1st Symposium on Advances in Educational Technology: Outlook

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Abstract. This is an overview of the Proceedings of the 1st Symposium on Advances in Educational Technology (AET 2020), which was held in Kyiv, Ukraine, on November 12-13, 2020. It includes an introduction, a summary of the papers, and some reflections on the event and its future.

Keywords: AI in education, augmented reality in education, cloud-based learning environments, cloud technologies for mathematics learning, cloud technologies for informatics learning, computer simulation in science and mathematics learning, ICT in primary and secondary education, ICT in higher education, learning environments, learning technology, management of professional development in the digital space, training of social managers for digital society, massive open online courses, methodology of informatization in education, modelling systems in education, psychological safety in the digital educational environment, soft skills development, STEM education, virtualization of learning

1. Introduction

1.1. AET 2020 at a glance

Symposium on **A**dvances in **E**ducational **T**echnology (AET) is a peer-reviewed international conference focusing on research advances and applications of combined use of computer hardware, software, and educational theory and practice to facilitate learning. Today, AET is the premier interdisciplinary forum for learning scientists, academicians, researchers, professionals, policy makers, postgraduate students and practitioners to present their latest research results, ideas, developments, and applications.

Figure 1: AET 2020 logo

AET topics of interest are:

- Artificial intelligence, knowledge engineering, and intelligent tutoring systems

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- Aspects of environmental augmented reality security and ethics
- Augmented reality gamification
- Augmented reality in professional training and retraining
- Augmented reality in science education
- Augmented reality social and technical issues
- Cloud technologies for informatics learning
- Cloud technologies for mathematics learning
- Cloud technologies for physics learning
- Cloud technologies of mobile learning
- Cloud technologies of open education
- Cloud-based and mobile learning technologies for teacher and VET
- Cloud-based e-learning platforms, tools and services
- Cloud-based learning environments
- Cloud-based learning management systems
- Computer simulation in science and mathematics learning
- Design and implementation of augmented reality learning environments
- Development of soft skills for teachers of institutions of professional, special before higher and higher education in the context of digitalization
- Educational data mining and learning analytics
- ICT in higher education for a sustainable future society
- ICT in secondary education for a sustainable future society
- Learning environments models
- Learning technology
- Machine learning, robot learning and artificial learning
- Management of professional development of specialists in the digital space of formal and non-formal education
- Massive open online courses
- Methodology of informatization in education
- Methods of using cloud-oriented learning tools
- Mobile and blended learning
- Mobile technology of augmented reality
- Modelling systems in education
- Open learning systems and virtual conferences for training professionals
- Psychological safety of participants in the educational process in the digital educational environment
- Seamless learning and holistic education modelling and design
- STEAM education
- Supporting the development of 21st century skills through ICT
- Training and professional development of specialists in the digital twin of the educational institution

- Training of managers of a socio-political profile in the context of society digitalization: a humanistic aspect
- Virtualization of learning

This article represents the 1st Symposium on Advances in Educational Technology (AET 2020), held in Kyiv, Ukraine, on November 12–13, 2020. AET 2020 proceedings comprises 110 contributed papers that were carefully peer-reviewed and selected from 282 submissions (https://aet.easyscience.education/2020/). Each submission was reviewed by at least 3, and on the average 3.1, program committee members. The accepted papers present the state-of-the-art overview of successful cases and provides guidelines for future research.

The two-volume work presents the contributions of 18 sessions of the symposium.

1.2. AET 2020 program chairs

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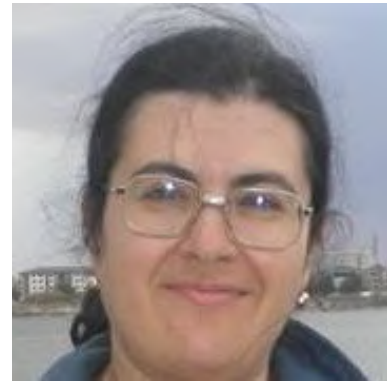
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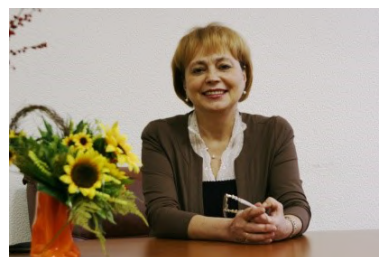
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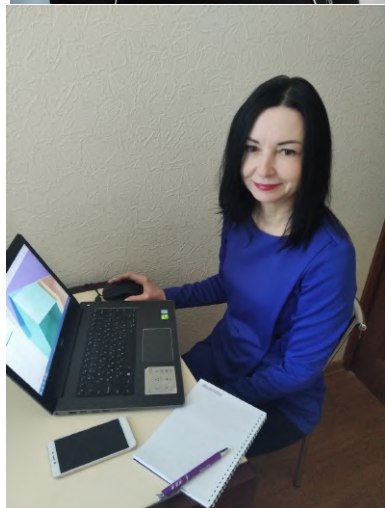
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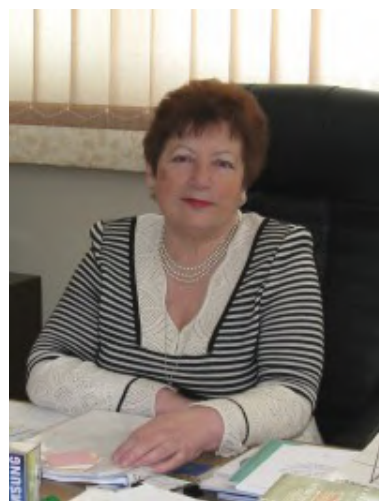
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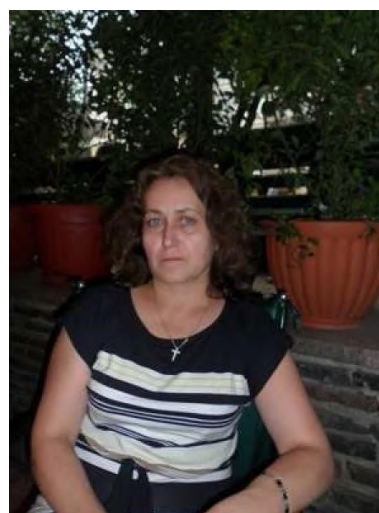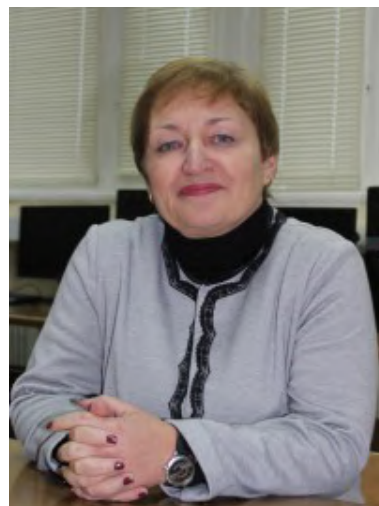
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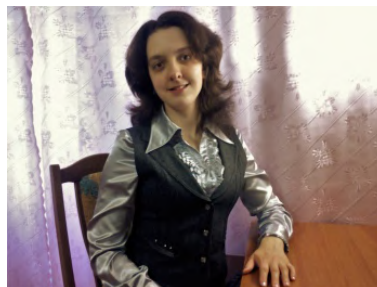E-mail: malchenko.svitlana@kdpu.edu.ua

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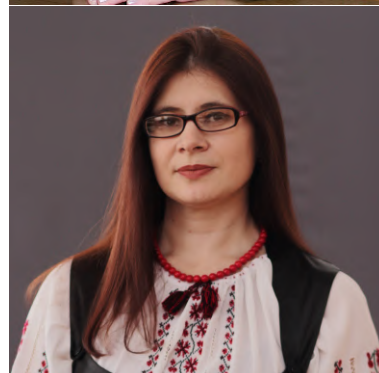
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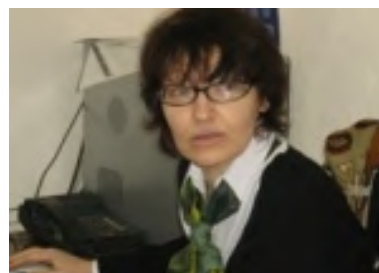
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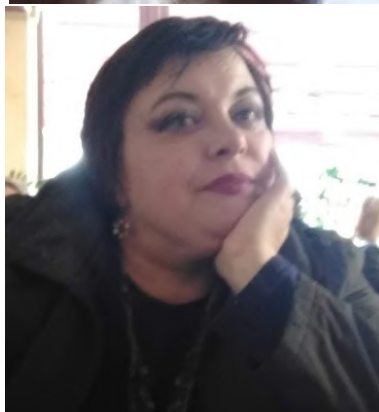
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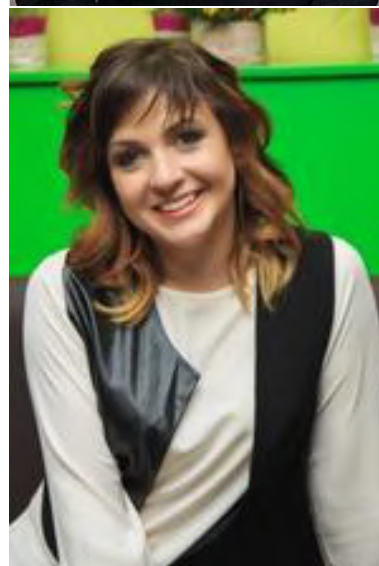
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2. Articles overview

2.1. Session 1: Artificial intelligence in education

One of the relevant current vectors of study in machine learning is the analysis of the application peculiarities for methods of solving a specific problem. Oksana V. Klochko (figure 2), Vasyl M. Fedorets, Vitalii I. Klochko and Maryna V. Kormer study this issue on the example of methods of solving the clustering and classification problem. Currently, we have a considerable number of machine learning algorithms – e.g. Expectation Maximization, Farthest First, K-Means, Expectation-Maximization, Hierarchical Clustering, Support vector machines, K-nearest neighbor, Logistic regression, Random Forest etc. – which can be used for clustering and classification. However, not all methods can be used for solving a specific task. The article "The use of ensemble classification and clustering methods of machine learning in the study of Internet addiction of students" [97] describes the technology of empirical comparison of methods of clustering and classification problems solving using WEKA free software for machine learning. Empirical comparison of data clustering methods was based on the results of a survey

conducted among students majoring in Computer Studies and dedicated to detecting signs of Internet Addiction (IA) (Internet Addiction is a behavioural disorder that occurs due to Internet misuse). As a continuation of the study of Internet Addiction of students, a survey of students of other specialties was conducted. Ensemble methods of machine learning classification were used to analyze these data. Empirical comparison of clustering algorithms (Expectation Maximization, Farthest First and K-Means) and ensemble classification algorithms (AdaBoost, Bagging, Random Forest and Vote) with the application of the WEKA machine learning system had the following results: it described the peculiarities of application of these methods in feature clustering and classification, the authors developed data instances' clustering and classification models to detect signs of Internet addiction among students, the study concludes that these methods may be applicable to development of models detecting respondents with signs of IA related disorders and risk groups.

This article highlights further research by the authors, begun in [95].

0. **Initialization**: Get an initial estimate for parameters θ^0 (e.g. all the μ_k, σ_k^2, and π variables). In many cases, this can just be a random initialization.
1. **Expectation Step**: Assume the parameters (θ^{t-1}) from the previous step are fixed, compute the expected values of the latent variables (or more often a *function* of the expected values of the latent variables).
2. **Maximization Step**: Given the values you computed in the last step (essentially known values for the latent variables), estimate new values for θ^t that maximize a variant of the likelihood function.
3. **Exit Condition**: If likelihood of the observations have not changed much, exit; otherwise, go back to Step 1.

Figure 2: Presentation of paper [97].

The basis of any discipline is a set of didactic units. The task of the educational process management apparatus is to ensure compliance with the requirements for the order of the didactic units and their full implementation within the framework of the formation of the curriculum while minimizing its duration. A significant difficulty is the logical linking of didactic units with each other, since it is impossible to break the logic of presentation of materials of one discipline and there is a relationship between didactic units of different disciplines. The article "Analysis and application of semantic networks in education" [94] by Arnold E. Kiv, Vladimir N. Soloviev, Elena Yu. Tarasova (figure 3), Tetyana I. Koycheva and Katrina V. Kolesnykova the topological characteristics of the concept graphs related to various disciplines. Authors develop the algorithm to implement the subject area model in the form of a semantic knowledge network. 125 concepts are analyzed that provide optimal mastering disciplines and establish the connection between them. A survey of the dynamics of the popularity of the term "network science" from 2004 to 2020 using Google Trends showed a steady trend of user interest. On average, 80 requests are executed (calculated in arbitrary units), with the largest volume of requests being 100.

This article highlights further research by the authors, begun in [91, 253, 254].
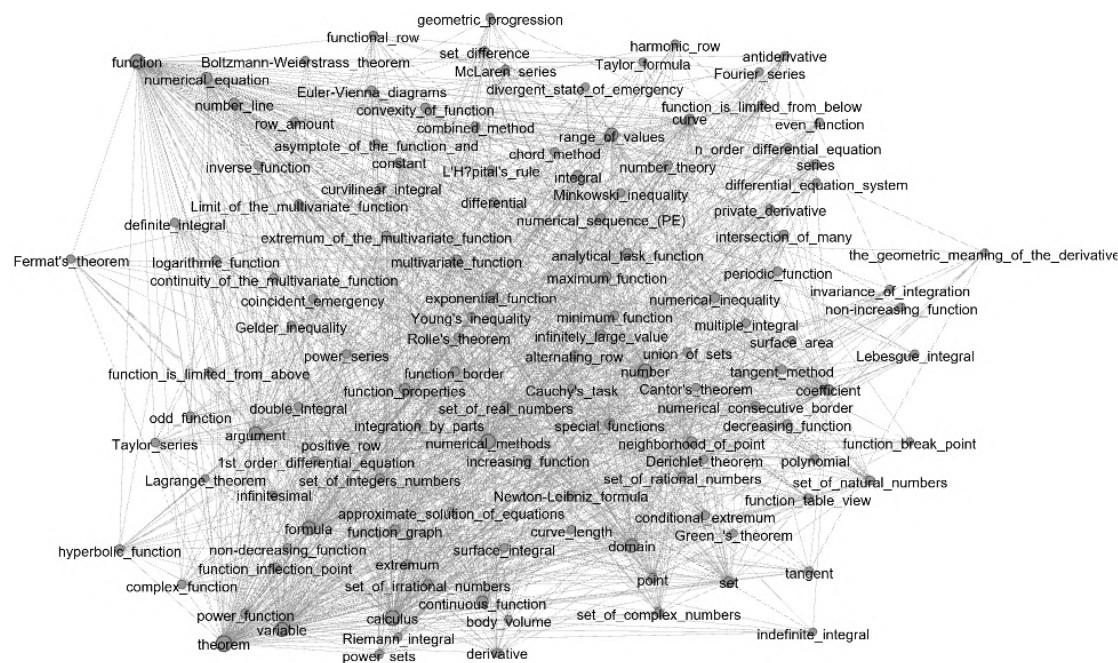
Figure 3: Presentation of paper [94].

The article "Ontological approach to the presentation of the subject area of the discipline" [285] by Ivan M. Tsidylo (figure 4), Serhii V. Kozibroda, Tetiana I. Gargula, Anatolii A. Hryhoruk, Lyubov M. Lytvyn and Andrei V. Voznyak considers the problem of methodology of designing computer ontology of the subject area of the discipline by future specialists in the field of digital technologies. The scheme of ontology of the subject discipline is presented in which the set of concepts of the future computer ontology and the set of relations between them are represented. The main criteria of the choice of systems of computer ontologies for designing computer ontology of the subject discipline: software architecture and tools development; interoperability; intuitive interface are established. The selection of ontology design methods by means of computer ontology systems has been specified. An algorithm for designing a computer ontology of the subject area of the discipline by future specialists in the field of digital technologies is proposed. The effectiveness of the proposed scheme of ontology of the subject area of the discipline and the proposed method of technology has been investigated experimentally on three indicators: 1) the speed of construction of ontologies; 2) the number of defects; 3) the speed of addition of already created ontologies.

This article highlights further research by the authors, begun in [39, 286, 287].

Data science is the field of study that involves tools, algorithms, and knowledge of maths and statistics to discover knowledge from the raw data. Data science is developing fast and penetrating all spheres of life. More people understand the importance of the science of data and the need for implementation in everyday life. Data science is used in business for business analytics and production, in sales for offerings and, for sales forecasting, in marketing for customizing customers, and recommendations on purchasing, digital marketing, in banking and
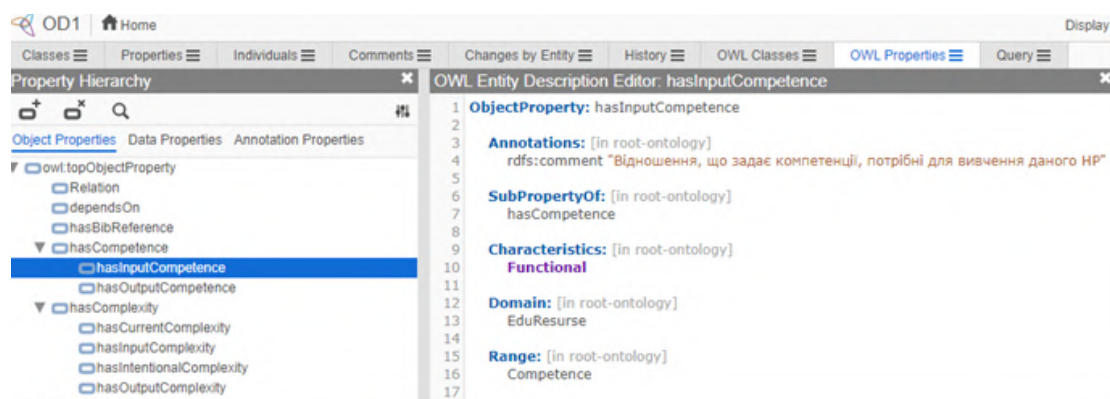
Figure 4: Presentation of paper [285].

insurance for risk assessment, fraud detection, scoring, and in medicine for disease forecasting, process automation, and patient health monitoring, in tourism in the field of price analysis, flight safety, opinion mining, etc. The article "Data science in economics education: examples and opportunities" [224] by Nina O. Rizun, Maryna V. Nehrey (figure 5) and Nataliia P. Volkova concerns the issue of data science tools implementation, including the Text Mining and Natural Language Processing algorithms for increasing the value of Economics Education for the development of modern and technologically flexible society. The article deeply discusses the opportunities of using Text Analytics and Topic modeling for conducting scientific studies and applying them in the educational process. Presented examples demonstrate the nature of tasks and approaches which could develop students' research skills in the public perception analysis. Such approaches also allow students to gain practical experience in the study and interpretation of the influence of additional metadata, characterizing the comments authors, on differences in their opinions about events, companies, goods, and services. Finally, the Data science study programs for economics at top-20 universities are selected and discovered.

This article highlights further research by the authors, begun in [328].

The article "Using intelligent agent-managers to build personal learning environments in the e-learning system" [204] by Oleksandr Yu. Burov, Nadiia B. Pasko, Oleksandr B. Viunenko, Svitlana V. Agadzhanova (figure 6) and Karen H. Ahadzhanov-Honsales focuses on the issues of developing the structure of a multi-agent environment for e-learning systems and proposes a computer technology to ensure student activities in e-learning modular systems. The relevance of the research topic is due to the low level of modern e-learning systems adaptation to the individual characteristics of the student, the lack of ability to predict learning outcomes. The technology enables to take into consideration the factors affecting the students' learning outcomes and to form an individual trajectory of the learning session from a holistic perspective.

This article highlights further research by the authors, begun in [35, 36, 212].

2.2. Session 2: Augmented reality in education

Using the virtual teaching aids with AR technology in different spheres of education, including physics, has been analysed by Oleksandr V. Kanivets (figure 7), Irina M. Kanivets, Tetyana
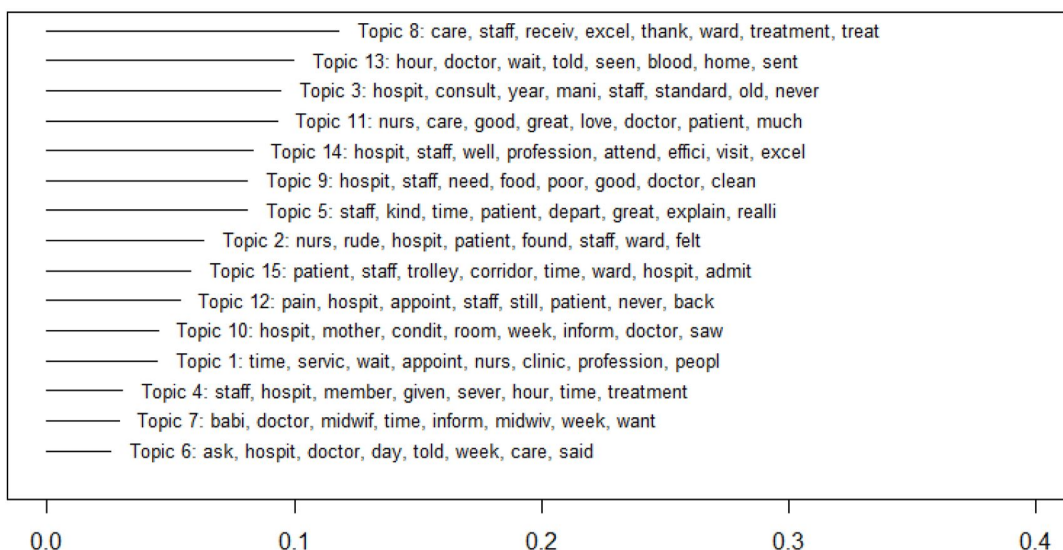
Figure 5: Presentation of paper [224].

M. Gorda and Oleksandr Yu. Burov in the article "Development of augmented reality mobile application in physics to study the electric circuit" [82]. The analogy between physical and electronic models has been drawn and the development of mobile app to study simple electric circuit has been substantiated. The reasonability of creating the technique of the augmented reality mobile apps has been given. The milestones in the development of the augmented reality app have been outlined: development of electronic models, installation of the game engine Unity3D, development of all program scenes, operation testing and demonstration. Using the scenarios for electronic models rotation and movement has been particularly focused on. Own developed augmented reality mobile app for mobile devices "Augmented reality program to study the simplest electric circuit" has been presented. The created mobile app reads, recognizes the designer marker and displays the product electronic model on the screen. It is established that the augmented reality program developed by the team of authors as the mobile teaching software can be used to do the tasks for the students' individual work, as well as for the classroom studies at the universities.

This article highlights further research by the authors, begun in [37, 80, 81].

The article "Digital technology implementation for students' involvement base on 3D quest game for career guidance and estimating students' digital competences" [222] by Oleksandr V. Prokhorov, Vladyslav O. Lisovichenko, Mariia S. Mazorchuk, Olena H. Kuzminska (figure 8) reveals the process of creating a career guidance 3D quest game for applicants who aim to apply for IT departments. The game is based on a 3D model of the computer science and information technologies department in the National Aerospace University "Kharkiv Aviation Institute". The quest challenges aim to assess the digital competency level of the applicants and first-year students. The paper features leveraged the theoretical background, software tools, development stages, implementation challenges, and the gaming application scenario. The game
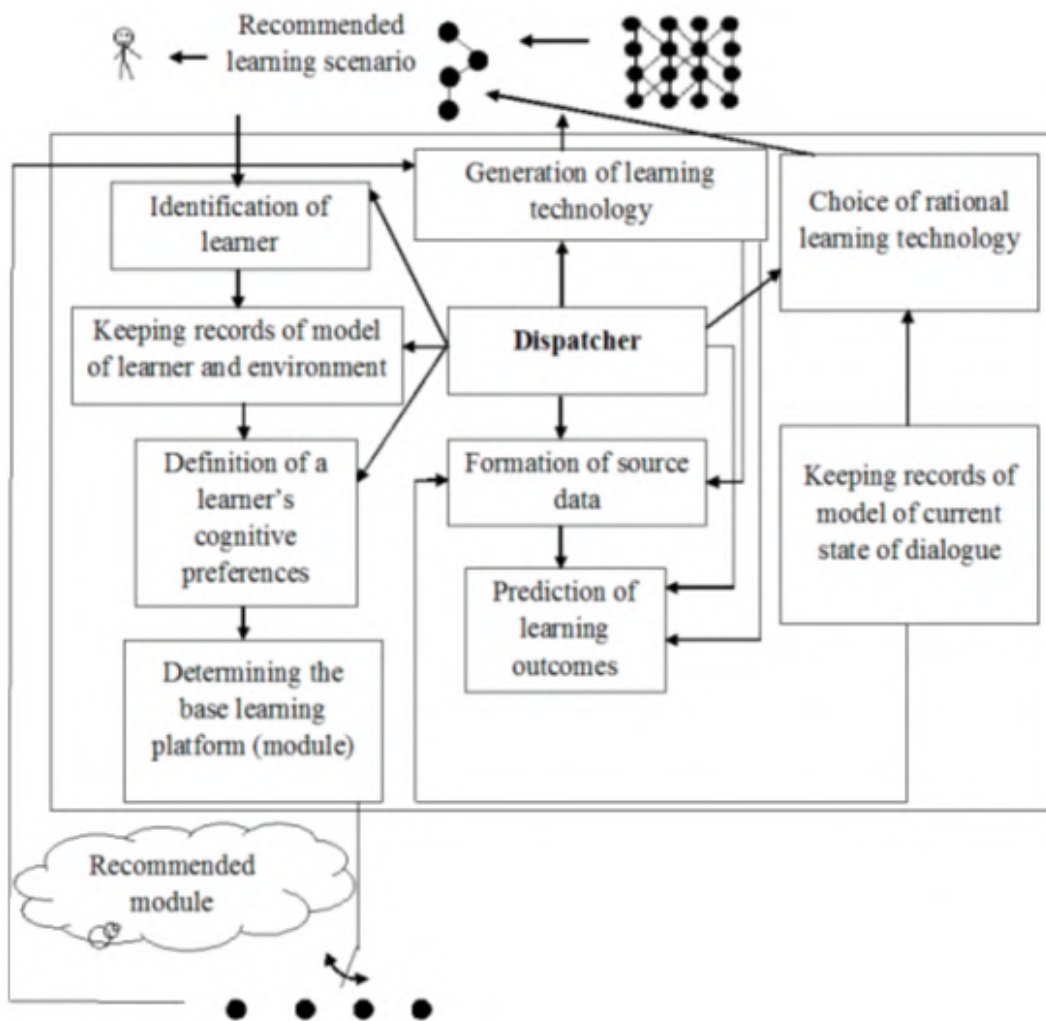
Figure 6: Presentation of paper [204].

scenario provides for a virtual tour around a department of the 3D university. As far as the game replicates the real-life objects, applicants can see the department's equipment and class-rooms. For the gaming application development, the team utilized C# and C++, Unity 3D, and Source Engine. For object modeling, authors leveraged Hammer Editor, Agisoft PhotoScan Pro, and the photogrammetry technology that allowed for realistic gameplay. Players are offered various formats of assessment of digital competencies based on the Digital Competence Framework for Citizens (DigComp 2.1): test task, puzzle, assembling a computer, and setting up an IT-specialist workplace. The experiment conducted at the online open house day 2020 proved the 3D quest game efficiency. The applicants estimated a 3D quest, as more up-to-date and attractive engagement. According to the results of the 3D quest, applicants demonstrated an average level of digital competence with some certain items difficulties at 0.5. Several psychometric item
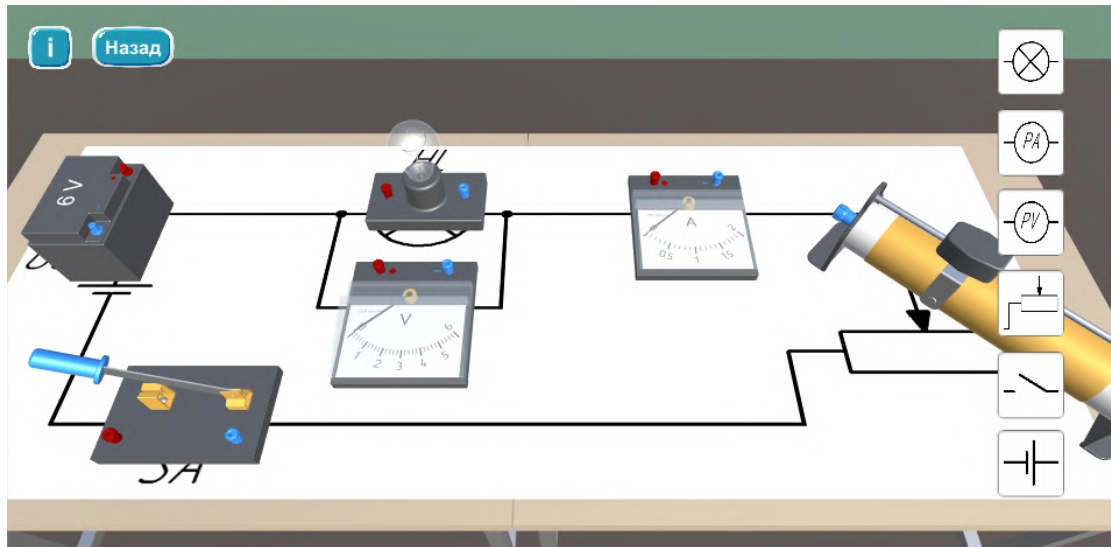
Figure 7: Presentation of paper [82].

characteristics were analyzed in detail that would allow us to improve the item's quality.

This article highlights further research by the authors, begun in [122, 123, 221].

Figure 8: Presentation of paper [222].

The article "Using the augmented/virtual reality technologies to improve the health-preserving competence of a physical education teacher" [98] by Oksana V. Klochko (figure 9), Vasyl M. Fedorets, Mariya P. Shyshkina, Tetiana R. Branitska, Nina P. Kravets deals with the results of the research aimed at the improvement of methodology of use of augmented reality for the development of health-preserving competence of a Physical Education teacher under conditions of post-graduate education. From the point of Umwelt phenomenology, augmented reality is characterized by correspondence to human nature, its cognitive, metaphoric, diverse, interactive, anthropomorphic nature. The article analyzes the vectors of using augmented reality in the

professional activity of a Physical Education teacher, particularly the one that is aimed at health preservation. The software that may be used with this purpose has been described. The positive attitude of Physical Education teachers to the use of the augmented/virtual reality for preserving students' health and development of their motion skills, intellect and creativity was determined in the research. The results of the survey show that the majority of teachers positively react to the idea of using augmented reality in their professional activity. However, in some cases, not a fully formed understanding of this issue was observed. The ways of solving the stated problem could be the inclusion of augmented technologies' techniques into the process of post-graduate education, taking into consideration the anthropological, ethical, cultural contexts as well as teacher involvement in the stated process. Based on the use of augmented/virtual reality technologies, the software application "Virtual Model of Identifying the Risks for Locomotor Apparatus Caused by Ligament Stretching", has been developed, which consists of 5 models. Namely, the virtual models of joints used in order to shape a teacher's understanding of the risks for the locomotor apparatus, which are represented as an anthropological-spatial system. As a result of research of efficiency of application of virtual models as a part of a methodology of development of the health-preserving competence of the Physical Education teachers the positive dynamics of educational results of the Physical Education teachers is defined.

This article highlights further research by the authors, begun in [96, 99, 333].
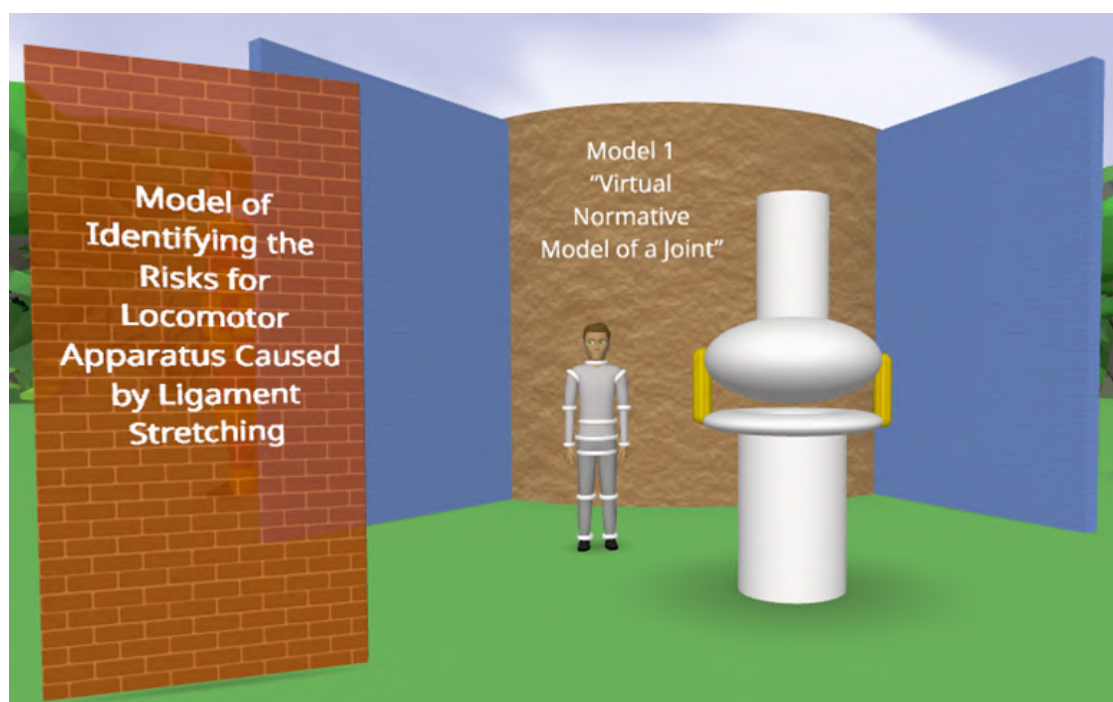
Figure 9: Presentation of paper [98].

The article "Assessing augmented reality possibilities in the study of school Computer Science" [179] by Vasyl P. Oleksiuk and Olesia R. Oleksiuk (figure 10) analyzes the phenomenon of augmented reality (AR) in education. AR is a new technology that complements the real world

with the help of computer data. Such content is tied to specific locations or activities. Over the last few years, AR applications have become available on mobile devices. AR becomes available in the media (news, entertainment, sports). It is starting to enter other areas of life (such as e-commerce, travel, marketing). But education has the biggest impact on AR. Based on the analysis of scientific publications, the authors explored the possibilities of using augmented reality in education. They identified means of augmented reality for teaching computer science at school. Such programs and services allow students to observe the operation of computer systems when changing their parameters. Students can also modify computer hardware for augmented reality objects and visualize algorithms and data processes. The article describes the content of author training for practicing teachers. At this event, some applications for training in AR technology were considered. The possibilities of working with augmented reality objects in computer science training are singled out. It is shown that the use of augmented reality provides an opportunity to increase the realism of research; provides emotional and cognitive experience. This all contributes to engaging students in systematic learning; creates new opportunities for collaborative learning, develops new representations of real objects. The authors studied the relationship between some factors that influence the introduction of augmented reality in school computer science, such as: the age of teachers, student interest, the use of gadgets in education, play and entertainment style of learning. Several augmented reality STEM projects have been selected. On the basis of expert evaluation, the attitude of teachers to these projects was determined and the most rated of them were evaluated.

This article highlights further research by the authors, begun in [10, 177, 178].
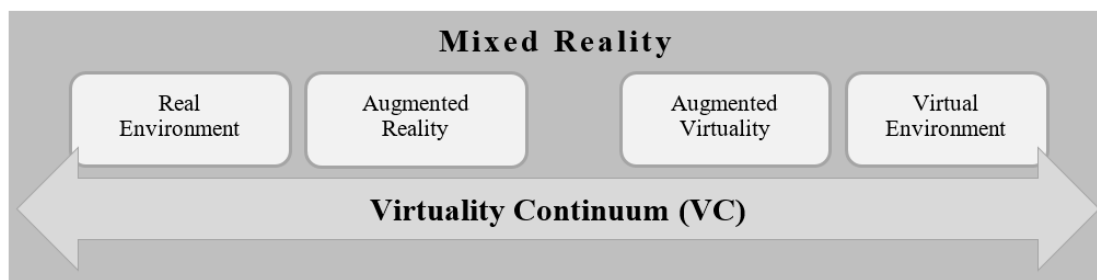
Figure 10: Presentation of paper [179].

Motivation students by providing personalized researches and using IT during classes is relevant in the frame of STEM approach of education. However, there is a lack of researches devoted to the justification of these approaches. The aim of the article "Comparing Google Lens recognition accuracy with other plant recognition apps" [27] by Zhanna I. Bilyk (figure 11), Yevhenii B. Shapovalov, Viktor B. Shapovalov, Anna P. Megalinska, Sergey O. Zhadan, Fabian Andruszkiewicz, Agnieszka Dołhańczuk-Śródka and Pavlo D. Antonenko is justifying of the choosing of AR-plant recognition application choosing to provide personalized during both, educational process at school and extracurricular activities. All apps were analyzed and characterized by all processes of interaction of the app with the user. In addition, social environments of the apps and their usage during extracurricular activities described. The didactics of usage of AR-recognition apps on biology classes have been described. To provide usability analysis,

a survey of experts on digital education on installation simplicity, level of friendliness of the interface, and correctness of picture processing was conducted. To evaluate the rationality of usage, apps were analyzed on the accuracy of plants recognition of the "Dneprovskiy district of Kiev" list. It is proven that Google Lens is most recommended to use. Taking to account results of the analysis, as alternative Seek or Flora Incognita; however, these apps were characterized by lower accuracy.

This article highlights further research by the authors, begun in [26, 243, 244].
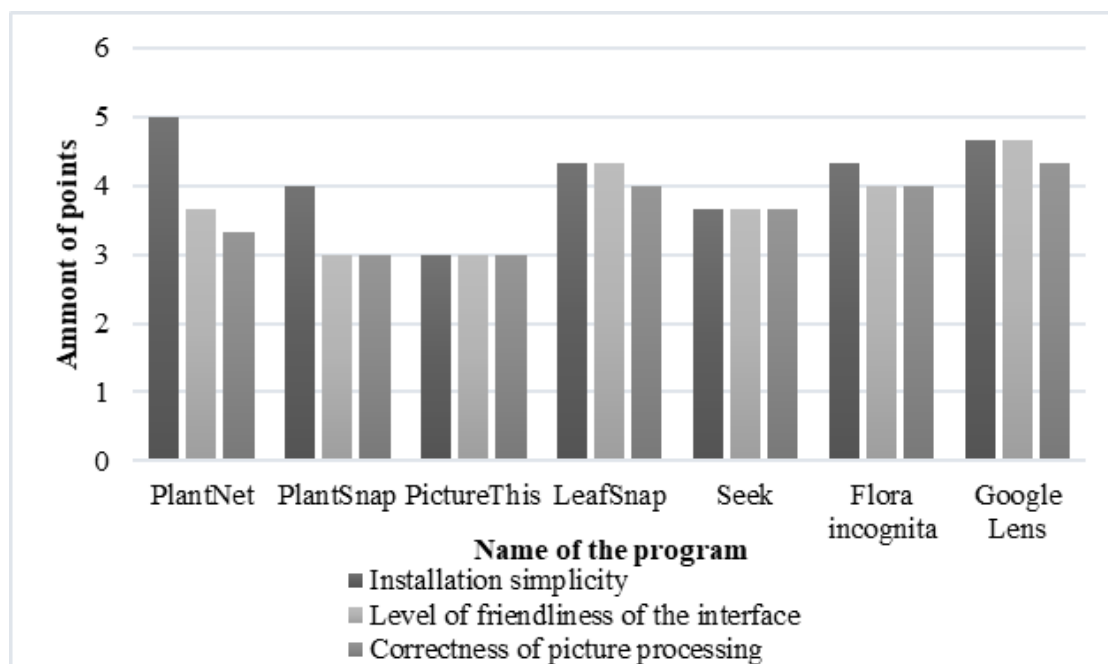
Figure 11: Presentation of paper [27].

The article "Using Unity to teach game development" [125] by Vladyslav S. Kuznetsov, Mykhailo V. Moiseienko, Natalia V. Moiseienko (figure 12), Bohdan A. Rostalny and Arnold E. Kiv gives an overview of issues arising in connection with the organization and conduct of the course "Computer game development" in the master's program 014.09 Secondary education (Informatics). The study of the experience of similar courses in other educational institutions does not give an idea of what conditions are the best for conducting it, because "Computer game development" is mainly present in the curriculum of the Software Engineering specialty and is not limited to one course. The game development course is described in terms of content, software and teaching methods. This course, which was attended by 40 students in three years, was evaluated in the light of the approach proposed by A. D. Ritzhaupt and based on the students' opinion. As a result of this research, it was concluded that a course in video game development could be based on the Unity Engine, as it has a small entry threshold, free for academic purposes, a crossplatform, real game engine, common in the gaming industry. A team strategy for this course is also effective.
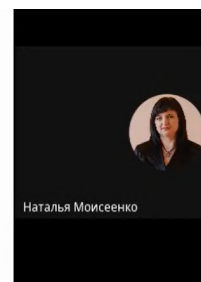
This article highlights further research by the authors, begun in [61, 69, 85].

Using Unity to teach game development

Vladyslav Kuznetsov, Mykhaylo Moiseienko,
Natalia Moiseienko and Bohdan Rostalny

Kryvyi Rih State Pedagogical University

Figure 12: Presentation of paper [125].

2.3. Session 3A: Cloud-based learning environments

The article "Systematicity of students' independent work in cloud learning environment of the course "Educational Electronic Resources for Primary School" for the future teachers of primary schools" [103] by Oleksandr H. Kolgatin (figure 13), Larisa S. Kolgatina, Nadiia S. Ponomareva, Ekaterina O. Shmeltser, Aleksandr D. Uchitel deals with the problem of out-of-class students' independent work in information and communication learning environment based on cloud technologies. Results of appropriate survey among students of pedagogical university are discussed and used for preparing courseware "Educational Electronic Resources for Primary School" for the future teachers of primary schools. It is determined that the leading problems are needs in more careful instruction according to features of the task completing, insufficient experience in self-management, the lack of internal motivation. Most of all, students recommend to provide the tasks with detail instruction (oral or written) and to pay attention to careful planning the time that is necessary for full completion of the task. Results of students' learning activity and achievements during study this course in conditions of COVID-19 pandemic are discussed. Some requirements for management of students' out-of-classroom independent work in cloud learning environment are formulated as a result of this analysis.

This article highlights further research by the authors, begun in [102, 217, 237].

The article "Familiarity with free software through online services" [317] by Vladyslav Ye. Velychko (figure 14), Svitlana O. Omelchenko, Elena G. Fedorenko and Hennadiy M. Kravtsov considers the use of online services in the study of free software. Free software is based on the philosophy of freedom and the right to intellectual creativity. To date, a significant number of software products have been created and distributed through the repository, but they are not used in educational activities. The study allowed to clarify the factors that promote and hinder the use of free software in educational activities. Based on questionnaires, analysis of open data, the work of researchers on the use of free software provided an opportunity to draw conclusions about the feasibility of using free software in educational activities. The article gives examples of the use of free software in educational activities. To get acquainted with free software, it was useful to use online resources, which is the purpose of this study.

This article highlights further research by the authors, begun in [89, 312, 315].

The article "Web-based support of a higher school teacher" [3] by Vitaliy V. Achkan (figure 15), Kateryna V. Vlasenko, Iryna V. Lovianova, Olha H. Rovenska, Iryna V. Sitak, Olena O. Chumak and Serhiy O. Semerikov looks into the issue of theoretical aspects of using Web 2.0 technology
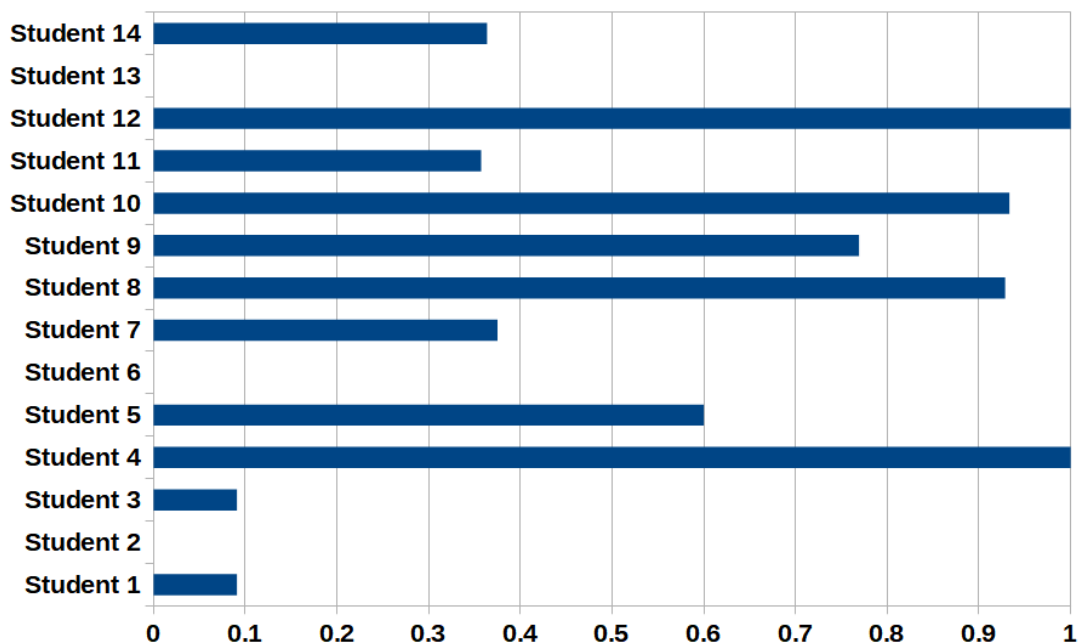
Figure 13: Presentation of paper [103].

in higher education. This paper describes the answers of 87 respondents who have helped to find out the types of activities that higher school teaches carry out and determine such Web 2.0 tools that can make this activity full. The authors carry out a theoretical analysis of researches and resources that consider the development of theoretical aspects of using Web tools in higher education. The research presents the characteristics common to online courses, principles of providing a functioning and physical placement of online systems in Web space. It is reasonable to make a conclusion about the feasibility of promoting online courses, the aim of which is to get Mathematics teachers acquainted with the technical capabilities of creating educational content developed using Web 2.0 technology.

This article highlights further research by the authors, begun in [138, 320, 321].

The article "Using the LearningApps.org online service in the Moodle system in the process of training of specialists in economic specialties" [72] by Roman M. Horbatiuk, Uliana T. Dudka (figure 16), Vitalii V. Kabak, Liliia Z. Rebukha, Olga Yu. Serdiuk, Ivan G. Riznitskii deals with the peculiarities of using LearningApps.org online service in the Moodle system in the process of training of specialists in economic specialties. Methodology of integrating interactive tasks in economic disciplines of LearningApps.org online service into the Moodle learning management system has been considered. Practical aspects of using interactive tasks while teaching professionally oriented educational disciplines by education applicants of economic specialties have been reflected. The didactic component of the Moodle system in the process of realization of distance and mixed learning in the pandemic period and formation of future specialists' professional, informational and communicative competencies, development of their creative thinking has been revealed in the process of research activities.
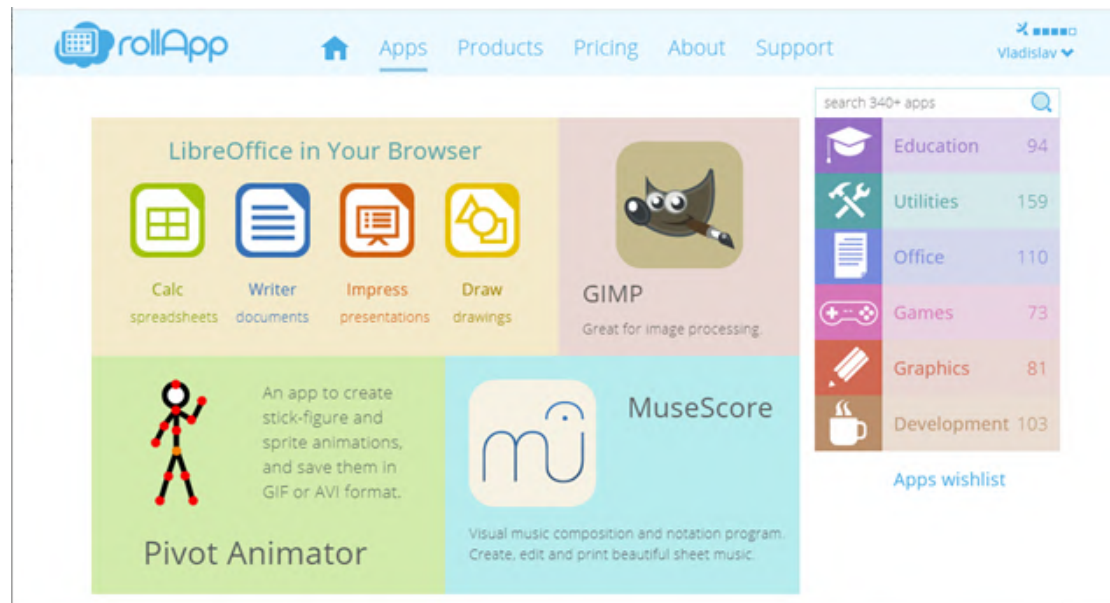
Figure 14: Presentation of paper [317].

This article highlights further research by the authors, begun in [70, 71, 126].

The article "Peculiarities of using LearningApps service in the process of developing a motivational component of professional training of future professionals in terms of adaptive learning" [310] by Hanna B. Varina (figure 17), Viacheslav V. Osadchyi, Svetlana V. Shevchenko, Kateryna S. Averina and Evgeniy A. Lavrov considers the adaptive learning system as a system that can help each student to achieve the optimal level of intellectual development in accordance with his natural abilities and inclinations. The main advantages of using interactive exercises in the process of organizing educational activities using the technical capabilities of the LearningApps service are considered. The paper demonstrates the ways of using the appropriate service in the process of implementing a personalized approach to educational activities, presents the results of an empirical study focused on the implementation of the LearningApps service in the process of studying first-year students of psychological disciplines. Statistic data show the feasibility of using the service LearningApps in the development of the motivational component of professional training of future professionals in the conditions of adaptive learning.

This article highlights further research by the authors, begun in [187, 190, 307].

The need for additional analysis of the effectiveness of e-learning implementation models and their resource support in higher education institutions in the context of the COVID-19 pandemic has been actualized. An overview of solutions and case studies in the context of selecting and analyzing the effectiveness of individual services and learning management platforms is provided by Olena G. Glazunova, Maksym V. Mokriiev (figure 18), Olena H. Kuzminska, Valentyna I. Korolchuk, Nataliia V. Morze, Liliia O. Varchenko-Trotsenko and Roman A. Zolotukha in the article "Moodle tools for educational analytics of the use of electronic resources of the university's portal" [56]. It has been studied that in order to investigate the effectiveness of

Figure 15: Presentation of paper [3].

using electronic resources to meet students' educational needs, it is advisable to use quantitative indicators in addition to student description results. This includes data from educational analytics on the frequency and duration of students' use of individual e-resources. Reviewed the functionality modules "Course Comparison" of the Moodle LMS and "Statistics", as well as the optional Analytics module. The results of applying these modules to the analysis of e-learning courses of the National University of Life and Environmental Sciences of Ukraine and Boris Grinchenko Kyiv University are presented. The reasons for students' low use of individual e-courses were investigated.

This article highlights further research by the authors, begun in [54, 57, 58].

The article "The use of serverless technologies to support data processing within the open learning and research systems" [19] by Ihor A. Bezverbnyi and Mariya P. Shyshkina (figure 19) highlights the promising ways of providing access to cloud-based tools using serverless solutions to support data processing within the open learning and research environment. It is emphasized that the implementation of serverless technologies is a current trend in the development of modern ICT open learning and research systems. The concept of the hybrid serverless cloud is

Figure 16: Presentation of paper [72].

considered. The analysis and evaluation of the existing experience of using different types of cloud-based solutions to data processing support are considered and evaluated. The example of the wave files processing using the lambda-function is examined. The issues of integration of different services within the open systems of learning and research are covered. A concept of the cloud-based open learning and research university environment involving the use of the serverless cloud-based components is considered. The reasonable ways of tools selection are evaluated and the prospects for their use within the cloud-based open learning and research environment are described.

This article highlights further research by the authors, begun in [170, 249].

Figure 17: Presentation of paper [310].

2.4. Session 3B: Cloud technologies for mathematics learning

The article "CoCalc tools as a means of open science and its didactic potential in the educational process" [147] by Pavlo V. Merzlykin, Maiia V. Marienko, Svitlana V. Shokaliuk (figure 20) covers the questions of expedient CoCalc environment use as an integrator of services that can be used during different kinds of learning activities.

This article highlights further research by the authors, begun in [136, 152, 288].

The article "Selection cloud-oriented learning technologies for the formation of professional competencies of bachelors majoring in statistics and general methodology of their use" [296] by Tetiana A. Vakaliuk (figure 21), Olga D. Gavryliuk, Valerii V. Kontsedailo, Vasyl P. Oleksiuk, Olga O. Kalinichenko scientifically substantiates the criteria for the selection of cloud-oriented learning technologies for the formation of professional competencies of bachelors majoring in statistics, as well as presents the results of expert evaluation of existing cloud-oriented learning technologies by defined criteria. The criteria for the selection of cloud-oriented learning technologies for the formation of professional competencies of bachelors majoring in statistics were determined: information-didactic, functional, and technological. To implement the selection of cloud-oriented learning technologies for the formation of professional competencies of bachelors majoring in statistics, and effective application in the process of formation of relevant competencies, the method of expert evaluation was applied. The expert evaluation was carried out in two stages: the first one selected cloud-oriented learning technologies to determine the most appropriate by author's criteria and indicators, and the second identified those cloud-oriented learning technologies that should be used in the educational process as a means to develop professional skills Bachelor of Statistics. According to the research, the most
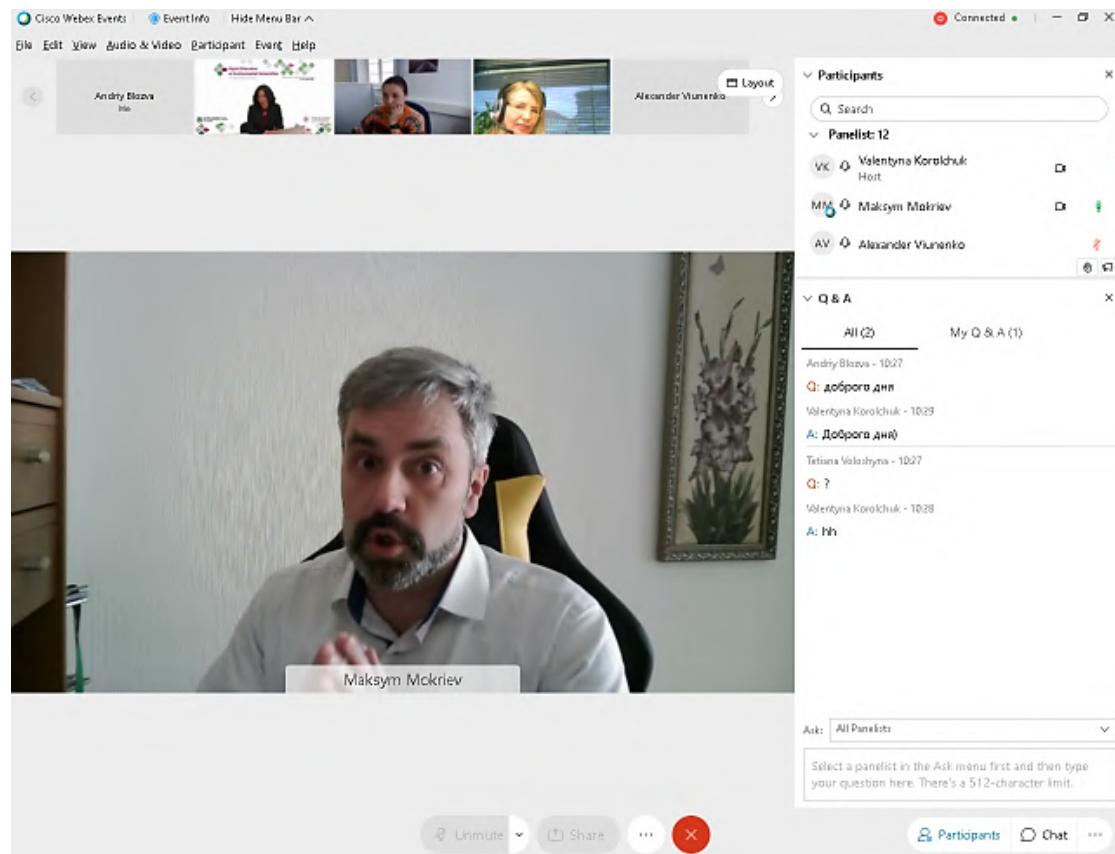
Figure 18: Presentation of paper [56].

appropriate, convenient, and effective cloud-oriented learning technologies for the formation of professional competencies of future bachelors of statistics by the manifestation of all criteria are cloud-oriented learning technologies CoCalc and Wolfram|Alpha. The general structure of the methodology of using cloud learning technologies for the formation of professional competencies of future bachelors of statistics is described.

This article highlights further research by the authors, begun in [289, 292, 293].

The article "Methodical recommendations for the development of online course structure and content" [324] by Kateryna V. Vlasenko, Iryna V. Sitak, Daria A. Kovalenko, Sergii V. Volkov, Iryna V. Lovianova, Serhiy O. Semerikov, Serhiy L. Zahrebelnyi (figure 22) looks into the matter of developing methodical recommendations for the structure and content of online courses. The research is dedicated to the analysis of peculiarities of developing the content of online systems and developing methodical recommendations for educational materials of online courses. The research considers the experts' experience in preparing, structuring, and developing the content of online courses and answers to the volunteers who have agreed to test the educational materials of the course "Methods for Teaching Mathematics to Students in Technical Universities" (http://formathematics.com/courses/imt/mnmtzvo-en/). The participants' responses have allowed evaluating the quality of the developed course and detecting its insignificant drawbacks. The
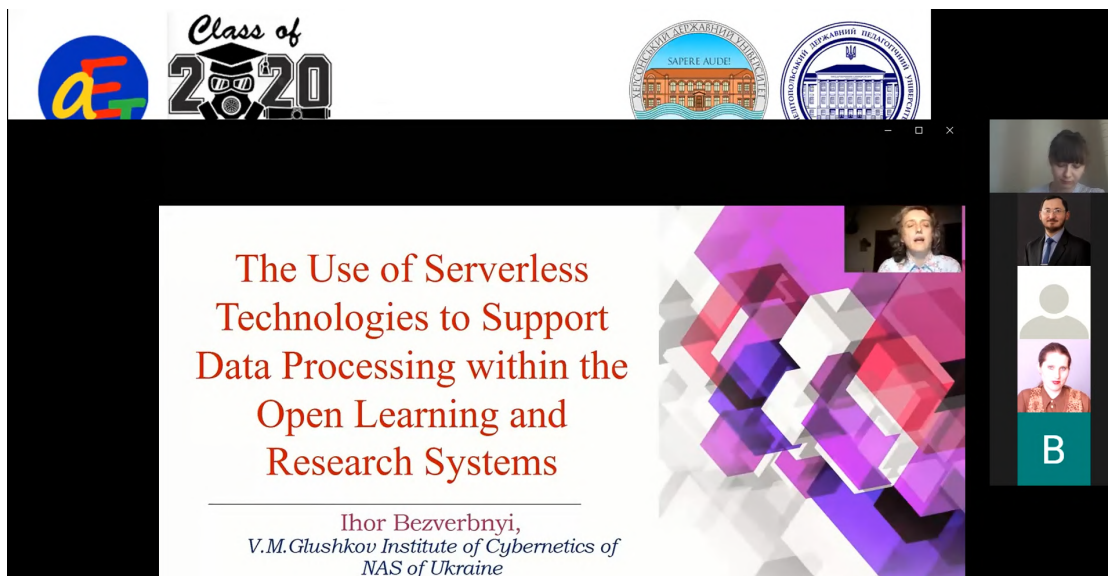
Figure 19: Presentation of paper [19].
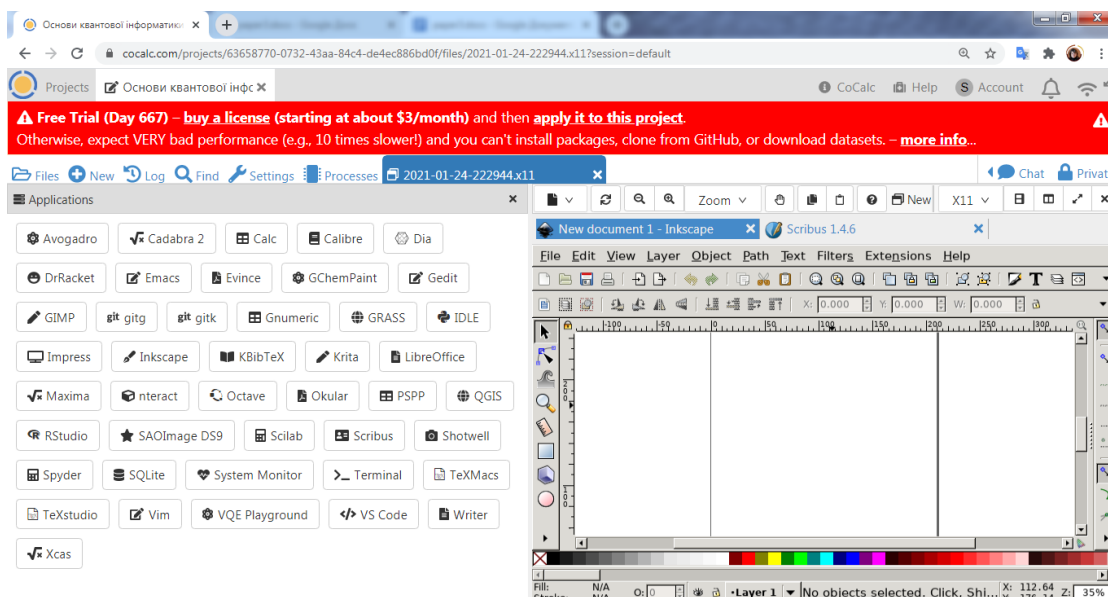
Figure 20: Presentation of paper [147].

article discusses general requirements for the structure and content of the online course, means for the implementation of a testing subsystem, peculiarities of developing educational video content and educational materials in PDF format, issues of implementing forum and survey subsystems, as well as means of assessing learning outcomes. Authors have grounds to conclude that the quality of the course is determined by the range of factors, among which they point
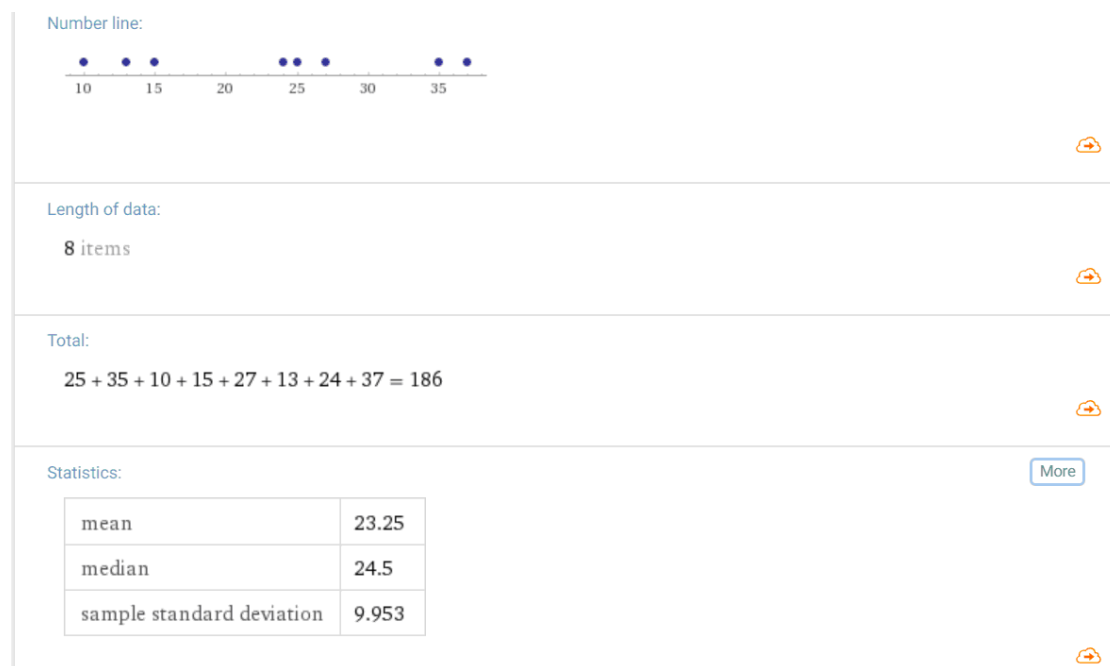
Figure 21: Presentation of paper [296].

out the course organization based on weekly planning, implementation of a testing subsystem under conditions of extended functionality, creation of abilities to organize feedback.

This article highlights further research by the authors, begun in [321, 322, 325].

In accordance with its aim, the article "Modelling in GeoGebra in the context of holistic approach realization in mathematical training of pre-service specialists" [22] by Liudmyla I. Bilousova, Liudmyla E. Gryzun (figure 23), Svitlana H. Lytvynova and Valentyna V. Pikalova represents students' modeling activity (held within inter-university projects of Kharkiv GeoGebra Institute) which resulted in the complex of GeoGebra models focused on holistic learning of Mathematics at higher school and university. Proper theoretical background for the complex design is elaborated and the stages of the students' modeling activity are covered. The models in the developed complex are grouped in the three sections. The first group consists of the models which enable to facilitate mastering basic essential mathematical concepts (objects) by the potential trainees. The second group is focused on the realization of transdisciplinary connections between Mathematics and other subject domains. The third group embraces models which provide real-life problems solving based on the models investigation. All the groups are represented in the article along with specific examples of the models. In order to facilitate potential trainees' personal cognitive activity that is expected by holistic education, it was elaborated procedure of cognitive activity which includes some tips on changing the parameters of the dynamic model, monitoring the results, investigating, making conclusions etc. Such a procedure is aimed to streamline understanding the essence of the concept (phenomenon). The didactic support for each model was developed by the students to involve potential trainees into the solving special problems and real-life tasks which encourage them to obtain holistic

Figure 22: Presentation of paper [324].

understanding of the basic concepts via special cognitive activity based on work with dynamic models. The said didactic support is characterized in the paper. The prospects of further research are outlined.

This article highlights further research by the authors, begun in [23, 24, 173].

The purpose of the article "Digital technologies in specialized mathematics education: application of GeoGebra in Stereometry teaching" [114] by Tetiana H. Kramarenko (figure 24), Olha S. Pylypenko and Olga Yu. Serdiuk is to improve methodology of teaching Mathematics via the use of digital technologies. The task of the paper is to identify the issues that require a theoretical and experimental solution. The objective of the paper is the educational process in the higher education institution, the subject of the paper is modern ICT. The result of the study is the
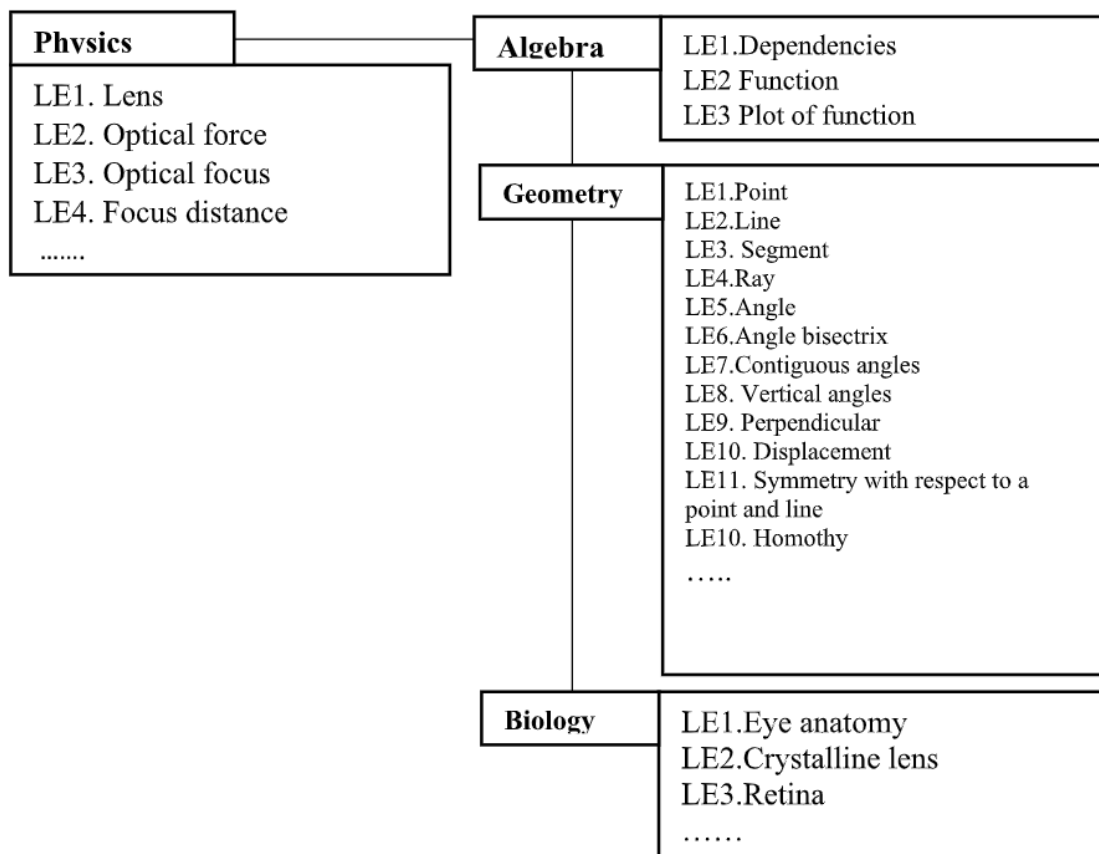
Figure 23: Presentation of paper [22].

learning tools of pedagogically considered and adequate bending of conventional and modern learning environment implemented into the educational process. The possibilities of using cloud technologies and Dynamic Mathematics system GeoGebra in the educational process through Stereometry specialized training have been revealed. The use of GeoGebra Dynamic Mathematics in Stereometry teaching will favourably influence the formation of students' STEM competencies. In order to encourage Mathematics and Computer Science teachers to implement effectively the elements of STEM education, it is suggested that cloud-based learning tools such as GeoGebra be used in the teaching process.

This article highlights further research by the authors, begun in [113, 115, 216].

2.5. Session 3C: Cloud technologies for informatics learning

The article "Cloud labs as a tool for learning Cisco CyberSecurity Operations and DevNet Associate Fundamentals courses" [12] by Nadiia R. Balyk, Yaroslav Ph. Vasylenko, Vasyl P. Oleksiuk, Olesia R. Oleksiuk, Galina P. Shmyger (figure 25) is devoted to the study of the problem of using the corporate cloud of the university in the process of studying some courses of the Cisco Network Academy. Today, many universities have similar academies, while others can
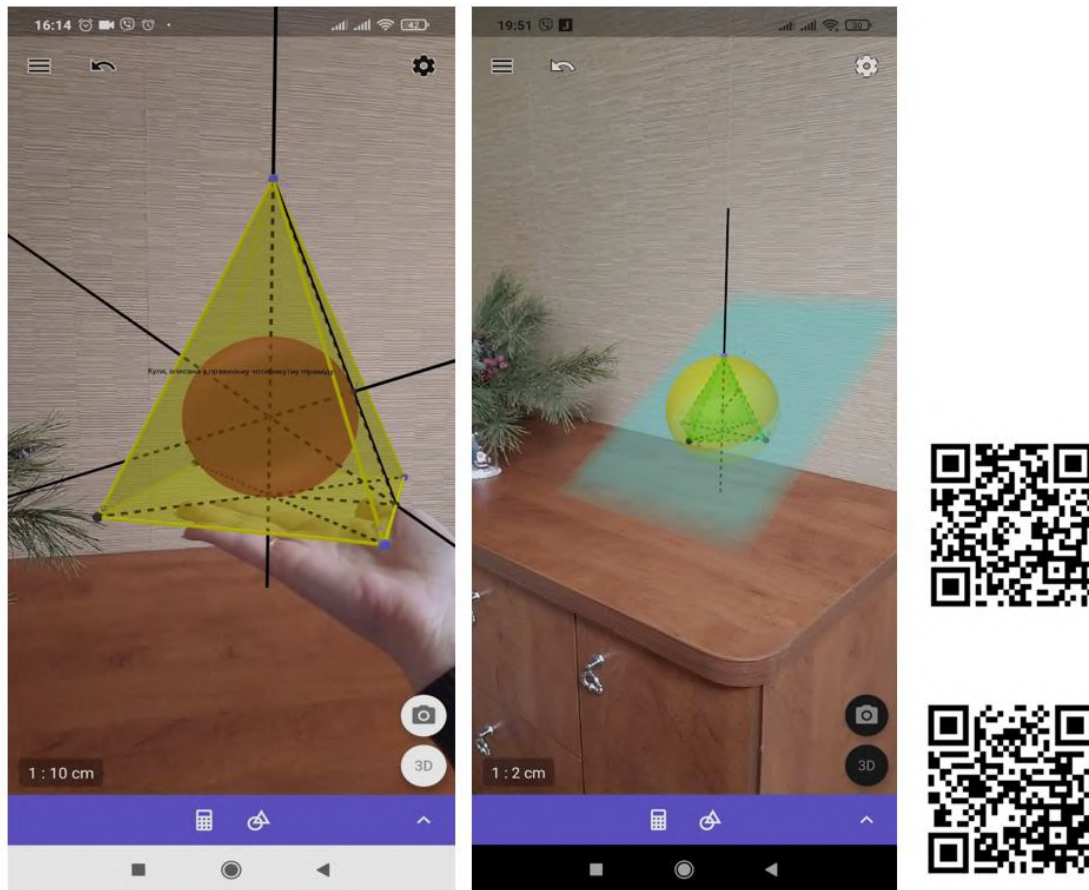
Figure 24: Presentation of paper [114].

open them. Based on the free software platforms Apache CloudStack and EVE-NG Community Edition, the authors have developed and implemented 2 cloud labs. One of them is designed to teach the course "CCNA CyberOperations", and other is "DevNet Associate Fundamentals Courses". Both laboratories work on the IaaS model. Thanks to the technology of built-in virtualization, the work of many virtual machines, storage of their state, traffic analysis and visualization of network topologies is supported. The article describes the experience of teaching students majoring in "Secondary Education. Computer Science". The authors conducted a survey of students who studied in the courses. The purpose of the survey was to determine how satisfied the learners were with the course. Statistical processing of the results was performed based on the Rasch model using MiniSteps software and R language. Students highly rated on-line curriculum materials, access to virtual machines, clear and easy to understand lessons, presenting information in multiple ways.

This article highlights further research by the authors, begun in [68, 176].

The article "An experiment on the implementation the methodology of teaching cloud technologies to future Computer Science teachers" [181] by Vasyl P. Oleksiuk (figure 26), Olesia R.
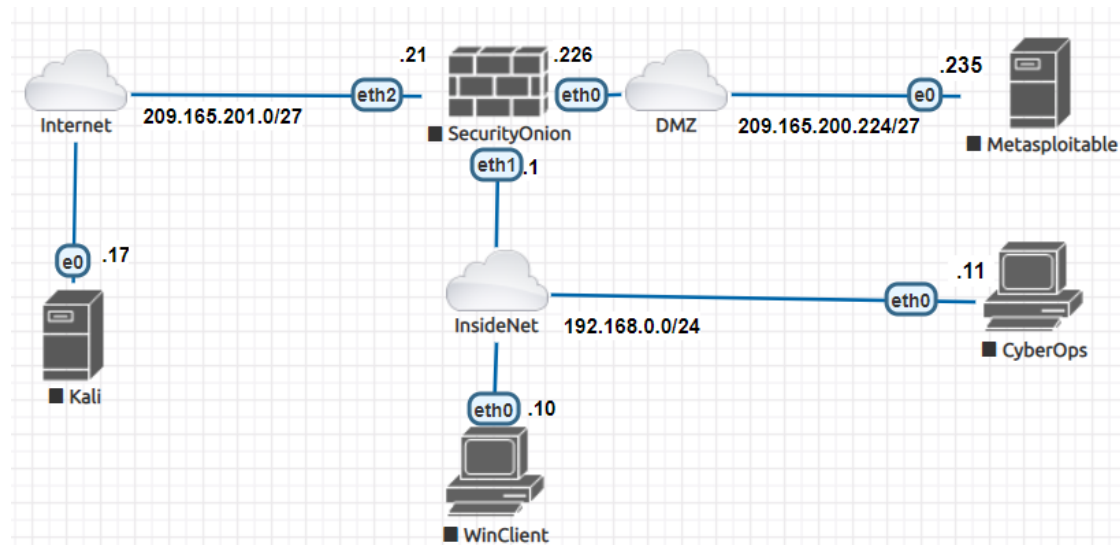
Figure 25: Presentation of paper [12].

Oleksiuk and Tetiana A. Vakaliuk deals with the problem of training future computer science teachers for the use of cloud technologies. The authors analyzed courses from leading universities to study cloud technologies. On this basis the model of application and studying of cloud technologies in the process of training of future teachers of informatics was developed. The basic principles of this model are proposed: systematic, gradual, continuous. It contains target, content, operating and effective component. Therefore, the stages of using cloud computing technology were proposed: as a means of organizing learning activities, as an object of study, as a means of development. The article summarizes the experience of designing a cloud-based learning environment (CBLE). The model is based on such philosophical and pedagogical approaches as systemic, competent, activity, personality-oriented, synergistic. Hybrid cloud is the most appropriate model for this environment. It combines public and private cloud platforms. CBLE also requires the integration of cloud and traditional learning tools. The authors described the most appropriate teaching methods for cloud technologies such as classroom learning, interactive and e-learning, practical methods. The article contains many examples of how to apply the pro-posed methodology in a real learning process. The evaluation of the effectiveness of the author's methodology was carried out by using diagnostic tools such as analysis of questionnaires, tests, laboratory and competency tasks. The paper contains a justification and description of the pedagogical experiment. The authors performed a quantitative analysis of its results and verified their reliability using the methods of mathematical statistics.

This article highlights further research by the authors, begun in [8, 180, 255].

The application of virtualization technologies to train future IT specialists in IP telephony has been considered in the article "Virtualization technologies in the training future IT specialists to the subject "IP telephony"" [206] by Vitaliy I. Mezhuyev, Liliia V. Pavlenko, Maksym P. Pavlenko (figure 27). Requirements for students' professional training in the field of IP telephony have been defined. The components of the network training laboratory for training IP telephony
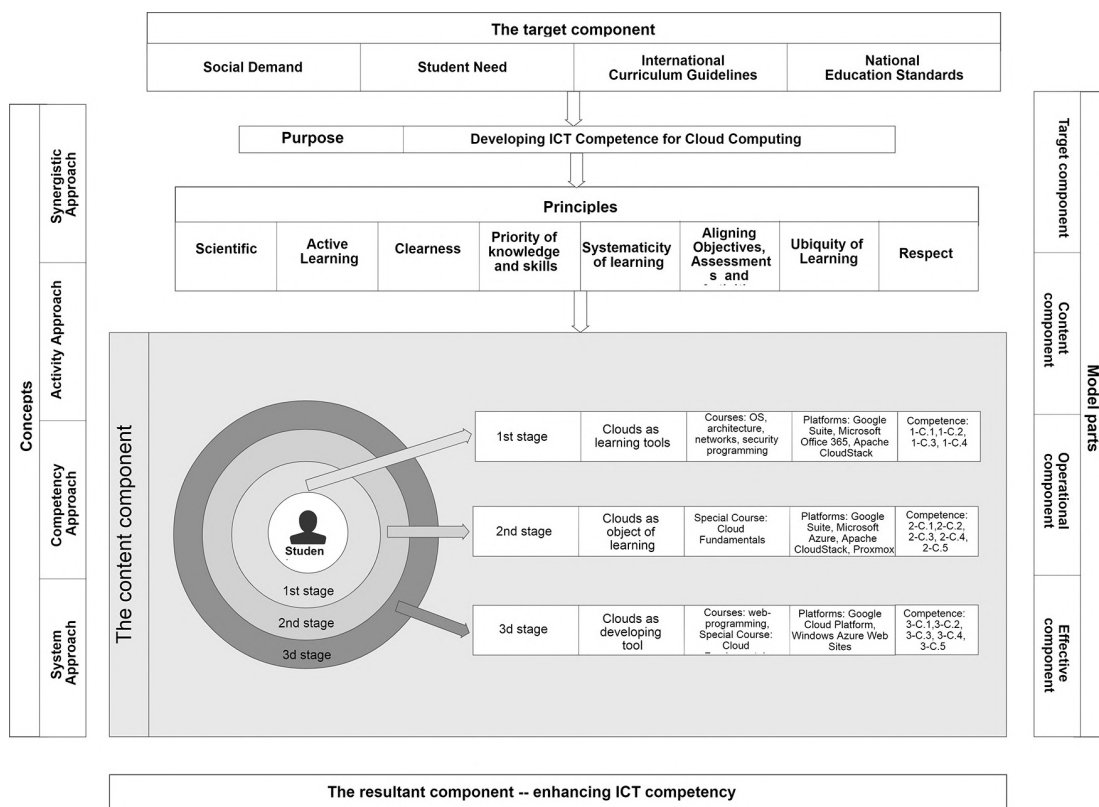
Figure 26: Presentation of paper [181].

have been determined. Modern approaches to the application of virtualization technologies have been analyzed. Features of using virtualization technologies for learning IP telephony have been determined. The analysis of modern virtualization technologies has showed the prospects of using native virtualization as a basis for creating a virtual training laboratory using VirtualBox software. The conducted pedagogical experiment has confirmed the effectiveness of using the developed virtual laboratory and repository of virtual hosts for training IP telephony to future IT specialists. Virtual machines increase student mobility, they can be exported and moved to another computer, and there the virtual machine can be started immediately. This is a significant advantage of virtualization during the SARS-CoV-2 pandemic, when students have to study remotely. Each student can have his own virtual laboratory.

2.6. Session 4: Computer simulation in science and mathematics learning

The article "Using dynamic vector diagrams to study mechanical motion models at agrarian university with GeoGebra" [51] by Leonid O. Flehantov, Yuliia I. Ovsiienko, Anatolii V. Antonets, Vladimir N. Soloviev (figure 28) is devoted to study of effectiveness of one of the visualization options we use when teaching the students of an agricultural university the basics of math modeling. The main goal of this research is to test the hypothesis that visibility and visualization
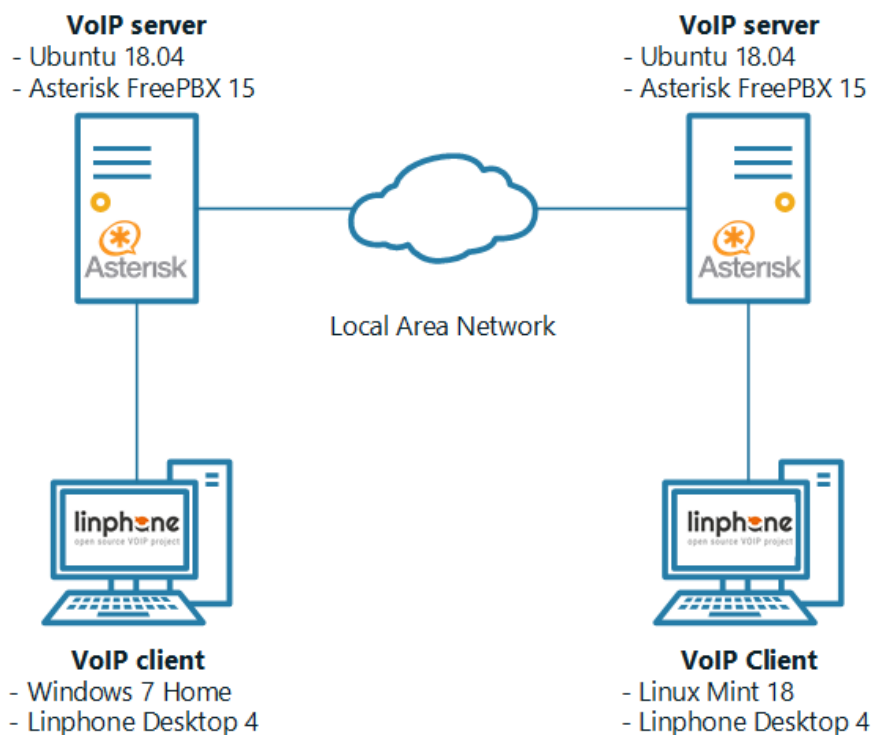
Figure 27: Presentation of paper [206].

improve the educational achievements of students if for visualization we use the dynamic vector diagrams of characteristics of mechanical movement (in particular, these are velocity and acceleration or the acting force). There are discussion of the methodology and examples of the use of dynamic vector diagrams when teaching the basics of mathematical modeling. Authors described how their students are computing and plotting graphs and dynamic vector diagrams when they doing their practical learning exercises in math modeling and how they using them to analyze the mechanical motion of a body. Primarily authors research and discuss the effectiveness of using dynamic vector diagrams. Other visualization options such as using plots of the dynamic characteristics of mechanical movement by Excel and GeoGebra was discussed earlier in [50]. In this article authors described their experience of using of dynamic vector diagrams in teaching the basics of math modeling at agrarian university and compared the research results were obtained with previous ones. Also authors compare the educational achievements of students in the basics of math modeling were obtained by them using Excel and by GeoGebra software which allow to plot and study the dynamic vector diagrams much easy.

This article highlights further research by the authors, begun in [17, 201, 234].

Computer geometric modeling is important pre-processing steps in the object's mathematical representation using curves that may be constructed using analytic functions, a set of points, or other curves and surfaces. The article "Some geometric objects related to a family of the ballistic
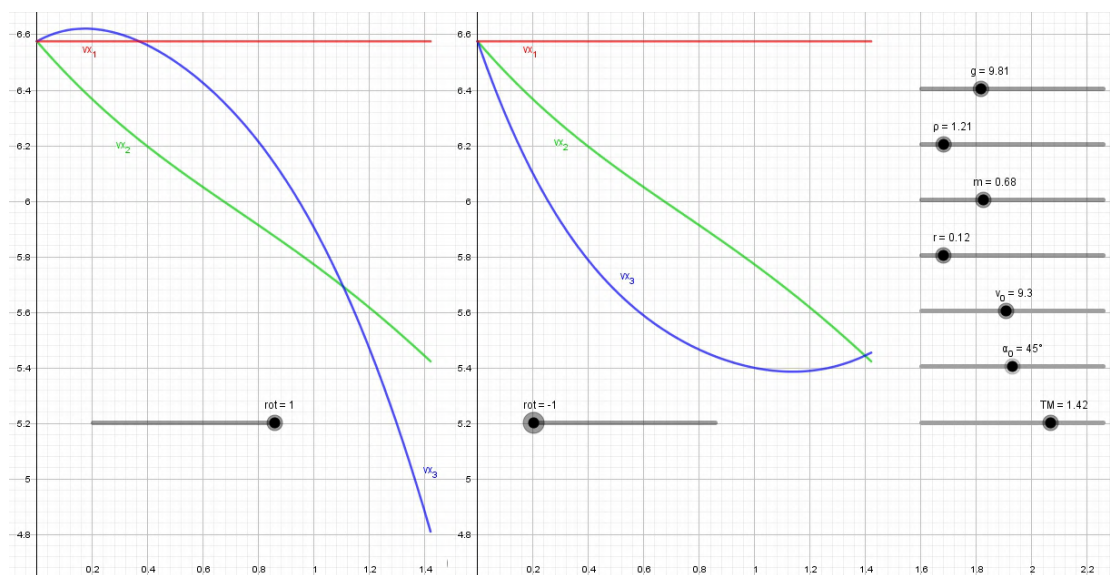
Figure 28: Presentation of paper [51].
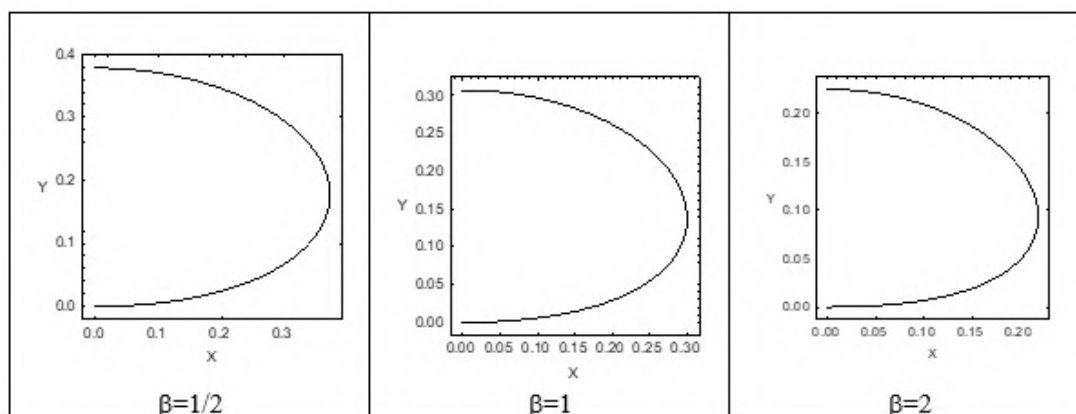
Figure 29: Presentation of paper [232].

trajectories in a viscous medium" [232] by Zarema S. Seidametova (figure 29) and Valerii A. Temnenko describes some remarkable curves related to a family of the ballistic trajectories in a viscous medium with a linear resistance. The envelope of the family of trajectories, the trajectory of the farthest flight and the curve of maximum flight altitudes are presented in parametric form. A geometric interpretation of the entire set of ballistic trajectories in the form of some surface (the Galileo's dome) is also presented.

This article highlights further research by the authors, begun in [227, 228, 230].

Another article "An inverse method of the natural setting for integer, half-integer and rational "perfect" hypocycloids" [231] by Zarema S. Seidametova (figure 30) and Valerii A. Temnenko describes a family of remarkable curves (integer and half-integer hypocycloids and rational

perfect hypocycloids) given in an inverse-natural form using a simple trigonometric relation $s = s(\chi)$, where s is the arc coordinate and χ is the angle defining the direction of the tangent. In the paper authors presented all perfect hypocycloids with the number of cusps $\nu \leq 10$. From designing the hypocycloid using inverse natural setting easy to determine the number of cusps and find the values of the λ_m parameter, corresponding to perfect hypocycloids.
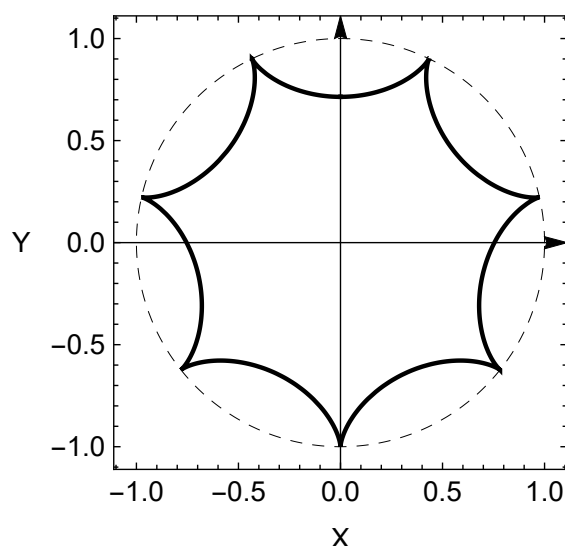
Figure 30: Presentation of paper [231].

The article "Guessing games experiments in Ukraine. Learning towards equilibrium" [76] by Oleksii P. Ignatenko (figure 31) deals with experimental game theory and data analysis. The research question, formulated in this work, is how players learn in complex strategic situations which they never faced before. Author examine data from different games, played during lectures about game theory and present findings about players progress in learning while competing with other players. Author proposed four "pick a number" games, all with similar-looking rules but very different properties. These games were introduced (in the body of scientific popular lectures) to very different groups of listeners. In this paper Oleksii P. Ignatenko present data gathered during lectures and develop tool for exploratory analysis using R language. Finally, he discuss the findings propose hypothesis to investigate and formulate open questions for future research.

This article highlights further research by the author, begun in [74, 75].

2.7. Session 5A: ICT in primary and secondary education

The main topic of the article "Strategic branches of economic and managerial training of principals in Ukraine using business-simulations" [209] by Vitalii Ya. Pazdrii (figure 32), Viktoriya O. Kuprievych and Svitlana H. Lytvynova focused on ways of introducing and using of modern simulation into education of youth 14-19 ages in schools, colleges, institutes and universities of post-socialistic countries (for example Ukraine). Actuality of this theme is determined by need of
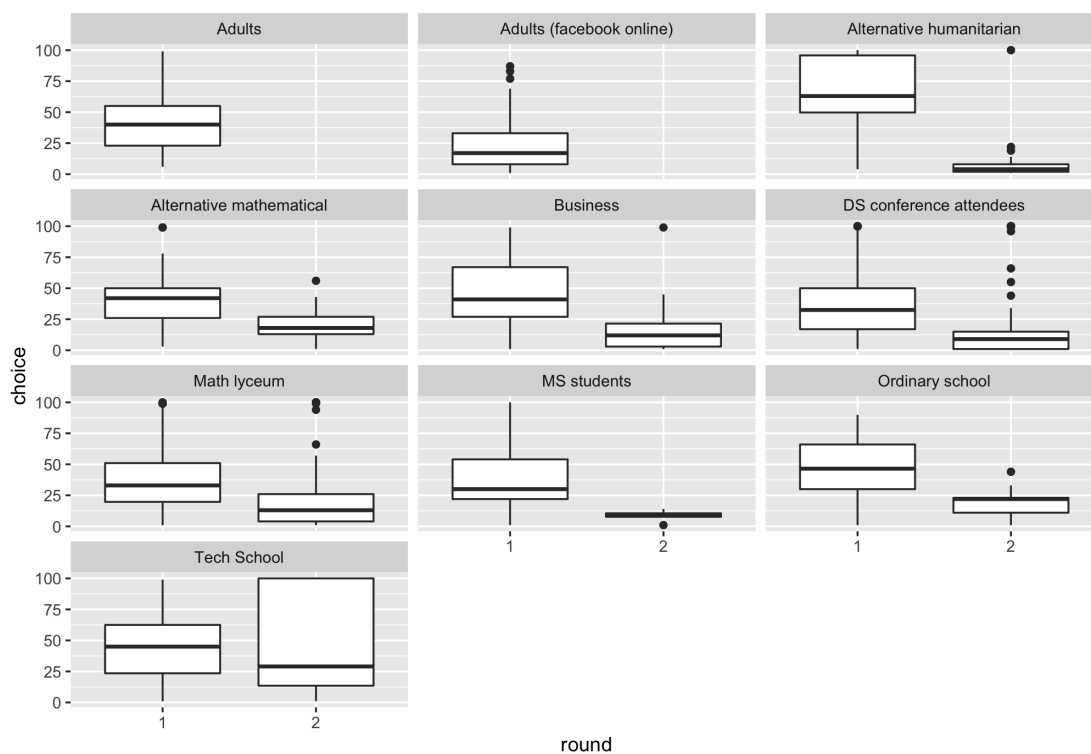
Figure 31: Presentation of paper [76].

increasing of economic literacy, activity and responsibility of Ukraine's society for really realization of economic reforms. All persons, especially youth age 14-19, must have new instruments and skills for reaction and self-realization in new dynamic and quickly changing world. Authors discovered experience, problems and innovative decisions of practical realized state experiment project "Development business education in Ukraine as part of entrepreneurial state policy", which had started from six secondary's schools in Kropyvnytskyi (Central Ukraine). Project team used business-simulation ViAL+ for experiment and modernization of entrepreneurial education. Because, this instrument is adopted for Ukrainian conditions, laws and economic culture, traditions. This project became part of the developing of entrepreneurial skills of pupils, which is one of the priorities of the concept of the New Ukrainian School. Also, this experience became a case of providing of entrepreneurial education at the other Ukrainian regions. The main parts of experiment are courses for secondary school "Business Education" for 7-10 classes, summer schools of Business Leadership, local and All-Ukrainian business-tournaments. Also authors described experience of using simulation for youth 16-19 ages in colleges and universities. In articles also are revealed main problems and ways of solving.

This article highlights further research by the authors, begun in [60, 140, 208].

The current state of implementation of distance learning in general secondary education institutions and the existing disadvantages in the organization of this form of education during quarantine were analyzed in the article "Build a technology for mass organization of distance
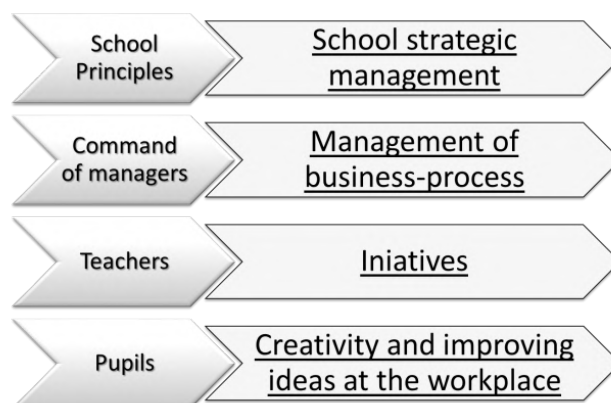
Figure 32: Presentation of paper [209].

learning for pupils in quarantine" [256] by Oleg M. Spirin, Kateryna R. Kolos (figure 33), Olena A. Kovalchuk, Olena O. Demianchuk and Feliks M. Zhuravlev; besides, the necessary means for the effective organization of distance learning were allocated. The expediency of the deployment on the basis of the Moodle platform "Educational portal for general secondary education institutions" was substantiated and the preconditions for its using by the participants of the educational process of these institutions are determined; the structure of the electronic educational resource is presented. It is established that it is much better for students to use the weekly format of the course, which provides enough time for any student not only to learn educational materials either independently or with the support of a tutor according to the curriculum, but also for homework, recreation, hobbies and self-improvement. An example of the structure of a distance course for a particular class of general secondary education is given. Compulsory content elements in the structure of the distance course are distinguished.

This article highlights further research by the authors, begun in [182, 185, 298].

The article "The use of software and hardware Arduino for the students' formation of research and engineering competencies" [334] by Vitalii M. Zadorozhnii (figure 34) and Nataliia V. Valko shows the experience of using the Arduino hardware and software complex in order to develop research competencies of secondary school and high school students. Here are some examples of research projects that allow children to demonstrate their engineering skills and encourage them to further study subjects such as physics and computer science. The possibilities of Arduino to improve ready-made projects and develop their own engineering ideas are outlined. Particular attention is paid to the development of measuring devices and installations for school physical experiment, in particular devices for the study of uniformly accelerated motion. The results of research received by students during the experiment are shown. The results of students' research activities and their devices can be reproduced by other teachers and students for use during the teaching of physics in a specialized school, especially during a school experiment.

This article highlights further research by the authors, begun in [191, 299, 302].

The article "Social media as a strategic tool in school management: experience of Ukraine and USA" [84] by Liubov A. Kartashova, Nataliia O. Prykhodkina, Tetiana A. Makhynia, Hanna M.

Figure 33: Presentation of paper [256].

Tymoshko, Olena A. Sholokh and Feliks M. Zhuravlev presents the results of the analysis of using of social media in school management in Ukraine and United States of America. Social media is broadly defined as a lot of relatively inexpensive and widely available electronic instruments that allow any person to publish and receive information, collaborate and build relationships with other people. The authors of the article break up social media into social networks, blogs, content hosting. There are some constructive conclusions made in the article. The educational opportunities of social media among Ukrainian specialists are very underestimated. The value of social media as an instrument of the educational process is undeservedly belittled. Many educators treat them with neglect and skepticism, considering social media exclusively as an entertaining resource. Using of social media for educational purposes is perceived by American students, teachers, researchers as self-evident and inalienable function. The American didactic experience reveals that social media can be successfully used to arrange the work of the teaching staff and students, hold individual and collective consultations enhancing intellectual and creative potential of students. The data reports "Global Guide 2020", "90 days that changed K-12 teaching & learning: strengthening the bonds of communications", "2019 Social Media Trends in Education Report", "Digital learning during the pandemic: Emerging Evidence of an Education Transformation" and the Ukrainian State Education Quality Service for 2020 are analyzed in the article. The authors had a content analysis on the massive open online courses (MOOC) by the Ukrainian platforms EdEra, Prometheus and VUM online and the English ones such as edX, Udemy, FutureLearn, XuetangX and Coursera, whose self-study contributes to the readiness for the effective using of social media in school management.

The purpose of the article "Prospects of quantum informatics and the study of its basics in the school course" [134] by Liudmyla V. Lehka, Andrii O. Bielinskyi, Svitlana V. Shokaliuk, Vladimir N. Soloviev, Pavlo V. Merzlykin, Yelyzaveta Yu. Bohunenko (figure 35) is to review the main points of the experimental content of the basics of quantum computer science adapted for
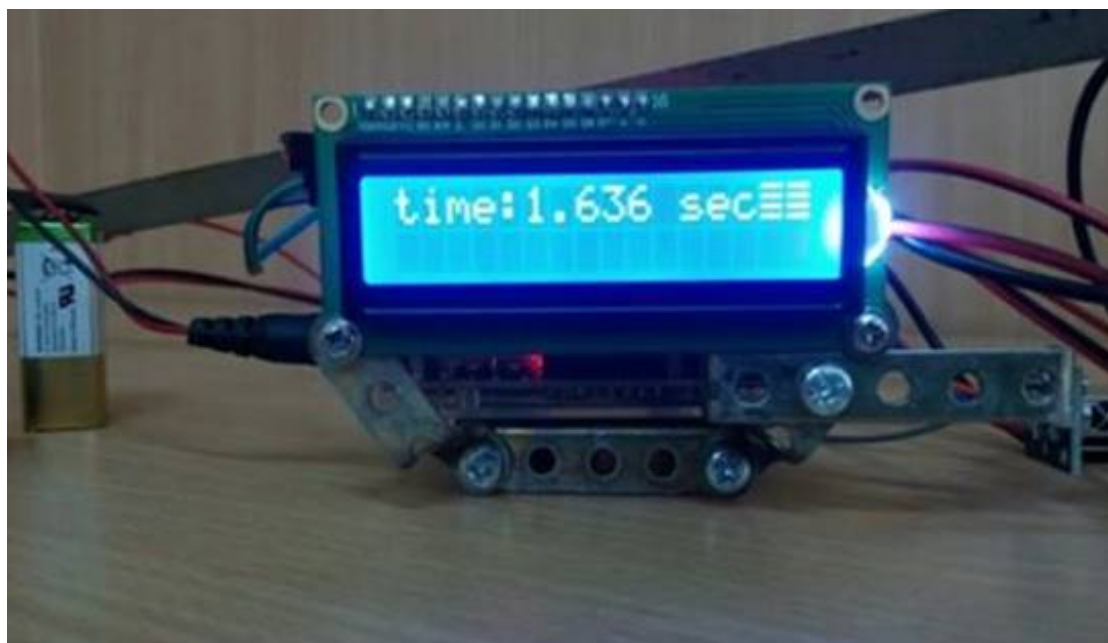
Figure 34: Presentation of paper [334].

lyceum students, based on the prospects of the quantum approach to information processing for ultra-fast calculations in modeling objects of complex dynamical systems. In addition, software tools and Internet services are offered to organize effective training.

This article highlights further research by the authors, begun in [135, 136, 335].
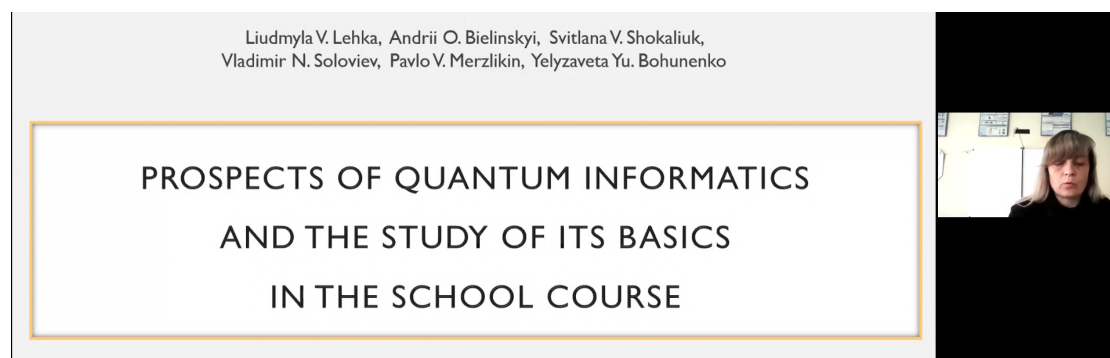
Figure 35: Presentation of paper [134].

The article "The practical experience of the use of digital learning resources by Ukrainian teachers to ensure the sustainable development and democratization of education process" [197] by Oksana V. Ovcharuk, Iryna V. Ivaniuk, Oleksandr Yu. Burov, Maiia V. Marienko, Nataliia V. Soroko, Olena O. Gritsenchuk and Oksana Y. Kravchyna deals with the revealing and analysis of the practical experience of the Ukrainian teachers' use of the digital resources in the classroom

activities with pupils. The online instruments and digital resources for the realisation of STEM-education, Education for Democratic Citizenship, and Entrepreneurship Education are presented in the article. The national online resources revealed in the article ensure the creation of the sustainable, multicultural, and democratic environment for teachers and students including key competencies areas: entrepreneurship, citizenship, civic education and STEM. The presented digital learning tools reveal the results of the teachers' works on the implementation of the key subject areas trough ICT and allow to creative use of digital technologies, identify teachers' and pupil' needs and finding didactic approaches, solve technical problems, identifying gaps in digital and civic competencies. Using the analysed resources teachers become aware of the need to improve and update their own digital competence and pupils' digital competence as well; ability to support the creative and sustain digital environment in their schools; search for opportunities for self-development and awareness of digital evolution that is proclaimed by the UN '2030 Agenda for Sustainable Development' adopted in 2015; the need to raise awareness how to organise distance learning in the conditions caused by COVID-19 pandemic. The objective is to present the examples and the experience of the use of digital educational resources by Ukrainian educators, which are aimed at building the digital environment, developing the key competencies: digital civic and entrepreneurship according to the European tendencies. The presented experience can be applied in the schools and improve the existing gaps in the teachers' use of digital learning tools.

This article highlights further research by the authors, begun in [195, 196, 257].

The use of digital technology in various fields of education today is one of the most important trends in the educational process in the world. The article "The state of ICT implementation in Ukrainian general secondary education institutions in 2019 and 2020" [294] by Tetiana A. Vakaliuk (figure 36), Dmytro S. Antoniuk and Olga O. Kalinichenko presents the results of the analysis of the current state of implementation of ICT in the educational process of institutions of general secondary education in Ukraine. For this purpose, a survey was conducted among students of the first year of the Zhytomyr Polytechnic State University of 2019 and 2020 years of admission, within which 17 questions were asked to students related to the use of information and communication technologies in the educational process. As a result of the research, the introduction of the discipline "Educational technologies and digital education" into the training of future information technology specialists was substantiated, as well as the certification educational program "Information systems and cloud technologies in the educational process", designed for general education teachers, educators for higher education institutions, experts in the field of additional educational services, and other professionals. Besides, the course "Application Packages" for specialties 121 "Software Engineering", 122 "Computer Science", 123 "Computer Engineering", 125 "Cybersecurity" and 126 "Information Systems and Technologies" at the Zhytomyr Polytechnic State University has been expanded for study some cloud services that can serve as an alternative to the usual MS Office. In conclusion, authors can conclude that the positive dynamics in the use of various ICT tools in education is present (in comparison with school graduates in 2019 and 2020). This means that teachers are increasingly turning to such tools when teaching their subjects.

This article highlights further research by the authors, begun in [153, 239, 291].

The article "The formation of a successful personality of primary school children during media education implementation (using praxeological tales)" [279] by Hryhorii V. Tereshchuk, Iryna I.
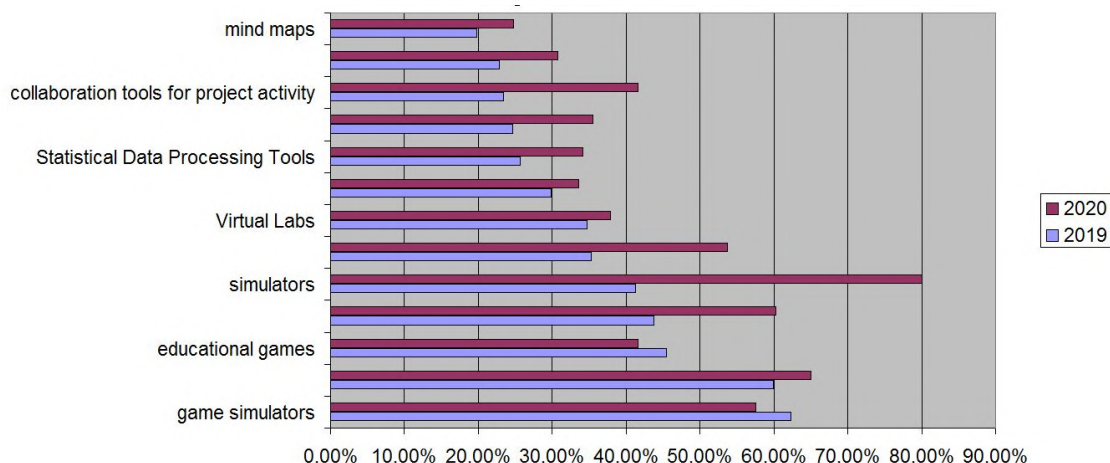
Figure 36: Presentation of paper [294].

Kuzma (figure 37), Oleksandra I. Yankovych, Halyna I. Falfushynska and Iryna A. Lyakhova substantiates the relevance of implementing the technology of formation of a successful personality of a primary school age pupil during media education implementation using praxeological tales at primary school. A technology model is developed. The necessity of solving problems of success simultaneously with increasing the level of media culture of a pupil, the formation of key competencies for life, preparation of a child for the life's self-realization on the basis of the partnership implementation of schoolchildren, parents and teachers is proved. The necessity of the embodiment of the pedagogy of heart and the pedagogy of success by spreading the idea about the connection between success and sensitivity, humanity, providing support to those who need it is shown. The results of the latest research on the role of moral values, cooperation in human evolution, the prosperity of society, are reflected. The need for these results discussion with parents and pupils is shown. The diagnostic toolkit for determining the levels of formation of the successful personality of primary school pupils is specified. The effective forms and methods of the schoolchildren education are substantiated: the creation of electronic books, projects "Rules of Success Achievement", "Stories of Success", "Sensitivity and cruelty: which wins?", "Rivalry or cooperation: my choice?", watching movies about successful people with special needs, analysis of media products on the topic of success. The ways of educating parents about the problems of children's success are determined. The results of experimental research are analyzed. The necessity of studying the rules of achieving success on the basis of reading and comprehensive analysis of praxeological tales, improving the content of textbooks in the context of achieving success, increasing interest to children's periodicals is revealed. The formation of a successful pupil is considered as one of the ways to strengthen the Ukrainian state. The necessity of raising the authority of the teaching profession is proved.

This article highlights further research by the authors, begun in [47, 278, 330].

The article "Educational trainings as one of the effective forms of digital competence development of secondary school teachers" [67] by Tetiana L. Hodovaniuk, Tetiana M. Makhometa, Irina M. Tiahai, Mariia O. Medvedieva, Svitlana M. Pryshchepa and Andrei V. Voznyak (figure 38)
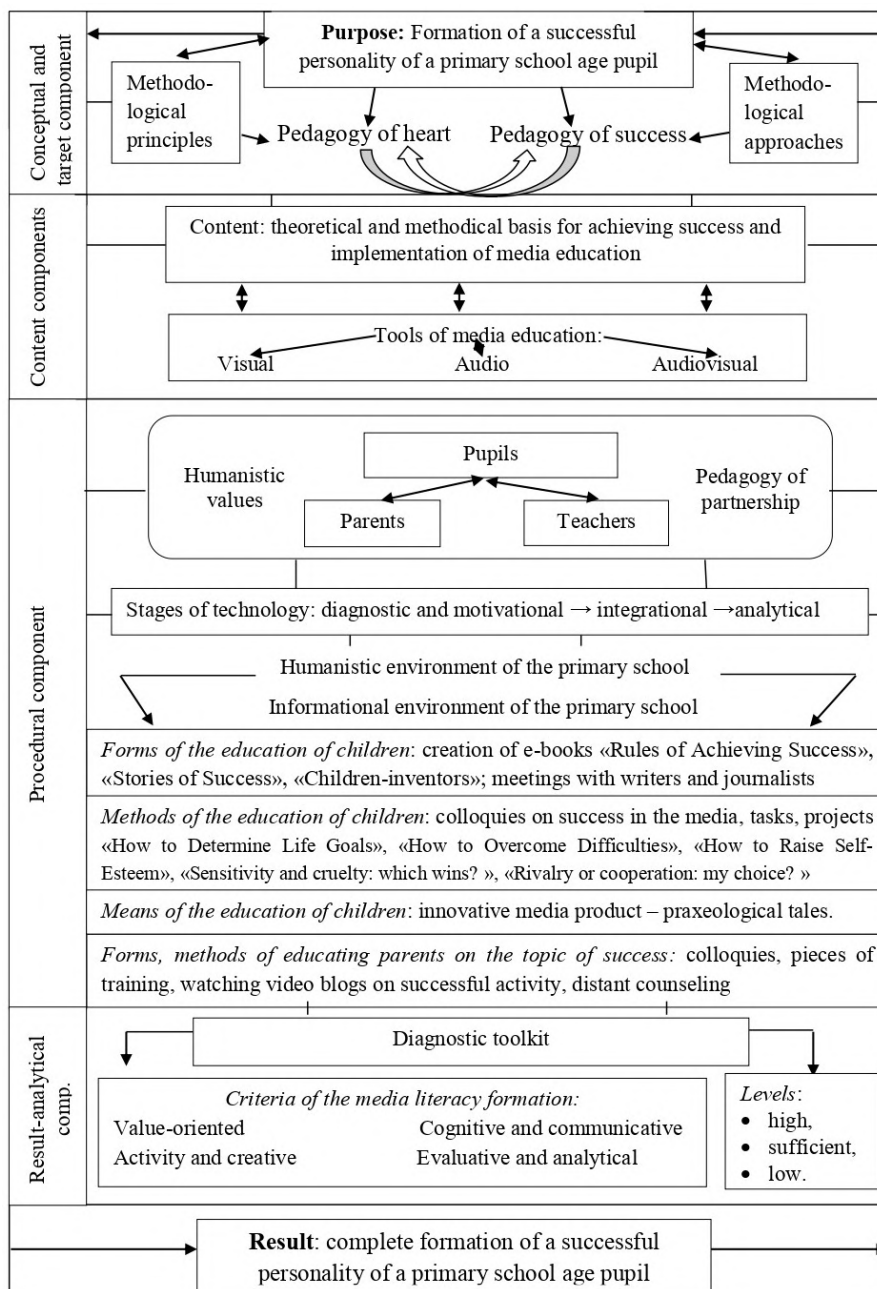
Figure 37: Presentation of paper [279].

considers possibilities of developing digital competence of teachers by using educational training as an optional form of organization of the educational process and professional development of teachers. Different approaches to the interpretation of the concept of digital competence of specialists, in particular practicing teachers, are identified. Described training as one of the

active forms of obtaining knowledge in the system of continuing education of teachers. Given examples of online tools that were used during training sessions for practicing teachers to develop one of the main components of their professional competence – digital competence. Provided static data on the effectiveness of this form of digital competence development, obtained as a result of a survey of participating teachers described in the article of educational trainings.

This article highlights further research by the authors, begun in [66, 210, 290].

Figure 38: Presentation of paper [67].

Ukrainian primary schools are experiencing significant changes as to Reform 'New Ukrainian School'; it reflects rapid updating of information technology and high level of children's informational activity. Nowadays education has a number of resources to support the teaching and learning for primary school students considering the fact that this school generates the foundation for student's success in the contemporary digital society. Primary schools are basically focused on development of subject knowledge and general study skills. The article "Practical activity organization of primary school students with using e-simulators" [172] by Nadiia V. Olefirenko (figure 39), Vira M. Andriievska, Nataliia O. Ponomarova, Olena O. Gulich, Lyudmila P. Ostapenko and Iryna A. Lyakhova deals with the practical activity organization of primary school students with using e-simulators as one of resources for developing subject knowledge and general study skills. The examples of using interactive e-simulators for young learners by teachers-to-be are demonstrated in the article. The research shows that interactive e-simulators provide real task variability, uniqueness of exercises, operative assessment of correction, adjustment of task difficulty, shade of competitiveness and game. The paper presents principles of construction of interactive authors' e-simulators: developed e-simulators should generate learners' interest; be visually presented to create pleasant emotional background;

problem definition should involve learners into critical analysis of input data as to their adequacy, redundancy, relevance; e-simulators should allow learners to operate free; the principle of reliance on pedagogical and research tools of personal IT devices means the recognition of the power of modern personal IT devices and their feasibility of use in the learning process as effective and affordable tools of educational and research activities. Based on the analysis of existing experience of using e-simulators in the practice of primary education, authors found that for primary school teachers it is important not only the ability to use ready-made simulators, but also the ability to create ones independently, improve them, use knowledge of tools and their functional capabilities, select and formulate tasks for young learners, assess adequately the quality of the developed e-simulators.

This article highlights further research by the authors, begun in [173, 174, 218].
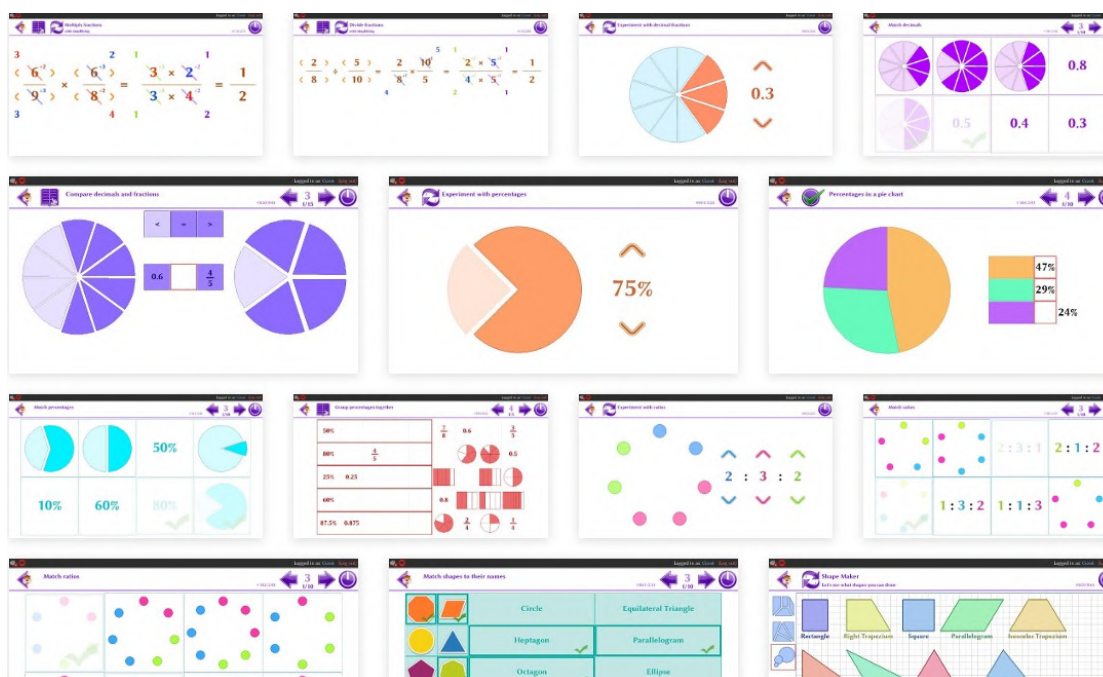
Figure 39: Presentation of paper [172].

The article "Integrated use of the LearningApps.org resourse and information devices in the process of biology school course studying" [261] by Alla V. Stepanyuk (figure 40), Liudmyla P. Mironets, Tetiana M. Olendr, Ivan M. Tsidylo and Maryna V. Kormer considers the problem of integrated use of the LearningApps.org online resource in the process of Biology studying in secondary schools and information devices. The appropriateness of moving to a mixed form of learning that involves the creation of a polysubjective educational environment has been justified. The article concretizes the essence of the notion "polysubjective educational environment" (teacher, pupil, online resources, and information devices). It has been examined how well the scientific problem is developed in pedagogical theory and educational practice. The methodology of using the LearningApps.org online resource in the process of Biology studying

in a basic secondary school, which involves the use of information devices, the PlayMarket server applications, Smart technologies and a website has been created. In particular, a series of exercises of the LearningApps.org online resource has been simulated, the implementation of which should be integrated using a SMART Board, a mobile phone, a computer, a laptop, a tablet or other information devices. Possibilities of their combination with the methodology of using information devices at the lesson in the process of homework checking, learning new material, generalization and systematization of knowledge have been revealed. The proposed assignments can be used as individual exercises for pupils at the lesson and in extracurricular activities. The paper suggests the approach for homework checking, which involves besides computer control of pupils' learning outcomes, the use of Miracast wireless technology. The methodology of conducting a mobile front-line survey at the lesson on the learned or current material in Biology in the test form, with the help of the free Plickers application, has been presented. The expediency of using the website builder Ucoz.ru for creation of a training website in Biology has been substantiated. The methodology of organizing the educational process in Biology in a basic secondary school using the training website has been developed. The effectiveness of the proposed methodology of using the LearningApps.org online resource in combination with information devices in the process of Biology studying in a basic secondary school has been substantiated.

This article highlights further research by the authors, begun in [62, 262, 284].
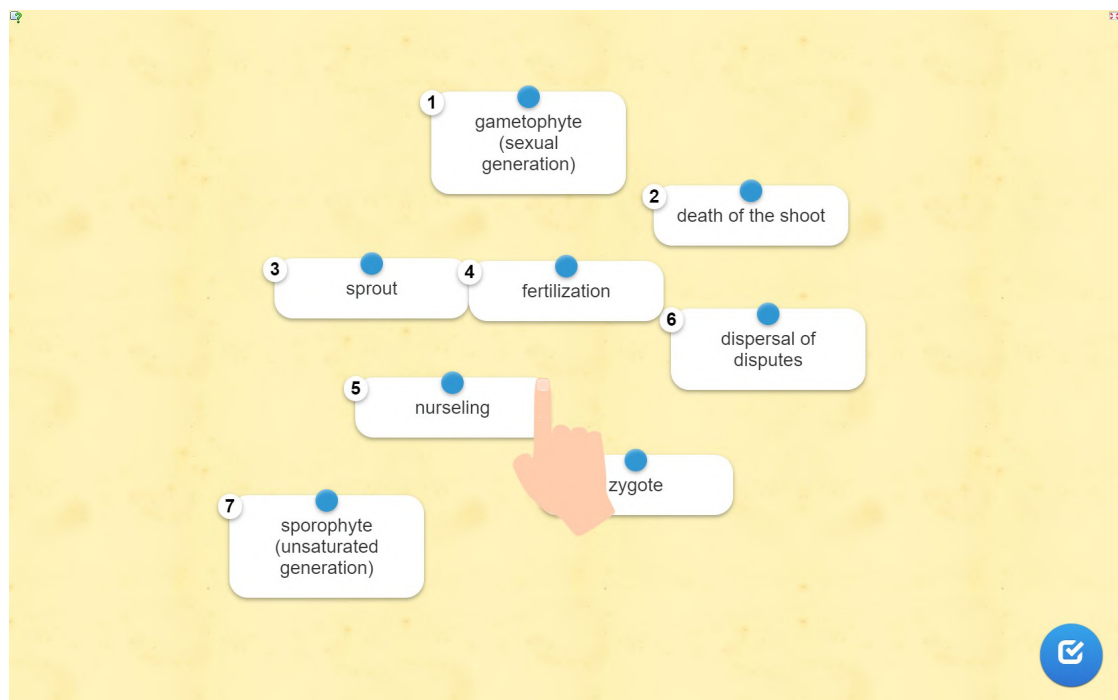
Figure 40: Presentation of paper [261].

The article "The current state of using the cloud-based systems of open science by teachers of general secondary education" [145] by Maiia V. Marienko (figure 41) presents the analysis of

the results of the ascertaining stage of the pedagogical experiment "Design of a cloud-oriented methodological system of training teachers of natural and mathematical subjects to work in a scientific lyceum". An analysis of recent research and publications has shown that scholars have sufficiently considered the problem of reforming teachers' training. A valuable trend is revealed in Ukrainian research on the design of cloud-based systems, it is devoted to the systems of open science, but the proposed systems relate exclusively to certain specialties, or are entirely scientific. Currently, there is no cloud-based system that would become a tool in the teachers of science and mathematics training to prepare them to work in the scientific lyceum. The current state of the art of using open science services by teachers of natural and mathematical subjects during the preparation of educational materials was clarified; the readiness of teachers to perform their own research and teach students to conduct research work is analyzed and the level of teachers' awareness of the functions and requirements of scientific lyceums is determined. The analysis of the conducted survey showed that most teachers recognize the need in scientific activities for a teacher of a scientific lyceum. Most respondents do not use English language resources and services due to their low level of language proficiency. It has been found that one of the most important ways to get involved in science, as for the math teachers' view, is the participation in scientific conferences. Analysis of the results of the ascertaining stage of the pedagogical experiment shows that there is a problem of preparing teachers of natural sciences and mathematics for work in the scientific lyceum. It needs further solution through preliminary testing and implementation of a specially created cloud-based methodological system that would support the introduction of the open science systems and services in teachers' training and educational process.

This article highlights further research by the authors, begun in [168, 251].
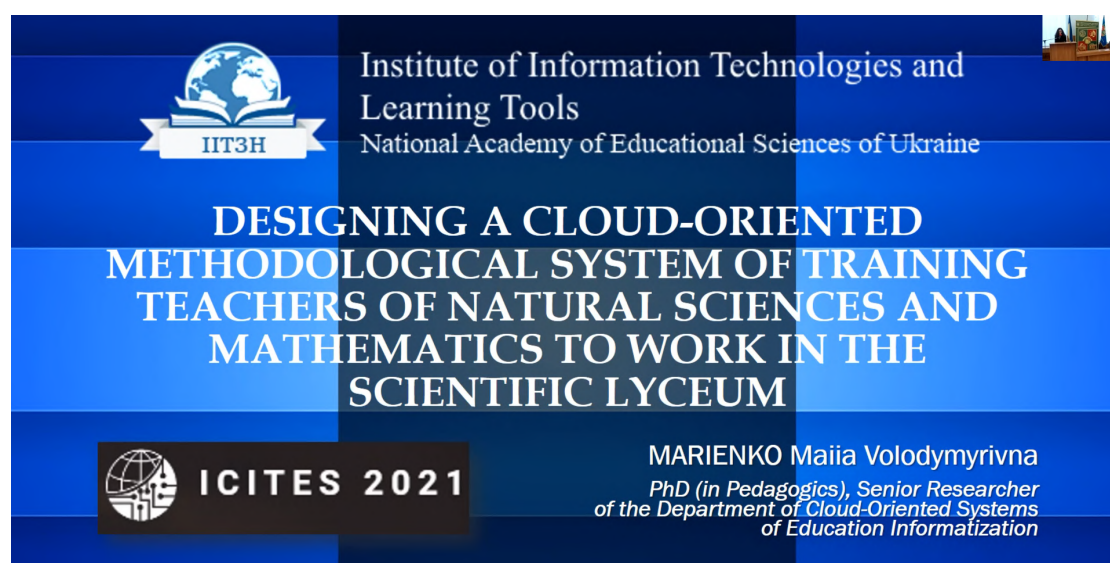
Figure 41: Presentation of paper [145].

2.8. Session 5B: ICT in higher education

The article "Integration of modern higher education into the global information space" [49] by Elena G. Fedorenko, Vladyslav Ye. Velychko, Olha G. Naboka and Hennadiy M. Kravtsov focuses on the special importance of informatization of education as the main aspect of the existence and development of modern higher education. Emphasis is placed on the importance of informatization of education, because the informatization of education is the main driving force for the integration of modern higher education in the global information space. The process of computerization of education is considered as the main basis of its informatization in the historical aspect. The importance of the introduction of information and communication technologies in the educational process of free software and the interest of scientists in this field of education is emphasized. The interest of modern scientists in consideration of such problems as application of information and communication technologies in training is analyzed; problems of informatization of education and goals of informatization of education; didactic and psychological aspects of application of information and communication technologies in educational process; problems associated with the widespread introduction of information and communication technologies in higher education and informatization of education in general. Emphasis is placed on the importance of acquired skills and abilities acquired as a result of informatization of education and introduction of information and communication technologies into the educational process. The goals of informatization of education of a modern higher educational institution are determined. The priority goals of informatization of education are singled out. The types of education that are directly related to information and communication technologies are considered. It is noted that the practice of introducing information and communication technologies in the educational process of higher education institutions is spreading every day and brings only positive results. The importance of free software during the COVID-19 pandemic is described, as GNU-licensed systems are used to organize distance learning. The conclusions emphasize the relevance of this study. It is noted that educational activities based on the use of information and communication technologies are the basis for changes in the structure of the educational process for both teachers and learners.

This article highlights further research by the authors, begun in [201, 263, 313].

The article "Possibilities of using the game simulator Software Inc in the training of future software engineers" [297] by Tetiana A. Vakaliuk, Valerii V. Kontsedailo, Dmytro S. Antoniuk, Olha V. Korotun, Serhiy O. Semerikov, Iryna S. Mintii, Olga O. Kalinichenko (figure 42) presents the possibilities of use game simulator Software Inc to form a sustainable professional competence of a software engineering specialist: the ability to: apply knowledge in practical situations; communicate in a foreign language; work in a team; act based on ethical considerations; commitment to preserving the environment; evaluate and take into account economic, social, technological and environmental factors affecting the sphere of professional activity; for lifelong learning. The use game simulators, in the educational process, allows to improve the quality of educational material and to enhance the educational effects from the use of innovative pedagogical programs and methods, as it gives teachers additional opportunities for constructing individual educational trajectories of students. In the process of research, students gain knowledge, skills of the future IT specialist and competences of the legal protection of the results of intellectual activity, technological audit, marketing, product realization in the

market of innovations. There are many ways in which a company can achieve a dominant position in the industry. For example, the staff of a virtual company can work on developing editorial software for designers, business tools for offices, video games for the console, and even, if time and skill level allows, they can develop their operating system. So in the game simulator Software Inc students are invited to build and design office buildings for optimal working conditions of their own software development company.

This article highlights further research by the authors, begun in [5, 233, 265].

Figure 42: Presentation of paper [297].

The article "Application of R programming language in learning statistics" [205] by Vitaliy I. Mezhuyev, Liliia V. Pavlenko, Maksym P. Pavlenko, Vitalii H. Khomenko (figure 43) examines the problem of teaching statistics to future programmers. The theoretical content of teaching statistics has undergone significant development and requires a change in its focus on the practical field, even while studying at a higher education institution. It is determined that the improvement of teaching statistics to students requires moving from theoretical teaching methods to the practical solution of applied problems and shifting of emphasis from the process of statistical calculations to the analysis and results interpretation. The research allowed establishing that the training of statistics of future programmers should be based on the use of applied system of tasks developed with the help of real data sets obtained as a result of statistical research. Such tasks allow increasing the educational motivation of students in comparison with synthetic examples, which are usually used in the study of statistics. The research has analyzed the software for statistical data analysis as well as identified features of its application

in the learning process. It is offered to use a specialized programming language R as the main learning tool.
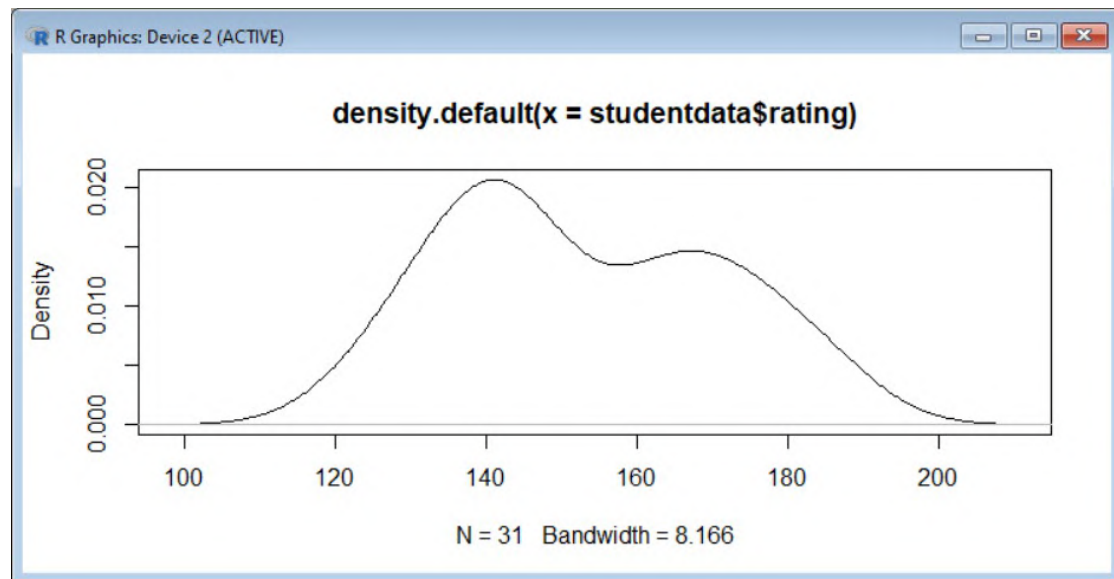
Figure 43: Presentation of paper [205].

The article "Analysis and summarization of the experience of developing adaptive learning systems in higher education" [184] by Kateryna P. Osadcha, Viacheslav V. Osadchyi, Vladyslav S. Kruglyk and Oleg M. Spirin (figure 44) provides a brief analysis and summarization of the existing experience of developing adaptive learning systems in higher education. Existing models of adaptive learning systems, which are necessary for the educational process in higher education, are analyzed. Conclusions are made as for the requirements for the design and modeling of the author's adaptive system of future specialists' professional training in a blended learning environment. The main ones are requirements for the approaches to modeling, types of adaptation implemented in the system, ways to ensure individualization and personification in the process of both face-to-face learning and learning with the help of information and communication technologies.

This article highlights further research by the authors, begun in [182, 183, 189].

The article "Features of the use of software and hardware of the educational process in the conditions of blended learning" [34] by Dmitriy O. Bukreiev, Alona V. Chorna (figure 45), Iryna M. Serdiuk and Vladimir N. Soloviev reveals the results of a study of the feasibility of using software and hardware for the educational process in a blended learning environment in secondary, higher and vocational education. The author conducted an analysis of domestic and international research on distance learning (distance learning needs, requirements for distance learning platforms, experience in implementing distance and blended learning). In the course of the research, the author revealed the standard composition of modern software and hardware of the educational process in the conditions of blended learning and analyzed the market of Ukraine for the availability of ready-made complexes of the company. Recommendations for

Figure 44: Presentation of paper [184].

approaches to teaching in each age group of students and approaches to choosing a complex for implementation in a mixed and distance learning environment, taking into account the individual needs of each educational institution or educational organization. The research is theoretical in nature and designed to create a basis for further research in a given vector.

This article highlights further research by the authors, begun in [237, 280, 282].
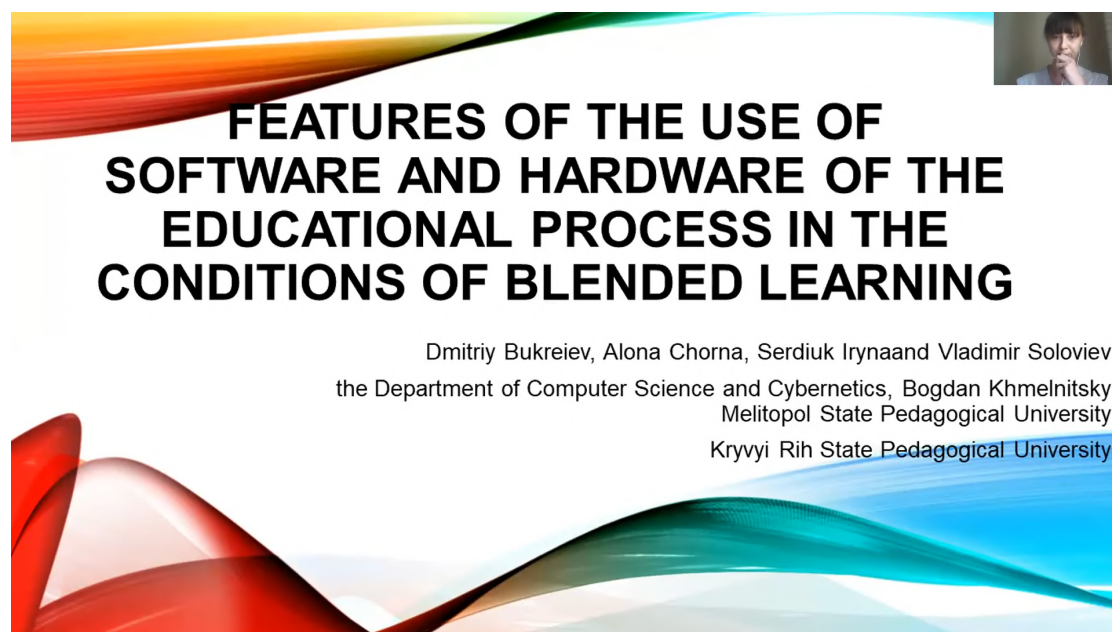
Figure 45: Presentation of paper [34].

Increasing demand for experts capable of high-quality assessment of the impact of a particular planned activity on the environment involves a more effective use of information and communication technologies (ICT) in the educational process of training ecology students. Iryna M. Barna (figure 46), Liudmyla R. Hrytsak, Halyna R. Henseruk and Svitlana H. Lytvynova present a methodology for students to study the educational material of the "Environmental Impact Assessment" course by using ICT. The methodology and algorithm for using the Padlet interactive whiteboard, Mindomo mind maps, Easel infographics, Google Drive and Google Docs in lectures and practical lessons are described in the article "Features of utilization information and communication technology in the process of teaching the "Environmental Impact Assessment" course" [16]. Particular attention is paid to the preparation of a group and individual projects using ICT. Tested in the Ternopil Volodymyr Hnatiuk National Pedagogical University, the methodology allows to implement a number of tasks such as: promotion of intensification and effectiveness of teaching; acquisition of practical skills to quickly find the necessary information on various online resources for ecology students; simulation of the real procedure of environmental impact assessment in the classroom; development of the ability to professionally communicate with experts in other fields of knowledge or activity, etc. Examination of the results of using ICT to study the "Environmental Impact Assessment" course has shown a significant increase in informational literacy among ecology students and their individual professional growth.

This article highlights further research by the authors, begun in [15, 139, 223].
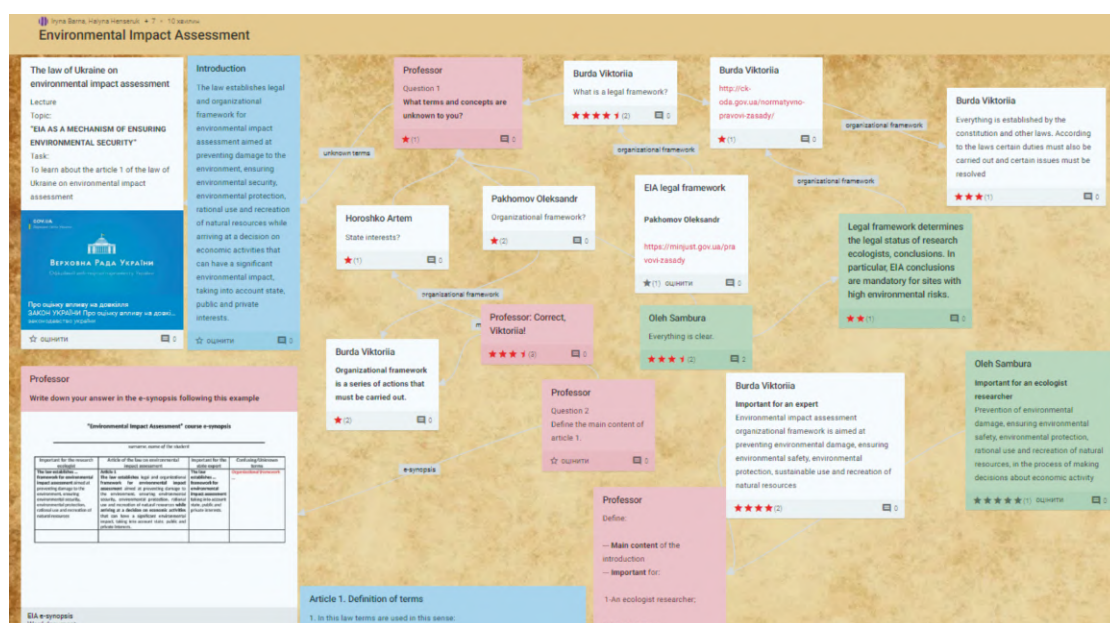
Figure 46: Presentation of paper [16].

The article "Innovative methods of information visualization in transport logistics and training organization" [151] by Olena M. Mikhailutsa, Tatiana O. Melikhova (figure 47), Andriy V. Pozhuyev and Hennadiy M. Kravtsov analyzes the benefits of using interactive teaching methods for students of technical and economic specialties using visualization as an example.
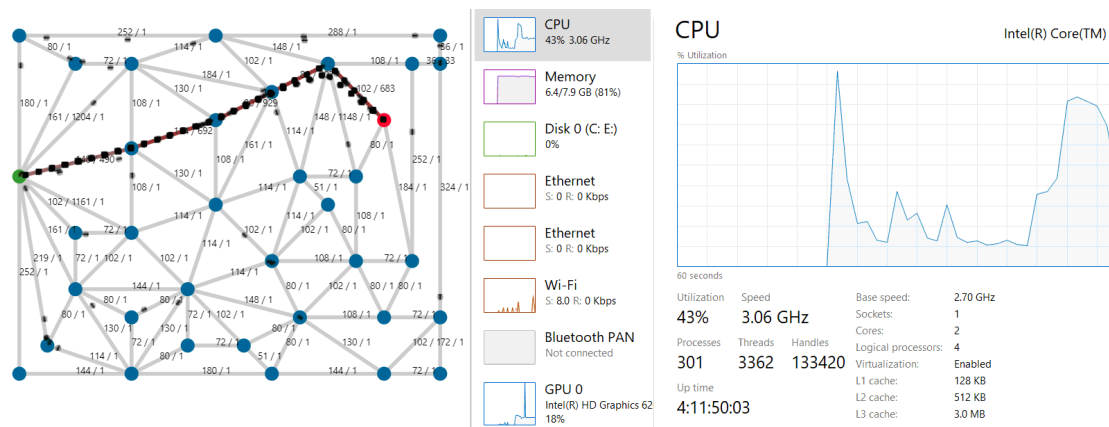
Figure 47: Presentation of paper [151].

In the analysis of existing innovative educational methods, attention is focused on the use of information technology in the formation of competencies of future specialists. In the process of building a software product, a comparative analysis of platforms for developing graphic applications as the main means of visualization on the Internet was carried out. To solve logistic problems that are of practical importance for both economic and technical areas, a visualization of the ant colony optimization algorithm is implemented. It includes building a graph, simulating dynamic network visualization the movement of a large number of ants, saving and loading the graph, providing the user with the ability to remove visible layers. To test the effectiveness of this approach, a multistage experiment was conducted, the results of which allowed us to draw a number of positive findings. In addition, the comparative survey of students from the experimental and control groups made it possible to find out the students' needs in the process of dual learning, which provided an opportunity to increase students' satisfaction with the quality of teaching disciplines.

This article highlights further research by the authors, begun in [117, 194].

A new training module on EU Food Safety Control was developed and implemented at the Department of Veterinary and Sanitary Examination (currently Department of Veterinary Hygiene) of NULES. The article "Information and communication technologies in application, dissemination and evaluation of Erasmus+ Jean Monnet activities" [52] by Mariia A. Galaburda (figure 48), Olena H. Kuzminska and Mykola K. Halaburda describes ICT used for the achievements of results of Erasmus+ Jean Monnet Module "EU Food Safety Control". Module in the EU food safety control was design to contribute to better understanding of applied system of European food safety assurance and the objectives of official food control at EU level within the frameworks of different types of competencies. To assess the effect of the educational course on food safety control, at the start and after completion of the Module, participants' knowledge were evaluated. The monitoring of the project results presents a comparative analysis of the implementation strategy for blended learning stage (before spring 2020) and distance learning under the COVID-19 disruption. Tools and the degree of involvement and satisfaction of participants in the project outputs were determined. Impact effort matrix technique reviled that

action taken with ICT are the best for achieving project result.

This article highlights further research by the authors, begun in [112, 121, 124].

Figure 48: Presentation of paper [52].

The article "Formation of information culture of vocational education specialists" [327] by Oksana P. Voitovych, Roman M. Horbatiuk, Ihor S. Voitovych (figure 49), Mariya P. Shyshkina and Nadiia M. Shostakivska reflects the system of multilevel continuing professional teaching of vocational education specialists. The basic principles of this process are investigated and the structure of training of vocational education specialists is determined by means of the analysis of the state standards of preparation of graduates in a specialty "Professional education", educational programs and curricula. There is made comparative analysis of the maintenance of preparation of graduates of a specialty "Professional education" on specializations "Digital technologies" and "Sphere of service (Tourist service)" for formation of their information culture.

This article highlights further research by the authors, begun in [192, 219, 250].

The article "Modern information and communication technologies in professional training of sociology students: the mainstreaming of the needs and significance" [79] by Liudmila V. Kalashnikova, Alla S. Lobanova, Iryna V. Hrabovets, Liudmila S. Chernous, Viktoria A. Chorna, Yevhen O. Davydenko and Feliks M. Zhuravlev (figure 50) presents an overview of the main possibilities of using information and communication technologies in applied sociology, as well as the urgent need and importance of computer training of the students. Filed the results of comparative analysis of universal, semi-universal statistical packages of computer processing of sociological information and professionally focused software products on the market today. Outlining the advantages and disadvantages of their use in empirical sociology to describe the quantitative and qualitative characteristics of objects of study, explanations of causality, forecasting of social processes. Characterized by modern information technology used for

The main components of information cultur[e] by S. Karagodov:
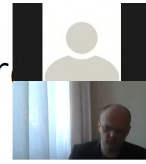
- information (computer) literacy;
- information competence;
- information value-content component;
- information reflection;
- information culturemaking.

Figure 49: Presentation of paper [327].

collecting and storing social data. It is proved that the leading component of the computer literacy specialist-sociologist is the formation, the development of algorithmic thinking, the ability to make the right choice in favor of a software package that satisfies all the requirements, and that would efficiently and professionally perform all the tasks of an applied nature.

This article highlights further research by the authors, begun in [77, 78, 137].

Figure 50: Presentation of paper [79].

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2.9. Session 6: Learning environments

The article "The evolution of the information and educational environment in the context of the theory of generational development" [260] by Aleksander V. Spivakovsky, Lyubov Ye. Petukhova, Serhii A. Omelchuk, Yevheniia A. Spivakovska, Vira V. Kotkova (figure 51) and Yuriy Yu. Yurchuk is devoted to reviewing system-organizing and personalized approaches to the modern learning environment. It is explored following modern society's requirements and technology. Authors suggested 6 stages in the development of the learning environment, stages of e-learning development, visualized the interdisciplinary approach to EdTech and comparative characteristics of traditional and e-learning. E-learning is understood as an umbrella term that covers web-based instruction, online learning, networked learning, computer-assisted learning and computer-mediated learning. Authors consider a model of the modern learning environment taking into account the characteristics of its subjects belonging to different generations. Generation theory is reviewed providing recommendations for the best possible educational content for Baby Boomers, Generations X, Millennials or Generation Y and Generation Z suitable to their adaptive style and values.

This article highlights further research by the authors, begun in [258, 259, 319].
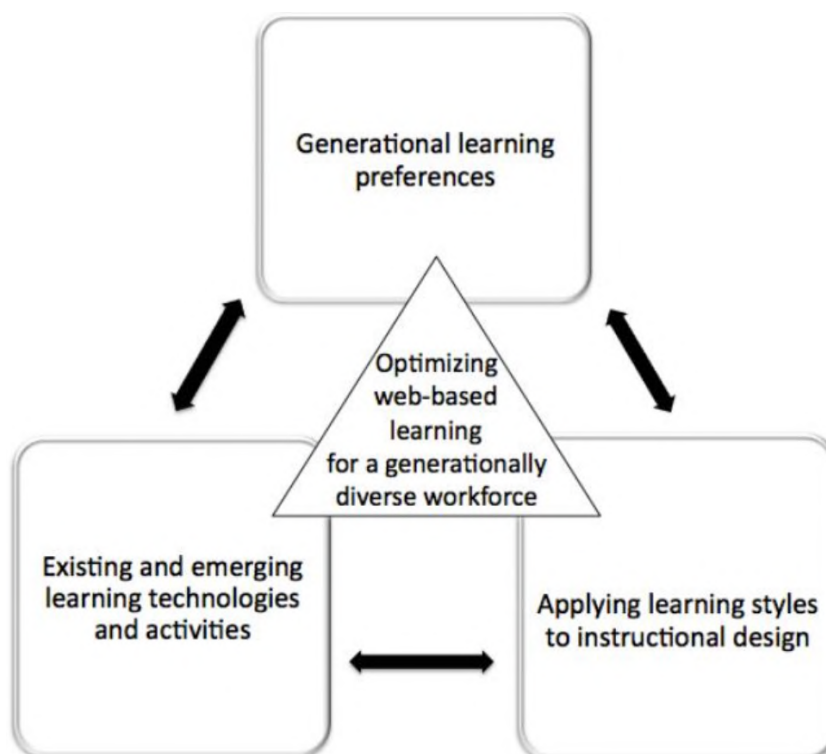
Figure 51: Presentation of paper [260].

The article "Methodology for using cloud-oriented environment for flipped learning of the future IT specialists" [55] by Olena G. Glazunova, Valentyna I. Korolchuk, Oleksandra V. Parhomenko, Tetiana V. Voloshyna, Natalia V. Morze and Eugenia M. Smyrnova-Trybulska

(figure 52) substantiates the components of a cloud-oriented environment for flipped learning in the process of training future information technology specialists in higher education institutions. The methodology for using services and resources of the cloud-oriented environment of the university, including mass open online courses, educational portal of the university, professional-oriented software and services for project management for flipped learning in the process of training future professionals is presented in three stages: preparatory, basic and integrated. In these stages, the necessary professional and personal skills were formed during the project tasks performing using the appropriate cloud resources and services of the university environment. At the preparatory stage, students worked on collective projects within one discipline using the cloud service Microsoft Teams in order to form and develop general competencies. At the basic stage, students were offered to perform tasks of mini-projects, group and individual projects during studying professionally-oriented disciplines using the GitHub cloud service. The integrated stage was implemented during work on interdisciplinary projects, the tasks for which were formed on the basis of the study of several disciplines using the Jira service. This paper investigates the effectiveness of the application of the developed methodology for flipped learning using the components of the university's cloud-oriented environment.

This article highlights further research by the authors, begun in [157–159].
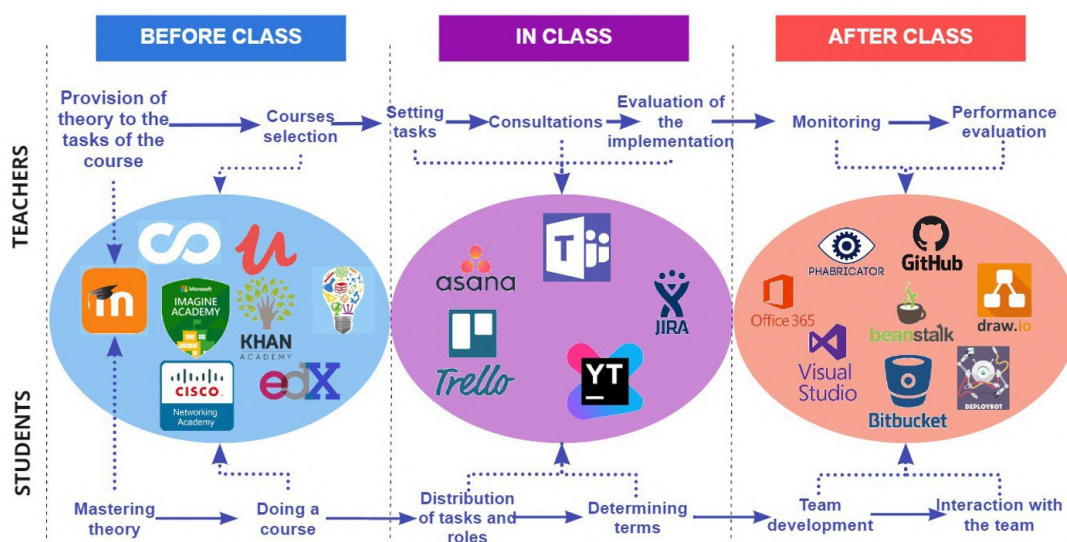
Figure 52: Presentation of paper [55].

Rapid development of modern machinery and its increasing complexity make high demands to the quality of training of its users. Among the variety of kinds, the important one is vehicles, both civil and military. In the teaching of associated subjects, there is an accepted hierarchy of teaching aids that includes common visual aids (posters, videos, scale models etc.) on the first stage, followed by simulators ranging in complexity, and finishing at real vehicles. It allows achieving some balance between cost and efficiency of training by partial replacement of more expensive and elaborated aids with the less expensive ones. However, the analysis of teaching experience in the Institute reveals that this balance is still suboptimal: the quality and

abundance of common aids may be increased, and the simulators may be used more effective. This fact raises the problem of extending the range and quality of available teaching aids for vehicle-related subjects, which is the aim of the article "360° photographic panoramas as an effective multifunctional aid for teaching technology subjects" [14] by Igor V. Barkatov, Volodymyr S. Farafonov, Valeriy O. Tiurin, Serhiy S. Honcharuk, Andrei A. Lozko, Volodymyr V. Marushchenko, Kostyantyn V. Korytchenko, Vitaliy I. Barkatov and Roman F. Muravlyov (figure 53). Benefiting from the modern information and visualization technologies, authors present a collection of new teaching aids, which are based on 360° (spherical, 3D) photographic panoramas joined with H5P interactive content framework or virtual reality devices. The nature of the aids, their potential applications, limitations and benefits in comparison to the common aids are discussed, and the practical recommendations about creating and implementing the aids are given. The proposed aids are shown to be cost-effective and proven to increase efficiency of training, according to the results of a teaching experiment. For the implementation, a tight collaboration between the Institute and an IT company was established. The authors conclude that the proposed aids may significantly improve the cost-efficiency balance of teaching technology subjects.

This article highlights further research by the authors, begun in [13].
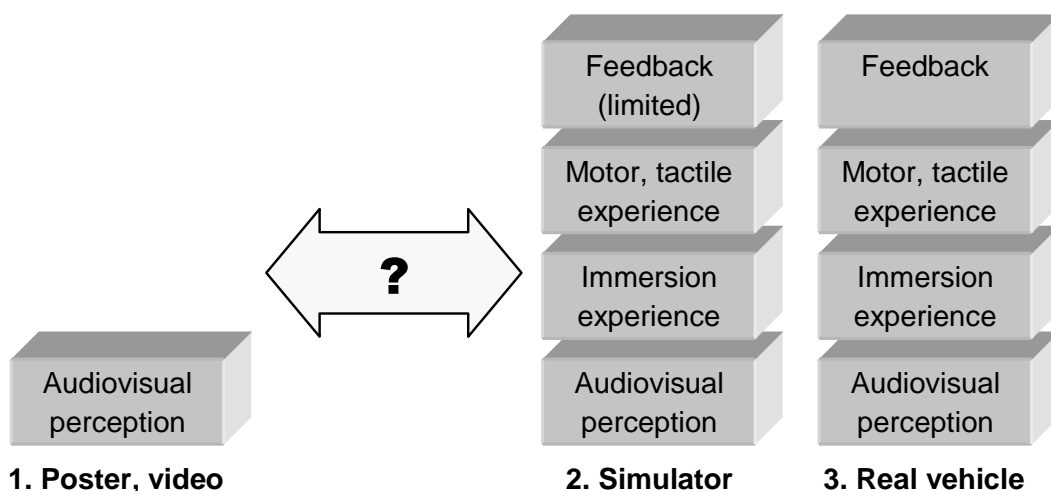
Figure 53: Presentation of paper [14].

The article "The implementation of inquiry-based learning in the organization of students' research activities on Mathematics" [323] by Kateryna V. Vlasenko, Olha H. Rovenska (figure 54), Iryna V. Lovianova, Oksana M. Kondratyeva, Vitaliy V. Achkan, Yana M. Tkachenko and Mariya P. Shyshkina looks into the issue of developing an interest of students' research activities on Mathematics. The study is dedicated to the feasibility of involving the inquiry-based learning to the organization of students' scientific research during the practice on the Approximation Theory and Fourier Series. The research considers the results of the survey among students who helped to evaluate their emotional state during the workshop. To collect the data authors used

$$|f - S_{20}|, \quad |f - V_{20,5,7}| \qquad\qquad |f - S_{20}|, \quad |f - V_{20,3,4}|$$
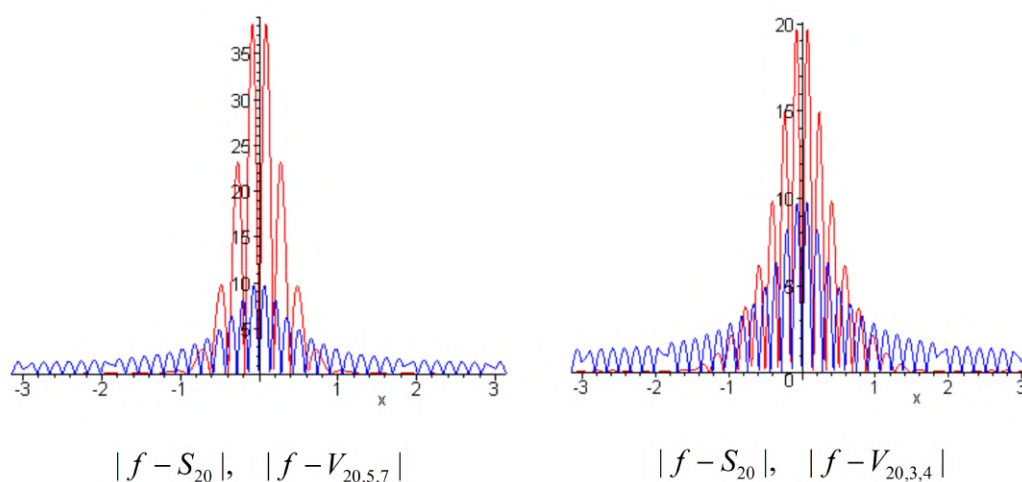
Figure 54: Presentation of paper [323].

the tool of express evaluation of positive and negative emotionality the Differential Emotion Scale by Izard. The article discusses the positive influence of the environment developed through the inquiry-based learning on students' emotional state and forming their interest in scientific research while organizing practic classes. Authors have grounds to conclude that there is the efficiency of implementing workshops based on the inquiry-based learning. The index reduction of students' negative emotions encouraged their activity during the practice and the improvement of interest in research activities.

This article highlights further research by the authors, begun in [171, 225, 226].

Liudmyla L. Nezhyva (figure 55), Svitlana P. Palamar, Halyna O. Vaskivska, Olha V. Kotenko, Liudmyla A. Nazarenko, Maryna S. Naumenko and Andrei V. Voznyak worked on expanding the methodological basis for the use of augmented reality on the examples of alphabets in accordance with the objectives of the school program of the 1st-grade of the New Ukrainian School, namely the content lines: "Interact orally", "Exploring the media", "Exploring linguistic phenomena". The methodological aspect of the application of augmented reality on the basis of interactive art books has also been expanded. In particular, within the line "Theatricalize" it is proposed to involve students in stage art, in the conditions of which they gained experience of performance, tried to improvise. Observation of artistic expression through augmented reality, work with interactive coloring pages and stickers, expression of appropriate emotions through acting ensures the development of the child's emotional intelligence, creative thinking, initiative, self-awareness, self-control, ability to overcome barriers associated with uncertainty and risks, effectively cooperate with and understand one another. The result of the research characterizes different directions of application of augmented reality in the literary field of primary education: visualization, observation and research of artistic image, demonstration of its expression; visualization, observation and research of the artistic world of a literary work; organization of the reader's interaction with the literary hero; organization of game activities in the lesson of literary reading (study of the work with the help of a game developed by means

of augmented reality); organization of theatrical performances with the help of interactive bracelets and stickers with AR applications. The article "Augmented reality in the literary education of primary school children: specifics, creation, application" [169] is devoted to the creation of an augmented reality appendix to the topic "Ukrainian folk tales". Due to the fact that the leading activity in primary school is gaming, the AR application based on a fairy tale as a game-trip was created. The development of the application provides for the implementation of further tasks: analysis of the work, interpretation of the work, activation of the emotional impact of works on the reader. The augmented reality for the accompaniment of the creative reading of the fairy tale was created with the help of Unity programs and the Vuforia plugin. The basis of the game-trip is a fairy-tale map with stations and special interactive tags. A specially designed program attaches a virtual AR object to the label and activates the image of the hero, the episode of the fairy tale, the text of the question on the screen.

This article highlights further research by the authors, begun in [6, 167, 198].

Figure 55: Presentation of paper [169].

2.10. Session 7: Learning technology

The article "Introspection as a condition of students' self-management in programming training" [25] by Liudmyla I. Bilousova, Oleksandr H. Kolgatin (figure 56), Larisa S. Kolgatina and Olena H. Kuzminska is devoted to the study of types of managing the student's educational activity. The educational discipline "Practicum of problem solving in informatics" for students of third year study, future teachers of informatics have been chosen for realising pedagogical conditions of computer-oriented management of students' educational activity. Progressive turn from direct management through co-management, subsidiary management to self-management was the main idea of designing the courseware. The information and communication educational environment has been based on the platform of learning management system Moodle. The

Workshop elements of Moodle played the central role in management of students' educational activity. The results of pedagogical observation and assessment showed the efficiency of suggested approach. Additionally, there were shown the lack of students' competency in time planning and introspection on the base of the experimental data.

This article highlights further research by the authors, begun in [21, 101, 237].
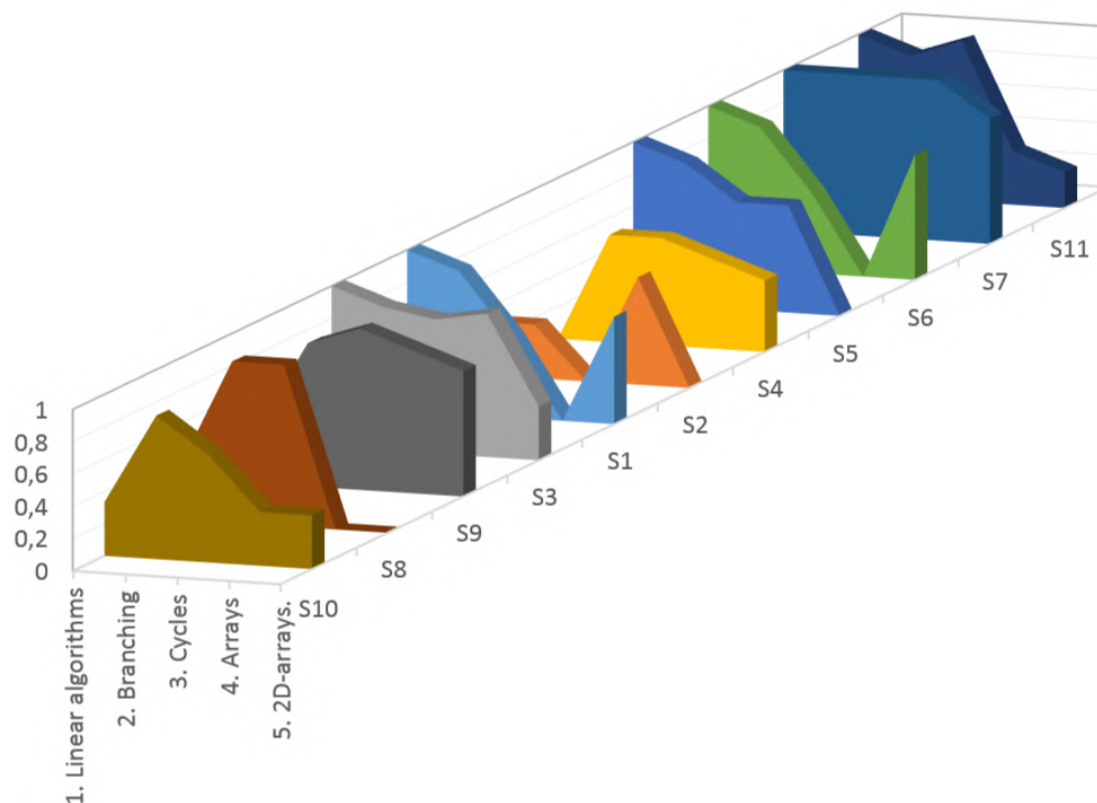
Figure 56: Presentation of paper [25].

The main idea of the article "The values of biological education from the point of view of 2020 events (or biotechnological human improvement through the eyes of students)" [108] by Elena V. Komarova (figure 57) and Arnold E. Kiv is that the value potential of academic disciplines contributes to the implementation of the idea of sustainable development in the framework of secondary and higher biological education. As a result of a study carried out in 2019, authors found that in basic school the content of the subject "Biology" is primarily aimed at the formation of ideas about the main terminal values – "life", "health", "nature"; in high school – about terminal values – "life", "health", and also about instrumental values – "persistence". In their 2020 study, authors investigated the influence of the bioethical content of biological disciplines on the formation of value ideas of future biology students and future biology teachers about modern scientific innovations (using the example of genome editing and biotechnological human improvement), the development of the ability to evaluate them from a bioethical point of view. It is assumed that the formation of the ability to give a bioethical

assessment of events taking place in the scientific world and ongoing discoveries is one of the main in the implementation of the idea of sustainable development in the field of education.

This article highlights further research by the authors, begun in [104–106].
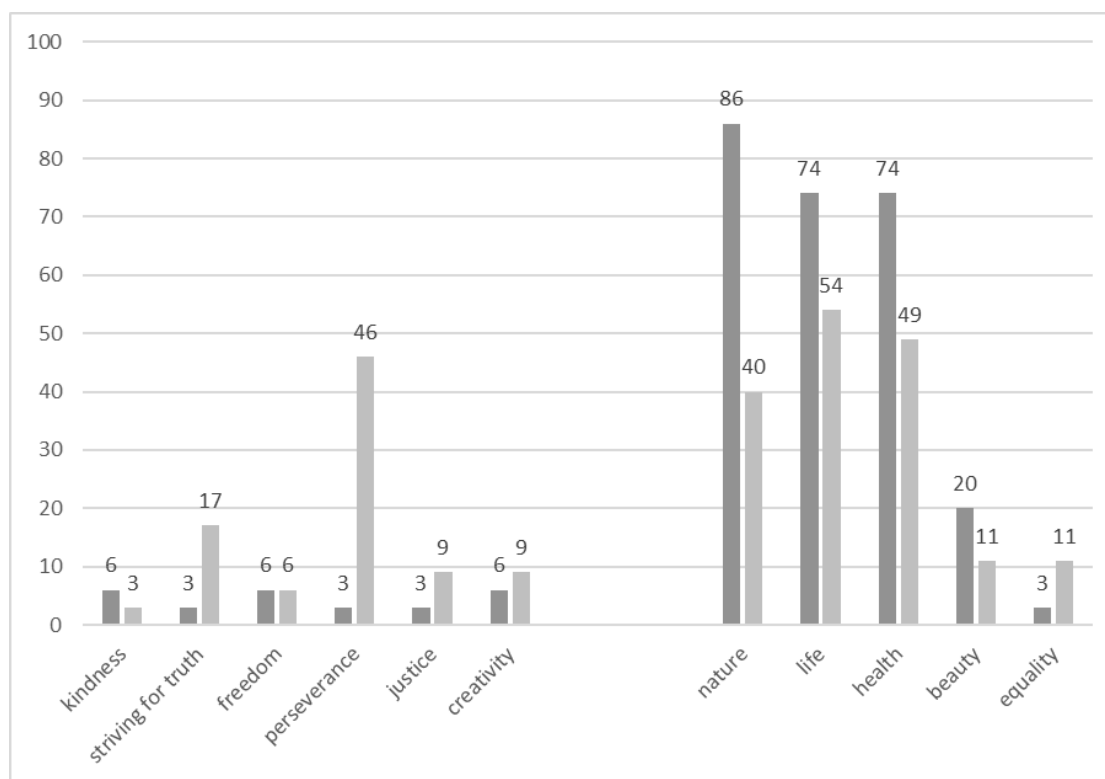
Figure 57: Presentation of paper [108].

The article "The learning-style-based approach and optimal use of e-resources in teaching ecological disciplines" [46] by Tetiana M. Derkach, Tetiana V. Starova (figure 58) and Alexander V. Krajnikov aims to optimise electronic resources used in teaching ecological chemistry following the educational preferences of students. An approach is used to select e-resources in accordance with the available individual learning preferences of students, teaching styles of teachers and the content of the discipline. The R. Felder and B. Soloman model studied the learning preferences of students of Kryvyi Rih State Pedagogical University majoring in chemistry and informatics and students of Kyiv National University of Technologies and Design majoring in industrial pharmacy. Most students in both groups study visually, sensitively, actively and sequentially. Didactic materials on the theme "Ecological chemistry of the lithosphere" of the content module "Ecological chemistry of environmental objects" were elaborated according to student groups' learning profiles. Expanding the content of the course of ecological chemistry is proposed by including an additional topic on the problems of environmental pollution of medicinal plants. The new topics' content is considered to better match the educational material with the prevailing sensitive learning style in most students and simultaneously strengthen the ecological component and form the necessary competencies in future professionals. Forms of

work that involve the use of different cognitive functions are described and therefore contribute to their balanced development. It allows a person to be flexible in the unrestrained development of technological progress, be open to different ways of obtaining information, and perceive it without resistance and stress.

This article highlights further research by the authors, begun in [45, 100, 248].
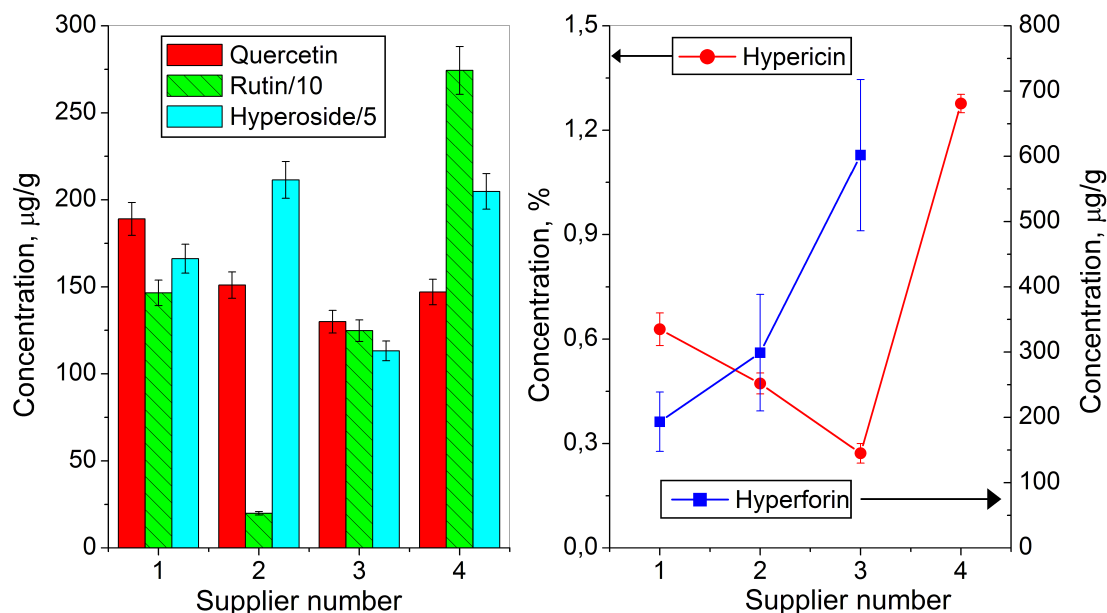
Figure 58: Presentation of paper [46].

The article "Content analysis of course books and online courses for teaching English for specific purposes for IT professionals" [270] by Svitlana V. Symonenko, Nataliia V. Zaitseva, Kateryna P. Osadcha and Olena H. Kuzminska deals with the issue of English language training for IT professionals at Ukrainian universities. Understanding the importance of studying foreign languages has been confirmed by a number of normative documents. Peculiarities of professional training of IT specialists at higher education institutions with the focus on foreign language training are considered. Pedagogical conditions for formation of the communicative competence of IT professionals are analysed. The content analysis of existing English course books, textbooks and online courses for IT professionals has been conducted to find out the content of foreign language training. It is stated that English language teaching aids in information technology, computer engineering, computing and software engineering can be used in the learning process, however, their use requires thorough refinement and modification. The series of guides, manuals and online courses for teaching English for professional purposes are presented.

This article highlights further research by the authors, begun in [269, 271, 272].

Integration of ICT significantly increases the possibilities of the educational process and extends the boundaries of the educational sphere as a whole; it is also a necessary condition for the implementation of distance learning. Publicly available resources, such as e-mail, blogs, forums, online applications, video hosting sites, can serve as the basis for building open learning

and education. Informational educational technologies of learning foreign languages are in the focus of this study. The article "Use of YouTube resources in the process of training German Language Teachers" [43] by Olha V. Chorna, Vita A. Hamaniuk (figure 59), Oksana Y. Markheva, Andrei V. Voznyak and Aleksandr D. Uchitel represents the results of theoretical analysis of content on the subject of its personal- and didactic-definite orientation, as well as some aspects of the practical use of commonly used YouTube video materials in the process of teaching German as the first or second foreign language in higher education, namely at the pedagogical university. Taking into account the practical experience of using the materials of several relevant thematic YouTube channels with a fairly wide constant audience, a concise didactic analysis of their product is presented and recommendations on converting video content into methodological material in the framework of practical course of German language by future teachers are offered. Possibilities of using alternative resources of YouTube in terms of distance learning in view of mediation skills development in the interpretation of this concept by authors of CEFR Companion Volume with New Descriptors (2018) are considered. Four groups of resources that can be used as teaching materials are identified and analyzed; some examples of their preparing and use by the training of future foreign language teachers are offered. The focus was also on open resources ONCOO and TWINE, which can be used in particular to develop the autonomy of future foreign languages teachers, and the capabilities of these resources are characterized. Due to the suggested recommendations, the following tasks can be solved: enrichment of the vocabulary; semantization of phraseological units, constant figures of speech, cliché; development of pronunciation skills; expansion of linguistic and ICT-competences; improving listening and speaking skills; increasing motivation to learn, etc.

This article highlights further research by the authors, begun in [44, 86, 198].

The article "Professional preparation of future teachers of vocational training in the transport area of expertise with use of the author's educational application" [213] by Mykhailo H. Pohorielov, Olena O. Lavrentieva (figure 60), Volodymyr I. Bondarenko, Igor G. Britchenko, Andrii A. Dorohan and Aleksandr D. Uchitel presents the content, as well as approaches to the use in the educational process of the author's Electronic educational methodical complex (EEMC) "Construction of car". The course is created for students of the speciality 015 Professional education (Transport, the operation and repairing of automobiles). Its content covers general topics including the study of a car engine, electrical equipment and automotive driveline. The created electronic course embraces, in addition to textual material, illustrations, dynamic models, instructions, manuals, textbooks, reference books and glossaries, test material for each topic. Its possibilities of application during lectures, in the course of performing 15 laboratory works, organizing test control of knowledge, as well as for managing students' independent study activities have been shown. Approaches to expert evaluation of the developed electronic study course by 11 criteria have been disclosed. The directions for further improvement of the content and methods of organizing the study and cognitive activity of students when using the course have been highlighted. These include the organization of level assimilation of the material, the creation of an individual educational trajectory of students. A rather high assessment of the developed author's course received from experts allows it to be used in the system of vocational preparation specialists in the transport area of expertise.

This article highlights further research by the authors, begun in [127–129].

The article "Teaching foreign language professional communication using augmented reality

Mediation

Mediation of content:
 to convey the content of the text (to convey specific information orally and / or in writing); describe data (graphs, charts, tables, etc. orally and / or in writing; processing of texts orally and / or in writing; translate written text (orally and / or in writing.)

Mediation of meanings (concepts): to prepare abstracts (reports, seminars, presentations, discussions) orally and / or in writing; to express a personal opinion (including on the content of the literary text); analyze and critically process works of fiction or fragments of these works; convey conceptual information (work in a group or manage group work).

Mediation of communication:
speech interaction in a group, joint design of content / information /, presentation of a common point of view and the ability to organize speech interaction in a group to develop a common opinion and its verbal design through communication; to communicate, create conditions for its course (creating a multicultural environment, performing the functions of a mediator that provides communication in informal situations, as well as simplifies communication in conflict or similar situations with significant differences in the views of interlocutors).

Figure 59: Presentation of paper [43].

elements" [4] by Svitlana M. Amelina (figure 61), Rostyslav O. Tarasenko, Serhiy O. Semerikov and Yuliya M. Kazhan deals with the analysis of the possibilities of AR-technology application for the development of foreign language professional communication skills when students learn a foreign language (on the example of German). The advantages of using AR-technology in this process are defined, namely: the possibility of involving different channels of information perception, the integrity of the representation of the object under study, and detailing its individual structural elements if necessary, more efficient acquisition of the domain terminological vocabulary, and the development of foreign-language communicative skills. It is shown that QR codes can be easily and affordably used to retrieve information about the object of study from public internet sources. The use of AR elements in the process of learning a foreign language, in the form of virtual excursions, is proposed. The results of a survey of students after the virtual excursions are presented. The technological and didactic requirements for organising vocational foreign language studies using AR-technology have been determined.

This article highlights further research by the authors, begun in [273, 276, 281].

The article "Media education technology at preschool educational institutions" [41] by Volodymyr M. Chaika, Iryna I. Kuzma, Oleksandra I. Yankovych (figure 62), Kateryna M. Binytska, Oksana T. Pysarchuk, Tetiana V. Ivanova, Halyna I. Falfushynska and Iryna A. Lyakhova substantiates the media educational technology at preschool educational institutions, in which diagnostic-target, integration and analytical stages are distinguished. The problems in media education implementation at preschool establishments have been identified and the prospects
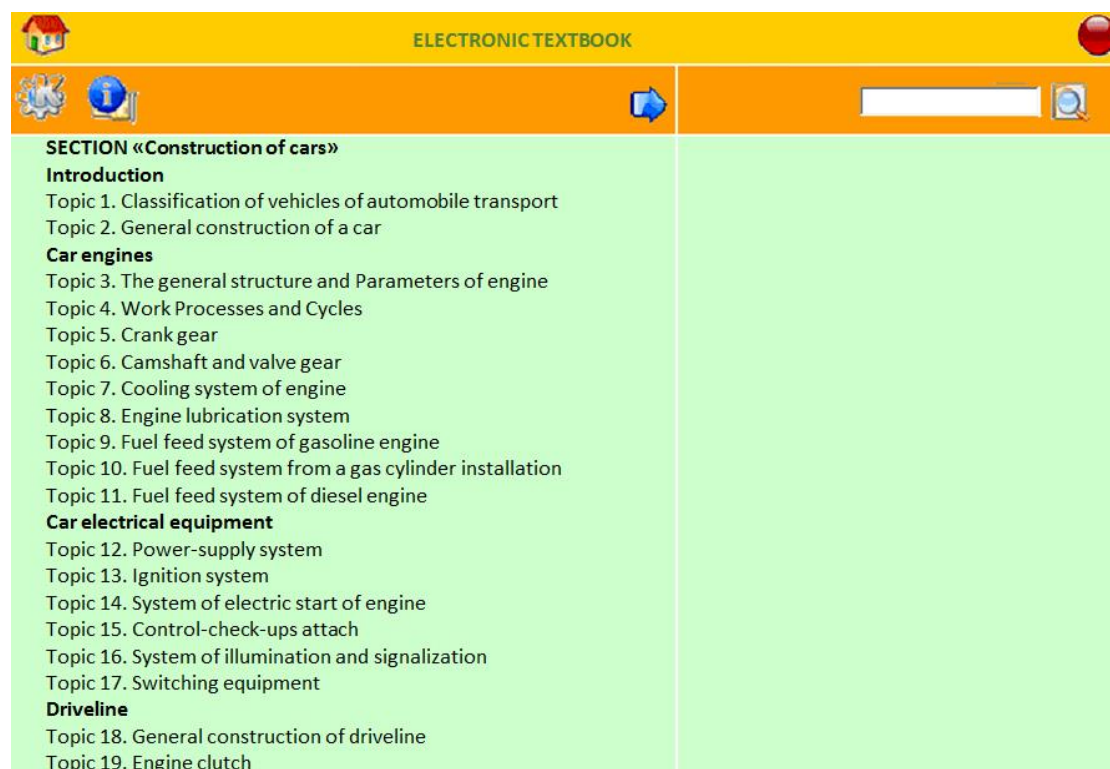
Figure 60: Presentation of paper [213].

for their solving have been determined. The psychological factors of forming media literacy of children of the senior preschool age have been highlighted. Diagnostic toolkit has been developed and indicators of high, sufficient and low levels of media literacy of preschoolers have been determined. The experience of conducting media educational classes "Grains of media education", the use of media educational tales in working with children have been highlighted. The expediency of media education for kindergarten teachers of preschool educational institutions of Ukraine, formation their motivation for media educational activities with children has been proved. The effectiveness of implementing the media education technology at preschool educational institutions has been confirmed on the basis of positive dynamics of levels of preschoolers' media literacy formation.

This article highlights further research by the authors, begun in [278, 329, 330].

The purpose of the article "Training teachers-to-be to create infographics and its expert evaluation" [175] by Nadiia V. Olefirenko (figure 63), Nataliia O. Ponomarova, Vira M. Andriievska, Olena O. Gulich, Andrii Y. Gaidus and Iryna A. Lyakhova is to develop methods for preparing students to create infographics for educational purposes and its expert evaluation. Creating an educational infographic is an interesting, but quite complex activity for a teacher, which requires both the expansion of existing psychological and pedagogical knowledge and skills, and the formation of new ones. The modules "Infographics in educational activities" and "Expert evaluation of e-tools' quality for teaching students" are offered for teachers-to-be. The
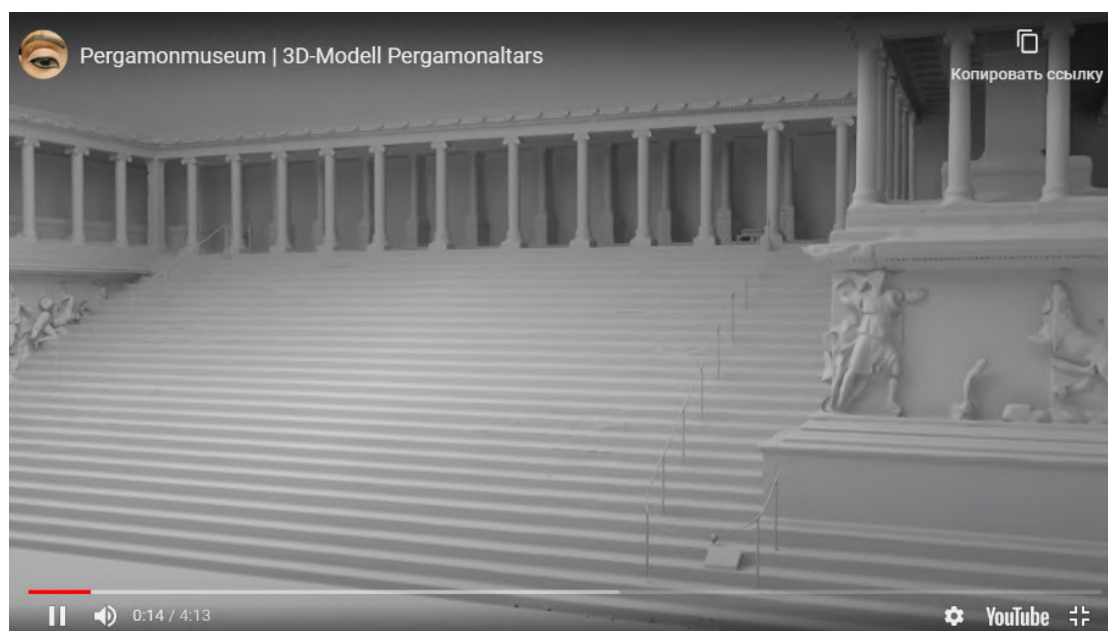
Figure 61: Presentation of paper [4].

determination of the weighting factor of each criterion by expert evaluations was organized. Experimental implementation of the developed modules is carried out. On the basis of the criterion rank, the significance of each criterion was calculated. The indicators to determine the level of preliminary expert evaluations of e-tools are proposed. The results are calculated with nonparametric methods of mathematical statistics. The conclusion is the expert evaluation has different activity stages, gradually becoming a common phenomenon.

This article highlights further research by the authors, begun in [173, 174, 218].

The aim of the article "The algorithm of electronic multilingual terminological dictionary compilation" [295] by Tetiana A. Vakaliuk, Oksana A. Chernysh (figure 64) and Vitalina O. Babenko is to provide a thorough analysis of the algorithm of electronic multilingual terminological dictionary compilation. Electronic multilingual terminological dictionary is viewed as a dynamic electronic lexicographic edition that provides translation, explanatory, encyclopedic parametres of terminological units and is open to current trends in its fields of knowledge representation. Electronic multilingual terminological dictionary covers five knowledge areas, namely Information Technologies, Linguistics, Accounting and Taxation, Engineering, and Economics. It provides English, French, German, Polish and Russian equivalents with encyclopedic reference in all target languages. Moreover, it is absolutely adapted to constant updating, extension and integration with other systems needed. Such dictionary creation presupposes determination of its volume and structure, lexical units' selection and their frequency feedback, and proper arrangement of translation equivalents. Therefore, the algorithm of electronic multilingual terminological dictionary compilation includes seven stages that are dedicated to register creation and arrangement, information system creation and trial, as well as dictionary set-up. All stages are interconnected and interrelated. Accordingly, meticulous stages com-
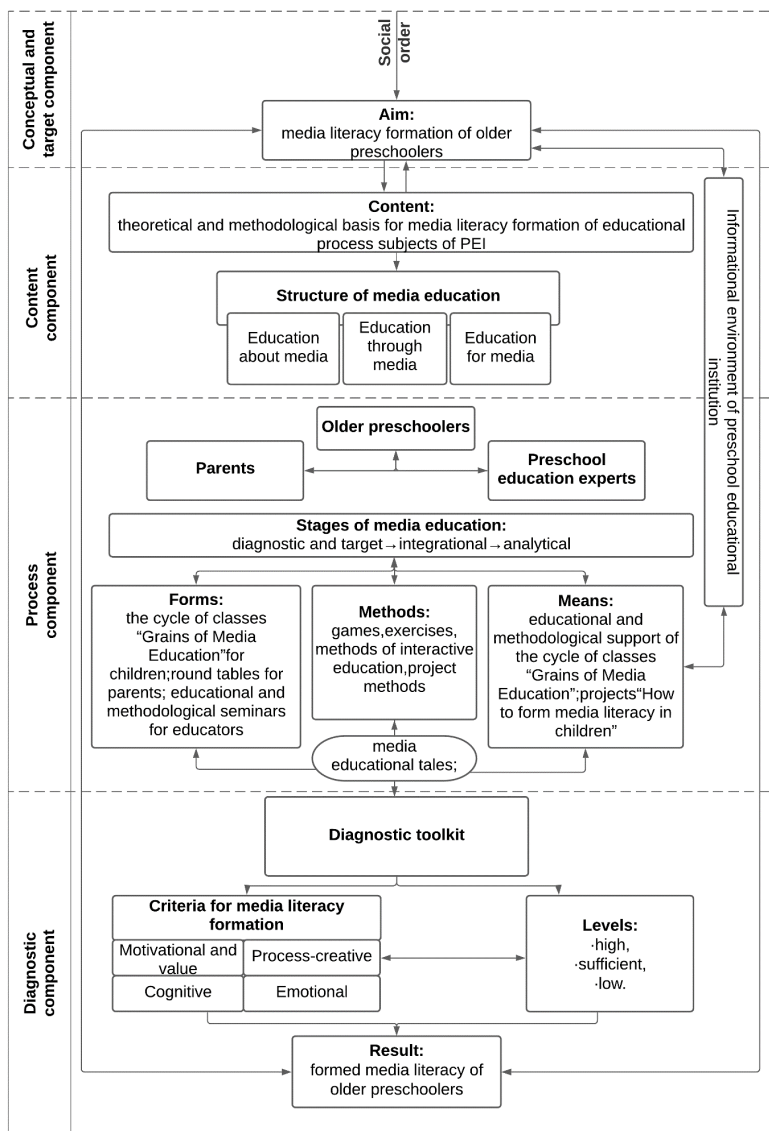
Figure 62: Presentation of paper [41].

pletion significantly contributes to quality electronic multilingual terminological dictionary compilation.

This article highlights further research by the authors, begun in [153, 154, 247].

The article "Organisation of Business English for specific purposes course on Moodle" [241] by Hanna M. Shalatska (figure 65), Olena Yu. Zotova-Sadylo, Oksana V. Balanaieva and Hennadiy M. Kravtsov investigates the factors that determine organizing of business English for specific purposes courses on Moodle platform. Authors have analyzed the Moodle tools that contribute to student's language skills development which are in line with prospective professional activities of the learners. In addition, authors have considered the means Moodle provides in terms of
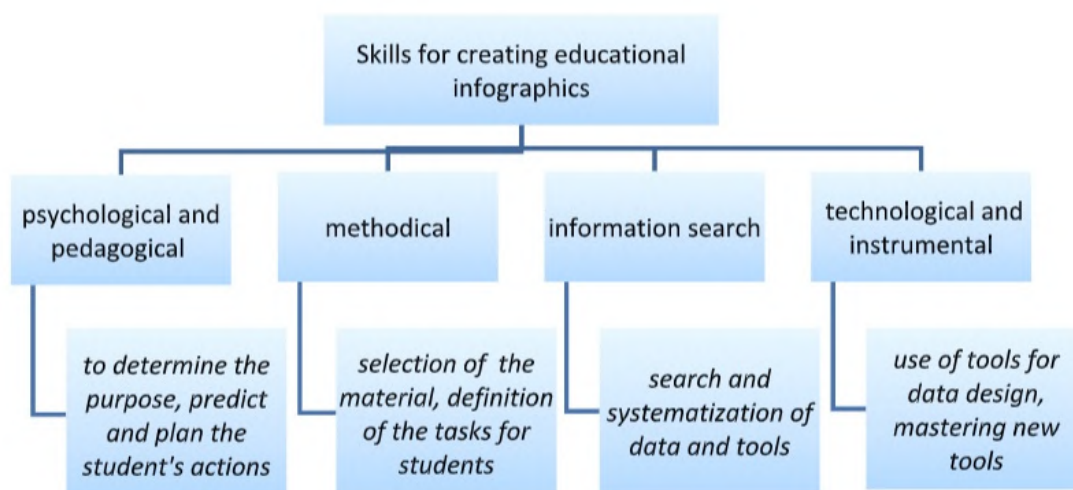
Figure 63: Presentation of paper [175].
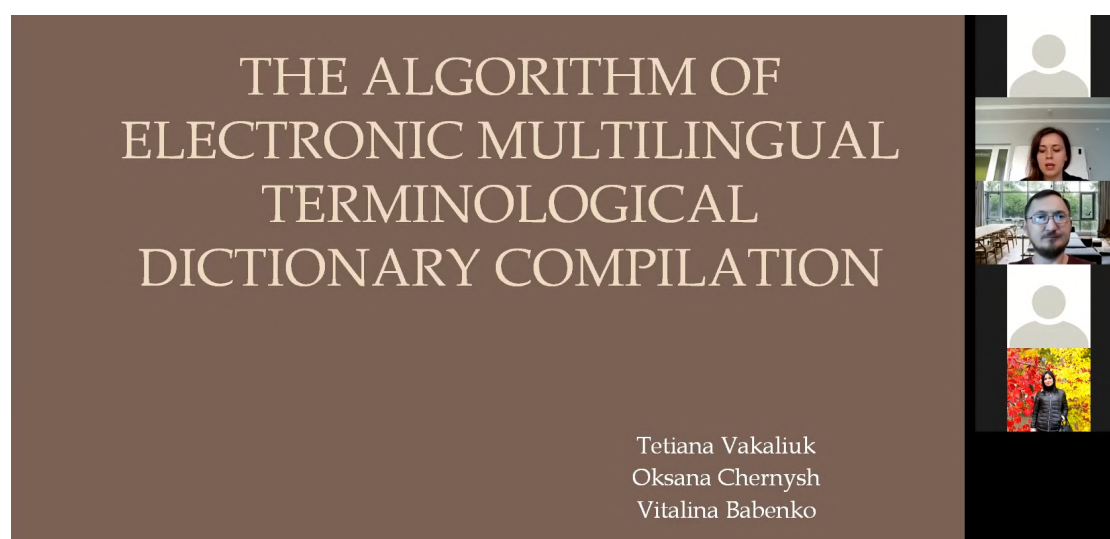
Figure 64: Presentation of paper [295].

their capability to replenish lack of classic instructor-led in-class teaching and switching of the educational process to online mode as a result of COVID-19 pandemic. The objective of the study is to examine English for specific purposes (ESP) Moodle-based courses as a means to advance the level of English language proficiency in distant learning environment; and to analyze the content peculiarities of ESP courses "Business Communication Technology for Law Students" and "Business English" (for Computer Engineering) focusing on nourishing four fundamental language skills (speaking, reading, listening, writing). Some principles of ESP Moodle course tailoring have been highlighted; they are outcome-oriented approach (providing the learning

results are applicable in the professional activity, the materials have been added to the course by right), functional language application (the language structures should be presented in career relevant context), layout (focus on speaking and listening activities), learner's centered approach (a student is a key stakeholder) and facilitating role of the educator. One aim of this study is to assess the extent to which the services providing by Moodle, like Interactive Content (H5P), WIKI, Database Activities, Forums, BigBlueButton and others contribute to enhancing four language skills of the learners. The comprehensive analysis has revealed some predicaments the course designer has to cope with, for example lack of background knowledge in the specific domains or significant difference in the level of English language proficiency within one class. Experimental courses are being testing currently in Donetsk Law Institute of Ministry of Internal Affairs of Ukraine and Kryvyi Rih National University. More than 300 students of different legal and IT specialisms are engaged in the approbation. It should be taken into account that the article represents the interim results and the experimental study has development outlook.

This article highlights further research by the authors, begun in [146, 240, 242].
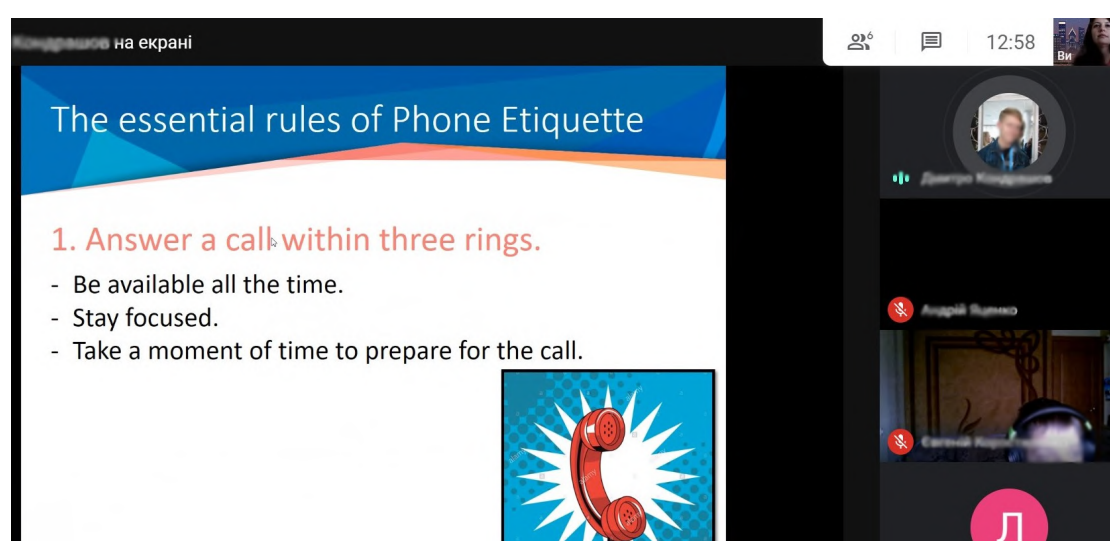
Figure 65: Presentation of paper [241].

The problem of improvement of educational technologies in connection with the revealed problems, aggravated in the conditions of COVID-19, is considered in the article "Ensuring the effectiveness of e-learning based on online technology analysis of factors influencing the cognitive independence of students" [133] by Evgeniy A. Lavrov, Viktoriya G. Logvinenko (figure 66), Viacheslav V. Osadchyi, Olga Ye. Siryk and Yana I. Chybiriak. A new approach to building a system of flexible learning, based on "tuning" the technologies of student interaction with the educational environment, is proposed. Such adaptation is carried out using the mathematical model of educational process control developed by the authors, the parameters of which are characteristic of the factors that form the cognitive independence of students.The presented information technology for assessing the factors that shape the cognitive independence of students can be integrated into any educational system due to the universal capabilities that

Google services provide. The developed technology is very useful for studying the real picture of individual factors of cognitive independence in the educational process, organized with the help of electronic educational technology.The main functional capabilities and advantages of the developed information technology are: the ability to organize adaptive learning, the ability to organize questionnaires in any electronic educational system, simplicity and ease of use, modular structure, and others.

This article highlights further research by the authors, begun in [130–132].
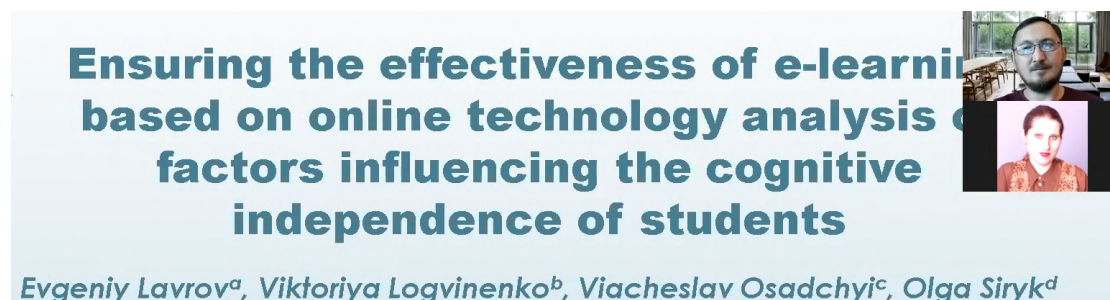
Figure 66: Presentation of paper [133].

The article "Expanding opportunities for professional development through the use of integrated teaching" [29] by Svitlana V. Bodnar (figure 67), Viktor V. Koval, Mariana M. Petrova, Tetiana M. Lesina, Mykhailo M. Bocharov and Antonina V. Kichuk highlights the problem of introducing integrated teaching the students majoring in economics in the educational process of Ukrainian tertiary non-linguistic schools. It presents the peculiarities of the immersion into a foreign language environment arising from the acquisition of the professional knowledge in a foreign language. Some strategies for integrated teaching are suggested: 1) systematic repetition of the linguistic and professional material; 2) use of each language unit, which is under study, in its maximum possible linguistic and professional environments and in the connection with the previously learned material; 3) implementation of a major subject (Microeconomics) and a foreign language (English) integration in the educational process of Ukrainian tertiary schools. The programme duration was 4 months. A total of 90 students majoring in economics participated in the programme of integrated teaching. After the completion of the programme the students' professional knowledge and foreign language proficiency were assessed and their feedback collected and analyzed. Data were obtained from pre-and-post assessment tests of language and professional proficiency. Results indicated the effectiveness of the suggested educational strategies, the use of which provided a possibility of the transition from training period to a real professional communication.

2.11. Session 8: Training of social managers for digital society

The article "Online training of youth club members of Ukraine in projecting volunteer activities in the conditions of the spread of COVID-19" [119] by Oleksandr G. Kucheryaviy, Dmytro G. Gryshchuk and Olena G. Glazunova deals with the features of the solution of the problem of value and meaning content and the methodology of online training of young people (platforms:
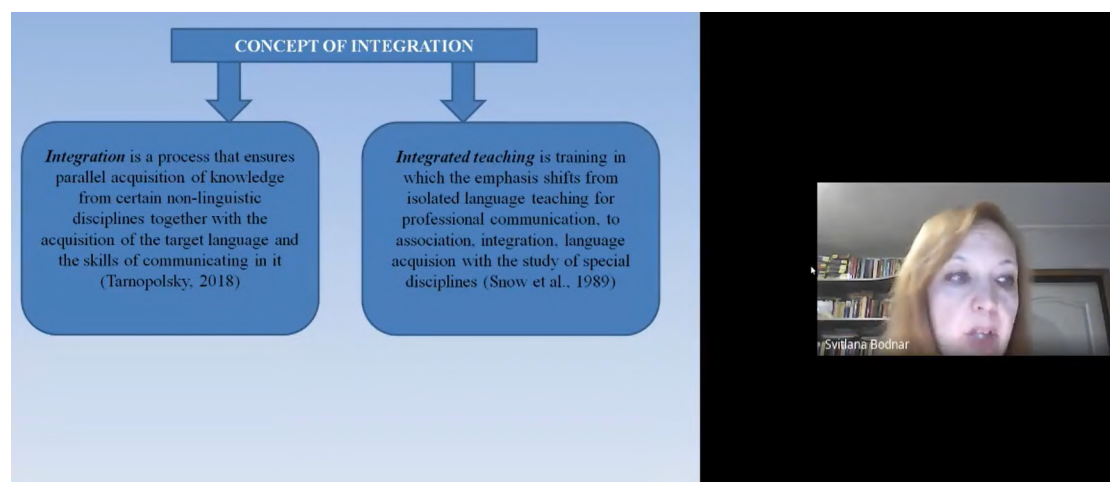
Figure 67: Presentation of paper [29].

Zoom, Moodle, Google Classroom, etc.) to project volunteer actions in the situation of a global coronavirus pandemic. A certificate is submitted concerning the acquisition by youth club members of previous experience of spiritual, patriotic and online design activities. The volunteer project competences framework as a target for relevant online learning is highlighted. The following guiding principles for the development of its content are defined, namely: dominance of online – providing motivation for the activity of young people in the creation of socially significant volunteer projects; priority in the content of the basis of knowledge about information and communication technologies, project method, gerontology, psychotherapy, psycho-hygiene, self-organization, health culture and readiness for volunteer action in crisis conditions, continuity of content of online education of volunteers by means of self-preservation of personality, preventing and overcoming panic, fear and anxiety in a situation; personal orientation and emotionally-sensual saturation of the methodology of online support of subjects of the projecting volunteer activity, etc. Based on these principles, emphasis is placed on the value and meaning potential of the projected experimental special course. The sum of two groups of humanistic methods online-preparation of young people to create volunteer projects is defined, namely: 1) methods of motivation and organization of volunteer project action; 2) methods of stimulation of projecting activity of young volunteers. Attention is paid to the features of the experimental testing of the special course and methodology, and to the criteria for assessing the readiness of youth club members to the create the volunteer projects.

This article highlights further research by the authors, begun in [53, 57, 58].

In recent years, the concept of gender mainstreaming in project management has become more popular and in demand. Mainstreaming gender in project management cycle requires knowledge and skills of all stakeholders and coordinated actions and commitments of all actors (government, international donors, territorial communities, non-governmental organizations, educational institutions and others). The article "Training on gender mainstreaming in project management: case of international donor programs and projects for Ukrainian local communities' development" [18] by Galina V. Berezhna, Olena V. Aleinikova, Oksana A. Kovtun, Hanna B. Danylchuk,

Vitalina O. Babenko and Pavlo P. Nechypurenko (figure 68) focuses on finding an answer to the main question – how to mainstream gender in project cycle management to ensure effectiveness and gender-sensitivity of local development projects, taking into account the requirements of international donor programs and projects. The paper highlights the main issues of theory and practice of gender mainstreaming in programs and projects, engendering of community-based development projects, role and participation of women in project management, prospects of implementing gender mainstreaming concept in educational process for project managers. Questions which are raised in paper are: "What is gender mainstreaming and how it should be implemented into project cycle?", "How to mainstream gender in different types of Ukrainian local-development projects according to requirements and approaches of international donors and national legislation?", "What is project management now and how it would change in the future?"; "What is the current state of women in project management profession – globally and in Ukraine?"; "What challenges / barriers / obstacles women face as project managers?"; "Prospects for women in project management – how can they meet challenges and overcome barriers?", "How gender mainstreaming should be implemented in the design of education policies and programs for project managers?"

Figure 68: Presentation of paper [18].

The article "Main determinants of the use of cloud technologies in the development of professional stability of the future specialist in the conditions of adaptive learning" [309] by Hanna B. Varina (figure 69), Kateryna P. Osadcha, Svetlana V. Shevchenko, Valentyna V. Voloshyna, Ivan G. Riznitskii and Aleksandr D. Uchitel considers practice-oriented possibilities of using cloud technologies in the process of development of the main components of professional stability of the future specialist of socionomic direction in the conditions of blended learning. The research is devoted to the use of cloud services in the formation of not only ICT competence, but also the development of professional stability of the future specialist. The study substantiates the importance of cloud services and analyzes the use of cloud technologies Google Workspace for Education, distance learning system Moodle in the modern information and educational environment of higher education. The authors clarify the didactic capabilities of cloud services and identify the psychological and pedagogical conditions for the development of components

of professional stability, as a dominant integral of the competitiveness of the future specialist. The methodical aspects of designing the process of development of professional stability of the individual on the basis of the use of cloud services aimed at improving the mental capacity of the applicant of higher education are highlighted. In the framework of theoretical and methodological analysis of the problem of professional stability of the psychologist identified the following main components: cognitive, motivational, behavioral, emotional and volitional. Professional stability is closely interrelated with the processes of professional and personal development, professional adaptation, the level of efficiency of the individual. In the process of implementing the program of implementation of cloud technologies, the authors consider the professional stability of man as a dialectical synthesis of sustainability and variability, preservation and development. As a result of processing the empirical research at the ascertaining stage, it is determined: the motive of "obtaining a diploma" is dominant among students; there is a tendency of students to dominate the external negative motive (ie uncertainty, lack of internal personal meaning of the choice of profession); most respondents found an underestimated level of development of empathic abilities; the pragmatic type of orientation dominates, ie the system of dominant needs is plans and successes in the activity executed by the person; the level of anxiety, frustration, aggression and rigidity in most students is on average; identified the level of formation of the components of the vitality of the individual, as a measure of the individual's ability to withstand a stressful situation, maintaining internal balance and not reducing the success of professional activities; Assessing the features of emotional self-regulation of students in blended learning, it was found that most students are dominated by the average level of development of this ability (moderate level of fatigue, monogony, oversaturation, stress). The results of the formative stage revealed significant positive changes in the manifestation of the components of professional stability of future professionals. Prospects for further research are the development of a comprehensive program for the use of cloud technologies in non-formal education and personalization of the process of professional development of future professionals.

This article highlights further research by the authors, begun in [188, 306, 307].

2.12. Session 9: Massive open online courses

The article "The criteria of usability design for educational online courses" [326] by Kateryna V. Vlasenko, Sergii V. Volkov (figure 70), Iryna V. Lovianova, Irina V. Sitak, Olena O. Chumak, Serhiy O. Semerikov and Nataliia H. Bohdanova addresses the issue of implementing the usability principles of educational internet resources. The paper debates the latest researches on the question concerning the search for the factors that influence the results of online education. The analysis, which authors carried out, allowed us to focus on such known six criteria of usability design as Information Quality, System Navigation, System Learnability, Visual Design, Instructional Assessment, and System Interactivity and suggest the existence of the seventh criterion named Responsiveness. The research considers the principles of usability implementation following the example of the open platform of online education "Higher School Mathematics Teacher". The answers given by 203 respondents during the survey allowed defining the direction of implementing the usability criteria on the platform. Authors were eager to know the opinion of teachers and students who became the first users of the platform. The article discusses the criteria implementation while developing online courses on the platform.

minimum hardware requirements (a must-have - Internet access);

cloud technologies do not require the purchasing and maintaining of special software (applications can be accessed through a web browser window);

all operating systems and client applications, used by users and educational institutions, support Google Apps;

work with documents is possible with the help of any mobile device that has an Internet connection;

all Google Apps Education Edition tools are free.

Figure 69: Presentation of paper [309].

There was ground to conclude that when designing online platform courses, all seven usability subcategories are important.

This article highlights further research by the authors, begun in [90, 111, 236].
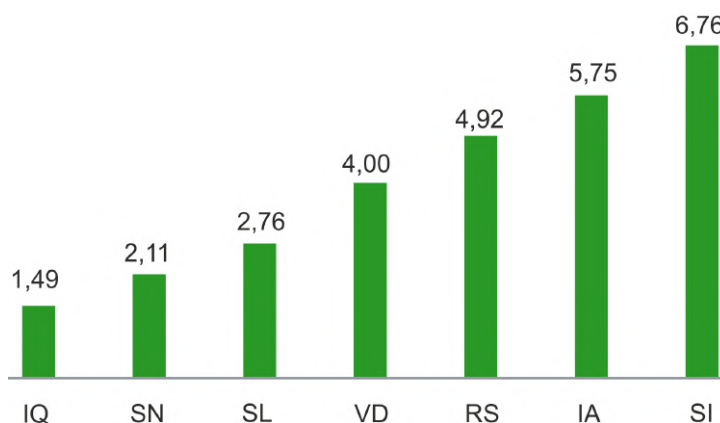
Figure 70: Presentation of paper [326].

Massive open online courses (MOOCs) are the new additional dimension of education that allow to study online courses from different universities geographically located anywhere around the world. Zarema S. Seidametova (figure 71) consider the MOOCs classification based on pedagogical approaches and product functionalities (cMOOC, xMOOC, quasi MOOC) in the article "MOOCs types and course development" [229]. Author present diagrams of the planning, prior preparation and the development of the MOOC. There are four stages of the process: preproduction, production, postproduction and maintenance. Author present the

typical roadmap of MOOC development: guidelines to develop course content, video content implementation, and development of roles. Author introduce as example the video content matrix of the quasi-MOOC "Unity Augmented Reality for Beginners". Author recommend the following roles for the MOOC development team: experts, curriculum designers and technical specialists. This set of roles needs for effective design of MOOC.

This article highlights further research by the authors, begun in [227, 228, 230].
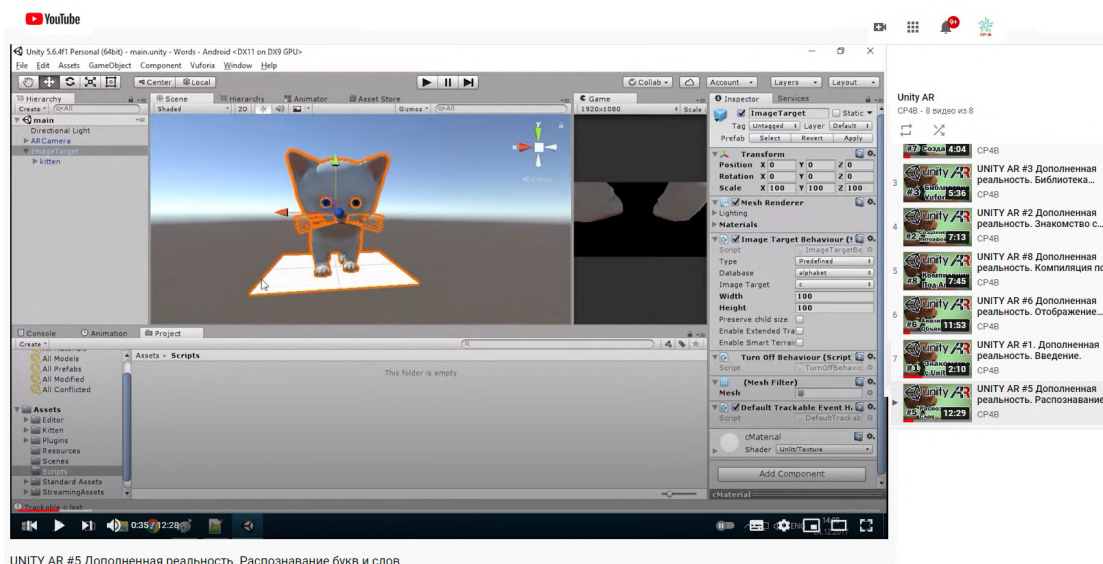
Figure 71: Presentation of paper [229].

2.13. Session A: Methodology of informatization in education

The article "The method of teaching graphic 3D reconstruction of architectural objects for future IT specialists" [65] by Ihor V. Hevko (figure 72), Olha I. Potapchuk, Iryna B. Lutsyk, Viktorya V. Yavorska, Lesia S. Hiltay and Oksana B. Stoliar present the method of teaching future IT specialists modern 3D technologies of graphic reconstruction of architectural objects has been developed and tested in the educational process. The peculiarity of the implementation of the stages of the proposed methodology of graphic reconstruction is exemplified through building the model of the Parochial Cathedral of St. Mary of the Perpetual Assistance of the 1950s. Sequence and content of operations for analytical and design engineering stage are substantiated. After analysing and assessing the most popular specialized software means, the 3DS Max environment is chosen to build a three-dimensional model. The complex method of graphic reconstruction of historical architectural objects is proposed. This method consists in constructing a three-dimensional model of an object, based on a combination of a design technique using modern 3D technologies and methods for analysing archival descriptive information and data on a set of images using parallax estimation of a data array of stereopairs of images. The cathedral model is built on the basis of archive photographs and drafts. Reconstruction of spacious configuration of the objects is based on parallax assessment of images. There are

described methods of implementing modelling by 3DS Max tools and preparing the model for 3D printing in Cura. Substantiated the effectiveness of the proposed training method to teaching future IT specialists of 3D technologies of graphic reconstruction. This method contributes to the formation of students' system of theoretical and practical knowledge on the design of buildings and structures using modern digital technologies for their graphic reconstruction it has been proved.

This article highlights further research by the authors, begun in [63, 64].
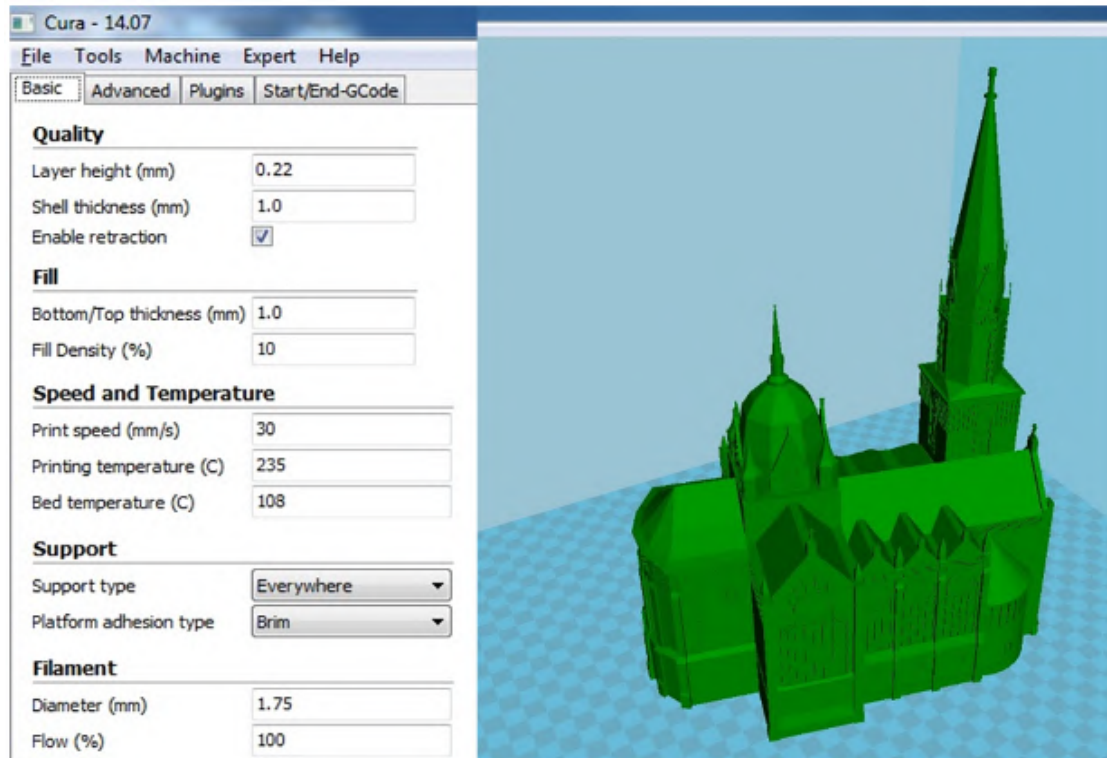
Figure 72: Presentation of paper [65].

Modern tendencies of development of digital educational environment of university and model of its introduction in pedagogical university are considered by Nadiia R. Balyk, Galyna P. Shmyger, Yaroslav Ph. Vasylenko and Vasyl P. Oleksiuk (figure 73). The article "Digital educational environment of teachers' professional training in pedagogical university" [11] analyses the concept of the educational environment, its components and features of the structure. The concept of digital educational environment is introduced. The components of digital educational environment for the teachers' professional training of the Ternopil Volodymyr Hnatiuk National Pedagogical University (TNPU) are described: technological, didactic and social. The features of this environment such as: information saturation and openness, digital transformation, social practices and cooperation are considered. The study of the effectiveness of digital educational environment for teachers' professional training was carried out on the basis of TNPU. In total, 432 masters of all specialties of the University participated in this study.

The study used the method of expert assessments for statistical processing of results. The study was conducted to determine the level of importance of all indicators of each component of the digital educational environment. The results of the study illustrate the significant changes in the technological and social components of the university digital educational environment, which have a significant impact on the teachers' professional training.

This article highlights further research by the authors, begun in [9, 10, 180].
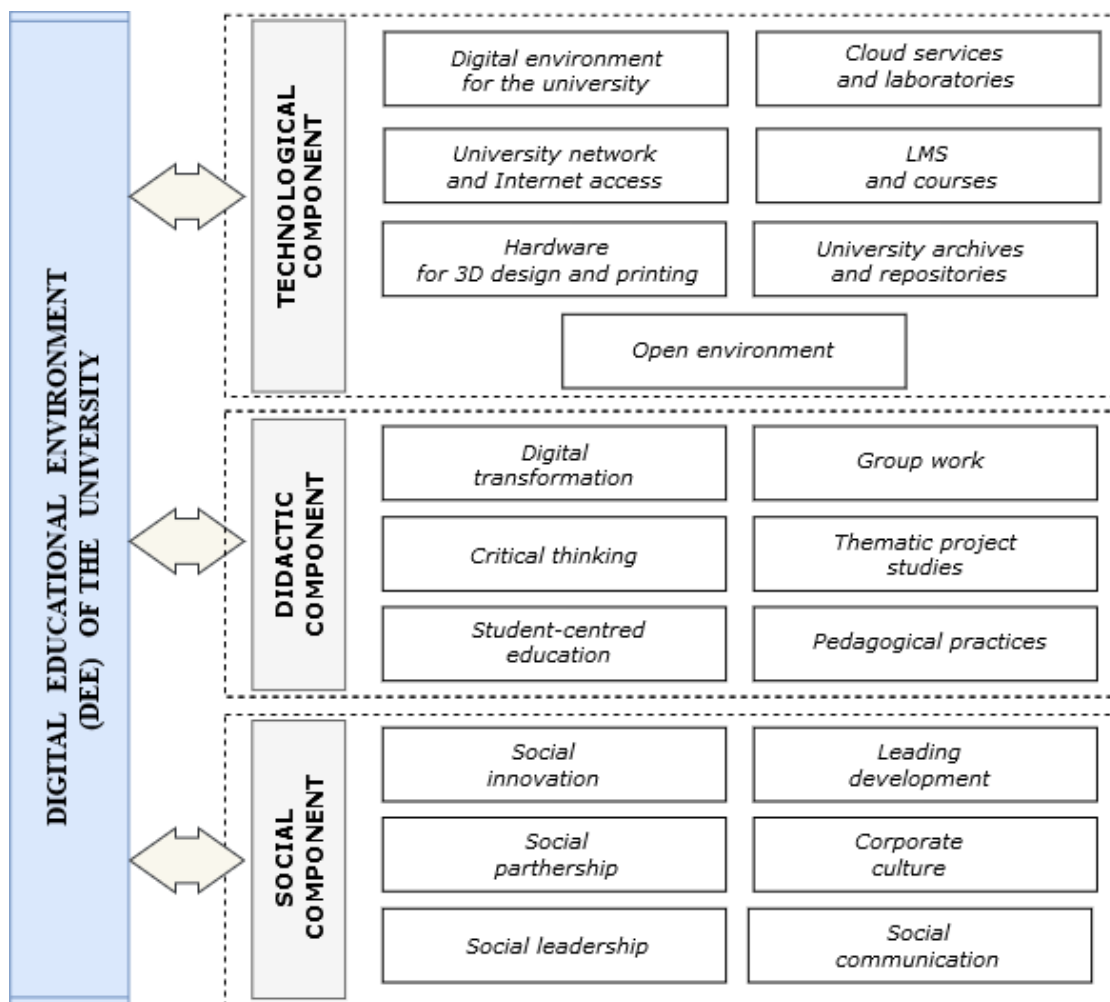
Figure 73: Presentation of paper [11].

Modern development of education is associated with the use of information and communication technologies. To date, there is considerable experience in the use of computer training systems. New forms and methods of teaching based on modern information and communication technologies are being developed and used, the concept of e-education has appeared. In relation to free software, the period of systematization of the accumulated experience and its theoretical substantiation of application in educational activity has come. The theoretical basis proposed in

the article "Theoretical bases of application of Free Software in preparation of pre-service teachers of Mathematics, Physics and Computer Science" [316] by Vladyslav Ye. Velychko (figure 74), Elena H. Fedorenko and Olga Yu. Serdiuk provided an opportunity to develop a system of free software in the training of pre-service teachers of Mathematics, Physics and Computer Science, which contains the conceptual, semantic, technological subsystem and subsystem of qualitative and quantitative indicators. The main purpose of the use of free software in the training of pre-service teachers of Mathematics, Physics and Computer Science is to increase the level of formation of information competence, which can not be fully formed without free software.

This article highlights further research by the authors, begun in [48, 313, 314].

The article "Experimental verification of efficiency of the formation of information and digital competence of bachelors of primary education based on an integrated approach" [332] by Olga G. Yaroshenko, Olena D. Samborska and Arnold E. Kiv (figure 75) deals with the organization, process and results of the experimental verification of the integrated approach to the modernization of information and digital training of future primary school teachers, which was theoretically grounded in the research. The experiment, which took place in some pedagogical colleges, involved the main forms of the educational process (classes, independent work, practical training, and tests), and included the study of the author's elective course "Modern Information and Digital Technologies in the Educational Process of Primary School". Appropriate methodological support has been developed for the formative stage of the pedagogical experiment. It consists of an electronic textbook "Modern Information and Digital Technologies in the Educational Process of Primary School", lesson plans, tasks for independent work and undergraduate pedagogical practice, test tasks of various types for current and final control, algorithms for practical work, and project topics. The educational process was based on electronic teaching aids such as slide libraries, video clips, interactive exercises and illustrations, electronic textbooks, including the author's teaching aids to the module "Google services in the work of primary school teachers". The two-year formative stage of the pedagogical experiment, which was attended by control and experimental groups of future bachelors of secondary education, confirmed the positive impact of the integrated approach on modernization of information and digital training of future primary school teachers and proved its effectiveness. During the period of its implementation, the levels of formation of cognitive, operational and value components of students' ID competence in the experimental group were significantly higher compared to the levels in the control group. Students in the experimental group were better prepared to conduct online training of primary school children in the conditions of quarantine restrictions caused by respiratory disease COVID-19. The statistical evaluation of the results of formation of students' ID competence in the conditions of realization of the integrated approach to modernization of ID training at the bachelor's level of higher education carried out by criterion 2 proved its efficiency.

This article highlights further research by the authors, begun in [20, 220, 331].

The ability to use the means of modern communication at different stages of the educational process, combining technical means with the latest educational technologies, is now a prerequisite for modern education. The methodological features of the use of ICT in information retrieval, project development, evaluation and self-evaluation are highlighted in the article "Use of information and communication technologies in the organization of blended learning of future vocational education professionals" [118] by Svitlana L. Kucher (figure 76), Roman M.
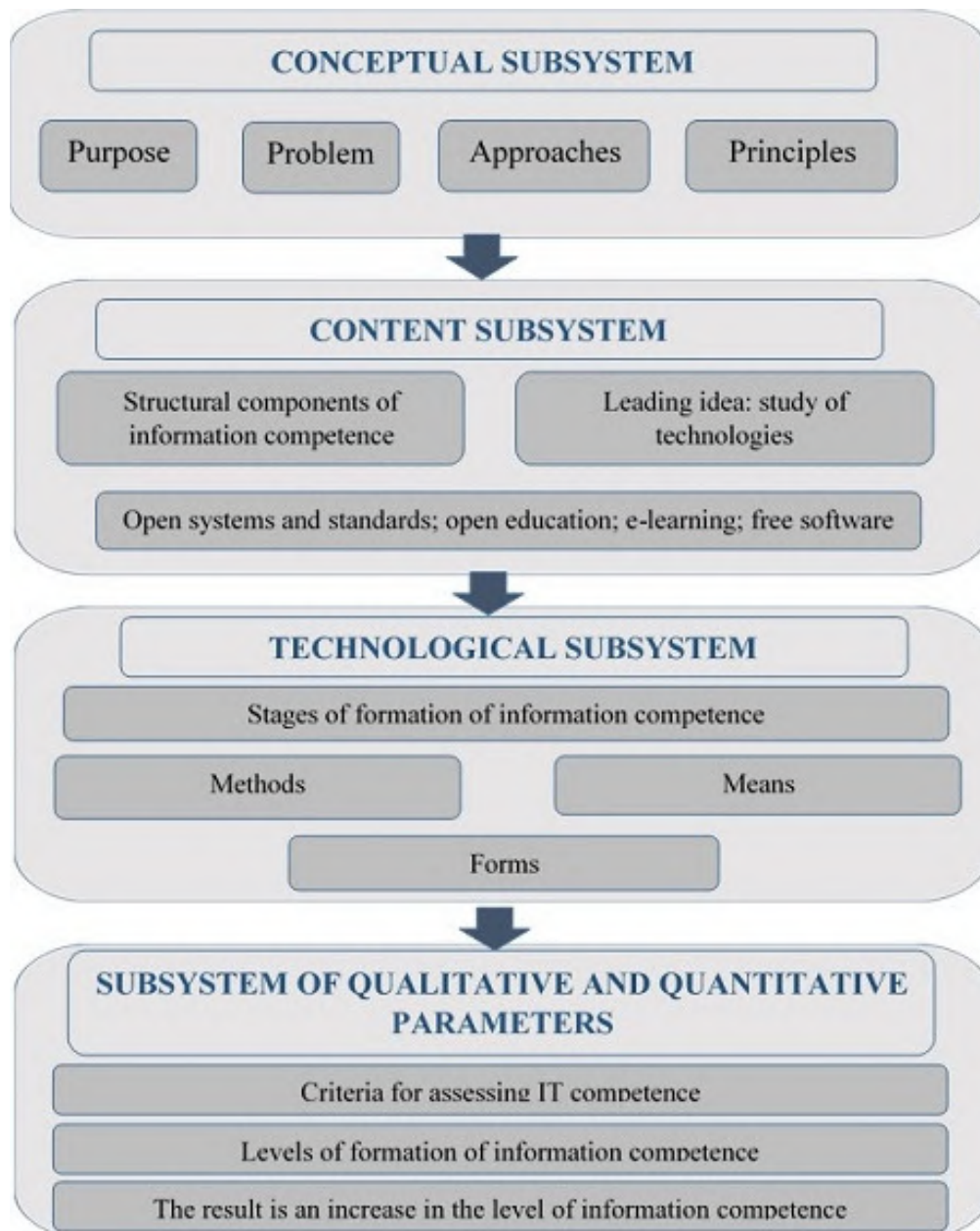
Figure 74: Presentation of paper [316].

Horbatiuk, Olga Yu. Serdiuk, Mykhailo M. Ozhha, Natalia M. Hryniaieva and Mark M. Fridman. Options for the appropriate use of public computer programs and means of communication to support online and blended learning, optimize feedback between the subjects of the educational process, an innovative approach to complex tasks. Mastering the tool software should become a fundamental part of the methodological system of education at the University.
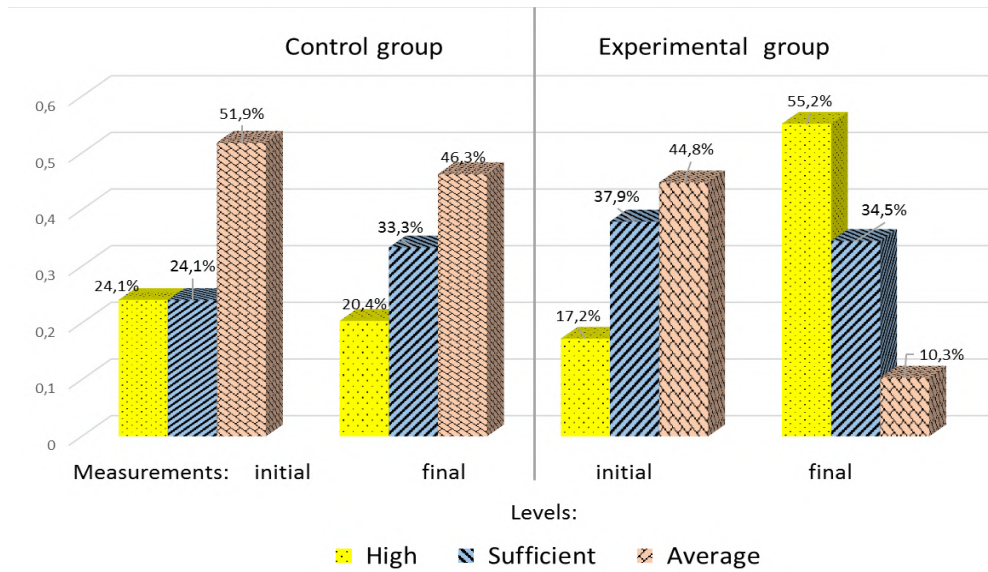
Figure 75: Presentation of paper [332].
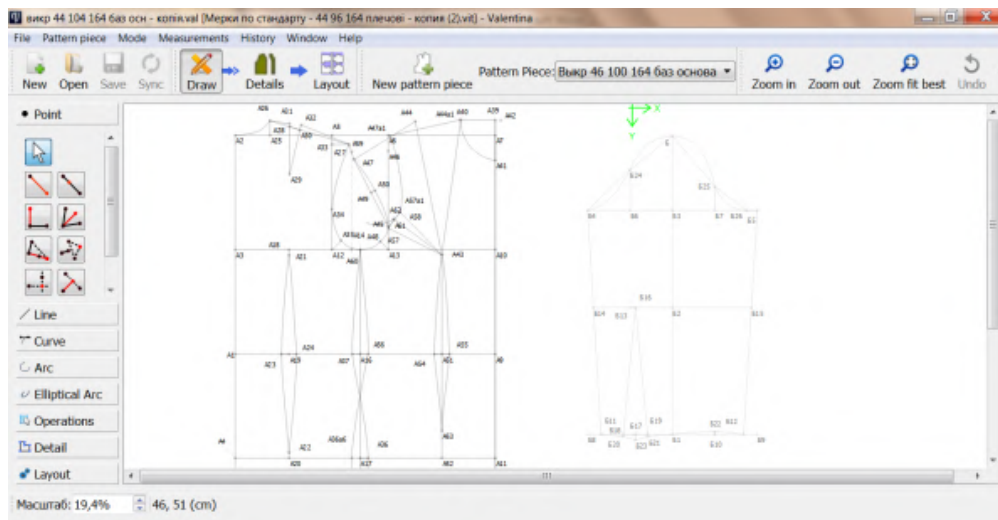
Figure 76: Presentation of paper [118].

In order to perform professional functions in the modern educational media space, the future computer science teacher must have skills of working with information and communication technologies, be aware of the methods of teaching educational material using media, be able to develop critical and analytical thinking and apply multimedia technologies in the educational process. The article "Development of media education in Ukraine: current state and modern requirements" [161] by Iryna M. Naumuk (figure 77) and Nataliia V. Valko focuses on the peculiarities of the introduction media education in Ukraine and highlights the importance of

media education development. The authors emphasizes the importance of media education and media literacy, which open up many opportunities for both students and teachers. As a result, the teacher develops the ability to assess information security, competently use sources of information, assess the reliability, see the correlation of information and knowledge, and properly organize the information process. Media education opens up great opportunities, helps to develop intellectual and creative potential, as well as critical thinking. The article describes the criteria for the future computer science teachers' media competence development.

This article highlights further research by the authors, begun in [42, 287, 301].
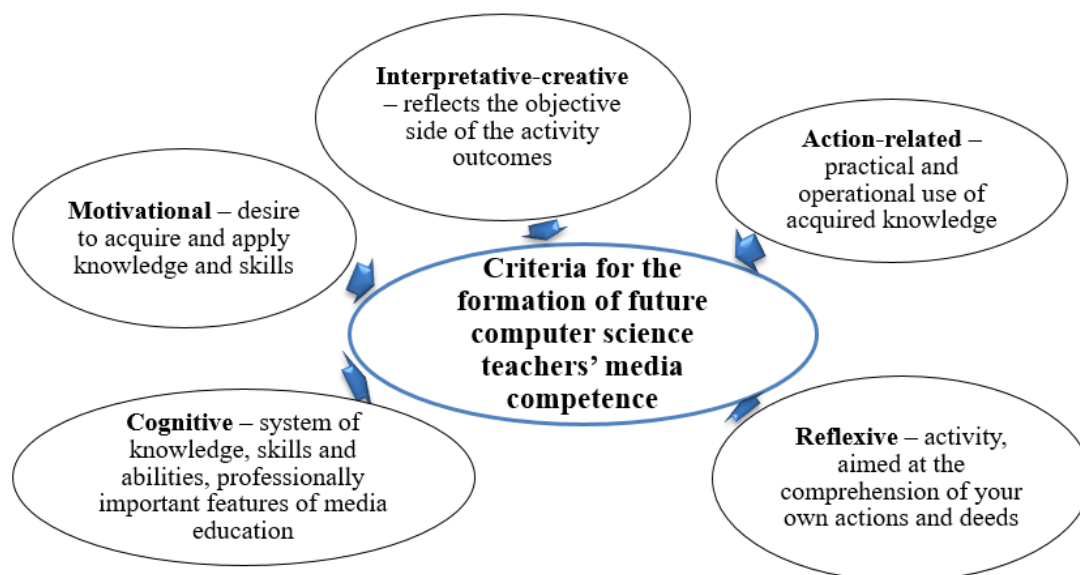
Figure 77: Presentation of paper [161].

The actuality of the article "Digital twin of an educational institution: an innovative concept of blended learning" [83] by Liubov A. Kartashova, Andrii M. Gurzhii, Valentyn O. Zaichuk, Tamara M. Sorochan and Feliks M. Zhuravlev lies in the fact that it features and singles out the problems occurring in organization of educational process during the period of forced breaks and formed needs of information society. It highlights the necessity of introduction of blended learning used to support the educational process continuity and to ensure the formation of motivation and interest of students/learners in process of knowledge acquirement. It shows the need to update the educational environment in conditions of digital prototype of educational institution, created in order to provide quality knowledge and ability to build an individual development trajectory for each learner. For the first time the use of state-of-the-art Digital Twin (DT) technology has been proposed to build a digital prototype of educational institution. It is shown that this technology is quite actively used in various fields. An analytical review of successful DT practices and clarification of problems caused by COVID-19 quarantine leads to the conclusion that DT can be used effectively in slowing down and limiting the spread of the disease, as well as preparing for possible long-term disruption of school attendance by learners. It is assumed that the usage of DT for each educational institution requires the

creation of authentic digital environment (web environment) aimed to support the educational process in blended learning format and based on integration of traditional teaching aids and digital resources. It is justified that the involvement of DT in education will logically combine physical and digital spaces as well as functional components of each educational institution and create their digital prototypes, which will actually function as dynamic and open web resources. DTs open to all participants of educational process the opportunity to obtain quality results in any circumstances that may be dictated by the society, while maintaining the integrity of educational system and pedagogical values of each educational institution.

2.14. Session B: Modelling systems in education

The article "Structural equation modeling in educational research: a case-study for PhD training" [203] by Liubov F. Panchenko (figure 78) and Vladyslav Ye. Velychko deals with the problem of using structural equation modelling (SEM) methodology in educational research. It allows the researcher to build multidimensional models of the phenomena and processes that are being studied. The SEM methodology is based on many well-known methods such as correlation, regression, factor analysis, variance analysis and covariance analysis. The methodology is mainly based on deductive logic, involves the preliminary construction of a structural model of relationships between variables in order to further check for consistency with the experimental data. The article summarizes the use of various SEM software in the training of doctors of philosophy of the world's leading universities and provides an example of using the SEM methodology in educational research for PhD student training. An important point in preparing specialists for using SEM is to select or obtain the necessary data sets that are representative and valid. During the research the Ukrainian teacher's self-efficacy model with SEM methodology was checked, and the obtained results were compared with the research data of the worldwide teacher's survey – The Teaching and Learning International Survey (TALIS). The lower self-efficacy of Ukrainian teachers, especially in the student engagement block, was showed.

This article highlights further research by the authors, begun in [199, 200, 202].

For a number of reasons, in particular the introduction of urgent quarantine measures, a temporary change is taking place in the format of full-time studies on distance learning. This requires a quick reorientation of the teacher and students to use educational solutions to provide remote access to teaching material. The article "Construction of an education model of natural disciplines' students in the distance learning conditions" [305] by Nataliia V. Valko, Viacheslav V. Osadchyi and Liudmyla V. Kuzmich studies the requirements for building a distance course in order to quickly adapt full-time education to distance learning. The features of the organization of distance STEM education are determined. The pedagogical and technological aspects of supporting distance learning STEM are established. The problems that may arise during the organization of distance learning are analyzed and models for overcoming them are considered. An example of constructing a course in accordance with established requirements is given.

This article highlights further research by the authors, begun in [120, 300, 304].

The analysis of four curricula of teachers training of natural sciences in higher education institutions is presented in the article "Analysis and prospects of the future teachers training of the integrated course "Natural sciences"" [303] by Nataliia V. Valko (figure 79) and Viacheslav V. Osadchyi. The question of curricula developing for pre-service teachers of natural
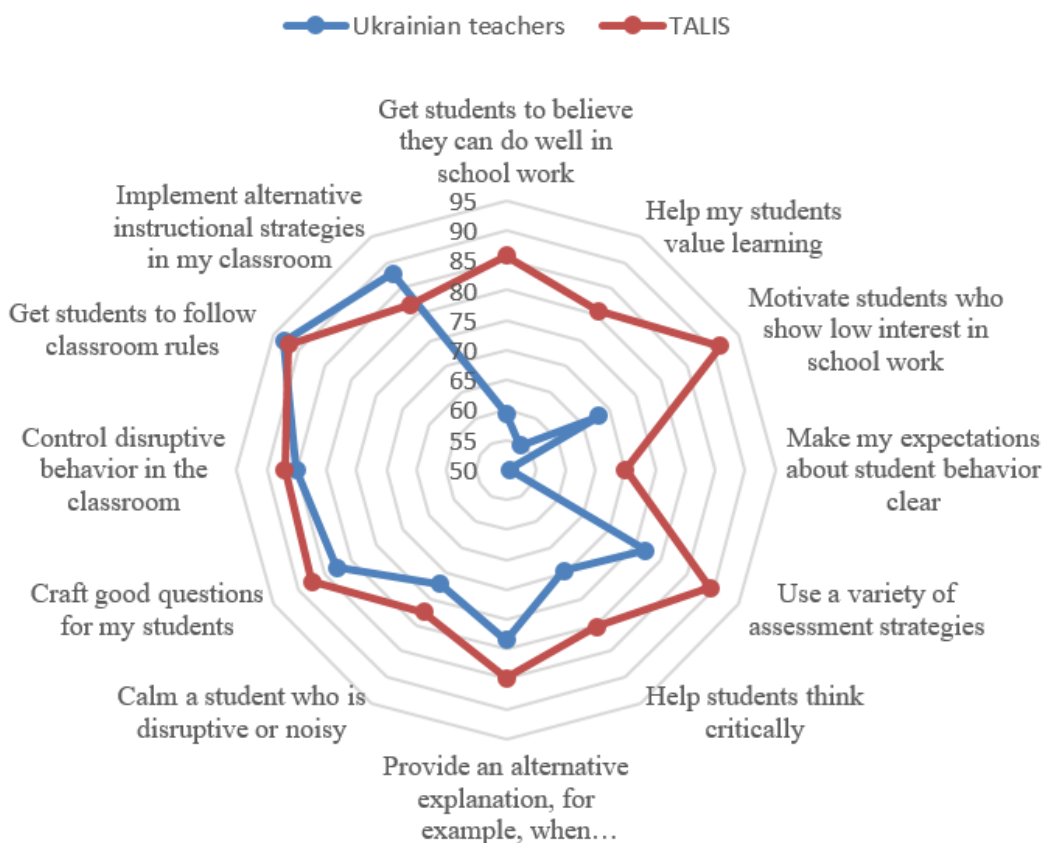
Figure 78: Presentation of paper [203].

sciences and introducing integrated courses in biology, physics and chemistry studying and conducting a new specialization in the educational branch "Secondary Education" should be studied. Authors analyzed the characteristics and the current state of curricula implementation into the educational process. The analysis of the normative framework regulated the teacher's activity is also made. In the framework of the components of teacher's professional activity there is considered terms of qualification characteristics. The considered professional standards and qualification characteristics made it possible to conclude the curricula correspond to the normative documents and modern requirements for the professional teacher's activity. The analysis of four curricula by sections is carried out. It made possible to compare the list of their components and the logical sequence of courses and to determine their common and distinctive features. The existence of the integrative component of each curriculum and its conformity to the formation of the professional competences of future teachers was established. The use of problem-oriented learning technology can form the subject competence, formulated in accordance with the basic subjects: physics, chemistry, biology, natural science. Subject competence in science is an integrative part of the course. They are based on the formation of

the integrity of representations of nature, the use of science and information on the basis of operation of the basic general laws of nature. The classification of integrated courses is made on the basis of the nature of the relationships between disciplines and the integration degree. The existence of integrative components in the list of the educational-professional/scientific program and their conformity with the classification of the integration of courses is established. Authors also defined the disciplines of influence on the formation of integrative competences of pre-service teachers of integrated courses of natural sciences.

This article highlights further research by the authors, begun in [59, 186, 302].

Figure 79: Presentation of paper [303].

2.15. Session C: Psychological safety in the digital educational environment

The article "The psychological safety of the educational environment of Ukrainian higher education institutions in a pandemic: empirical data of a comparative analysis of participants' assessments studying online" [33] by Olena I. Bondarchuk (figure 80), Valentyna V. Balakhtar, Yuriy O. Ushenko, Olena O. Gorova, Iryna M. Osovska, Nataliia I. Pinchuk, Nataliia O. Yakubovska, Kateryna S. Balakhtar and Maksym V. Moskalov highlights the problem of ensuring the psychological safety of participants of the educational process in the mass transition to distance learning, caused by the complex conditions of our time and the specific features of the digital environment in the COVID-19 pandemic. The study demonstrates the results of a comparative analysis of students' assessments studying online in a pandemic, the peculiarities of the psychological safety of the educational environment and its impact on students studying online in a pandemic. Also, this paper reveals the insufficient tendency to decrease the level of psychological safety of the educational environment for a significant number of subjects. There are statistically significant differences in the peculiarities of the psychological safety of participants in the educational process as to gender, age, and status. The survey of participants in the educational process presents the results as to their attitude to the peculiarities of learning under the conditions of the COVID-19. They testify to the deterioration of psychological safety

in the educational environment of higher education institutions, and, accordingly, the subjective well-being of participants in the educational process in a pandemic. There was a decrease in the number of respondents with a positive attitude to distance learning and a willingness to work exclusively online. The study displays the expediency of full-time and distance learning as such, which is optimal for the organization of the educational process and contributes to the psychological safety of participants in the educational process.

This article highlights further research by the authors, begun in [31].
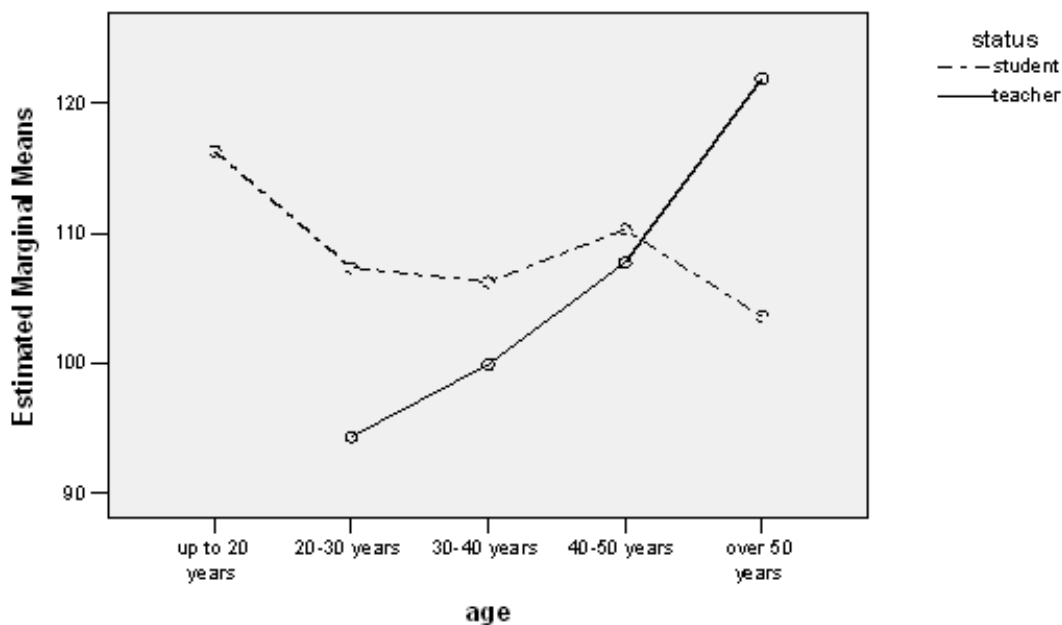
Figure 80: Presentation of paper [33].

The article "Development of heads' personal readiness of vocational education institutions for managerial activity in the conditions of distance postgraduate education" [211] by Nataliia I. Pinchuk (figure 81), Svitlana V. Kazakova, Yuriy O. Ushenko, Ivan V. Pustovalov, Nataliia V. Hordienko, Oksana L. Anufrieva, Olena A. Prokopenko, Oleksandra I. Pinchuk and Olga V. Fliarkovska highlights the problem of psychological features of heads' personal readiness of vocational education institutions to manage in the context of digitalization of educational space. The personal qualities of vocational education heads, significant in the context of the introduction of digital technologies of vocational training, are highlighted. The psychological features of adult education in general and postgraduate education, in particular, are determined. Specific problems of distance learning and distance postgraduate education are highlighted. The results of an empirical study of the peculiarities of the manifestation of indicators of heads' personal readiness to manage in the context of digitalization are presented. Difficulties in the manifestations of entrepreneurial activity, in assessing their effectiveness, the predominance of

egocentric orientation, differentiated attitude to others concerning the subjective, situational factors, limiting the focus on creating a creative digital educational environment in a large number of respondents were outlined. An insufficient general level of heads' personal readiness of the system of vocational education for management in the conditions of digitalization is stated. Psychological means of promoting the development of heads' personal readiness of vocational education institutions for management activities in the conditions of distance postgraduate education are determined. The program of development of heads' personal readiness of institutions of professional education to administrative activity in the conditions of distance postgraduate education is covered. The results of the analysis of the effectiveness of the program for the development of heads' personal readiness of vocational education institutions for management activities in the process of psychological training in the conditions of distance postgraduate education are presented.
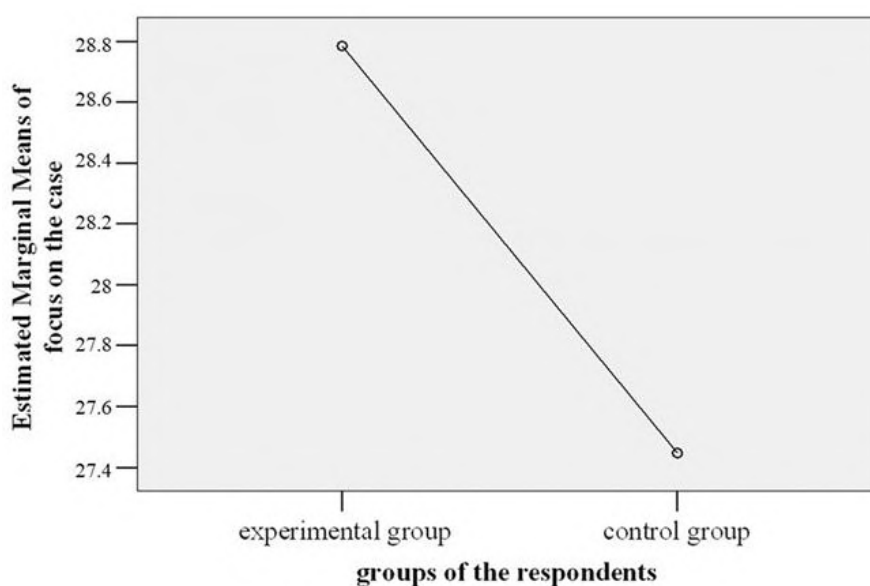
Figure 81: Presentation of paper [211].

The article "Creativity of foreign languages teachers in Ukrainian higher education institutions: empirical data" [7] by Kateryna S. Balakhtar (figure 82), Olena I. Bondarchuk and Serhii E. Ostapov highlights the problem of creativity of foreign languages teachers of higher education as a powerful resource for self-realization and the development of the personality of higher education student. The research aims at describing the teachers' creativity as their ability to creative non-standard thinking, to effectively solve complex problems of both professional activity and their own lives. The article highlighted the results of empirical research of value, cognitive and behavioural components and individual-psychological and organizational-professional factors of creativity of foreign language teachers. According to the results of ANOVA, there were established statistically significant differences in the manifestations of creativity of foreign language teachers depending on their gender, age and organizational and professional

characteristics. Authors offer the structure of the program of the development of creativity of the foreign languages teacher directed on the development of value, cognitive and behavioural components and individual-psychological and organizational-professional factors..
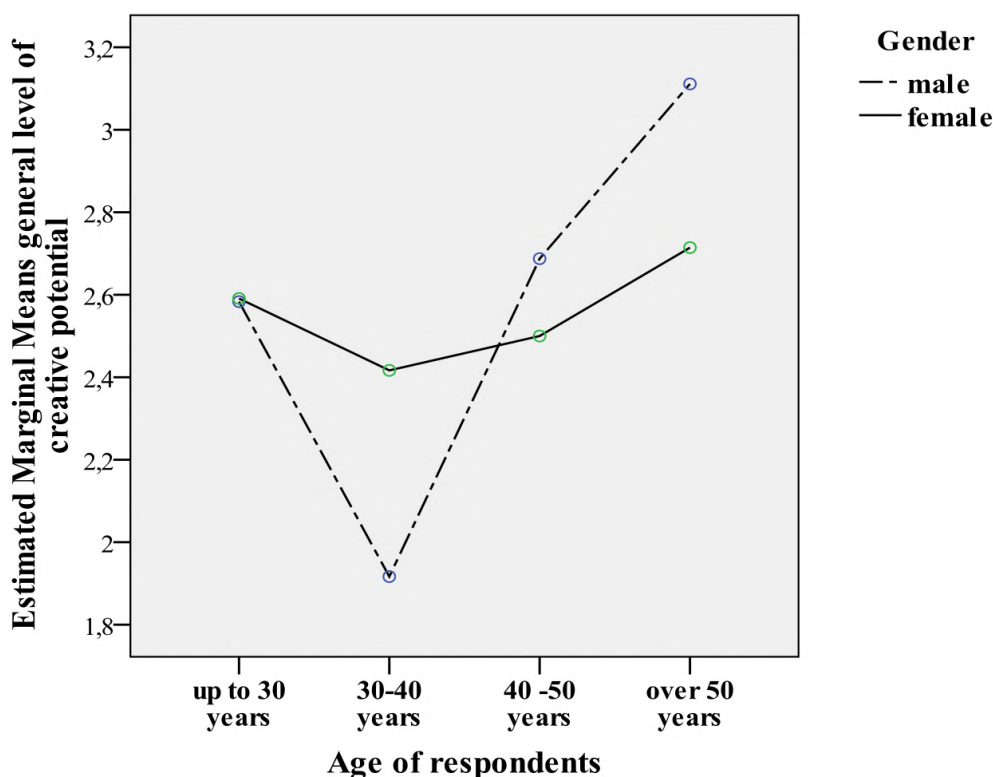
Figure 82: Presentation of paper [7].

The focus of the article "Experience of using ICT tools for monitoring the psychological component of the quality of teacher's activity of the higher education institutions" [32] by Olena I. Bondarchuk (figure 83), Valentyna V. Balakhtar, Kateryna S. Balakhtar, Valeriy O. Kyrichuk, Nataliia O. Yakubovska, Serhii E. Ostapov and Tamara V. Grubi is on the quality of education as a multifaceted category, and the monitoring of the quality of education – as a purposeful and specially organized system of studying, assessment, analysis of data on the state of education of students. Emphasis is on the psychological component of monitoring the quality of education, which involves creating a positive socio-psychological atmosphere for participants in the educational process, both students and teachers. Creating a comfortable atmosphere allows teachers to perform their work effectively, and higher education institutions – implement the main task of ensuring the quality of teaching staff. The article highlighted the experience of monitoring the psychological component of the quality of higher education using various ICT tools – Google services, specially created websites for professional psychological diagnostics, author's programs of psychological testing ("Comprehensive diagnosis of psychosocial development of the teacher's personality using a computer program "Personnel – Ψ""), etc. This study aims to study current conditions, namely the development of digital

technologies. The need to use electronic resources (Google services) has increased, which allows you to create text documents, presentations, spreadsheets, forms, drawings, programs and other documents. In order to provide the monitoring of the quality of the psychological component of higher education teachers' activity, Google Forms was elaborated to obtain information about the psychological state and satisfaction with the quality of educational services by the participants of the educational process, their relationship, the socio-psychological climate in higher education and others, amongst to respond to social and educational change on time.
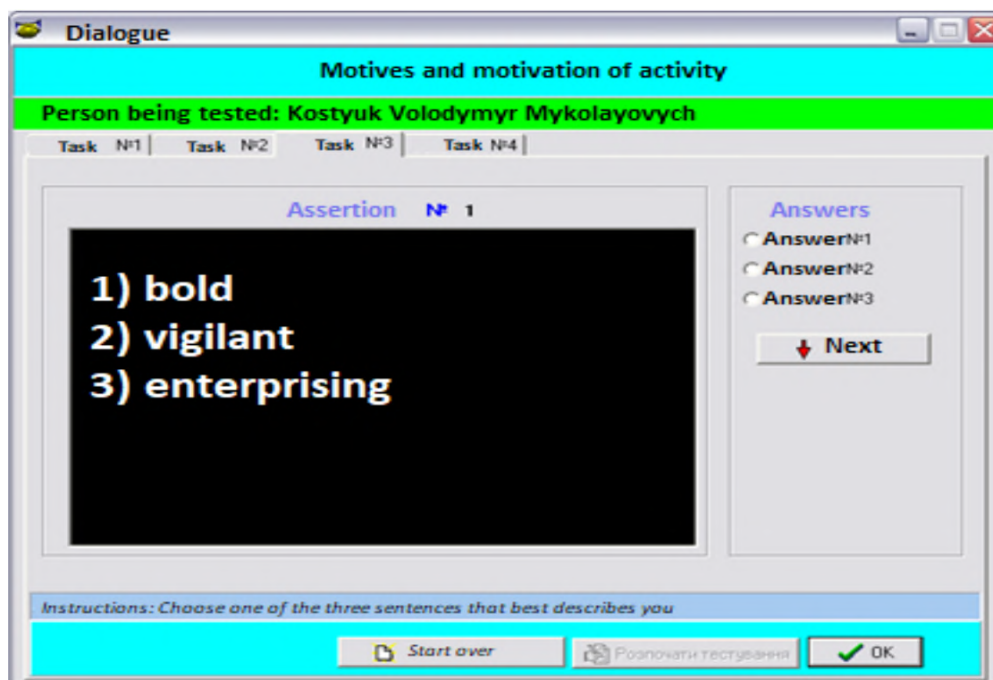
Figure 83: Presentation of paper [32].

Trends of modern society development, boom of the computer technologies, globalization and informatization affect all areas of public life, including education. In the conditions of transformational and epidemiological changes the significance, aim and mission of modern education include not just gaining basic knowledge and necessary skills and abilities but also the development of a cultural code, an independent approach to acquiring new knowledge, cultural values, and new forms of the activity. Currently, to solve this problem, innovative methods are used; these methods contribute to more effective acquisition of new knowledge with a high degree of students' involvement in the educational process. These methods also include augmented and virtual reality technologies, i.e. they can be both a learning tool and the research objectives. The article "Features of implementation of augmented and virtual reality technologies in the psycho-correctional process of development of emotional intelligence of high school students in terms of professional self-determination" [308] by Hanna B. Varina (figure 84), Kateryna P. Osadcha, Svetlana V. Shevchenko and Olena G. Glazunova presents a practice-oriented model of introducing the components of augmented and virtual reality in

the process of developing the high school students' emotional intelligence at the stage of their professional self-identification as a key factor of the development of professional self-awareness. An empirical study of high school students' emotional intelligence, based on the elements of augmented and virtual reality, which was carried out before piloting the program showed the following results – the majority of students are dominated by a low level of emotional intelligence. The least pronounced is the ability to manage both their own emotional state and the emotions of other people. In particular, authors have to emphasize a tendency of high school students of social type of professional self-identification to recognize the emotions of other people. Participants with a realistic type of professional self-identification have a low level of empathy; those having the entrepreneurial type of professional self-identification have low scores on the scale of emotional management. As a result of approbation of the components of augmented and virtual reality, it was found out that the level of intrapersonal emotional intelligence significantly increased among the respondents with a social orientation of professional self-identification. The priority task of designing a comprehensive program for the introduction of augmented reality in the modern educational space is to increase ergonomics, safety of the use of augmented and virtual reality elements in the process of development of high school students' key life competencies.

This article highlights further research by the authors, begun in [187, 190, 193].
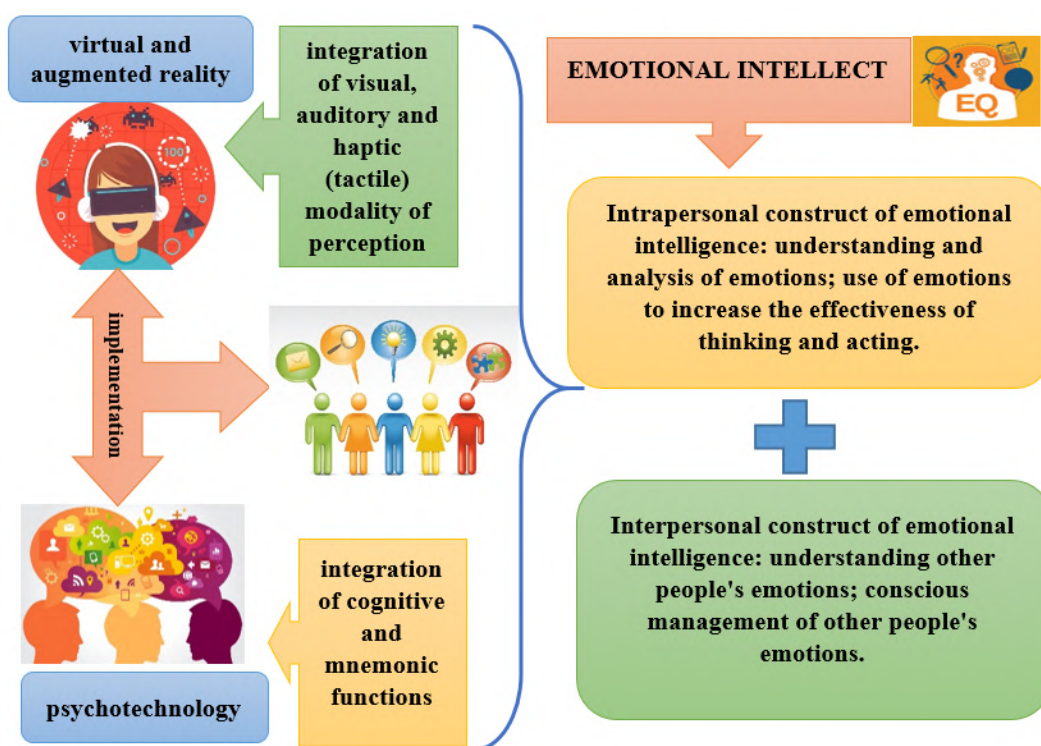
Figure 84: Presentation of paper [308].

The article "Psychological security in the conditions of using information and communication

technologies" [336] by Larysa P. Zhuravlova, Liubov V. Pomytkina, Alla I. Lytvynchuk (figure 85), Tetiana V. Mozharovska and Valerii F. Zhuravlov substantiates the relevance and expediency of the study of psychological security of the personality in the conditions of using information and communication technologies (ICT). The purpose of the research is an empirical study of the psychological safety of teachers of higher education institutions in the conditions of using information and communication technologies. The influence of traditional (classroom, offline) and distance (online) types of training on the sense of security of teachers of higher education institutions in the conditions of using ICT is analyzed. Today's realities, in particular the global pandemic caused by the spread of COVID-19 virus infection, have significantly accelerated the introduction and implementation of distance learning and significantly expanded the range of participants in the educational process. Therefore, it has been suggested that teachers of higher education institutions assess traditional (classroom, offline) learning as safer than distance (online). The results of an empirical study of psychological safety in the conditions of using ICT by teachers of higher education institutions are presented. A comparative analysis of the sense of security by teachers of higher education institutions in the context of traditional (classroom, offline) and distance (online) learning was performed. Associations of distance and traditional learning have been found to have significant differences. Groups of concepts in which associations of respondents are invested ("negative", "positive", "neutral") are defined. It is analyzed that associations for the phrase "distance learning", "full-time learning" are located on three semantic "fields": actions, states and characteristics of the referent of the word-stimulus; actions, states and characteristics of other subjects; feelings and emotions. Differences in the perception of distance and traditional learning by teachers depending on the time they spend on online learning were identified. It is determined that the level of psychological security is equally mediocre in both traditional and distance learning. Statistically significant relationships were found between the sense of security in online and offline learning.

The article "Research of teachers' occupational health by means of digital technologies" [150] by Halyna M. Meshko, Oleksandr I. Meshko, Iryna M. Trubavina, Nadia M. Drobyk, Vasil V. Grubinko, Nadiia I. Bilyk and Nataliia V. Habrusieva (figure 86) is devoted to the problem of studying the teachers' state of occupational health and finding ways of its preservation and strengthening under the conditions of quarantine, caused by a coronavirus infection. To study the general state of teachers' occupational health, authors used Google Forms questionnaire, which had been developed by the authors of the research. The questionnaire included defining the characteristics of teachers' motivation to engage in healthy activities, the study of the internal picture of occupational health, and their emotional well-being at school before and during the quarantine. The focus of the research was the analysis of the main psychological indicators of occupational health (emotional well-being, occupational stress resistance, satisfaction from teaching), considering the length of working in a school, type of school, gender. The results of the study of teachers' occupational health and its comprehensive analysis served as the basis for determining the content and form of providing them with consulting services. The study presents functions, directions, and the program of the Center of Pedagogical Consulting to preserve and strengthen teachers' occupational health, identify the opportunities to use digital technologies in the implementing of pedagogical consulting under quarantine restrictions, associated with the COVID-19 pandemic.

This article highlights further research by the authors, begun in [148, 149, 283].

Figure 85: Presentation of paper [336].
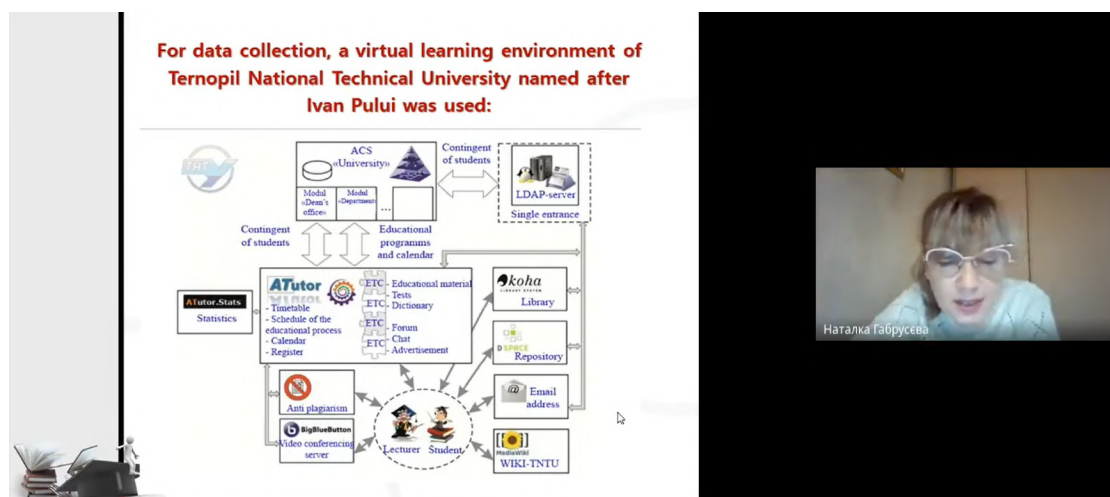
Figure 86: Presentation of paper [150].

2.16. Session D: Soft skills development

The article "Development of professional competence of primary school teachers of the New Ukrainian School in the aspect of foreign language teaching" [116] by Inna A. Kravtsova, Alina O. Kravtsova, Vita A. Hamaniuk (figure 87), Olga S. Bilozir and Andrei V. Voznyak is devoted to the problems of development of professional competence of primary school teachers in the aspect of teaching foreign languages according to the requirements of the concept of the New

Ukrainian School. The analysis and the description of Internet resources as a means of providing the results of foreign language learning in a primary school are made. As knowledge of a foreign language is a social necessity of a contemporary person, the use of Internet resources will help to modernize the study of foreign languages in primary school in accordance with the requirements of the concept of the New Ukrainian School. Acquirement of professional competence of primary school teachers in the method of organizing distance learning is a priority of higher education institutions in the training of future teachers and continuing education.

This article highlights further research by the authors, begun in [6, 198, 210].

In the era of the information society, with the experience of social isolation during the pandemic, each of us is permanently influenced by a flurry of information that varies in content, quality, verifiability, motivational orientation. Therefore, the primary task is to create conditions for information security. One approach to solving this problem is media literacy education. The article "The role of media literacy in the conditions of information risks: specifics of educational communicative experience 2020 regarding the freedom of media communication and social isolation" [215] by Iryna K. Pokulyta, Olha V. Sotska and Ivan G. Riznitskii discusses strategies of the introduction of media education in international organizations, analyzes the specifics of media education and media literacy in various aspects and examines the role of critical thinking in countering information aggression as an intensification of risks and dangers in terms of establishing norms of social distance for prevention of epidemiological threats.

This article highlights further research by the authors, begun in [214].

The article "The use of Moodle in the teaching of philosophy and distance learning" [2] by Andrii I. Abdula, Halyna A. Baluta, Nadiia P. Kozachenko (figure 88), Darja A. Kassim and Feliks M. Zhuravlev highlights the importance of philosophy and special philosophical disciplines for the modern general education, assuming their role in the soft skills training, and more concretely in developing critical thinking in students. However, the emerging trend of reducing the university philosophy courses can make it difficult to fulfill this role in full. In this context using the distance learning tools and learning management systems can help to provide an appropriate educational environment (also in view of the current pandemic situation) to ensure the sufficient level of learning outcomes in philosophical literacy and critical thinking skills. Moreover, the modern e-learning tools and technologies can facilitate the involvement of students into the global educational space and promote development of their lifelong learning skills. In elaborating a virtual learning environment for philosophy courses, one has to take into account certain features of philosophical disciplines, which are instrumental in their structure and may cause some difficulties by its implementation. Namely, the learning outcomes in philosophy courses may not easily be parametrized, philosophical questions often allow for multiple alternative answers, and philosophical discourse is essentially communicative. Remarkably, the Moodle learning management system is well suited for addressing these issues and enhancing the learning process. To this effect authors propose various task types to maintain high standards of learning achievements: test control in the flipped classroom, control of work with primary sources, control of self-study, test implementation of interim thematic control. In this way the Moodle system can well be regarded as an efficient virtual tool for an on-line support of a general philosophy course. Still, one should be fully aware that this tool can only play a supporting role and cannot entirely replace a substantive philosophical dialogue actually occurring either in a "physical" classroom or by means of a video-conference platform (such as

Classification according to the development of communicative speech competence

No.	Title	Lexical	Grammatical	Semantic	Phonological	Orthographic	Orthoepic	Socio-linguistic
1	Study-languages-onlinecom	+	+		+	+	+	+
2	cambridgeclub	+	+	+	+	+	+	+
3	Lingualeo	+	+	+	+		+	+
4	Iqsha	+	+	+		+		+
5	Duolingo	+	+	+	+	+	+	+
6	Cambly	+	+	+	+	+	+	+
7	Englishdom	+		+	+	+		+
8	Learnenglishkids.british-council.org	+	+	+	+	+	+	+
9	Interneturok	+	+	+	+	+	+	+
10	Puzzle-English	+	+	+	+	+	+	+
11	Busuu	+	+	+	+	+	+	+
12	Poliglotiki	+	+	+	+	+		+
13	Memrise	+		+	+			+
14	Starfall	+		+	+			+
15	Simpler	+	+		+			
16	Cambridge English	+		+				
17	Games to learn English	+	+	+	+	+		+
18	Teremoc	+		+		+		
19	Novakids	+	+	+	+	+	+	+
20	Skyeng	+	+	+	+	+	+	+
21	EnglishDom	+	+		+	+	+	+
22	Preply	+	+	+	+	+	+	+
23	English show	+	+	+	+	+	+	+
24	Doma.uchi	+		+	+			+

«+» – the development of the specified competence is available.
« » – the development of this competence is absent or insignificant.

Figure 87: Presentation of paper [116].

Zoom, Google Meet, etc.). Modes of study, directly related to communication, are integral part of the methodology of philosophy and its teaching, since philosophy itself is a discursive and pluralistic field. Nevertheless, taking into account the features of the discipline, it is possible to provide not only an effective test control, but also to implement a number of general educational goals, such as updating the basic knowledge, memorization, activating the cognitive interest, developing the ability to reason, and - last but not least – the skill of acquiring and assimilating information. The paper presents a comparative statistical analysis of the student academic

achievement by studying philosophy in a lecture room and distantly during the pandemic.

This article highlights further research by the authors, begun in [1, 40, 207].

General characteristics of the statistical sample		
	2019	**2020**
Number	330	297
Sum	20826	18999
Average	63,1091	63,9697
Mode	50	50
Median	62	63
Dispersion	388,6385	498,1376
Mean deviation	16,4436	18,0229
Asymmetry	0,1281	-0,2849

Figure 88: Presentation of paper [2].

The article "Applied technology of fiction and non-fiction conceptual presentation via ICT tools: pedagogical function of graphic mimesis" [142] by Rusudan K. Makhachashvili, Svetlana I. Kovpik (figure 89), Anna O. Bakhtina, Nataliia V. Morze and Ekaterina O. Shmeltser deals with the technology of structuring and visualizing fictional and real life empirical concepts with the help of emoji symbols in open source digital text mining platforms that not only activates students' thinking, but also develops creative attention, makes it possible to reproduce the meaning of poetry in a succinct way, develops comprehensive digital literacy. The application of this technology has yielded the significance of introducing emoji in the study and mastering of literature is absolutely logical: an emoji, phenomenologically, logically and eidologically installed in the digital continuum, is separated from the natural language provided by (ethno)logy, and is implicitly embedded into (cosmo)logy. The technology application object is the text of the twentieth century Cuban poet José Ángel Buesa. The choice of poetry was dictated by the appeal to the most important function of emoji – the expression of feelings, emotions, and mood. It has been discovered that sensuality can reconstructed with the help of this type of meta-linguistic digital continuum. It is noted that during the emoji design in the Emoji Maker program, due to the technical limitations of the platform, it is possible to phenomenologize one's own essential-empirical reconstruction of the lyrical image. Creating the image of the lyrical protagonist sign, it was sensible to apply knowledge in linguistics, philosophy of language, psychology, psycholinguistics, literary criticism. By constructing the sign, a special emphasis was placed on the facial emogram, which also plays an essential role in the transmission of a wide range of emotions, moods, feelings of the lyrical protagonist. Consequently, the Emoji Maker digital platform allowed to create a new model of digital presentation of fiction, especially considering the psychophysiological characteristics of the lyrical protagonist. Thus,

the interpreting reader, using a specific digital toolkit – a visual iconic sign (smile) – reproduces the polylateral metalinguistic multimodality of the sign meaning in fiction. The effectiveness of this approach is verified by the poly-functional emoji ousia, tested on texts of fiction. The experiment with the construction of signs and concepts in the Emoji Maker platform was supplemented by another experiment involving students in its visualization. The location specificity of the experimenters and respondents of the experiment is taken as the basis for generating a sign – the image of Borys Grinchenko as a patron of the Borys Grinchenko Kyiv University. Consequently, an individual approach to the visualization of corpus data was tested using the web application Voyant Tools, which works as an open source, providing text mining data. It is proved that with the support of reading and interpreting texts or corpus, digital analysis of the text becomes a significant linguistic addition to the generated sign. And the visual complement can be based both on a specific text (poetry by Jose Angel Buesa) and on keywords / concepts (the image of Borys Grinchenko in the context of a specified location – at Borys Grinchenko Kyiv University).

This article highlights further research by the authors, begun in [144, 156, 235].
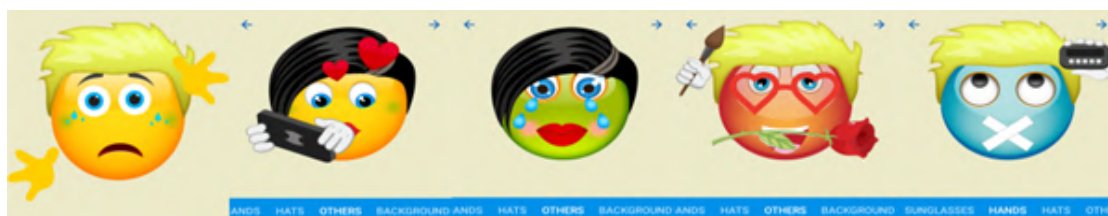
Figure 89: Presentation of paper [142].

The aims of the article "Digital and ICT literacy skills as one of the key competences of future foreign language teachers" [110] by Tetiana V. Konovalenko (figure 90), Yuliia A. Nadolska, Olga Yu. Serdiuk, Tamara B. Poyasok and Andrii M. Striuk are to share the results of the action research of the future foreign language teachers' digital and ICT literacy skills development and to demonstrate the opportunities for their development while pre-service teacher training process with the focus on the courses of Methodology of foreign language teaching and Practical course of foreign language as well as other positive practices. The authors present the results of comparative analysis of Ukrainian and American educational programmes for future foreign language teachers as for their opportunities to develop their digital and ICT literacy skills. The article discusses the digital and ICT literacy skills use in learning and teaching as an important component of future teachers' training and a contribution to the university education quality and the employability of university graduates. The projects which influenced the action research elaborating are described. The results of three surveys are presented. The post-action-research stage is described as the one influenced with students' and teachers' participation in projects alongside with the extremely increased use of ICT in the conditions of the pandemic.

This article highlights further research by the authors, begun in [109, 264, 266].

The aims of the article "Development of future foreign language teachers' soft skills by means of ICT in Ukrainian universities" [30] by Natalia V. Bondar (figure 91), Tetiana V. Konovalenko and Ivan G. Riznitskii are to overview the main aspects of soft skills development by means

Soft skills needed in life
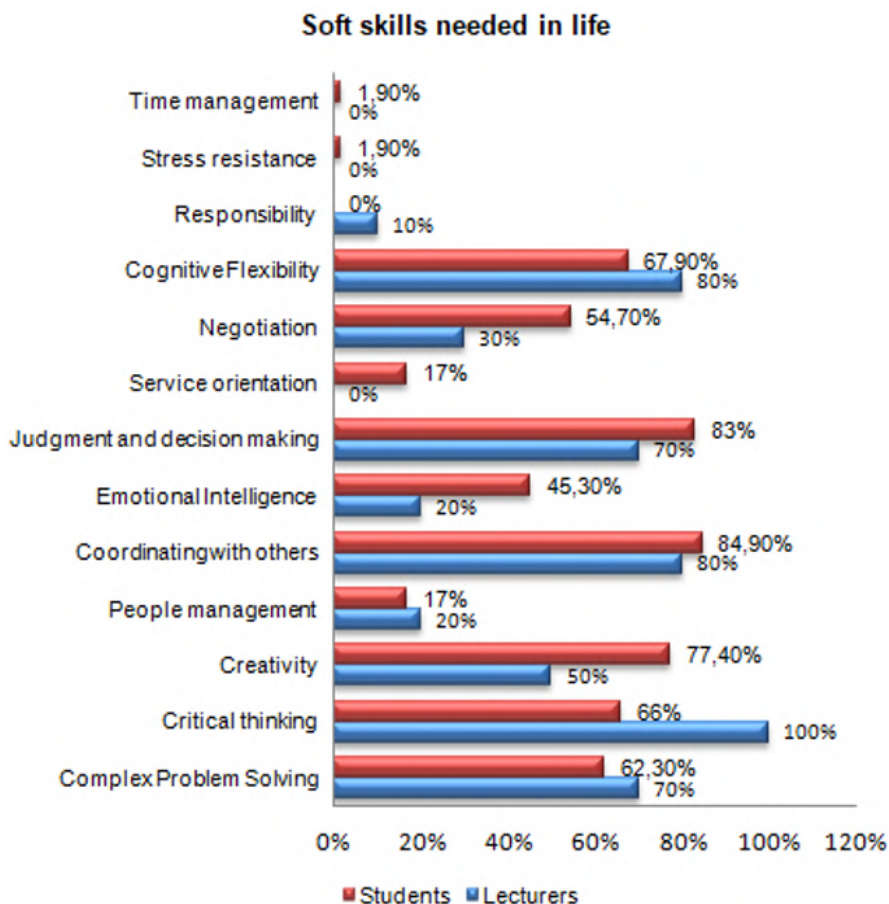
Figure 90: Presentation of paper [110].

of ICT in higher education Ukraine. The ways of future foreign language teachers' soft skills development are identified within the core and selective parts of the curriculum of Bachelor's level. The article discusses the essence of soft skills, their difference from hard skills and the main recent tendencies of their development by means of ICT in Ukrainian higher education. The idea of creating educational-professional hub and its programme aimed at future foreign language teachers' soft skills development is outlined.

Current trends in improving the educational system involve the parallel acquisition of multi-faceted knowledge, the maximum expansion of horizons and the preparation of students for the optimal choice of profession. Scientists and methodologists from many countries work in this direction. The solution of these problems is inextricably linked with the task of developing general intelligence and creative thinking. The role of lateral thinking in the creative process is discussed in the article "The development of creative thinking as an important task of educational process" [92] of Arnold E. Kiv, Kateryna V. Kolesnykova, Tatyana I. Koycheva, Alina O. Vinkovska (figure 92) and Ivan I. Donchev. Lateral thinking is an important component of creative thinking. The article discusses the essence of lateral thinking and possible ways

Figure 91: Presentation of paper [30].

to test it. Here authors discuss also the features of the probability distribution function for various psychological parameters characterizing the personality. It was noticed that the more universal the psychological parameter, the closer its probability distribution to the ideal normal distribution. It is shown that the probability distribution of the lateral thinking parameter is similar to the normal distribution of Eysenck's parameter for general intelligence. The latter indicates that lateral thinking is a fairly universal personality trait.

This article highlights further research by the authors, begun in [93, 238, 318].

Figure 92: Presentation of paper [92].

2.17. Session E: STEM education

The ideas of the constructivist paradigm of education continue to develop in the XXI century. In this context, the STEM approach is being implemented very dynamically for the formation of curricula of formal and non-formal education institutions. At the same time, M. Montessori pedagogy educational centers remain popular in Ukraine. Based on the use of web mapping service Google Maps, Iryna A. Slipukhina (figure 93), Arkadiy P. Polishchuk, Sergii M. Mieniailov, Oleh P. Opolonets and Taras V. Soloviov searched, identified and quantitatively analyzed the distribution of educational institutions in Ukraine that use the STEM-STEAM-STREAM approach and methodological tools of M. Montessori pedagogy. The results of data processing are presented in the article "Methodology of M. Montessori as the basis of early formation of STEM skills of pupils" [252] via maps and diagrams, which indicate the number of Montessori pedagogy centers and STEM-STEAM-STREAM training centers for each region. Based on the data of the official websites of educational institutions, an analysis of the content and organization of some Montessori centers in Ukraine was carried out that is demonstrated by means of examples. To obtain a conclusion about the state of development of pedagogical technologies the method of Gartner Hype Cycle is used. Comparison of the principles of pedagogy M. Montessori and STEM approach to education reveals many common didactic features based on the ideas of constructivism in education. In particular, authors want to note the features of active interaction of subjects of the educational process, the development of curiosity, change of the teacher functions.

Figure 93: Presentation of paper [252].

Under STEM education, a lot of computer-based methods were used to improve motivation, personalization and enchaining of the quality educational process. However, the attention has not been devoted to using of the IoT and smart tools to measure parameters during educational research process. It stands even more relevant due to the growth of the amount of the smart-watch/band used by people. The methods of using personal smart tools under STEM classes and

researches have been developed in the article "Using of personal smart tools in STEM education" [245] by Yevhenii B. Shapovalov (figure 94), Zhanna I. Bilyk, Stanislav A. Usenko, Viktor B. Shapovalov, Kateryna H. Postova, Sergey O. Zhadan and Pavlo D. Antonenko. Colmi land 1, Xiaomi Mi Band, Samsung Smart Fitness Band, Xiaomi Mi Smart Scale were used to test the proposed methods. Firstly, As is – To be Business Process Model and Notation method was used to evaluate changes in educational processes for both, pedagogical and technical points of views. It is proven that proposed methods are characterizing by the higher efficiency compare to classical educational process. For the first time, the techniques of using personalized smart tools to measure during the experiments are described in the paper and ready to use.

This article highlights further research by the authors, begun in [246, 274, 275].
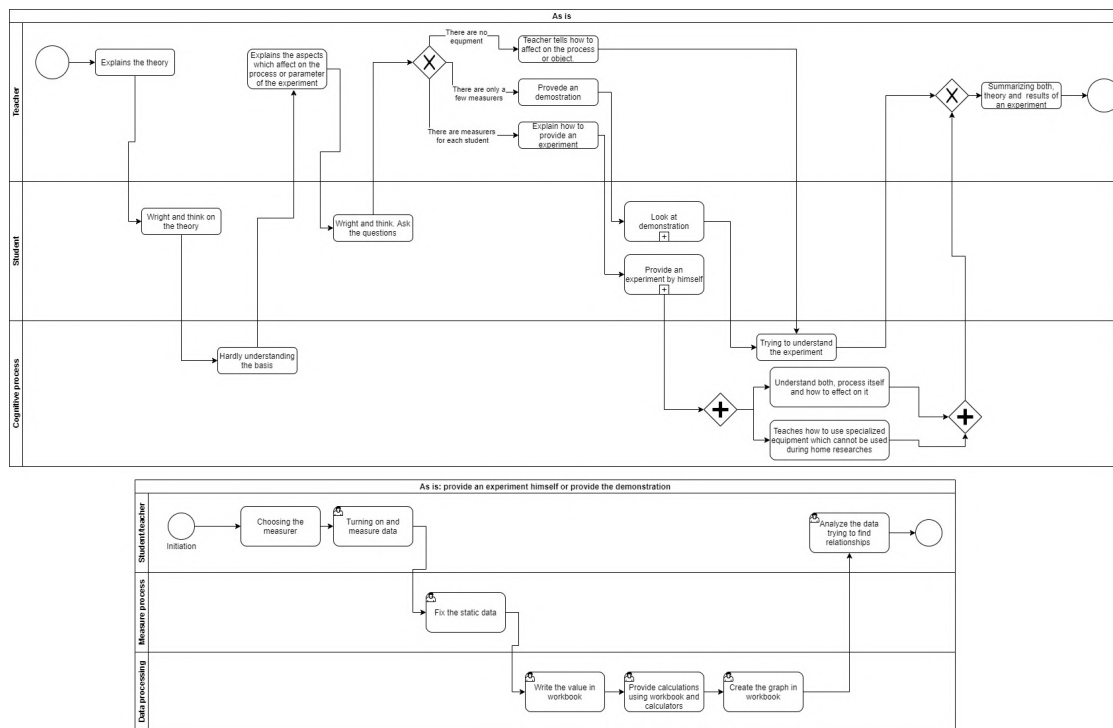
Figure 94: Presentation of paper [245].

The current state of development of robotics as an applied industry shows its intensive development. As a result, there is a growing demand for robotics specialists because of an urgent need for specialists to develop, design and program robots. This contributes to the popularity of robotics as an educational trend in Ukraine and around the world. The introduction of educational robotics as a part of STEAM education is a powerful step for development of students' soft skills, training for the implementation of real socially significant projects, formation of practical value of theoretical knowledge, scientific world outlook and successful life in a digital society as a whole. Taking into account the trends in the development of robotics as an applied industry and educational trend, there is a need in training pre-service teachers to make them able to teach children educational robotics. In this regard, there is the issue of

determining the structure of competences in educational robotics for teachers and ways of their development. The research proves that pre-service computer science teachers are the readiest to teach educational robotics in secondary schools. The article "Model of the competences in educational robotics" [160] by Nataliia V. Morze and Oksana V. Strutynska (figure 95) is devoted to the issues of developing a model of competences in educational robotics for teachers, as well as their formation in pre-service computer science teachers. The effectiveness of the model of competences in educational robotics is confirmed within the process of teaching disciplines of educational robotics for pre-service computer science teachers.

This article highlights further research by the authors, begun in [73, 159, 267].
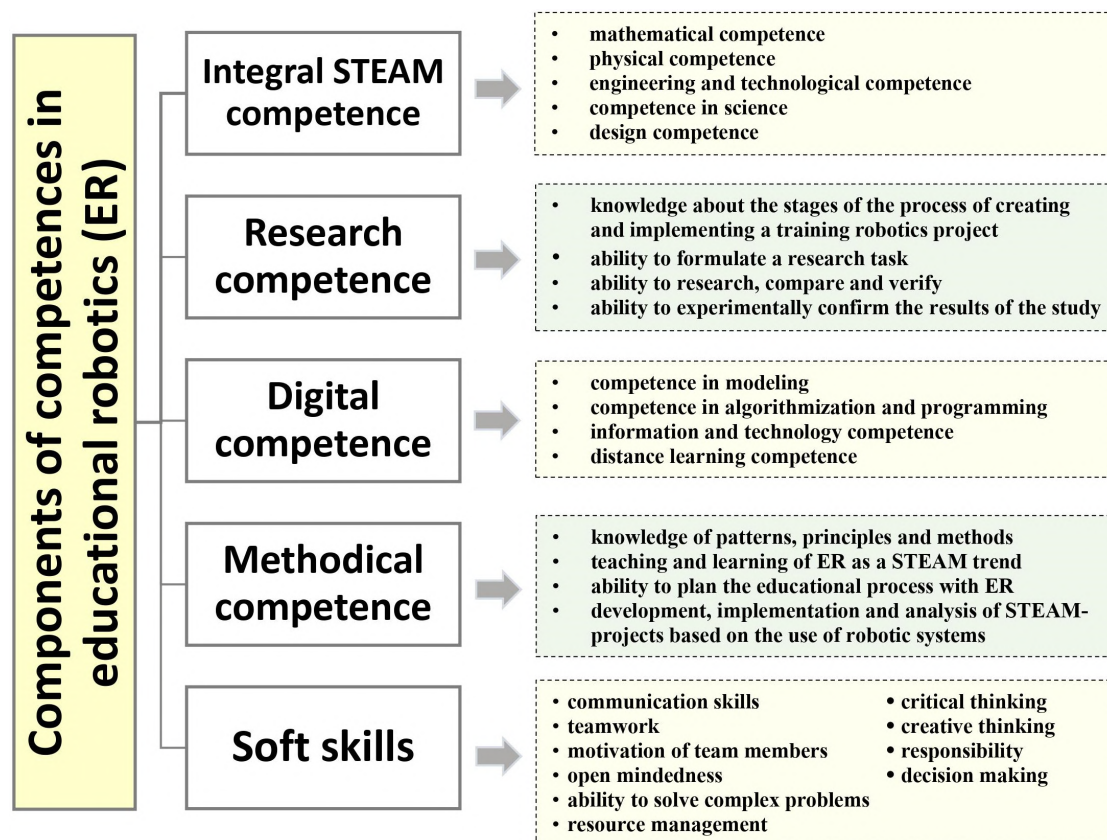
Figure 95: Presentation of paper [160].

2.18. Session F: Virtualization of learning

The article "The problem of the limitations of the educational model experiment on population genetics and its solution" [107] by Elena V. Komarova (figure 96) and Arnold E. Kiv highlights the difficulty of conducting an educational model experiment on population genetics is in meeting the requirements of mass and replication. The evolution of a model experiment to study the Hardy-Weinberg law according to the methods proposed by the authors is considered – from

the use of material models and manual counting of alleles and genotypes to the transition to automatic random distribution of elements of the genotypic structure of the population and automatic calculation of the resulting indicators. The technique of fully automated modeling of the genetic structure of the population allows to increase the size of the model sample by orders of magnitude. When using the technique in group work of students, it becomes possible to demonstrate the essence and differences of technical and biological replication as requirements for organizing a biological experiment. The technique is currently developed to work only with very large ideal populations.

This article highlights further research by the authors, begun in [104–106].

Model experiment 1. Study of the genetic structure of the ideal population (third option)

1. In column 2 for the parent generation P, we introduce the number of pairs of two-body gene alleles (in other words, the number of individuals).
2. We are determined by the ratio of the dominant (A) and recessive (a) alleles, and we introduce their values in columns 9 and 10 for the parent generation P.
3. Click the "Calculate" button.
4. Click the "Calculate" button opposite the lines F1, F2, F3, F4, F5.
5. Click on the "Show Graphs" button.
6. Based on the analysis of the obtained graphs and diagrams, formulate the conclusions of the plan:
   - Change in the frequency of genotypes in generations;
   - Change in the ratio of gene frequencies in generations;
   - The direction of evolutionary changes in the population.

Table 6. Genetic structure of the ideal population

Generation	Number of individuals	Distribution of genotypes						Gene frequencies		
		AA		Aa		aa		A(p)	a(q)	
1	2	3	4	5	6	7	8	9	10	
P	20000	2295	0.115	3410	0.171	14295	0.715	0.2	0.8	Calculate
F1	20000	2261	0.113	3478	0.174	14261	0.713	0.336	0.844	Calculate
F2	20000	2310	0.116	3380	0.169	14310	0.716	0.340	0.846	Calculate
F3	20000	2274	0.114	3452	0.173	14274	0.714	0.337	0.845	Calculate
F4	20000	2221	0.111	3558	0.178	14221	0.711	0.333	0.843	Calculate
F5	20000	2285	0.114	3430	0.172	14285	0.714	0.338	0.845	Calculate

Show Graphs

Figure 96: Presentation of paper [107].

The article "Using the virtual chemical laboratories in teaching the solution of experimental problems in chemistry of 9th grade students while studying the topic "Solutions"" [164] by Pavlo P. Nechypurenko (figure 97), Tetiana V. Selivanova, Maryna P. Chernova, Olga O. Evangelist, Yevhenii O. Modlo and Vladimir N. Soloviev discusses the importance of student research activities for the effective formation of the key competencies of a future specialist in the field of chemistry, the importance of the skills of primary school students to solve experimental problems in chemistry and the conditions for the use of virtual chemical laboratories in the process of the formation of these skills. The concept of "experimental chemical problem" was analyzed. The essence of the concept of "virtual chemical laboratories" is considered and their main types, advantages and disadvantages that define the methodically reasonable limits of the use of these software products in the process of teaching chemistry, in particular, to support the educational chemical experiment are described. The main advantages and disadvantages of the virtual chemical laboratories on the modeling of chemical processes necessary for the creation of virtual experimental problems in chemistry are analyzed. The features of the virtual

chemical laboratory VLab, the essence of its work and the creation of virtual laboratory work in it are described. It is determined that to support students' research activities, two types of virtual chemical laboratories are used: distance and imitation. The combination of these types of virtual chemical laboratories in the study of the topic "Solutions" provides an opportunity to take advantage of each of them and increase the level of support for learning research activities of students. Examples of developed virtual chemical works and their essence are given. Based on the implementation of virtual chemical laboratories in the educational process of various educational institutions, it is justified the assumption about the effectiveness of using the developed virtual experimental chemical problems to develop students' research activities when studying the topic "Solutions".

This article highlights further research by the authors, begun in [162, 163, 165].
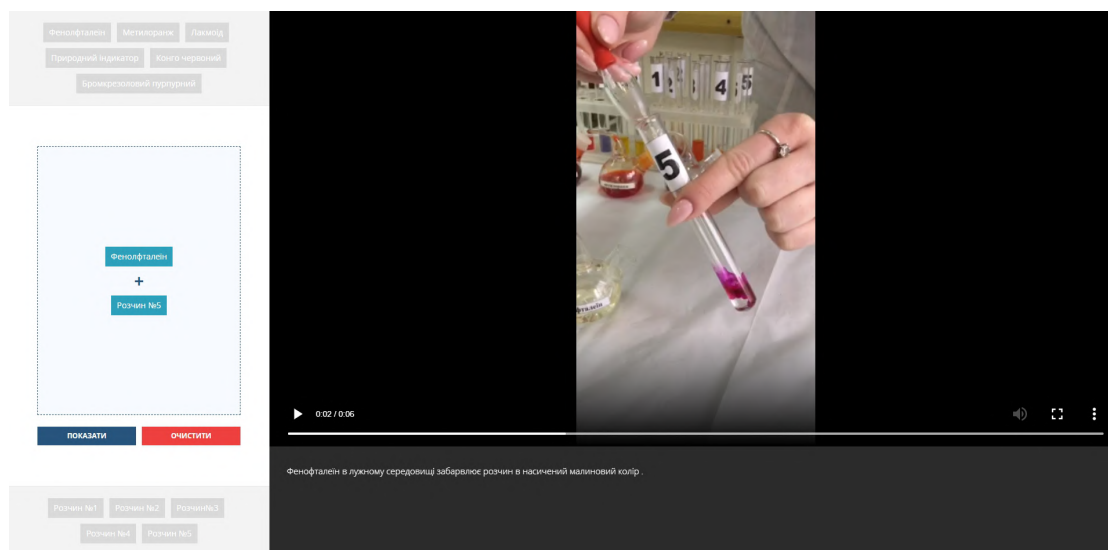
Figure 97: Presentation of paper [164].

The article "Trends in the development of e-learning for civil servants" [88] by Yevhen M. Khrykov (figure 98), Olga M. Ptakhina, Tetiana V. Sych, Dmytro I. Dzvinchuk and Maryna V. Kormer generalizes the information on numerous components of the system of public servants' lifelong education. One of the key areas of public administration development is the development of e-government, so e-learning is considered as an important means of preparing public servants to implement this task. The domestic and world experience of e-learning of public servants, which is realized in the form of distance education, mixed learning and as a component of the traditional classroom educational process, is analyzed. The threats and benefits of ICT training, based on the survey of civil servants trained in ICT in Ukrainian higher educational institutions are highlighted. The trends in the development of e-learning have been identified on the basis of scientific and empirical facts. These trends are more or less inherent in some countries, that is why these countries can determine the current challenges of e-learning development.

This article highlights further research by the authors, begun in [87, 268].

The article "Perception and interpretation of emoji in the pedagogical process: aposterior
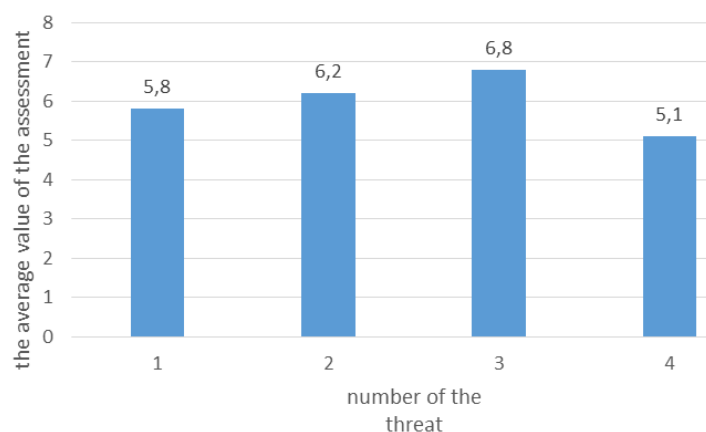
Figure 98: Presentation of paper [88].

features of artificial digital language" [143] by Rusudan K. Makhachashvili (figure 99), Svetlana I. Kovpik, Anna O. Bakhtina, Nataliia V. Morze and Ekaterina O. Shmeltser is based on data collected from an experiment that was conducted involving participants in the educational process. The essence of the experiment is to test the artificial digital language of emoji in the learning process from the standpoint of both teachers and students in the field of education. But the experiment was augmented by representatives of other professions (programmers, economists, artists, writers), which helped to expand the object of the study, extrapolating the findings of the experiment on different areas of activity surveyed. The results were obtained for the following categories of respondents: age, profession, knowledge of foreign languages. Experimental data helped revealed the following issues: 1) artificial emoji language reproduces polylaterality in structure (elements of sign generation) and semantics (multi-vector perception and interpretation of the sign). This explains the scale of differentiation of emoji characters; 2) the polylateral perception and interpretation of emoji depends on the speaker, which in study was classified according to the above categories. It was concluded that the perception and interpretation of the emoji sign depends on all the highlighted categories with an advantage to the professional activity of the speaker and their experience in a particular profession. The concept of a priori and a posteriori of artificial languages was also revealed for the purpose of the research. Language of emoji authors categorize as an apriori-posteriori since by form and meaning digital emoji signs display features of both types: the shape of the components of the emoji sign refer to other semiotic systems (such as cuneiform or Morse code); in terms of content, the emoji sign in digital communication can be interpreted depending on individual verbal skills, which, in turn, was considered through the prism of frame semantics (P-semantics) of Charles Fillmore. The experiment results demarcated perceptual characteristics and interpretation of digital emoji signs by respondents depending on the nature of their professional activity. Thus, it was concluded that representatives of the humanities and social sciences (both in service teachers and applicants for the pedagogical profession) and representatives of sciences (economists, programmers) have antithetical properties of perception and interpretation of emoji in digital communication. This coincides with the concept of mental frames embedded

in the thinking structure of each individual. The prospects of this research consist of bringing other educational professionals into the experiment, as well as non-teaching professionals to determine the deductive hypothesis of the role, function and influence of digital language of emoji on teachers and non-teachers. The latter will make it possible to identify the advantages and disadvantages of digitalization of society both in the educational process and outside its framework.

This article highlights further research by the authors, begun in [141, 144, 155].
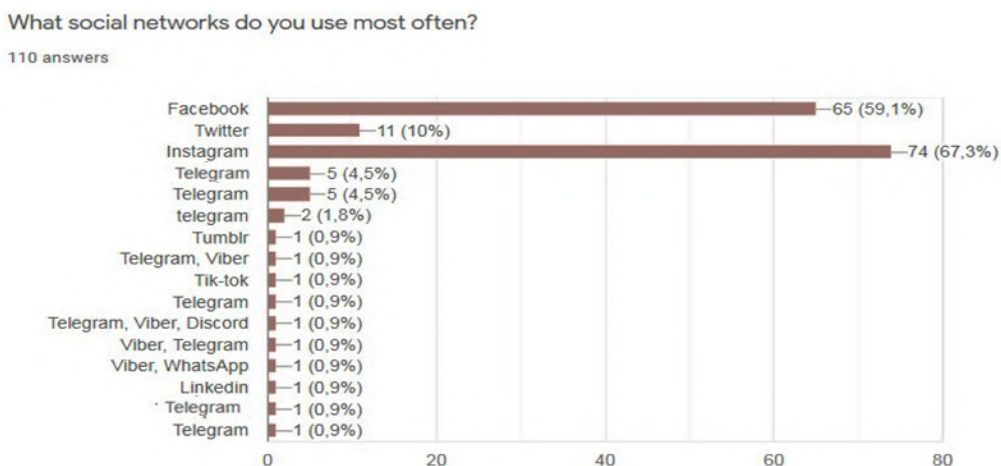
Figure 99: Presentation of paper [143].

The article "Implicit potential of immersive technologies implementation in the educational process at the universities: world experience" [28] by Kateryna M. Binytska (figure 100), Olha O. Bilyakovska, Oleksandra I. Yankovych, Galyna V. Buchkivska, Olena P. Binytska, Valentyna V. Greskova, Inna P. Ocheretna, Oleksandr Yu. Burov and Svitlana H. Lytvynova identifies the implicit potential of immersive technologies implementation in in the educational space of universities around the world. The content of basic research concepts has been determined. The advantages and disadvantages of using immersive technologies have been analyzed. The achievements of the world's universities have been clarified: the use of immersive technologies in the professional training of the future archaeologists to perform work on archaeological excavations has been reflected; in training architects and engineers for computer modeling of any of the most complex projects; in the training of the future pilots to guide the landing of aircraft on the aircraft carrier; in training rescuers to extinguish fires and rescue people; in the training of the future physicians for surgery or for experiments with hazardous chemicals. Emphasis is placed on the use of immersive technologies in the education of students with special educational needs to create inclusive learning environment, taking into account the needs and capabilities of each student. Based on the analysis of world experience in the use of immersive technologies in the educational space of universities, it was found that these technologies are used in the following areas: a) immersive learning technologies are actively used during distance learning, which allows, in particular during video conferencing to improve learning efficiency (University of British Columbia); b) to determine the level of empathy for the

problem of homelessness, which allows to get the social experience of a person who becomes homeless (Central Pacific Institute in Hawaii); c) to study the effects of ocean oxidation on coral reefs, to provide knowledge about the environmental problem and to develop negative emotions in students about human activities that harm the beautiful and pristine ecosystem (Punahou International University). It is generalized that the use of immersive technologies in the educational space of universities of the world is used not only in the process of professional training for various sectors of the economy to gain professional competencies, but also to gain social, emotional experience and to actualize environmental issues.

This article highlights further research by the authors, begun in [35, 37, 38].

Figure 100: Presentation of paper [28].

The article "Opportunities and ways of using laboratory equipment in a distance learning environment" [311] by Liudmyla V. Vasylieva, Denys Yu. Mikhieienko (figure 101), Iryna A. Getman and Maryna V. Kormer considers the issue of possibility and ways of performing laboratory works in the conditions of distance learning as well the experience of using virtual works as a forced replacement of traditional practical training. The peculiarities of distance learning organization under conditions of coronavirus pandemic are analyzed. The problems faced by the higher educational institutions in this situation based on the analytical data of the international commissions are reviewed. The problems that arose in the use of laboratory equipment for work in the conditions of the pandemic are analyzed. The advantages and disadvantages of remote execution of laboratory works are discussed. The problems arising when replacing real laboratory work with virtual ones are considered. The example of performing laboratory works under distant learning conditions by providing remote access to them via the Internet on the example of bioelectronics and biomechanics laboratory is considered. The directions of further development of virtual practical work at the department of computer

information technologies are formulated.

This article highlights further research by the authors, begun in [277].
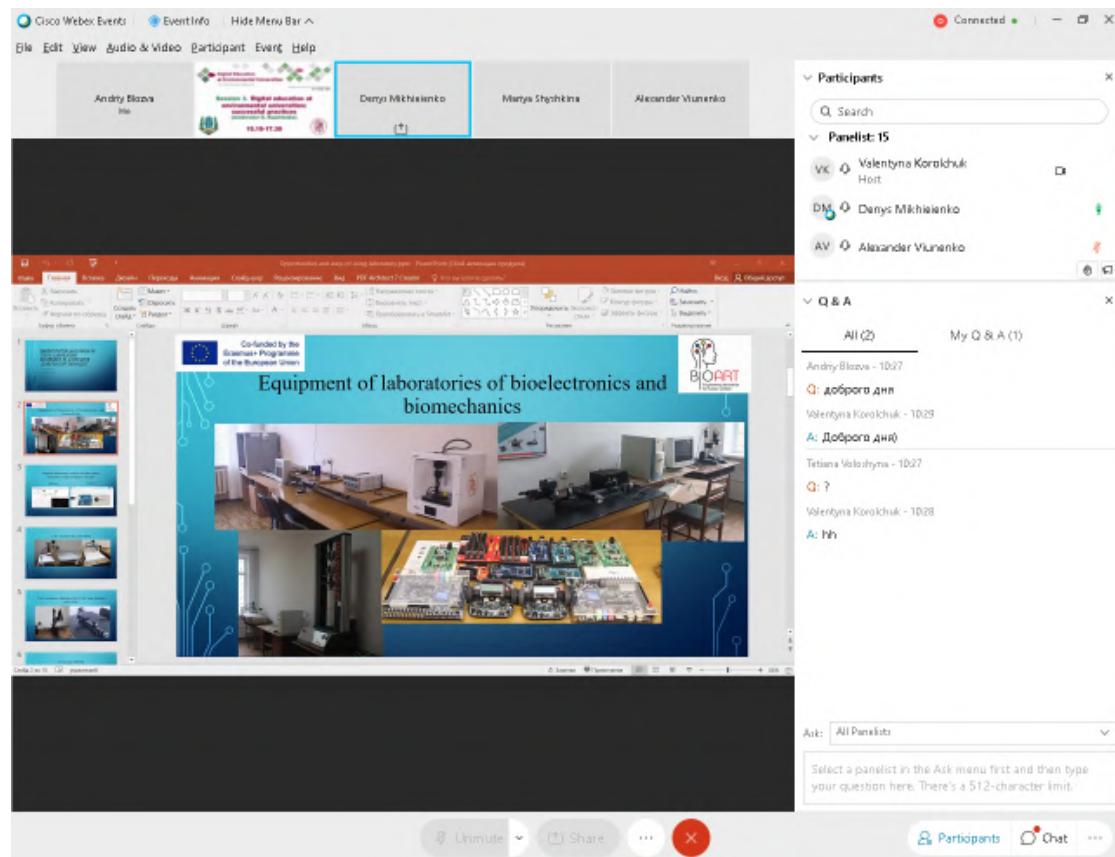
Figure 101: Presentation of paper [311].

The digitalization of education is much slower than in other areas, due to the high cost of digital solutions and their complex functionality. Recently, the situation is changing, and now education can get real benefits from technology with simple software solutions. Analysis of the effectiveness of education has shown that the countries of Europe and Central Asia have significant potential for the development of education. Technologies used in education used in Tutoring, Language learning, MOOC, School Education (K-12), STEM & coding, Robotics, Information platforms, for teachers, LMS (learning management system), IT Education, Upskilling, Tools, and Talent. These technologies provide an opportunity to improve learning processes and increase its efficiency. The article "EdTech landscape in Ukraine: smart education future in digital age" [166] by Maryna V. Nehrey (figure 102), Larysa M. Zomchak and Abdel-Badeeh M. Salem is show that in 2020, the EdTech startup ecosystem of Ukraine has more than 80 startups that have been used for education. SWOT-analysis indicate that the EdTech startup ecosystem is characterized by more weaknesses and threats than strengths and opportunities. Ukrainian education has significant potential for increasing efficiency and development.

Figure 102: Presentation of paper [166].

3. Conclusion

AET 2020 was organized by Academy of Cognitive and Natural Sciences (Ukrainian branch), University of Educational Management (with support of the vice-rector for research and digitalization Oleg M. Spirin), Bogdan Khmelnitsky Melitopol State Pedagogical University (with support of the rector Anatolii M. Solonenko) and National University of Life and Environmental Sciences of Ukraine (with support of the rector Stanislav M. Nikolaienko) in collaboration with Kryvyi Rih State Pedagogical University (with support of the rector Yaroslav V. Shramko), Kryvyi Rih National University (with support of the rector Mykola I. Stupnik) and Institute for Digitalisation of Education of the NAES of Ukraine (with support of the director Valeriy Yu. Bykov).

We are thankful to all the authors who submitted papers and the delegates for their participation and their interest in AET 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. Moreover, we would like to thank the developers and other professional staff of *Academy of Cognitive and Natural Sciences* (https://acnsci.org) and *Not So Easy Science Education* platform (https://notso.easyscience.education), who made it possible for us to use the resources of this excellent and comprehensive conference management system, from the call of papers and inviting reviewers, to handling paper submissions, communicating with the authors etc.

We are looking forward to excellent presentations and fruitful discussions, which will broaden our professional horizons. We hope all participants enjoy this workshop and meet again in

more friendly, hilarious, and happiness of further AET installments.

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