

Unlocking the power of synergy: the joint force of cloud technologies and augmented reality in education

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Abstract

This is an introductory text to a collection of selected papers from the 10th Workshop on Cloud Technologies in Education (CTE 2021) and 5th International Workshop on Augmented Reality in Education (AREdu 2022) which were held in Kryvyi Rih, Ukraine, on May 23, 2022. It consists of information on events and short summaries of selected papers.

Keywords

adaptive cloud learning platforms, blended learning, blockchain in education, cloud-based AI education applications, cloud-based e-learning platforms, tools and services, cloud-based learning environments, competency-based education platforms, digital transformation of education, educational data mining, emotion AI, immersive technology applications in education, mobile learning, smart campus technologies, social analytics in education, virtualization of learning: principles, technologies, tools, augmented reality gamification, design and implementation of augmented reality learning environments, augmented reality in science education, augmented reality in professional training and retraining

1. Introduction

1.1. CTE 2022: 10th Workshop on Cloud Technologies in Education

1.1.1. CTE 2022 at a glance

Cloud Technologies in Education (CTE) is a peer-reviewed international Computer Science workshop focusing on research advances, applications of cloud technology in education.

The Workshop occupies contributions in all aspects of educational technologies and cloud-based learning tools, platforms, paradigms and models, functioning programmes or papers relevant to modern engineering and technological decisions in the IT age.

CTE topics of interest since 2012 [1, 2, 3, 4, 5, 6, 7, 8, 9]:

- Adaptive Cloud Learning Platforms
- Blended Learning
- Blockchain in Education
- Cloud-based AI Education Applications
- Cloud-based E-learning Platforms, Tools and Services



Figure 1: CTE 2022 logo.

CTE 2022: 10th Workshop on Cloud Technologies in Education,

AREdu 2022: 5th International Workshop on Augmented Reality in Education, May 23, 2022, Kryvyi Rih, Ukraine

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CEUR Workshop Proceedings (CEUR-WS.org)

- Cloud-based Learning Environments
- Competency-Based Education Platforms
- Digital Transformation of Education
- Educational Data Mining
- Emotion AI
- Immersive Technology Applications in Education
- Mobile Learning
- Smart Campus Technologies
- Social Analytics in Education

The first part of this volume represents the proceedings of the 10th Workshop on Cloud Technologies in Education (CTE 2022), held in Kryvyi Rih, Ukraine, on May 23, 2022. It comprises 4 contributed papers that were carefully peer-reviewed and selected from 11 submissions. Each submission was reviewed by at least 3 program committee members. The accepted papers present the state-of-the-art overview of successful cases and provides guidelines for future research.

1.1.2. CTE 2022 committees

Program committee

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- *Vitalina Babenko*, V. N. Karazin Kharkiv National University, Ukraine [12]
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- *Olga Bondarenko*, Kryvyi Rih State Pedagogical University, Ukraine [14]
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- *Roman Danel*, VŠTE České Budějovice, Czechia
- [17] *Gemma Tur Ferrer*, Universitat de les Illes Balears, Spain [18]
- *Helena Fidlerová*, Slovak University of Technology in Bratislava, Slovakia [19]
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- *Viacheslav Osadchyi*, Borys Grinchenko Kyiv University, Ukraine [41]
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- *Yevhenii Shapovalov*, Junior Academy of Sciences of Ukraine, Ukraine [48]
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- *Yuriy Tryus*, Cherkasy State Technological University, Ukraine [50]
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- *Kateryna Vlasenko*, National University of “Kyiv-Mohyla Academy”, Ukraine [54]
- *Yuliia Yechkalo*, Kryvyi Rih National University, Ukraine [55]

Organizing committee

- *Serhiy Semerikov*, Kryvyi Rih State Pedagogical University, Ukraine [56]
- *Andrii Striuk*, Kryvyi Rih National University, Ukraine [57]

1.2. 5th International Workshop on Augmented Reality in Education

1.2.1. AREdu 2022 at a glance

Augmented Reality in Education (AREdu) is a peer-reviewed international Computer Science workshop focusing on research advances, applications of virtual, augmented and mixed reality in education.

AREdu topics of interest since 2018 [58, 59, 60, 61, 62]:



Figure 2: AREdu 2022 logo.

- Virtualization of learning: principles, technologies, tools
- Augmented reality gamification
- Design and implementation of augmented reality learning environments
- Augmented reality in science education
- Augmented reality in professional training and retraining

The second part of this volume represents the proceedings of the 5th International Workshop on Augmented Reality in Education (AREdu 2022), held in Kryvyi Rih, Ukraine, on May 23, 2022. It comprises 2 contributed papers that were carefully peer-reviewed and selected from 5 submissions. Each submission was reviewed by at least 3 program committee members. The accepted papers include a current summary of successful cases as well as directions for future research.

1.2.2. AREdu 2022 committees

Program committee

- *Olga Bondarenko*, Kryvyi Rih State Pedagogical University, Ukraine [63]
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- *Irina Georgescu*, Bucharest University of Economics, Romania [65]
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- *Hamraz Javaheri*, German Research Center for Artificial Intelligence (DFKI), Germany [67]
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- *Volodymyr Kukharenko*, Kharkiv National Automobile and Highway University, Ukraine [73]
- *Svitlana Lytvynova*, Institute for Digitalisation of Education of the NAES of Ukraine, Ukraine [74]
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- *Viacheslav Osadchyi*, Borys Grinchenko Kyiv University, Ukraine [81]
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- *Tetiana Vakaliuk*, Zhytomyr Polytechnic State University, Ukraine [87]
- *Nataliia Valko*, Kherson State University, Ukraine [88]
- *Nataliia Veretennikova*, Lviv Polytechnic National University, Ukraine [89]
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Organizing committee

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- *Serhiy Semerikov*, Kryvyi Rih State Pedagogical University, Ukraine [93]

2. Articles overview

2.1. CTE 2022 overview

The research “Economic analysis of factors associated with education and employment” [94] by George Abuselidze (figure 3) and Gia Zoidze aims to analyze the current state of the Georgian economy and labor market, including workforce structure, challenges, and trends, by conducting qualitative and quantitative studies. Market requirements were analyzed, and consultations were held with experts, employers, and representatives from the Center for the Development of Quality Education. The study also examined the compatibility of higher education programs with market demands, practical components in the educational process, and the relationship between higher education institutions and students. The findings suggest that promoting professional education, with the proper involvement of the state, can positively impact the economy and the country’s situation. Additionally, the study examined the influence of higher education on employment and income, indicating a discernible return on investment, but also highlighting that human capital developed in the higher education system is not efficiently employed. The

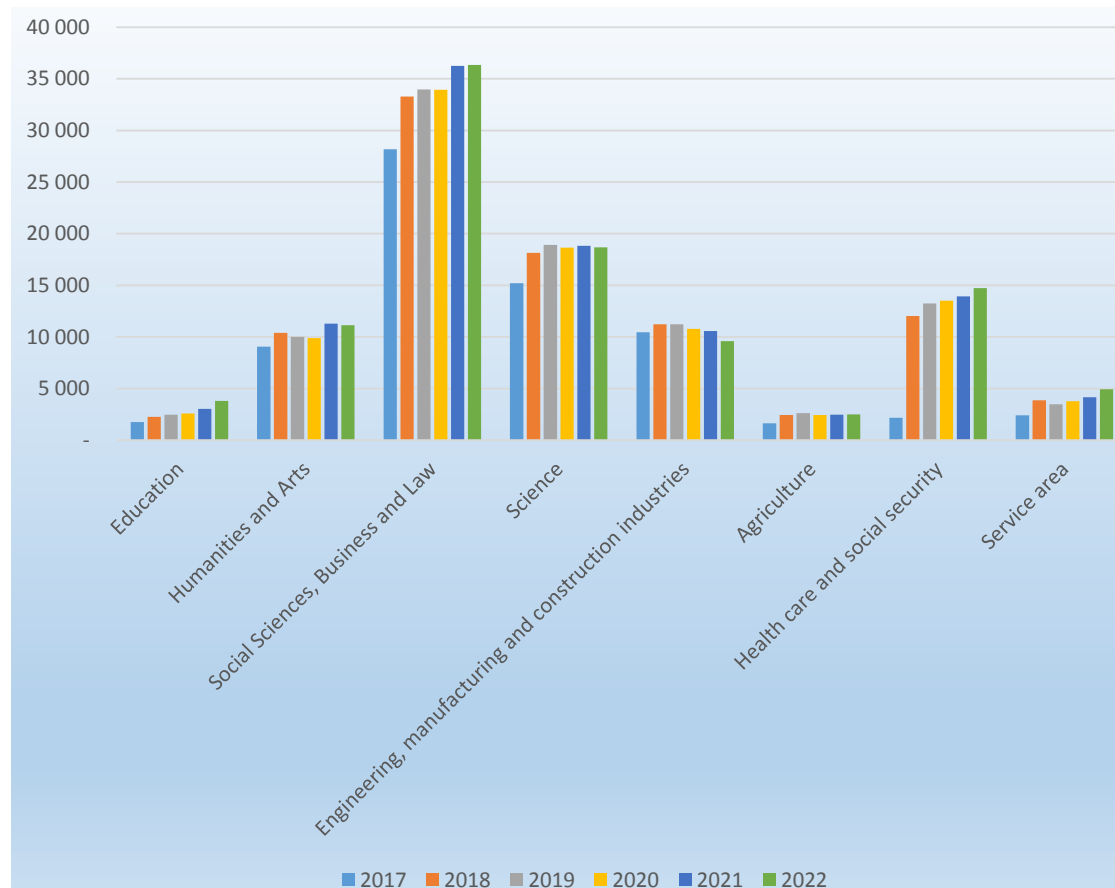


Figure 3: Presentation of paper [94].

study concludes with recommendations to address the issues facing the Georgian labor market and envision labor force demand. Overall, this research sheds light on the intersection of education and technology in addressing workforce needs in the Georgian context.

The authors' related works are referenced as [95, 96, 97].

The article "Smart education in the prospective teachers' training" [98] by Natalia Ye. Dmitrenko, Oksana V. Voloshyna, Svitlana S. Kizim (figure 4), Kateryna V. Mnyshenko and Svitlana V. Nahorniak explores the concept of smart education and its potential for developing the professional training of future teachers. The main components of smart education, including smart students, smart pedagogy, and smart environments, are examined, and the principles underlying this approach to education, such as mobile access and the creation of new knowledge, are defined. The features of smart education are also discussed, with a focus on its implementation in the context of the COVID-19 pandemic and military events in Ukraine. The study identifies the functions of the smart system in the pedagogical cycle, including its content, technological components, and facilities for students and teachers. The criteria for evaluating smart complexes, such as automation, sequencing, assessment, data collection, and self-organization, are

Smart Education in the Prospective Teachers' Training

Natalia Dmitrenko, Oksana Voloshyna, Svitlana Kizim,
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The main elements of this system:

- a smart student,
- a smart pedagogy,
- a smart environment.

The smart learning environment is considered as a technology-oriented learning environment that support the quick adaption of the entire educational process and proper interaction between learners and the environment in a sophisticated manner. The smart environment includes space, place, time, technology, devices, control and interaction.

Criteria of a smart complex:

- 01 automation;
- 02 sequencing;
- 03 assessment;
- 04 data collection in real time;
- 05 self-organization.

The main principles of smart complexes:

- 1 ensuring compatibility between the software of different operating systems;
- 2 mobility, continuity and free access to any information;
- 3 autonomy of the teacher and student;
- 4 definition and application of various motivational models;
- 5 assessment of changes and competence;
- 6 change of education due to individual capabilities and interests of the student.

Distance learning systems for creating smart complexes: Moodle, Google Classroom, iSpring Online, and Edmodo.

Figure 4: Presentation of paper [98].

identified. The study also examines distance learning systems for creating smart complexes in the training of prospective teachers, drawing on student surveys to evaluate the advantages and disadvantages of using smart technologies in the educational process. Finally, the article outlines avenues for further research on the integration of smart education into teacher training programs. Overall, this research contributes to the literature on education science by highlighting the potential of smart education for enhancing the professional development of future teachers.

The authors' related works are referenced as [99, 100, 101].

The COVID-19 pandemic led to a public health emergency that required the confinement of populations worldwide, including the suspension of face-to-face classes at all educational levels in the Spain. In response, educational centers and teachers turned to social media as the primary means of communication to continue teaching and socialization processes. The study "Possibilities and limitations of social media in education processes during the pandemic: The

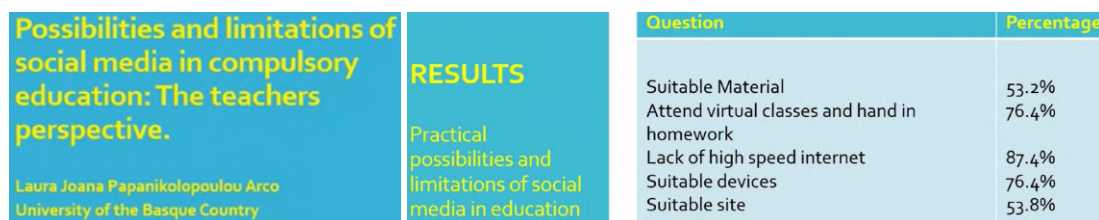


Figure 5: Presentation of paper [102].

teachers perspective” [102] by Laura Joana Papanikolopoulou Arco (figure 5) aims to investigate the possibilities and limitations of social media as the sole means of communication in education, from the perspective of teachers. The methodology involves the distribution of an anonymous questionnaire to secondary education centers in the Basque Country and Navarra regions, with data collection conducted electronically. The results reveal the possibilities and limitations of digital media in teaching processes, identifying both surmountable and insurmountable challenges. Overall, this research contributes to the growing body of knowledge on the role of technology in education, with implications for future educational policy and practice.

The author’ related works are referenced as [103, 104, 105].

The use of student response systems (SRS) has gained significant attention in recent years as a tool for increasing student engagement and improving the overall learning experience during online lectures. In the study “Interactive surveys during online lectures for IT students” [106], Olena S. Holovnia (figure 6), Natalia O. Shchur, Iryna A. Sverchevska, Yelyzaveta M. Biliuk and Oleksandra A. Pokotylo provide a comprehensive overview of different SRS platforms such as Mentimeter, AhaSlides, Kahoot!, Wooclap, Socrative, Poll Everywhere, and Slido, and compare their features to determine their suitability for facilitating students’ engagement in online lectures.

The authors then present their experience using Mentimeter in the Operating Systems course for second-year IT students of Zhytomyr Polytechnic State University with specializations in Software Engineering, Computer Science, Computer Engineering, and Cybersecurity. The study collects data through observation, surveys, and existing data and uses visual and statistical analyses to analyze the data. The study reports an increase in the number of students’ answers within the lectures and highlights IT students’ problems and preferences during online lectures.

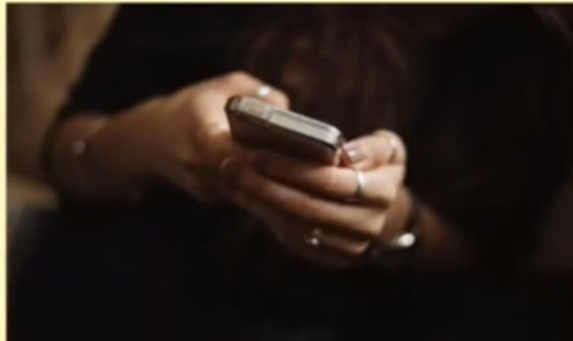
Holovnia et al. [106] provide recommendations for using SRS during online lectures to improve the interaction between the lecturer and the audience, including increasing the number of questions, reducing the time between questions, and using open-ended questions to encourage critical thinking. This study contributes to the literature on SRS in online learning and provides valuable insights for educators seeking to enhance student engagement and learning outcomes in online lectures.

The authors’ related works are referenced as [107, 108, 109].

2.2. AREdu 2022 overview

The paper “Using a mobile application to teach students to measure with a micrometer during remote laboratory work” [110] presents the experience of developing and using a mobile

Interactive surveys during online lectures for IT students



Olena Holovnia,
Natalia Shchur,
Iryna Sverchevska,
Yelyzaveta Bailiuk,
Oleksandra Pokotylo
Zhytomyr Polytechnic
State University,
Ukraine

Student response systems (features comparison) — slide 1 of 2

Free version features available	Mentimeter	AhaSlides	Kahoot!	Wooclap	Socrative	Poll Everywhere	Slido
Maximum participants	unlimited	7	10	1000	5	40	100
Maximum number of questions per event	2	unlimited	unlimited	2	1000	unlimited	3
Question types	multiple-choice, word cloud, open-ended, scales, ranking	multiple-choice, word cloud, open-ended, scales, image choice	multiple-choice, poll, find on image, rating, open-ended, word cloud, find a number, matching, sorting, fill in the blank, brainstorming	multiple-choice, true/false, short answer	multiple-choice, open-ended, word cloud, clickable images, ranking, survey, Q&A, competitions	multiple-choice, word cloud, quiz, rating, open text, ranking, survey	multiple-choice, word cloud, rating, open text, ranking, survey

The distribution of the answers on some questions

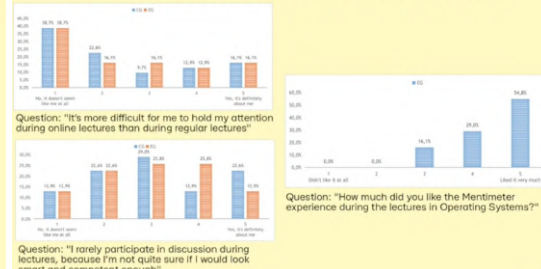


Figure 6: Presentation of paper [106].

application for teaching micrometer measurements during remote laboratory work in higher education. The Oleksandr V. Kanivets, Irina M. Kanivets, Tetyana M. Gorda, Oleksandr V. Gorbenko and Anton O. Kelemesh (figure 7) conducted a literature analysis and found that while ICT is widely used in higher education, computer programs and mobile applications are typically developed for secondary school disciplines. To address this gap, the authors developed a mobile application that includes theoretical, educational, and practical components. The application was found to improve students' success rates in laboratory work on the topic of measuring parts with a micrometer during distance learning, with a 7.3% increase in the percentage of qualitative success compared to distance learning without the application. The paper details the process of developing the application, including modeling the micrometer in the CAD system, creating training scenes in the Unity game engine, and writing scripts to fully immerse students in the learning process. Overall, the paper highlights the potential of mobile applications in facilitating laboratory work during distance learning and provides a valuable example for educators looking to incorporate technology into their teaching practice.

The authors' related works are referenced as [111, 112, 113].

The article "Development of the information system for navigation in modern university campus" [114] by Liudmyla E. Gryzun (figure 8), Oleksandr V. Shcherbakov and Bogdan O.

USING A MOBILE APPLICATION TO TEACH STUDENTS TO MEASURE WITH A MICROMETER DURING REMOTE LABORATORY WORK

Oleksandr V. Kanivets
Irina M. Kanivets
Tetyana M. Gorda
Oleksandr V. Gorbenko
Anton O. Kelemesh



Poltava – 2022

THE MAIN SCREEN OF THE PROGRAM

THE SCENE OF PRACTICAL TRAINING



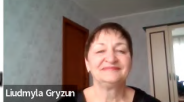
Figure 7: Presentation of paper [110].

Bida presents algorithmic, interface, and technological solutions for developing an information system for indoor navigation in university campuses. The scientific and applied problem of indoor navigation is analyzed, and the capabilities of existing navigation systems with similar functionalities are evaluated. The study concludes that the analyzed analogues have certain limitations. The functional and non-functional requirements for the university navigation system are specified, and its architecture is defined as a set of interconnected modules, for which appropriate interface and algorithmic solutions are elaborated. The design and development stages of the university navigation system are highlighted, along with its implemented

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Liudmyla Gryzun

Development of the information system for navigation in modern university campus

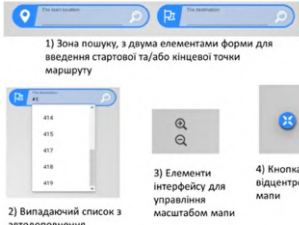




Professor LIUDMYLA GRYZUN,
Professor OLEKSANDR SHCHERBAKOV,
Master student BOGDAN BIDA

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The graphic module as a set of interface elements and program code



- 1) Зона пошуку, з двома елементами форми для введення стартової та/або кінцевої точки маршруту
- 2) Випадаючий список з автодоповнення
- 3) Елементи інтерфейсу для управління масштабом мапи
- 4) Кнопка відцентрування мапи
- 5) Елементи інтерфейсу для зміни поточного повороту та відображення його номеру
- 6) Кнопки для відкриття вікон з інструкцією, налаштуваннями, сканером відповідно зверку-вниз

The technological approaches to the design and development of the navigation system

- Angular as a framework for SPA web-apps development
- RxJs – library for reactive programming
- svgdotjs – library for svg processing in OOP style
- zxing/ngx-scanner – library for QR-codes scanning in real time



Figure 8: Presentation of paper [114].

functionality. The study establishes that the main limitations inherent in similar systems implementing indoor navigation can be overcome during the design process. The results of the system implementation in a national university are discussed, and user feedback is presented. The study confirms the feasibility of developing and using an information system for navigation in university campuses. Finally, the prospects for further work in this area are discussed.

The authors' related works are referenced as [115, 116, 117].

3. Conclusion

The Academy of Cognitive and Natural Sciences, in partnership with the Institute for Digitalisation of Education of the NAES of Ukraine, Kryvyi Rih State Pedagogical University, Kryvyi Rih National University, Ben-Gurion University of the Negev, and Zhytomyr Polytechnic State University, had the pleasure of hosting the 10th Workshop on Cloud Technologies in Education (CTE 2021) and the 5th International Workshop on Augmented Reality in Education (AREdu 2022).

We extend our sincere gratitude to the authors who submitted their papers and the delegates for their active participation and unwavering interest in our workshops, which have provided

a platform for the exchange of ideas and innovation. Our heartfelt appreciation goes to the program committee members for their continuous guidance and to the peer reviewers whose diligent efforts have substantially enhanced the quality of the papers by providing constructive criticisms, improvements, and corrections. We acknowledge and thank the authors for their significant contributions to the success of the conference.

Furthermore, we express our deepest appreciation to the developers and other professional staff of the *Academy of Cognitive and Natural Sciences* (<https://acnsci.org>) and *Not So Easy Science Education* platform (<https://notso.easyscience.education>) for providing us with an excellent and comprehensive conference management system that has facilitated every aspect of the conference's organization, from the call for papers and reviewer invitations to paper submissions, author communications, and beyond.

We anticipate excellent presentations and fruitful discussions that will broaden our professional horizons, and we trust that all participants will derive immense satisfaction from these workshops. We look forward to the day when we will be able to meet again in person under more tranquil and peaceful circumstances.

References

- [1] S. O. Semerikov, A. M. Striuk, CTE - Workshop on Cloud Technologies in Education, CTE Workshop Proceedings 1 (2013) 1–2. doi:10.55056/cte.308.
- [2] S. O. Semerikov, A. M. Striuk, I. O. Teplytskyi, CTE 2013: 2nd Workshop on Cloud Technologies in Education, CTE Workshop Proceedings 2 (2014) 1–8. doi:10.55056/cte.311.
- [3] S. O. Semerikov, A. M. Striuk, I. O. Teplytskyi, 3rd Workshop on Cloud Technologies in Education, CTE Workshop Proceedings 3 (2015) 1–8. doi:10.55056/cte.309.
- [4] S. O. Semerikov, A. M. Striuk, M. P. Shyshkina, Preface, CTE Workshop Proceedings 4 (2017) 1–6. doi:10.55056/cte.357.
- [5] S. O. Semerikov, M. P. Shyshkina, Preface, CTE Workshop Proceedings 5 (2018) i. doi:10.55056/cte.307.
- [6] A. E. Kiv, V. N. Soloviev, S. O. Semerikov, CTE 2018 – How cloud technologies continues to transform education, CTE Workshop Proceedings 6 (2019) 1–19. doi:10.55056/cte.352.
- [7] A. E. Kiv, M. P. Shyshkina, S. O. Semerikov, A. M. Striuk, M. I. Striuk, H. M. Shalatska, CTE 2019 – When cloud technologies ruled the education, CTE Workshop Proceedings 7 (2020) 1–59. doi:10.55056/cte.306.
- [8] S. O. Semerikov, M. P. Shyshkina, A. M. Striuk, M. I. Striuk, I. S. Mintii, O. O. Kalinichenko, L. S. Kolgatina, M. Y. Karpova, 8th Workshop on Cloud Technologies in Education: Report, CTE Workshop Proceedings 8 (2021) 1–69. doi:10.55056/cte.183.
- [9] A. E. Kiv, S. O. Semerikov, M. P. Shyshkina, A. M. Striuk, M. I. Striuk, Y. V. Yechkalo, I. S. Mintii, P. P. Nechypurenko, O. O. Kalinichenko, L. S. Kolgatina, K. V. Vlasenko, S. M. Amelina, O. V. Semenikhina, 9th Workshop on Cloud Technologies in Education: Report, CTE Workshop Proceedings 9 (2022) i–lxxvii. doi:10.55056/cte.75.
- [10] L. A. Abdillah, I. N. Sari, D. E. Indriani, Computer science students simulation in cap-

- turing tacit knowledge by using NGT for reducing traffic jam, *International Journal of Engineering and Technology(UAE)* 7 (2018) 1463 – 1467.
- [11] F. Almeida, The Concept Of Human2Human In The Response To COVID-19, *International and Multidisciplinary Journal of Social Sciences* 9 (2020) 129–151. doi:10.17583/rimcis.2020.5524.
 - [12] V. O. Babenko, R. M. Yatsenko, P. D. Migunov, A.-B. M. Salem, MarkHub Cloud Online Editor as a modern web-based book creation tool, *CTE Workshop Proceedings* 7 (2020) 174–184. doi:10.55056/cte.342.
 - [13] L. Bilousova, L. Gryzun, N. Zhytienova, Interactive methods in blended learning of the fundamentals of UI/UX design by pre-service specialists, *Educational Technology Quarterly* 2021 (2021) 415–428. doi:10.55056/etq.34.
 - [14] M. J. Syvyi, O. B. Mazbayev, O. M. Varakuta, N. B. Panteleeva, O. V. Bondarenko, Distance learning as innovation technology of school geographical education, in: O. Y. Burov, A. E. Kiv (Eds.), *Proceedings of the 3rd International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, May 13, 2020, volume 2731 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2020, pp. 369–382. URL: <https://ceur-ws.org/Vol-2731/paper22.pdf>.
 - [15] M. Brun, J. E. Hinostroza, Learning to become a teacher in the 21st century: ICT integration in initial teacher education in Chile, *Educational Technology and Society* 17 (2014) 222 – 238.
 - [16] H.-C. Wang, C. P. Rosé, C.-Y. Chang, Agent-based dynamic support for learning from collaborative brainstorming in scientific inquiry, *International Journal of Computer-Supported Collaborative Learning* 6 (2011) 371–395. doi:10.1007/s11412-011-9124-x.
 - [17] Z. Neustupa, B. Stalmachová, R. Danel, Information systems for regeneration of landscape affected by mining, in: *11th International Multidisciplinary Scientific Geoconference and EXPO - Modern Management of Mine Producing, Geology and Environmental Protection, SGEM 2011*, volume 1, 2011, p. 809 – 816.
 - [18] A. Pérez-Garcías, G. Tur, S. Villatoro Moral, A. Darder-Mesquida, Itinerarios de aprendizaje flexibles en entornos digitales para un aprendizaje personalizado en la formación docente, *RIED-Revista Iberoamericana de Educación a Distancia* 25 (2022) 173–193. URL: <https://revistas.uned.es/index.php/ried/article/view/32326>. doi:10.5944/ried.25.2.32326.
 - [19] P. Richnák, H. Fidlerová, Impact and Potential of Sustainable Development Goals in Dimension of the Technological Revolution Industry 4.0 within the Analysis of Industrial Enterprises, *Energies* 15 (2022) 3697. doi:10.3390/en15103697.
 - [20] I. Georgescu, Arrow’s Axiom and Full Rationality for Fuzzy Choice Functions, *Social Choice and Welfare* 28 (2007) 303–319. doi:10.1007/s00355-006-0160-9.
 - [21] L. C. B. da Silva, A. C. Loureiro, F. M. Magoni, V. M. B. Gonçalves, Active methodologies and digital technologies in learning : A systematic literature review, in: *2022 17th Iberian Conference on Information Systems and Technologies (CISTI)*, 2022, pp. 1–5. doi:10.23919/CISTI54924.2022.9820582.
 - [22] L. I. Bilousova, L. E. Gryzun, A simulation of synchronized curriculum for IT-specialist training based on Petri nets, *Educational Dimension* 6 (2022) 55–67. doi:10.31812/educdim.4489.

- [23] V. A. Hamaniuk, German traces in Ukraine in German lessons: illustrative, interactive, communicative, *Educational Dimension* 2 (2020) 34–55. doi:10.31812/educdim.v54i2.3853.
- [24] C. Pribeanu, A. Balog, D. D. Iordache, Formative user-centered usability evaluation of an augmented reality educational system, in: *ICSOF 2008 - Proceedings of the 3rd International Conference on Software and Data Technologies*, volume ISDM, 2008, p. 65 – 72.
- [25] J.-J. Arino, M.-C. Juan, J.-A. Gil-Gómez, R. Mollá, A comparative study using an autostereoscopic display with augmented and virtual reality, *Behaviour & Information Technology* 33 (2014) 646–655. doi:10.1080/0144929X.2013.815277.
- [26] D. S. Shepiliev, S. O. Semerikov, Y. V. Yechkalo, V. V. Tkachuk, O. M. Markova, Y. O. Modlo, I. S. Mintii, M. M. Mintii, T. V. Selivanova, N. K. Maksyshko, T. A. Vakaliuk, V. V. Osadchyi, R. O. Tarasenko, S. M. Amelina, A. E. Kiv, Development of career guidance quests using WebAR, *Journal of Physics: Conference Series* 1840 (2021) 012028. doi:10.1088/1742-6596/1840/1/012028.
- [27] O. H. Kolgatin, L. S. Kolgatina, N. S. Ponomareva, Stochastic process computational modeling for learning research, *Educational Dimension* 6 (2022) 68–83. doi:10.31812/educdim.4498.
- [28] Y. Krainyk, V. Perov, M. Musiyenko, Low-complexity high-speed soft-hard decoding for turbo-product codes, in: *2017 IEEE 37th International Conference on Electronics and Nanotechnology (ELNANO)*, 2017, pp. 471–474. doi:10.1109/ELNANO.2017.7939798.
- [29] O. Gayevska, H. Kravtsov, Approaches on the augmented reality application in Japanese language learning for future language teachers, *Educational Technology Quarterly* 2022 (2022) 105–114. doi:10.55056/etq.7.
- [30] V. M. Kukharenko, Problems of massive open online distance learning courses in distance learning systems, *CTE Workshop Proceedings* 1 (2013) 55–56. doi:10.55056/cte.89.
- [31] A. I. Kupin, O. V. Tarasova, T. S. Sulyma, S. V. Sokolova, I. O. Muzyka, V. V. Tron, Defining and modeling of students' professional thinking development dependence on their training process organization, *CTE Workshop Proceedings* 6 (2019) 33–47. doi:10.55056/cte.367.
- [32] V. H. Shamonina, O. V. Semenikhina, V. V. Proshkin, O. V. Lebid, S. Y. Kharchenko, O. S. Lytvyn, Using the Proteus virtual environment to train future IT professionals, *Educational Dimension* 1 (2019) 181–198. doi:10.31812/educdim.v53i1.3842.
- [33] L. Y. Midak, I. V. Kravets, O. V. Kuzyshyn, T. V. Kostyuk, K. V. Buzhdyhan, V. M. Lutsyshyn, I. O. Hladkoskok, A. E. Kiv, M. P. Shyshkina, Augmented reality while studying radio-chemistry for the upcoming chemistry teachers, in: S. H. Lytvynova, S. O. Semerikov (Eds.), *Proceedings of the 4th International Workshop on Augmented Reality in Education (AREdu 2021)*, Kryvyi Rih, Ukraine, May 11, 2021, volume 2898 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2021, pp. 147–158. URL: <https://ceur-ws.org/Vol-2898/paper08.pdf>.
- [34] I. S. Mintii, V. N. Soloviev, Augmented Reality: Ukrainian Present Business and Future Education, in: A. E. Kiv, V. N. Soloviev (Eds.), *Proceedings of the 1st International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, October 2, 2018, volume 2257 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2018, pp. 227–231. URL: <https://ceur-ws.org/Vol-2257/paper22.pdf>.

- [35] S. O. Semerikov, T. A. Vakaliuk, I. S. Mintii, V. A. Hamaniuk, V. N. Soloviev, O. V. Bondarenko, P. P. Nechypurenko, S. V. Shokaliuk, N. V. Moiseienko, V. R. Ruban, Development of the computer vision system based on machine learning for educational purposes, *Educational Dimension* 5 (2021) 8–60. doi:10.31812/educdim.4717.
- [36] L. Hrynevych, N. Morze, V. Vember, M. Boiko, Use of digital tools as a component of STEM education ecosystem, *Educational Technology Quarterly* 2021 (2021) 118–139. doi:10.55056/etq.24.
- [37] Y. O. Modlo, S. O. Semerikov, S. L. Bondarevskyi, S. T. Tolmachev, O. M. Markova, P. P. Nechypurenko, Methods of using mobile Internet devices in the formation of the general scientific component of bachelor in electromechanics competency in modeling of technical objects, in: A. E. Kiv, M. P. Shyshkina (Eds.), *Proceedings of the 2nd International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, March 22, 2019, volume 2547 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2019, pp. 217–240. URL: <https://ceur-ws.org/Vol-2547/paper16.pdf>.
- [38] Y. G. Nosenko, V. O. Bogdan, Characteristics of google cloud services in aspect of preschool educational institution management, *CTE Workshop Proceedings* 3 (2015) 9–15. doi:10.55056/cte.205.
- [39] V. Oleksiuk, O. Oleksiuk, The practice of developing the academic cloud using the Proxmox VE platform, *Educational Technology Quarterly* 2021 (2021) 605–616. doi:10.55056/etq.36.
- [40] K. Osadcha, V. Osadchyi, S. Semerikov, H. Chemerys, A. Chorna, The Review of the Adaptive Learning Systems for the Formation of Individual Educational Trajectory, in: O. Sokolov, G. Zholtkevych, V. Yakovyna, Y. Tarasich, V. Kharchenko, V. Kobets, O. Burov, S. Semerikov, H. Kravtsov (Eds.), *Proceedings of the 16th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume II: Workshops*, Kharkiv, Ukraine, October 06-10, 2020, volume 2732 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2020, pp. 547–558. URL: <https://ceur-ws.org/Vol-2732/20200547.pdf>.
- [41] S. Semerikov, V. Osadchyi, O. Kuzminska, 1st Symposium on Advances in Educational Technology: Outlook, *Educational Technology Quarterly* 2021 (2021) 429–604. doi:10.55056/etq.53.
- [42] L. F. Panchenko, The study of Coursera’s data analysis courses, *CTE Workshop Proceedings* 2 (2014) 111–124. doi:10.55056/cte.195.
- [43] S. Papadakis, A. E. Kiv, H. M. Kravtsov, V. V. Osadchyi, M. V. Marienko, O. P. Pinchuk, M. P. Shyshkina, O. M. Sokolyuk, I. S. Mintii, T. A. Vakaliuk, A. M. Striuk, S. O. Semerikov, Revolutionizing education: using computer simulation and cloud-based smart technology to facilitate successful open learning, *CEUR Workshop Proceedings* 3358 (2023) 1–18. URL: <https://ceur-ws.org/Vol-3358/paper00.pdf>.
- [44] O. Y. Burov, O. P. Pinchuk, A meta-analysis of the most influential factors of the virtual reality in education for the health and efficiency of students’ activity, *Educational Technology Quarterly* 2023 (2023). doi:10.55056/etq.435.
- [45] O. Pursky, A. Selivanova, I. Buchatska, T. Dubovyk, T. Tomashevskaya, H. Danylchuk, Features of learning motivation in the conditions of coronavirus pandemic (COVID-19), *Educational Technology Quarterly* 2021 (2021) 375–387. doi:10.55056/etq.31.

- [46] D. Budianskii, M. Drushlyak, O. Semenikhina, Analysis of e-resources for the specialist's rhetorical culture development, *Educational Technology Quarterly* 2021 (2021) 87–102. doi:10.55056/etq.15.
- [47] N. V. Rashevskaya, S. O. Semerikov, N. O. Zinonos, V. V. Tkachuk, M. P. Shyshkina, Using augmented reality tools in the teaching of two-dimensional plane geometry, in: O. Y. Burov, A. E. Kiv (Eds.), *Proceedings of the 3rd International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, May 13, 2020, volume 2731 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2020, pp. 79–90. URL: <https://ceur-ws.org/Vol-2731/paper03.pdf>.
- [48] Y. Shapovalov, V. Shapovalov, B. Shapovalov, P. Antonenko, Synchronization competencies provided by traditional educational system with real-life required competencies in conditions of digital sociality, *Educational Technology Quarterly* 2022 (2022) 169–181. doi:10.55056/etq.3.
- [49] A. M. Striuk, M. V. Rassovytska, Development cloud-based learning environment for subdivision of university based owncloud, *CTE Workshop Proceedings* 2 (2014) 40–44. doi:10.55056/cte.209.
- [50] Y. V. Tryus, Cloud technologies in the professional training of computer science students, *CTE Workshop Proceedings* 1 (2013) 147–148. doi:10.55056/cte.177.
- [51] T. Vakaliuk, Structural model of a cloud-based learning environment for bachelors in software engineering, *Educational Technology Quarterly* 2021 (2021) 257–273. doi:10.55056/etq.17.
- [52] N. V. Valko, T. L. Goncharenko, N. O. Kushnir, V. V. Osadchyi, Cloud technologies for basics of artificial intelligence study in school, *CTE Workshop Proceedings* 9 (2022) 170–183. doi:10.55056/cte.113.
- [53] I. Khyzhniak, K. Vlasenko, I. Viktorenko, V. Velychko, Training of future primary school teacher for use digital educational resources in their professional activities, *Educational Technology Quarterly* 2021 (2021) 103–117. doi:10.55056/etq.23.
- [54] K. Vlasenko, S. Volkov, I. Sitak, I. Lovianova, D. Bobyliev, Usability analysis of on-line educational courses on the platform “Higher school mathematics teacher”, *E3S Web of Conferences* 166 (2020) 10012. doi:10.1051/e3sconf/202016610012.
- [55] V. V. Tkachuk, Y. V. Yechkalo, S. O. Semerikov, S. M. Khotskina, O. M. Markova, A. S. Taraduda, Distance learning during covid-19 pandemic: mobile information and communications technology overview, *Educational Dimension* 7 (2022) 282–291. doi:10.31812/educdim.7612.
- [56] P. Nechypurenko, S. Semerikov, VlabEmbed - the New Plugin Moodle for the Chemistry Education, in: V. Ermolayev, N. Bassiliades, H. Fill, V. Yakovyna, H. C. Mayr, V. S. Kharchenko, V. S. Peschanenko, M. Shyshkina, M. S. Nikitchenko, A. Spivakovsky (Eds.), *Proceedings of the 13th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer, ICTERI 2017*, Kyiv, Ukraine, May 15-18, 2017, volume 1844 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2017, pp. 319–326. URL: <http://ceur-ws.org/Vol-1844/10000319.pdf>.
- [57] A. M. Striuk, Problematic questions of software requirements engineering training, *Educational Dimension* 4 (2021) 90–101. doi:10.31812/educdim.v56i4.4441.
- [58] A. E. Kiv, V. N. Soloviev, Preface, in: A. E. Kiv, V. N. Soloviev (Eds.), *Proceedings of the*

- 1st International Workshop on Augmented Reality in Education, Kryvyi Rih, Ukraine, October 2, 2018, volume 2257 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2018. URL: <https://ceur-ws.org/Vol-2257/preface.pdf>.
- [59] A. E. Kiv, M. P. Shyshkina, S. O. Semerikov, A. M. Striuk, Y. V. Yechkalo, AREdu 2019 - How augmented reality transforms to augmented learning, in: A. E. Kiv, M. P. Shyshkina (Eds.), *Proceedings of the 2nd International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, March 22, 2019, volume 2547 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2019, pp. 1–12. URL: <https://ceur-ws.org/Vol-2547/paper00.pdf>.
- [60] O. Y. Burov, A. E. Kiv, S. O. Semerikov, A. M. Striuk, M. I. Striuk, L. S. Kolgatina, I. V. Oliynyk, AREdu 2020 - How augmented reality helps during the coronavirus pandemic, in: O. Y. Burov, A. E. Kiv (Eds.), *Proceedings of the 3rd International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, May 13, 2020, volume 2731 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2020, pp. 1–46. URL: <https://ceur-ws.org/Vol-2731/paper00.pdf>.
- [61] S. H. Lytvynova, S. O. Semerikov, A. M. Striuk, M. I. Striuk, L. S. Kolgatina, V. Y. Velychko, I. S. Mintii, O. O. Kalinichenko, S. M. Tukalo, AREdu 2021 - Immersive technology today, in: S. H. Lytvynova, S. O. Semerikov (Eds.), *Proceedings of the 4th International Workshop on Augmented Reality in Education (AREdu 2021)*, Kryvyi Rih, Ukraine, May 11, 2021, volume 2898 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2021, pp. 1–40. URL: <https://ceur-ws.org/Vol-2898/paper00.pdf>.
- [62] S. Papadakis, A. E. Kiv, H. M. Kravtsov, V. V. Osadchyi, M. V. Marienko, O. P. Pinchuk, M. P. Shyshkina, O. M. Sokolyuk, I. S. Mintii, T. A. Vakaliuk, L. E. Azarova, L. S. Kolgatina, S. M. Amelina, N. P. Volkova, V. Y. Velychko, A. M. Striuk, S. O. Semerikov, Unlocking the power of synergy: the joint force of cloud technologies and augmented reality in education, *CEUR Workshop Proceedings* (2023) 1–23.
- [63] S. O. Semerikov, T. A. Vakaliuk, I. S. Mintii, V. A. Hamaniuk, V. N. Soloviev, O. V. Bondarenko, P. P. Nechypurenko, S. V. Shokaliuk, N. V. Moiseienko, D. S. Shepiliev, Design methodology for immersive educational resources, *Educational Dimension* 6 (2022) 176–199. doi:10.31812/educdim.4716.
- [64] N. Shakhovska, R. Holoshchuk, S. Fedushko, O. Kosar, R. Danel, M. Repka, The Sequential Associative Rules Analysis of Patient's Physical Characteristics, in: N. Shakhovska, S. Montenegro, Y. Estève, S. Subbotin, N. Kryvinska, I. Izonin (Eds.), *Proceedings of the 1st International Workshop on Informatics & Data-Driven Medicine (IDDM 2018)*, Lviv, Ukraine, November 28–30, 2018, volume 2255 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2018, pp. 82–92. URL: <https://ceur-ws.org/Vol-2255/paper8.pdf>.
- [65] A.-M. Androniceanu, I. Georgescu, C. Dobrin, I. V. Dragulanescu, Multifactorial components analysis of the renewable energy sector in the OECD countries and managerial implications [Analiza komponentów wielofunkcyjnych sektora energii odnawialnej w krajach OECD i implikacje kierownicze], *Polish Journal of Management Studies* 22 (2020) 36 – 49. doi:10.17512/pjms.2020.22.2.03.
- [66] Y. V. Prystupa, V. A. Hamaniuk, Results of integration of Ukrainian education into the European educational area, *Educational Dimension* 4 (2021) 8–24. doi:10.31812/educdim.v56i4.4392.
- [67] H. Javaheri, M. Mirzaei, P. Lukowicz, How Far Can Wearable Augmented Reality Influence

- Customer Shopping Behavior, in: *MobiQuitous 2020 - 17th EAI International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services*, MobiQuitous '20, Association for Computing Machinery, New York, NY, USA, 2021, p. 464–469. doi:10.1145/3448891.3448930.
- [68] M. C. Juan, D. Joele, A comparative study of the sense of presence and anxiety in an invisible marker versus a marker augmented reality system for the treatment of phobia towards small animals, *International Journal of Human-Computer Studies* 69 (2011) 440–453. doi:10.1016/j.ijhcs.2011.03.002.
- [69] G. Rotidi, K. Kedraka, E.-M. Frementiti, C. Kaltsidis, University Pedagogy in Greece: Pedagogical Needs of Greek Academics from Ionian University, in: A. Kavoura, E. Kefallonitis, P. Theodoridis (Eds.), *Strategic Innovative Marketing and Tourism*, Springer Proceedings in Business and Economics, Springer International Publishing, Cham, 2020, pp. 737–744. doi:10.1007/978-3-030-36126-6_81.
- [70] O. H. Kolgatin, L. S. Kolgatina, N. S. Ponomareva, E. O. Shmeltser, Systematicity of students' independent work in cloud learning environment, *CTE Workshop Proceedings* 6 (2019) 184–196. doi:10.55056/cte.379.
- [71] Y. M. Krainyk, A. Razzhyvin, O. Bondarenko, I. Simakova, Internet-of-Things Device Set Configuration for Connection to Wireless Local Area Network, in: D. Luengo, S. Subbotin, P. Arras, Y. V. Bodyanskiy, K. Henke, I. Izonin, V. G. Levashenko, V. Lytvynenko, A. Parkhomenko, A. Pester, N. Shakhovska, A. Sharpanskykh, G. Tabunshchik, C. Wolff, H. Wuttke, E. Zaitseva (Eds.), *Proceedings of the Second International Workshop on Computer Modeling and Intelligent Systems (CMIS-2019)*, Zaporizhzhia, Ukraine, April 15–19, 2019, volume 2353 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2019, pp. 885–896. URL: <https://ceur-ws.org/Vol-2353/paper70.pdf>.
- [72] V. Kukharenko, B. Shunevych, H. Kravtsov, Distance course examination, *Educational Technology Quarterly* 2022 (2022) 1–19. doi:10.55056/etq.4.
- [73] V. M. Kukharenko, Cloud technology in science research, *CTE Workshop Proceedings* 3 (2015) 146–157. doi:10.55056/cte.258.
- [74] N. Morze, O. Buinytska, L. Varchenko-Trotsenko, S. Vasylenko, D. Nastas, A. Tiutiunyk, S. Lytvynova, System for digital professional development of university teachers, *Educational Technology Quarterly* 2022 (2022) 152–168. doi:10.55056/etq.6.
- [75] T. A. Vakaliuk, V. V. Kontsedailo, D. S. Antoniuk, O. V. Korotun, I. S. Mintii, A. V. Pikilnyak, Using game simulator Software Inc in the Software Engineering education, in: A. E. Kiv, M. P. Shyshkina (Eds.), *Proceedings of the 2nd International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, March 22, 2019, volume 2547 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2019, pp. 66–80. URL: <https://ceur-ws.org/Vol-2547/paper05.pdf>.
- [76] O. B. Matsiy, A. V. Morozov, A. V. Panishev, The Recurrent Method to Solve the Assignment Problem, *Cybernetics and Systems Analysis* 51 (2015) 939–946. doi:10.1007/s10559-015-9786-x.
- [77] P. Nechypurenko, T. Selivanova, M. Chernova, Using the Cloud-Oriented Virtual Chemical Laboratory VLab in Teaching the Solution of Experimental Problems in Chemistry of 9th Grade Students, in: V. Ermolayev, F. Mallet, V. Yakovyna, V. S. Kharchenko, V. Kobets, A. Kornilowicz, H. Kravtsov, M. S. Nikitchenko, S. Semerikov, A. Spivakovsky (Eds.),

- Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume II: Workshops, Kherson, Ukraine, June 12-15, 2019, volume 2393 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2019, pp. 968–983. URL: https://ceur-ws.org/Vol-2393/paper_329.pdf.
- [78] Y. H. Nosenko, M. V. Popel, M. P. Shyshkina, The state of the art and perspectives of using adaptive cloud-based learning systems in higher education pedagogical institutions (the scope of Ukraine), *CTE Workshop Proceedings* 6 (2019) 173–183. doi:10.55056/cte.377.
 - [79] V. P. Oleksiuk, O. R. Oleksiuk, Examining the potential of augmented reality in the study of Computer Science at school, *Educational Technology Quarterly* 2022 (2022) 307–327. doi:10.55056/etq.432.
 - [80] K. Osadcha, V. Osadchyi, V. Kruglyk, O. Spirin, Modeling of the adaptive system of individualization and personalization of future specialists' professional training in the conditions of blended learning, *Educational Dimension* 5 (2021) 109–125. doi:10.31812/educdim.4721.
 - [81] T. Vakaliuk, I. Pilkevych, D. Fedorchuk, V. Osadchyi, A. Tokar, O. Naumchak, Methodology of monitoring negative psychological influences in online media, *Educational Technology Quarterly* 2022 (2022) 143–151. doi:10.55056/etq.1.
 - [82] L. Panchenko, Digital storytelling in adult education: barriers and ways to overcome them, *Educational Technology Quarterly* 2021 (2021) 673–688. doi:10.55056/etq.41.
 - [83] O. Burov, O. Pinchuk, Extended reality in digital learning: influence, opportunities and risks' mitigation, *Educational Dimension* 5 (2021) 144–160. doi:10.31812/educdim.4723.
 - [84] P. Nechypurenko, S. Semerikov, O. Pokhlietova, Cloud technologies of augmented reality as a means of supporting educational and research activities in chemistry for 11th grade students, *Educational Technology Quarterly* (2023). doi:10.55056/etq.44.
 - [85] Y. Shapovalov, V. Shapovalov, R. Tarasenko, Z. Bilyk, I. Shapovalova, A. Paschke, F. Andruszkiewicz, Practical application of systemizing expedition research results in the form of taxonomy, *Educational Technology Quarterly* 2022 (2022) 216–231. doi:10.55056/etq.40.
 - [86] M. V. Rassovytska, A. M. Striuk, The system of cloud-oriented tools of learning computer science disciplines of engineering specialties students, *CTE Workshop Proceedings* 5 (2018) 20–26. doi:10.55056/cte.131.
 - [87] T. Vakaliuk, O. Chyzhmotria, O. Chyzhmotria, S. Didkivska, V. Kontsedailo, The use of massive open online courses in teaching the fundamentals of programming to software engineers, *Educational Technology Quarterly* (2023). doi:10.55056/etq.37.
 - [88] N. V. Valko, V. V. Osadchyi, V. S. Kruhlyk, Cloud resources use for students' project activities, *CTE Workshop Proceedings* 8 (2021) 304–317. doi:10.55056/cte.240.
 - [89] O. Duda, N. Kunanets, O. Matsiuk, V. Pasichnyk, N. Veretennikova, A. Fedonuyk, V. Yunchyk, Selection of Effective Methods of Big Data Analytical Processing in Information Systems of Smart Cities, in: M. Emmerich, V. Lytvyn, V. Vysotska, V. B. Fernandes, V. Lytvynenko (Eds.), *Proceedings of the 2nd International Workshop on Modern Machine Learning Technologies and Data Science (MoMLT+DS 2020)*. Volume I: Main Confer-

- ence, Lviv-Shatsk, Ukraine, June 2-3, 2020, volume 2631 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2020, pp. 68–78. URL: <https://ceur-ws.org/Vol-2631/paper6.pdf>.
- [90] N. Volkova, O. Tarnopolsky, O. Lebid, K. Vlasenko, Students' computer-based workshops in mandatory classes of english for students majoring in psychology and linguistics: A comparative experimental study, *Educational Technology Quarterly* 2021 (2021) 274–292. doi:10.55056/etq.55.
 - [91] M. M. Volikova, T. S. Armash, Y. V. Yechkalo, V. I. Zaselskiy, Practical use of cloud services for organization of future specialists professional training, *CTE Workshop Proceedings* 6 (2019) 486–498. doi:10.55056/cte.408.
 - [92] A. M. Striuk, Formation of software design skills among software engineering students, *Educational Dimension* 6 (2022) 1–21. doi:10.31812/educdim.4519.
 - [93] V. Tkachuk, Y. V. Yechkalo, S. Semerikov, M. Kislova, Y. Hladyr, Using Mobile ICT for Online Learning During COVID-19 Lockdown, in: A. Bollin, V. Ermolayev, H. C. Mayr, M. Nikitchenko, A. Spivakovsky, M. V. Tkachuk, V. Yakovyna, G. Zholtkevych (Eds.), *Information and Communication Technologies in Education, Research, and Industrial Applications - 16th International Conference, ICTERI 2020, Kharkiv, Ukraine, October 6-10, 2020, Revised Selected Papers*, volume 1308 of *Communications in Computer and Information Science*, Springer, 2020, pp. 46–67. doi:10.1007/978-3-030-77592-6_3.
 - [94] G. Abuselidze, G. Zoidze, Economic analysis of factors associated with education and employment, *CEUR Workshop Proceedings* (2023) 24–37.
 - [95] G. Abuselidze, A. Slobodanyk, Social responsibility of business and government in the conditions of the COVID-19 pandemic, *E3S Web of Conferences* 210 (2020). doi:10.1051/e3sconf/202021015016.
 - [96] G. Abuselidze, The Impact of Banking Competition on Economic Growth and Financial Stability: An Empirical Investigation, *European Journal of Sustainable Development* 10 (2021) 203. doi:10.14207/ejsd.2021.v10n1p203.
 - [97] G. Abuselidze, Use of hedging instruments on example of grain market, *Engineering for Rural Development* 20 (2021) 1655 – 1662. doi:10.22616/ERDev.2021.20.TF359.
 - [98] N. Y. Dmitrenko, O. V. Voloshyna, S. S. Kizim, K. V. Mnyshenko, S. V. Nahorniak, Smart education in the prospective teachers' training, *CEUR Workshop Proceedings* (2023) 38–53.
 - [99] N. Dmitrenko, O. Voloshyna, Training of Prospective Teachers of Foreign Language to Work in Inclusive Classes, *Pedagogika* 129 (2018) 187–205. doi:10.15823/p.2018.13.
 - [100] L. Popko, S. Kizim, T. Mironova, L. Brovchak, O. Zhadeyko, Digital technologies: Cultural approach, *AD ALTA: Journal of Interdisciplinary Research* 12 (2022) 189–192.
 - [101] R. S. Gurevych, V. A. Frytsiuk, N. Y. Dmytrenko, Computer diagnostics of prospective teachers' readiness for professional self-development, *Information Technologies and Learning Tools* 69 (2019) 211–221. doi:10.33407/itlt.v69i1.2605.
 - [102] L. J. Papanikolopoulou Arco, Possibilities and limitations of social media in education processes during the pandemic: The teachers perspective, *CEUR Workshop Proceedings* (2023) 54–64.
 - [103] L. J. Papanikolopoulou Arco, Desigualdad educativa en medio de una pandemia: El papel inclusivo y exclusivo de los medios sociales según el profesorado, *Teknokultura. Revista de Cultura Digital y Movimientos Sociales* 19 (2022) 189–196. doi:10.5209/tekn.77712.

- [104] L. J. Papanikolopoulou Arco, La gestión educativa en tiempos de pandemia: el lugar de los medios sociales en el cambio de la enseñanza desde la perspectiva de los educadores, *Revista DIECISIETE* (2022) 131–144. doi:10.36852/2695-4427_2022_07.08.
- [105] L. J. Papanikolopoulou Arco, The Earthquake Impact on Tourism Industry: The Kos Case, *Tourism and Rural Space* 48 (2022) 156–166.
- [106] O. S. Holovnia, N. O. Shchur, I. A. Sverchevska, Y. M. Bailiuk, O. A. Pokotylo, Interactive surveys during online lectures for IT students, *CEUR Workshop Proceedings* (2023) 65–86.
- [107] O. M. Spirin, O. S. Holovnia, Using Unix-like operating systems virtualization technologies in training the bachelors of Computer Science, *Information Technologies and Learning Tools* 65 (2018) 201–222. doi:10.33407/itlt.v65i3.2055.
- [108] O. Holovnia, Linux Online Virtual Environments in Teaching Operating Systems, in: O. Sokolov, G. Zholtkevych, V. Yakovyna, Y. Tarasich, V. Kharchenko, V. Kobets, O. Burov, S. Semerikov, H. Kravtsov (Eds.), *Proceedings of the 16th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume II: Workshops*, Kharkiv, Ukraine, October 06-10, 2020, volume 2732 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2020, pp. 964–973. URL: <https://ceur-ws.org/Vol-2732/20200964.pdf>.
- [109] O. S. Holovnia, V. P. Oleksiuk, Selecting cloud computing software for a virtual online laboratory supporting the Operating Systems course, in: A. E. Kiv, S. O. Semerikov, M. P. Shyshkina (Eds.), *Proceedings of the 9th Workshop on Cloud Technologies in Education, CTE 2021*, Kryvyi Rih, Ukraine, December 17, 2021, volume 3085 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2021, pp. 216–227. URL: <https://doi.org/10.55056/cte.116>. doi:10.55056/cte.116.
- [110] O. V. Kanivets, I. M. Kanivets, T. M. Gorda, O. V. Gorbenko, A. O. Kelemesh, Using a mobile application to teach students to measure with a micrometer during remote laboratory work, *CEUR Workshop Proceedings* (2023) 87–107.
- [111] O. V. Kanivets, I. Kanivets, N. V. Kononets, T. Gorda, E. O. Shmeltser, Development of mobile applications of augmented reality for projects with projection drawings, in: A. E. Kiv, M. P. Shyshkina (Eds.), *Proceedings of the 2nd International Workshop on Augmented Reality in Education*, Kryvyi Rih, Ukraine, March 22, 2019, volume 2547 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2019, pp. 262–273. URL: <https://ceur-ws.org/Vol-2547/paper19.pdf>.
- [112] O. V. Kanivets, I. M. Kanivets, T. M. Gorda, O. A. Burlaka, Development of a machine vision program to determine the completeness of wrapping plants in the soil, *CEUR Workshop Proceedings* 3077 (2022) 27–43.
- [113] O. V. Kanivets, I. M. Kanivets, T. M. Gorda, Development of an augmented reality mobile physics application to study electric circuits, *Educational Technology Quarterly* 2022 (2022) 347–365. doi:10.55056/etq.429.
- [114] L. E. Gryzun, O. V. Shcherbakov, B. O. Bida, Development of the information system for navigation in modern university campus, *CEUR Workshop Proceedings* (2023) 108–126.
- [115] L. Bilousova, L. Gryzun, N. Zhytienova, V. Pikalova, Search Algorithms Learning Based on Cognitive Visualization, in: V. Ermolayev, F. Mallet, V. Yakovyna, H. C. Mayr, A. Spivakovsky (Eds.), *Proceedings of the 15th International Conference on ICT*

- in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume I: Main Conference, Kherson, Ukraine, June 12-15, 2019, volume 2387 of *CEUR Workshop Proceedings*, CEUR-WS.org, 2019, pp. 472–478. URL: <https://ceur-ws.org/Vol-2387/20190472.pdf>.
- [116] L. Bilousova, L. Gryzun, I. Sivochka, Petri Nets Android application as a mobile aid for students' mastering modelling, *Journal of Physics: Conference Series* 1840 (2021) 012033. doi:10.1088/1742-6596/1840/1/012033.
- [117] L. I. Bilousova, L. E. Gryzun, S. H. Lytvynova, Practice of applying functional approach to the design of digital learning aids, *Journal of Physics: Conference Series* 2288 (2022) 012008. doi:10.1088/1742-6596/2288/1/012008.