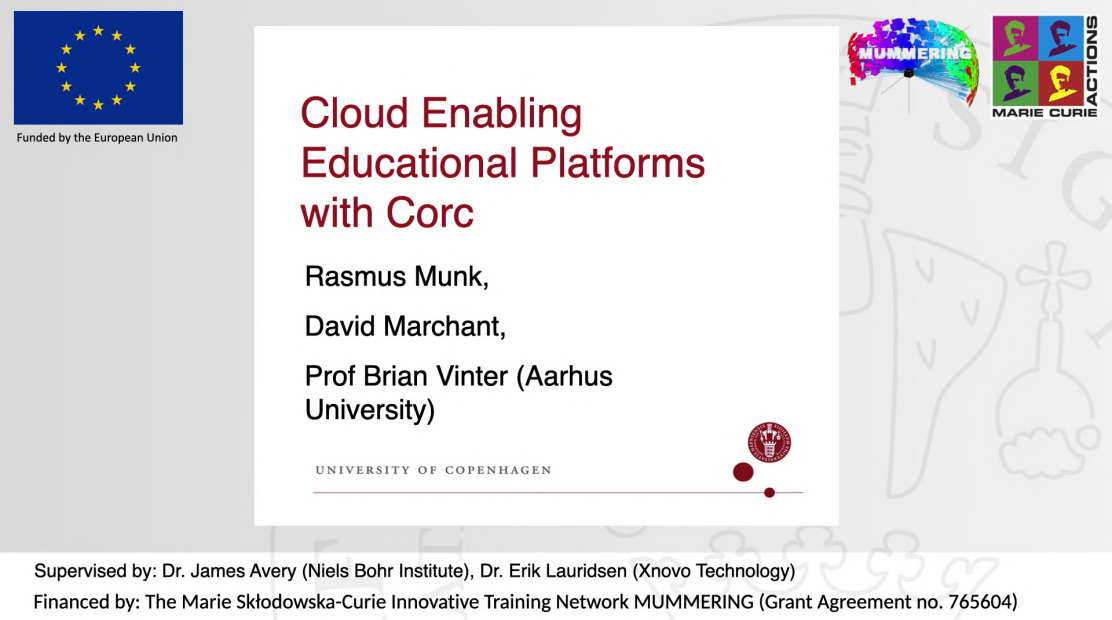

Figure 26: Presentation of paper [133].

The article "Methodology of formation of modeling skills based on a constructive approach (on the example of GeoGebra)" [34] by Marina G. Drushlyak (figure 27), Olena V. Semenikhina, Volodymyr V. Proshkin, Serhii Ya. Kharchenko and Tetyana D. Lukashova highlights further research by the authors, begun in [3, 12, 19, 35, 47, 48, 197]. Author's methodology of forming modeling skills involves 4 steps: Step 1 – the teacher step by step constructs the curve by means

of cloud based service GeoGebra; Step 2 – the teacher offers a description-definition of the curve and provides a ready-made algorithm by which students model the curve independently in GeoGebra; Step 3 – the teacher offers an algorithm for constructing a curve model, and students need to characterize the properties of the curve or give its definition based on the results, Step 4 – students are offered definitions of curves that they have to model in GeoGebra). An example of realization of the author's methodology is given, the pedagogical experiment on proof of its effectiveness is described.

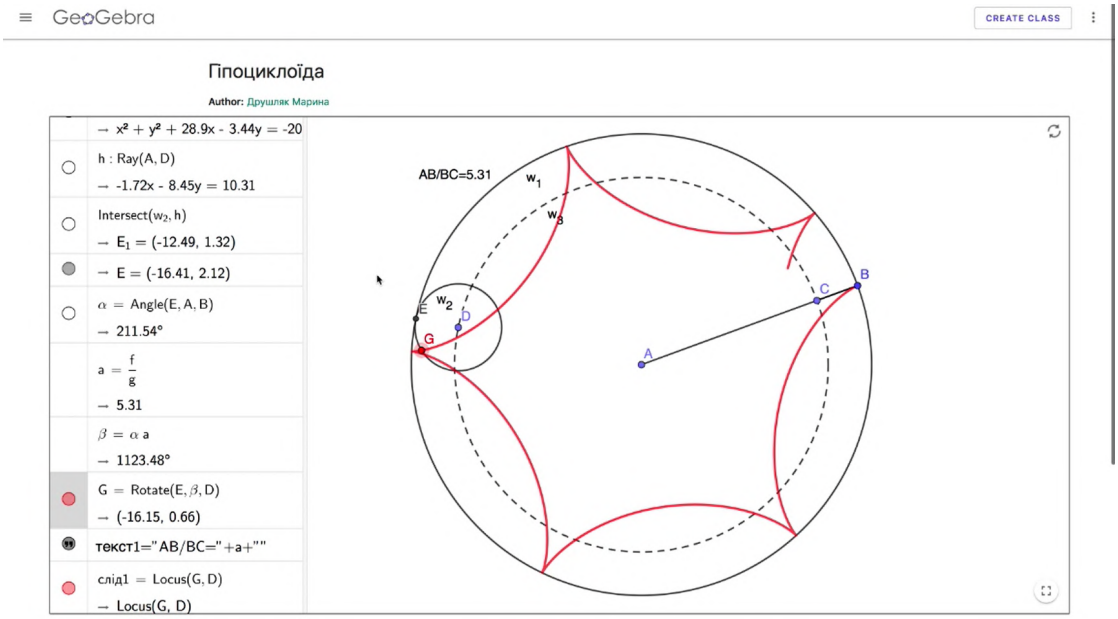

Figure 27: Presentation of paper [34].

2.7. Session 7: Educational Data Mining and Social Analytics in Education

The article "The learning process simulation based on differential equations of fractional orders" [30] by Oleksii P. Chornyi, Larysa V. Herasymenko and Victor V. Busher (figure 28) is an integrated study conducted to develop a learning model which would make it possible to identify the students' changes of knowledge, abilities and skills acquisition over time as well as the formation of special features of their individual background. Authors have justified the application of the cybernetic model based on fractional equations for the description and evaluation of the student's learning process. Learning is dealt as a transformation of young people's knowledge, abilities and skills into a complex background, which envisages its implementation in the future professional activity. The advantage of the suggested model is better approximation characteristics which allow the consideration of a wide range of factors affecting the learning process including the youth's neurodynamic and psychological nature. The research has employed both mathematical modeling methods and psychodiagnostic techniques (surveys, questionnaires). As a result of the findings, students who assimilate the content of

teaching information and form personal experience in different ways have compiled different groups; the learning curve constructed on the basis of the heterogeneous differential equation of second order with integer powers has been compared with the set of models with equations of fractional order of aperiodic and fractional power components. The prospect of the issue to explore is the improvement of the suggested model considering special characteristics of cognitive processes aimed at the formation of an individual path of the student's learning.

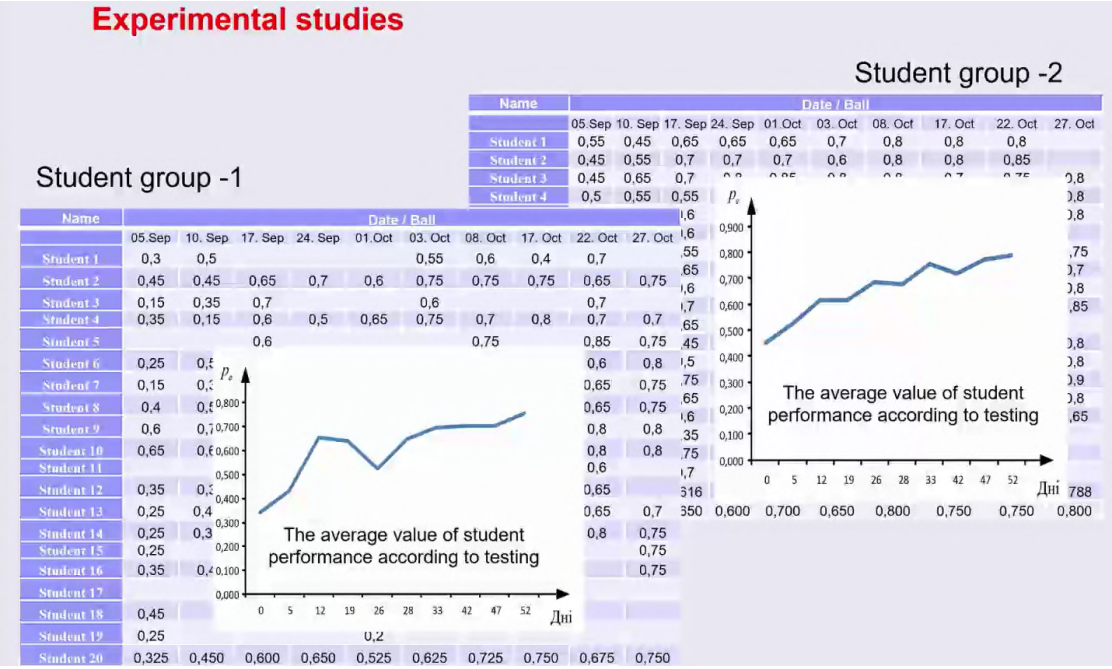

Figure 28: Presentation of paper [30].

author=, title=,

The article "Cloud technologies and learning analytics: web application for PISA results analysis and visualization" [111] by Mariia S. Mazorchuk (figure 29), Tetyana S. Vakulenko, Anna O. Bychko, Olena H. Kuzminska and Oleksandr V. Prokhorov analyzes the ways to apply Learning Analytics, Cloud Technologies, and Big Data in the field of education on the international level. This paper provides examples of international analytical researches and cloud technologies used to process the results of those researches. It considers the PISA research methodology and related tools, including the IDB Analyzer application, free R intsvy environment for processing statistical data, and cloud-based web application PISA Data Explorer. The paper justifies the necessity of creating a stand-alone web application that supports Ukrainian localization and provides Ukrainian researchers with rapid access to well-structured PISA data. In particular, such an application should provide for data across the factorial features and indicators applied at the country level and demonstrate the Ukrainian indicators compared to the other countries' results. This paper includes a description of the application core functionalities, architecture, and technologies used for development. The proposed solution leverages the shiny package available with R environment that allows implementing both the UI and server sides of the

application. The technical implementation is a proven solution that allows for simplifying the access to PISA data for Ukrainian researchers and helping them utilize the calculation results on the key features without having to apply tools for processing statistical data. This article highlights further research by the authors, begun in [163, 172, 181].

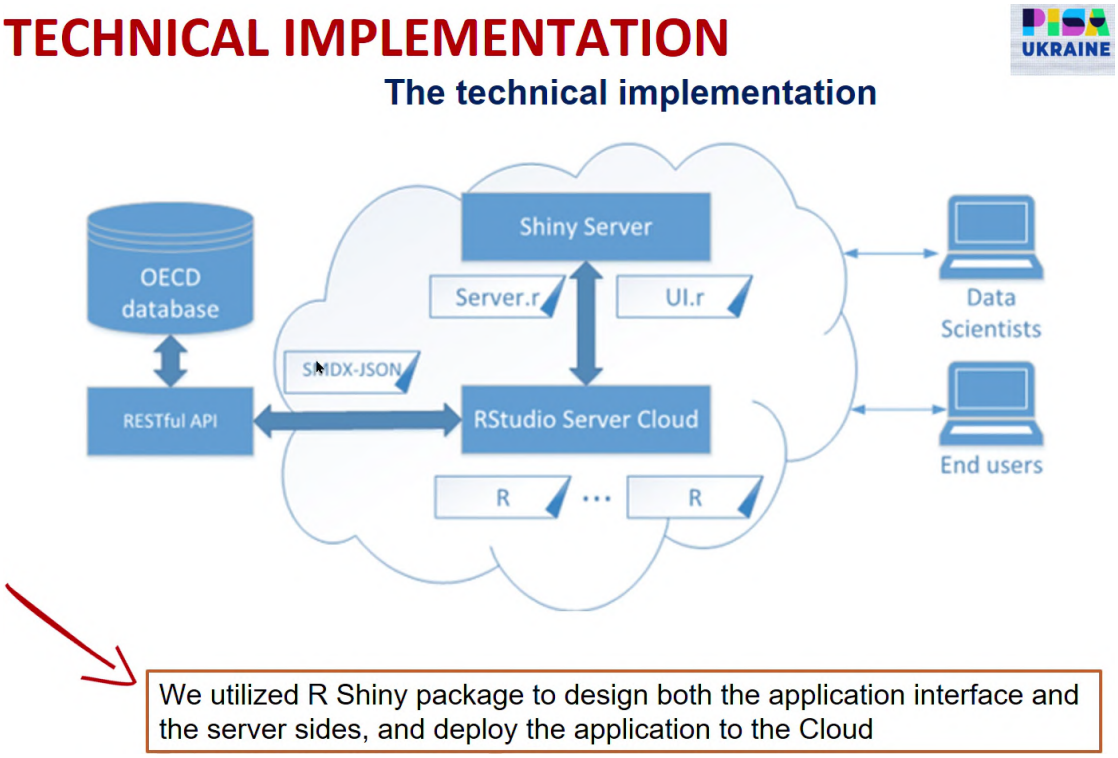

Figure 29: Presentation of paper [111].

In order for the learning process to always retain personal value for the learner, it is necessary that his or her motivation be maintained through an awareness of his or her purpose and goals. The article "Computer simulation of processes that influence adolescent learning motivation" [81] by Larysa O. Kondratenko, Hanna T. Samoylenko, Arnold E. Kiv, Anna V. Selivanova (figure 30), Oleg I. Pursky, Tetyana O. Filimonova and Iryna O. Buchatska presents a local model (at the individual object level) of enhancing external motivation, which give to determine students' efforts to get rewards. The concept of this model based on describing the behavior of agents (in our case students). The characteristics of the phenomenon in the motivation of learning at different stages of adolescent development are analyzed. The problem of computer modeling of educational processes with the help of agent modeling on the example of studying student motivation is considered. Internal and external factors that may strengthen or weaken the adolescent's motivation to study have been studied. The expediency of using information technologies of agent modeling to study the dynamics of strengthening or weakening student motivation is substantiated. Using the AnyLogic Cloud computing environment the change of dynamics of strengthening of motivation of teenagers on an example of model of strengthening

of external motivation is defined. This article highlights further research by the authors, begun in [177–180].

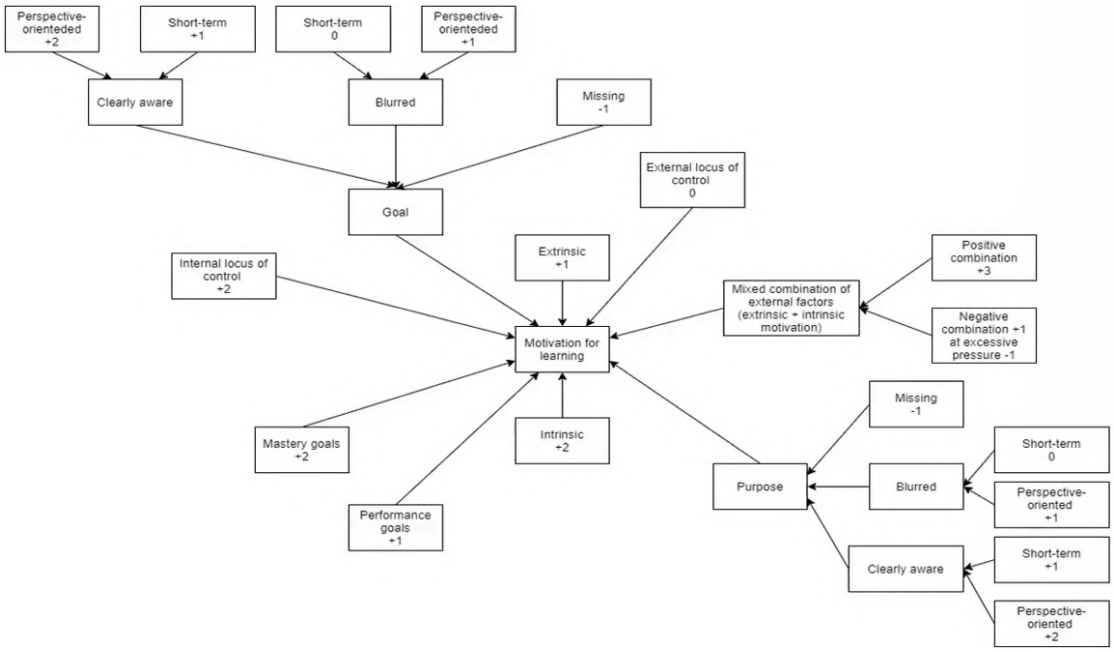

Figure 30: Presentation of paper [81].

The article "Simulation of intellectual system for evaluation of multilevel test tasks on the basis of fuzzy logic" [240] by Ivan M. Tsidylo (figure 31) and Serhiy O. Semerikov and Tetiana I. Gargula and Hanna V. Solonetska and Yaroslav P. Zamora and Andrey V. Pikilnyak highlights further research by the authors, begun in [23, 24, 45, 46, 106, 107, 116–119, 123, 125, 135, 182, 186, 189–191, 215, 216, 226, 233, 234, 238, 239, 277]. This article describes the stages of modeling an intelligent system for evaluating multilevel test tasks based on fuzzy logic in the MATLAB application package, namely the Fuzzy Logic Toolbox. The analysis of existing approaches to fuzzy assessment of test methods, their advantages and disadvantages is given. The considered methods for assessing students are presented in the general case by two methods: using fuzzy sets and corresponding membership functions; fuzzy estimation method and generalized fuzzy estimation method. In the present work, the Sugeno production model is used as the closest to the natural language. This closeness allows for closer interaction with a subject area expert and build well-understood, easily interpreted inference systems. The structure of a fuzzy system, functions and mechanisms of model building are described. The system is presented in the form of a block diagram of fuzzy logical nodes and consists of four input variables, corresponding to the levels of knowledge assimilation and one initial one. The surface of the response of a fuzzy system reflects the dependence of the final grade on the level of difficulty of the task and the degree of correctness of the task. The structure and functions of the fuzzy system are indicated. The modeled in this way intelligent system for assessing multilevel test tasks based on fuzzy logic makes it possible to take into account the fuzzy characteristics of the test: the level of

difficulty of the task, which can be assessed as “easy”, “average", “above average”, “difficult”; the degree of correctness of the task, which can be assessed as “correct”, “partially correct”, “rather correct”, “incorrect”; time allotted for the execution of a test task or test, which can be assessed as “short”, “medium”, “long”, “very long”; the percentage of correctly completed tasks, which can be assessed as “small”, “medium”, “large”, “very large”; the final mark for the test, which can be assessed as “poor”, “satisfactory”, “good”, “excellent”, which are included in the assessment. This approach ensures the maximum consideration of answers to questions of all levels of complexity by formulating a base of inference rules and selection of weighting coefficients when deriving the final estimate. The robustness of the system is achieved by using Gaussian membership functions. The testing of the controller on the test sample brings the functional suitability of the developed model.

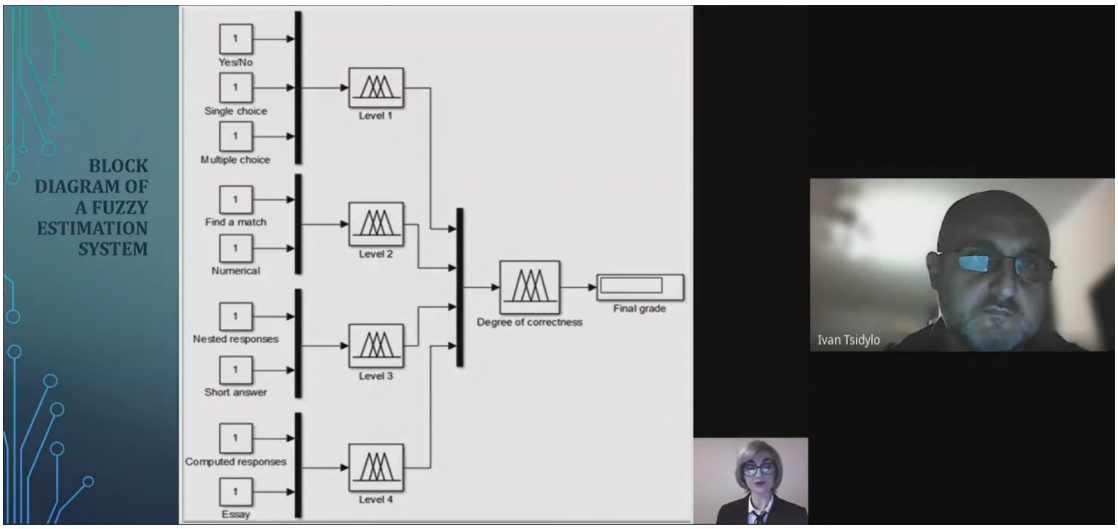

Figure 31: Presentation of paper [240].

The article “Peculiarities of cloud computing use in the process of the first-year students’ adaptive potential development” [256] by Hanna B. Varina (figure 32), Viacheslav V. Osadchyi, Kateryna P. Osadcha, Svetlana V. Shevchenko and Svitlana H. Lytvynova highlights further research by the authors, begun in [22, 97–103, 173–175, 255]. Technologies based on cloud computing is one of the demanded and actively developing areas of the modern information world. Cloud computing refers to an innovative technology that allows you to combine IT resources of various hardware platforms into a single whole and provide the user with access to them via a local network or the global Internet. Cloud services from various providers offer users access to their resources via the Internet via free or shareware cloud applications, the hardware and software requirements of which do not imply that the user has high-performance and resource-consuming computers. Cloud technologies represent a new way of organizing the educational process and offers an alternative to traditional methods of organizing the educational process, creates an opportunity for personal learning, collective teaching, interactive classes, and the organization of psychological support. The scientific article is devoted to the problem of integrating cloud technologies not only in the process of training highly qualified specialists,

but also in the formation of professionally important personality traits. The article describes the experience of introducing cloud technologies into the process of forming the adaptive potential of students in conditions of social constraints caused by the COVID-19 pandemic.

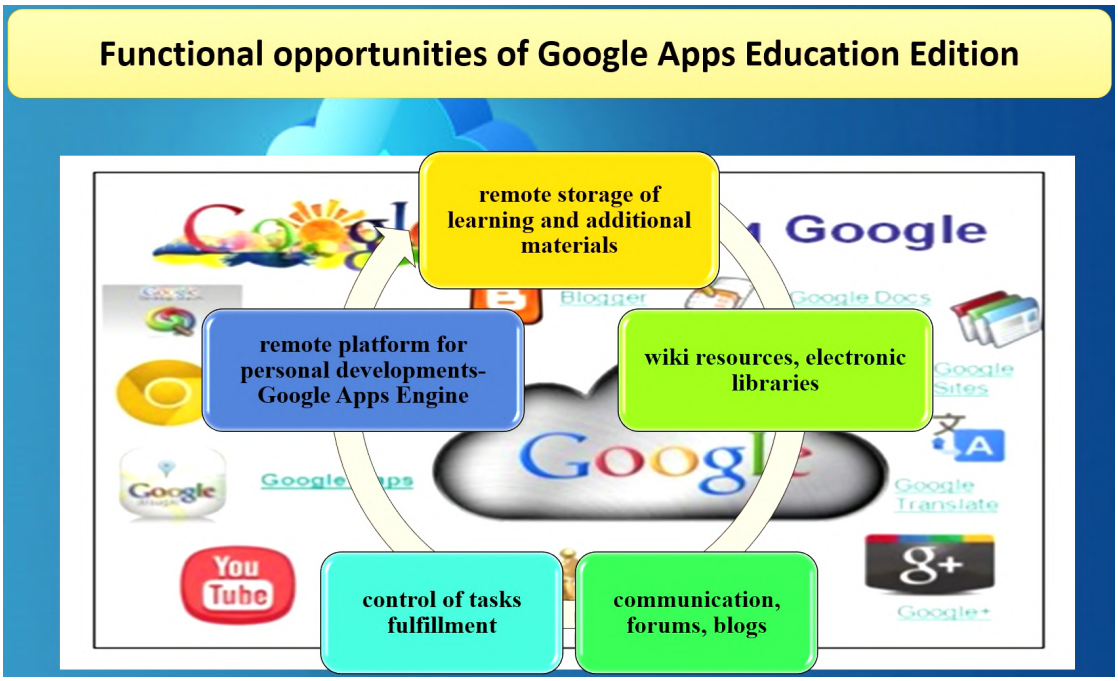

Figure 32: Presentation of paper [256].

3. Conclusion

8th Workshop on Cloud Technologies in Education (CTE 2020) was organized by Kryvyi Rih National University (with support of the rector Mykola I. Stupnik) in collaboration with Kryvyi Rih State Pedagogical University (with support of the rector Yaroslav V. Shramko), Institute of Information Technologies and Learning Tools of the NAES of Ukraine (with support of the director Valeriy Yu. Bykov) and University of Educational Management (with support of the vice-rector for research and digitalization Oleg M. Spirin).

We are thankful to all the authors who submitted papers and the delegates for their participation and their interest in CTE 2020 as a platform to share their ideas and innovation. Also, we are also thankful to all the program committee members for providing continuous guidance and efforts taken by peer reviewers contributed to improve the quality of papers provided constructive critical comments, improvements and corrections to the authors are gratefully appreciated for their contribution to the success of the workshop.

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