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TECHNICAL FACULTY  
"MIHAJLO PUPIN"  
ZRENJANIN**



**ITROCONFERENCE<sup>14</sup>**  
INFORMATION TECHNOLOGY AND EDUCATION DEVELOPMENT



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INFORMATION TECHNOLOGY AND EDUCATION DEVELOPMENT



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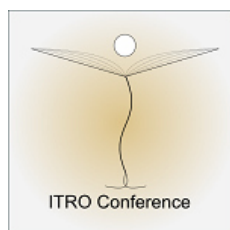
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## INTRODUCTION

International Conference on Information Technology and Education Development (ITRO) 2023, was held at the Technical Faculty "Mihajlo Pupin" for the fourteenth time. This year we have gathered our dear colleagues, scientists, researchers and students from several countries (Slovak Republic, Hungary, Macedonia, Bosnia and Herzegovina, India, Malaysia, USA and Serbia). They presented papers and promoted the results of research and scientific work in the field of information technology in education. The main course of the Conference was set up with some of the introductory lectures:

- "Challenges of the Technical Science Subject Teaching " held by Tünde Anna Kovács from Óbuda University, Bánki Donát Mechanical and Safety Engineering, Hungary;
- "VR Technologies in the Educational Process of Disabled People and in University Education On-line presentation" held by Csaba Szabó from Department of Computers and Informatics, Faculty of Electrical Engineering and Informatics, Technical University of Košice, Slovak Republic. Author and co-authors: Branislav Sobota, Štefan Korečko, Miriama Mattová, and Gabriel Strop;
- "Analysis of Students' Academic Achievements in the Field of Mathematics and Computer Science" held by Gordana Jauševac from University of East Sarajevo/Faculty of Transport and Traffic Engineering, Doboj, Bosnia and Herzegovina. Author and co-authors: G. Jotanovic, G. Jausevac , D. Nedic, D. Mandic (from University of Belgrade/Faculty of Education), and D. Glusac (from University of Novi Sad/Technical faculty "Mihajlo Pupin", Zrenjanin);
- "Toward intelligent data analysis in higher education institutions" held by Nina Bijedić from Faculty of Information Technologies University Džemal Bijedić of Mostar, Mostar, Bosnia and Herzegovina. Author and co-authors: A. Joldić and D. Gašpar.

The other presented papers have cast light on various aspects of contemporary education in our country and abroad, such as: school without mobile phones, the phenomenon of academic boredom, augmented reality learning environment, cloud technologies in education, etc. They addressed experiences, problems, questions, etc. in relation with information technologies and education development.

The conference was financially supported by the Provincial Secretariat for Higher Education and Scientific Research, Novi Sad. The Technical Faculty "Mihajlo Pupin" has provided the necessary technical support.

The ITRO Organizing Committee would like to thank to the authors of articles, reviewers and participants in the Conference who have contributed to its tradition and successful realization.

See you at the next ITRO Conference,

Chairman of the Organizing Committee  
PhD Vesna Makitan

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# Review of the Usage of Cloud Technologies in Education

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**Abstract** - Cloud technologies are increasingly used nowadays. A large number of institutions and organizations have already migrated their applications to the cloud. In this way, they use services offered by the service providers instead of using on-premise servers to host their applications. With this, the organizations get a scalable infrastructure, reduction of initial costs that are required to purchase an appropriate IT infrastructure, flexibility, security, automatic updates and disaster recovery. These are just some of the benefits that cloud technologies offer. This confirms the importance of acquiring skills for these technologies through the educational programs. This paper provides a comprehensive review of the usage of cloud technologies in different phases of education, determines the models of cloud services and the most used services in education. In addition, the opportunities offered by cloud providers to educational institutions are presented here in order for students to get a real work environment and acquire cloud computing skills.

## I. INTRODUCTION

Cloud technologies are widely used nowadays in different areas and for different purposes [42]. Amato et al. in [1] present a touristic recommendation system that is based on the preferences of the tourists and the user experience. It uses a cloud architecture that can process a huge amount of data. Cloud technologies are often used to perform complex operations. Ekanayake and Fox in [2] emphasize the usage of cloud technologies for performance analysis of high-performance parallel applications. Popel and Shyshkina in [3] provide a discussion about the involvement of cloud-based environment components in augmented reality. They noted that it is much easier for institutions to use augmented reality if they have deployed a cloud environment or use some cloud services. Aziz et al. in [4] present the possibility for adaptation of cloud technologies for improving the e-government services. They highlight a lot of benefits of cloud technology such as costs reduction, lower maintenance of the infrastructure, increased availability and reliability of the services, greater flexibility, energy efficiency, access to public sector information and so on. Some of the challenges for

adopting the cloud computing technologies are also depicted here such as standardization, services that can be easily reached by the end users, availability and affordability of the services, customization of services according to the users and the needs and great level of serviceability. Devasena in [5] show the importance of the usage of cloud technologies for business development. This study confirms the benefits of cloud technologies and their positive impact on the business services that are basis for the business development and improvement. Yamamoto et al. in [6] proposed a solution for processing a large-scale house data in a smart city using the cloud technologies. The proposed platform is scalable and can store and process a large-scale and heterogeneous log data. Near and Rahman in [7] present the possibility for the usage of cloud technology for video surveillance applications. They highlight the benefits of the cloud services for the high-resolution video surveillance management systems (VMS). Kumar et al. in [8] discussed the application of cloud technologies and various related services in digital library. According to the study, cloud computing techniques and methods that are applied to digital libraries can improve the utilization of the resources and with that to contribute to the development of a better implementation model.

Cloud technologies are also used in education. They are used for a variety of purposes. The main objective of this paper is to provide a comprehensive overview of the usage and application of cloud technologies in education.

The rest of the paper is structured as follows. Section II presents the specific usage of cloud technologies in education. Section III provides a review of studies. In this section we can see the research questions, the selection of appropriate studies and the research results. The last Section IV is a conclusion of our work. This section also presents the future research directions according to the overview of all studies.

## II. USAGE OF CLOUD TECHNOLOGIES IN EDUCATION

There are a lot of use cases of using cloud technologies in education. According to [9], the cloud computing is used by 43% of universities and colleges. The market size of cloud computing in the education sector in 2021 was 23.81 billion USD [9]. It is assumed that the size of the market will reach 173.62 billion USD by 2030. The cloud technologies allow access to resources from anywhere and at any time. This is really important for the educational institutions. The usage of cloud technologies in education can be described by the three basic service models:

- Software as a Service (SaaS) – The educational institutions can use software and applications that are offered by the cloud service providers. Applications are hosted in the cloud and the users access them over the Internet. Students often need to use applications in certain subjects. Instead of installing them separately, they can access them directly through the SaaS model. This provides flexibility and easier access to resources that are needed in the learning process.
- Platform as a Service (PaaS) – Professors in educational institutions can create virtual laboratories for students. In this environment students and educators can have access to tools, services and support for programming languages that can be used for exercising during the classes.
- Infrastructure as a Service (IaaS) – This model provides access to processing, storage and network resources which can be used for hosting applications. This is needed for students to test a real working environment that can be useful for acquiring new skills.

Cloud computing have a lot of benefits that are specific for the education sector [9]. Some of them are:

- Scalability and flexibility – Sometimes the number of users in educational applications increases significantly. All this requires resources with better performance. If we use on-premise infrastructure, in that case it can be difficult to ensure its scalability. This can be done very quickly by using the cloud infrastructure. In this way, we can handle the increasing number of users, requests,

data and traffic, but also ensure a good user experience.

- Time and freedom – The professors can upload the learning resources in the cloud. In this way, they would save time instead of printing and distributing them. The professors can also save the assignments for the students and lesson plans in the cloud. All these resources can be shared with other professors and the students. In addition, the resources can be accessed from anywhere just by using the Internet, which allows freedom for the professors and the students.
- Collaboration based on cloud – The cloud allows multiple students to work on the same assignment at the same time. They can also receive a real-time feedback from their educators. This is very important in the process of acquiring new knowledge and skills. The educators can also collaborate with each other.
- Support for students who cannot attend classes – There are students who are not able to attend classes regularly. Sometimes there are students who work in parallel with their studies and cannot attend classes. Cloud technologies and educational e-learning platforms that are often cloud-based can help them to continue with the learning process [43].
- Cost savings – Cloud technologies provide a cost-effective solution for educational institutions. They can use cloud infrastructure without having to make large upfront investments in physical IT infrastructure. In addition, cloud providers also offer the possibility of subscription, which enables a significant reduction in the costs for using the cloud services [10].

## III. REVIEW OF STUDIES

### A. Research Questions

With this review, we want to explore the usage of cloud technologies by the educational institutions. The main research questions in this review are:

- At which stage of education are the cloud technologies used, i.e. in primary, secondary or higher education?
- Which cloud service models are used or proposed?



- What types of cloud services are used or are proposed to be used by the educational institutions?
- Do educational institutions offer students a real working environment for using cloud services?

### B. Selection of Appropriate Studies

The main purpose of this study is to review the latest research papers for the usage of cloud technologies in education in the last 5 years. The studies are selected according to the following criteria:

- They should not be older than 5 years;
- They must include the usage of cloud technologies in education or proposal for their usage;

We excluded studies according to the following criteria:

- They are older than 5 years;
- They are theses, dissertations or review papers;
- Studies that have an informal context;
- Introduction studies to cloud computing and cloud services;

According to the given criteria, we selected a total of 31 research papers. The selected papers can be seen in Appendix A at the end of the paper.

### C. Research Results

- At which stage of education are the cloud technologies used, i.e. in primary, secondary or higher education?

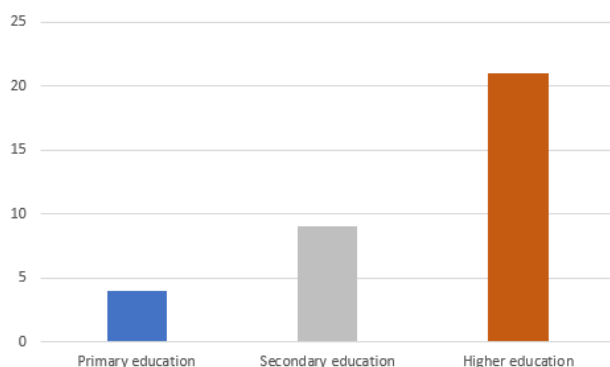


Figure 1. Stages of education in which cloud technologies are used

As can be seen in Figure 1, cloud technologies are mostly used in higher education, while they are least used in primary education. From the total number of

studies, 21 studies cover the usage of cloud technologies in higher education, 9 studies in secondary education and 4 studies in primary education. Considering the benefits offered by cloud technologies, our opinion is that they should be taught in secondary and even primary education. In this way, the students will be prepared to apply these technologies in the higher stages of education. In addition, they can contribute to the improvement of the educational process.

- Which cloud service models are used or proposed?

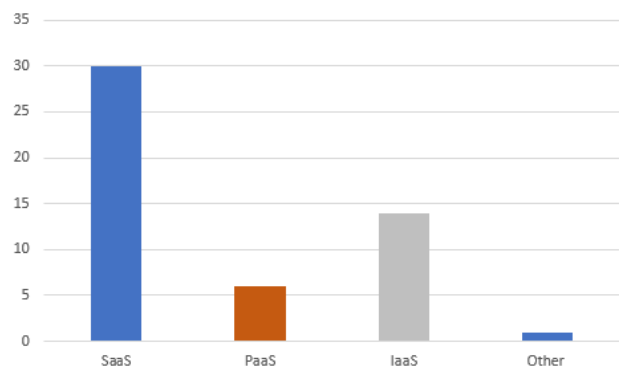


Figure 2. Used cloud service models

The most used or proposed service model is SaaS (Figure 2). It is mentioned in a total of 30 out of 31 studies. This confirms the importance of using SaaS. The next most used model is IaaS, which is used or proposed in 14 studies. PaaS model is mentioned in 6 studies. Only one study [17] includes usage of others non-standard cloud service models such as Desktop as a Service - DaaS and Communications as a Service – CaaS. Our opinion is that the usage of SaaS, PaaS and IaaS models in education can be really important for the students and the educational institution.

- What types of cloud services are used or are proposed to be used by the educational institutions?

From the research of the studies it can be seen that most of them propose cloud services that can be used, i.e. a total of 24, while a smaller part cover the real usage of cloud services, i.e. 8 studies. Most of the studies, i.e. 30, cover SaaS cloud applications (Figure 3). Other types of services that are covered in the studies are:

- Storage Services - 16 studies [11, 14, 15, 17, 18, 19, 21, 22, 23, 26, 27, 28, 33, 35, 37, 39]
- Processing Services - 3 studies [14, 17, 22]

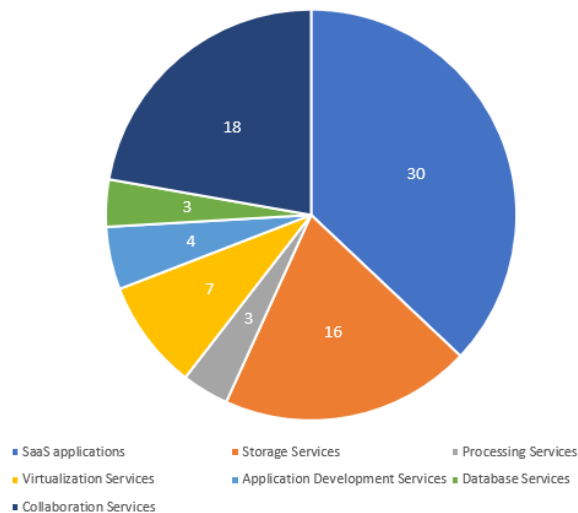


Figure 3. Used or proposed types of cloud services

- Virtualization Services - 7 studies [15, 16, 17, 19, 21, 27, 33]
- Application Development Services - 4 studies [13, 17, 19, 33]
- Database Services - 3 studies [19, 27, 33]
- Collaboration Services – 18 studies [17, 18, 21, 23, 26, 27, 28, 29, 30, 32, 33, 35, 36, 37, 38, 39, 40, 41]

All types of services can contribute to the improvement of the educational process in a different way.

- Do educational institutions offer students a real working environment for using cloud services?

As can be seen from the overview of the studies in Appendix A, a very small number of papers, only 6 [12, 13, 16, 19, 21, 27], cover the usage of real working environment for cloud services in educational institutions.

The institutions must consider the educational programs and benefits offered by cloud providers that provide a real working environment for their cloud services. For example, Amazon Web Services offers the AWS Academy Learner Labs environment which can be very useful for the educators and the students [44]. Microsoft has the Azure for Students program through which the students can earn free credits for using cloud services in the Microsoft Azure cloud platform. Google offers the module Google Cloud Free Tier which also offers free credits for using cloud services in the Google Cloud Platform [46].

#### IV. CONCLUSION

Cloud technologies can significantly contribute to the improvement of the educational process. According to this research, they are mostly used in higher education. The SaaS model is the most used model of cloud services. Very few educational institutions provide a real working environment for students to use cloud services. In the future, special attention should be paid to providing access to these services.

#### REFERENCES

- [1] Amato, F., Mazzeo, A., Moscato, V., & Picariello, A. (2014). Exploiting cloud technologies and context information for recommending touristic paths. In *Intelligent Distributed Computing VII: Proceedings of the 7th International Symposium on Intelligent Distributed Computing-IDC 2013*, Prague, Czech Republic, September 2013 (pp. 281-287). Springer International Publishing.
- [2] Ekanayake, J., & Fox, G. (2010). High performance parallel computing with clouds and cloud technologies. In *Cloud Computing: First International Conference, CloudComp 2009 Munich, Germany, October 19–21, 2009 Revised Selected Papers 1* (pp. 20-38). Springer Berlin Heidelberg.
- [3] Popel, M. V., & Shyshkina, M. P. (2018). The cloud technologies and augmented reality: The prospects of use. *arXiv preprint arXiv:1807.01966*.
- [4] Aziz, M. A., Abawajy, J., & Chowdhury, M. (2013, December). The challenges of cloud technology adoption in e-government. In *2013 International Conference on Advanced Computer Science Applications and Technologies* (pp. 470-474). IEEE.
- [5] Devasena, C. L. (2014). Impact study of cloud computing on business development. *Operations Research and Applications: An International Journal (ORAJ)*, 1(1), 1-7.
- [6] Yamamoto, S., Matsumoto, S., & Nakamura, M. (2012, December). Using cloud technologies for large-scale house data in smart city. In *4th IEEE International Conference on Cloud Computing Technology and Science Proceedings* (pp. 141-148). IEEE.
- [7] Neal, D. J., & Rahman, S. (2015). Video surveillance in the cloud?. *arXiv preprint arXiv:1512.00070*.
- [8] Kumar, D. K., Murthy, Y. S. S. R., Ramakrishna, D., & Rohit, A. V. (2012). Application of cloud technology in digital library. *International Journal of Computer Science Issues (IJCSI)*, 9(3), 374.
- [9] Benefits and Features of Cloud Computing in Education Industry. <https://devtechnosys.com/insights/cloud-computing-in-education/>. Accessed on: 24.09.2023.
- [10] Velinov, A., Zdravev, Z., & Nikolova, A. (2023). Optimization of Cloud Costs. *South East European Journal of Sustainable Development*, 7(1).
- [11] Elmurzaevich, M. A. (2022, February). Use of cloud technologies in education. In *Conference Zone* (pp. 191-192).
- [12] Bondarenko, O. V., Pakhomova, O. V., & Zaslavskiy, V. I. (2019). The use of cloud technologies when studying geography by higher school students. *arXiv preprint arXiv:1909.04377*.
- [13] Valko, N. V., Kushnir, N. O., & Osadchyi, V. V. (2020). Cloud technologies for STEM education.
- [14] Elmurzaevich, M. O. (2022). Formation of Students' Competence in the Use of Cloud Technologies In The Information Educational Environment. *World Bulletin of Social Sciences*, 8, 79-80.
- [15] Holinska, T., Komarovska, O., Melnyk, O., Pet'ko, L., Shpitsa, R., Sova, O., & Strohal, T. (2019). Cloud technologies in art entrepreneurship education. *Journal of Entrepreneurship Education*, 22(5), 1-6.
- [16] Zhaldak, M. I., Franchuk, V. M., & Franchuk, N. P. (2021, March). Some applications of cloud technologies in mathematical calculations. In *Journal of Physics: Conference Series* (Vol. 1840, No. 1, p. 012001). IOP Publishing.

- [17] Irgashevich, D. A. (2020). Methods of using cloud technologies in Islamic education institutions. *Methods*, 7(5).
- [18] Khodjayeva, N., & Sodikov, S. (2023). Methods and Advantages of Using Cloud Technologies in Practical Lessons. *Pioneer: Journal of Advanced Research and Scientific Progress*, 2(3), 77-82.
- [19] Markova, O., Semerikov, S., Striuk, A., Shalatska, H., Nechypurenko, P., & Tron, V. (2019). Implementation of cloud service models in training of future information technology specialists.
- [20] Valko, N. V., Goncharenko, T. L., Kushnir, N. O., & Osadchyi, V. V. (2022, March). Cloud technologies for basics of artificial intelligence study in school. In *CTE Workshop Proceedings (Vol. 9, pp. 170-183)*.
- [21] Iatsyshyn, A. V., Kovach, V. O., Romanenko, Y. O., & Iatsyshyn, A. V. (2019). Cloud services application ways for preparation of future PhD.
- [22] G'ayratovich, E. N. (2022). The Problem of Training Future Engineer Personnel on the Basis of Cloud Technology in Technical Specialties of Higher Education. *Eurasian Scientific Herald*, 13, 1-4.
- [23] Vakaliuk, T. A., Spirin, O. M., Lobanchykova, N. M., Martseva, L. A., Novitska, I. V., & Kontsedailo, V. V. (2021, March). Features of distance learning of cloud technologies for the organization educational process in quarantine. In *Journal of physics: Conference series (Vol. 1840, No. 1, p. 012051)*. IOP Publishing.
- [24] Nechypurenko, P. P., & Pokhliestova, O. Y. (2023). Cloud technologies of augmented reality as a means of supporting educational and research activities in chemistry for 11th grade students.
- [25] Kholoshyn, I., Bondarenko, O., Hanchuk, O., & Varfolomyeyeva, I. (2020). Cloud technologies as a tool of creating Earth Remote Sensing educational resources. *arXiv preprint arXiv:2007.10774*.
- [26] Vakaliuk, T., Spirin, O., Korotun, O., Antoniuik, D., Medvedieva, M., & Novitska, I. (2022). The current level of competence of schoolteachers on how to use cloud technologies in the educational process during COVID-19. *Educational technology quarterly*, 2022(3), 232-250.
- [27] Spirin, O., Oleksiuk, V., Oleksiuk, O., & Sydorenko, S. (2018). The group methodology of using cloud technologies in the training of future computer science teachers. *CEUR Workshop Proceedings*.
- [28] Petrovych, O. B., Vinnichuk, A. P., Poida, O. A., Tkachenko, V. I., Vakaliuk, T. A., & Kuzminska, O. H. (2022, March). The didactic potential of cloud technologies in professional training of future teachers of Ukrainian language and literature. In *CTE Workshop Proceedings (Vol. 9, pp. 259-277)*.
- [29] Volikova, M. M., Armash, T. S., & Yechkalo, Y. V. (2019). Practical use of cloud services for organization of future specialists professional training.
- [30] Hevko, I. V., Lutsyk, I. B., Lutsyk, I. I., Potapchuk, O. I., & Borysov, V. V. (2021, June). Implementation of web resources using cloud technologies to demonstrate and organize students' research work. In *Journal of physics: Conference series (Vol. 1946, No. 1, p. 012019)*. IOP Publishing.
- [31] Fedorenko, E. H., Velychko, V. Y., Omelchenko, S. O., & Zaselskiy, V. I. (2020). Learning free software using cloud services.
- [32] Khomenko, V., Pavlenko, L., Pavlenko, M., & Khomenko, S. (2020). Cloud technologies in informational and methodological support of university students' independent study.
- [33] Mustafayevich, U. M. (2022). Educational Aspects of using Cloud-Based Network Services in Training Future Engineers. *Spanish Journal of Innovation and Integrity*, 2, 13-19.
- [34] Onyema, E. M., Nwafor, C. E., Ugwugbo, A. N., Rockson, K. A., & Ogbonnaya, U. N. (2020). Cloud security challenges: implication on education. *Int J Comput Sci Mob Comput*, 9(2), 56-73.
- [35] Sobchenko, T., Dotsenko, S., & Tkachova, N. (2022, May). The results of the use of cloud technologies in the educational process of pedagogical universities in a pandemic. In *SOCIETY. INTEGRATION. EDUCATION. Proceedings of the International Scientific Conference (Vol. 1, pp. 246-260)*.
- [36] Mosenkis, I. L., Lukianyk, L. V., Stokal, O. M., Ponomarova, V. A., & Mykhailiuk, H. V. (2020). Application of cloud educational technologies for teacher competence development. *International Journal of Learning, Teaching and Educational Research*, 19(5), 289-303.
- [37] Varina, H. B., Osadcha, K. P., Shevchenko, S. V., & Voloshyna, V. V. (2023). Developing professional stability of future socioeconomic specialists using cloud technologies in blended learning. In *CEUR Workshop Proceedings (pp. 148-168)*.
- [38] Symonenko, S. V., Osadchyi, V. V., Sysoieva, S. O., Osadcha, K. P., & Azaryan, A. A. (2020). Cloud technologies for enhancing communication of IT-professionals.
- [39] Achar, S. (2021). Leveraging Cloud Technologies to Enhance Student Academic Performance. *Sage Science Review of Educational Technology*, 4(2), 39-52.
- [40] Velychko, V. (2021). Creation of open educational resources during educational practice by means of cloud technologies. *Cloud Technologies in Education*.
- [41] Valko, N. V., Osadchyi, V. V., & Kruhlyk, V. S. (2021, June). Cloud resources use for students' project activities. *CEUR Workshop Proceedings*.
- [42] Zdravev, Z., Velinov, A., & Spasov, S. (2021). Migration of Moodle instance to the cloud-case study at Goce Delchev University. *South East European Journal of Sustainable Development*, 5(2), 99-106.
- [43] Zdravev, Z., Boev, B., & Dzidrov, M. (2020). Implementation of e-learning and ICT in the educational process of UGD in the situation of Covid-19 emergency. *Истражувачки активности на МАНУ за справување со пандемијата од Ковид-19*.
- [44] AWS Academy Learner Labs. [https://www.awsacademy.com/vforcesite/LMS\\_Login](https://www.awsacademy.com/vforcesite/LMS_Login). Accessed on: 28.09.2023.
- [45] Build in the cloud free with Azure for Students. <https://azure.microsoft.com/en-us/free/students>. Accessed on: 28.09.2023.
- [46] Google Cloud Free Tier, Solve real business challenges on Google Cloud. <https://cloud.google.com/free>. Accessed on: 28.09.2023.

APPENDIX A: SUMMARY OF ALL SELECTED PAPERS

NO	YEAR	REFERENCE	TITLE OF THE PAPER	EDUCATION	USED OR PROPOSED MODEL OF CLOUD SERVICES	USED OR PROPOSED SERVICES	PROVIDING A REAL WORKING ENVIRONMENT TO USE CLOUD SERVICES
1	2019	[12]	The use of cloud technologies when studying geography by higher school students	Higher education	SaaS, IaaS	<p><u>Proposed:</u></p> <ul style="list-style-type: none"> <li>- SaaS applications related to geography (Gapminder, DESA Technology, Datawrapper.de, Time.Graphics, HP Reveal (Aurasma), MOZAIK education, Settera Online, Click-that-hood, Canva</li> </ul>	Yes
2	2019	[15]	Cloud technologies in art entrepreneurship education	/	SaaS IaaS	<p><u>Proposed:</u></p> <ul style="list-style-type: none"> <li>-Services for virtualization, network resources, memory resources, data resources, storage resources, business continuity, user devices and security</li> <li>-Application packages that are related to art entrepreneurship</li> <li>-Services that offer interactive tools and educational videos</li> </ul>	/
3	2019	[19]	Implementation of cloud service models in training of future information technology specialists	Higher education	SaaS, PaaS and IaaS	<p><u>Proposed:</u></p> <ul style="list-style-type: none"> <li>-Access to SaaS mathematical software</li> <li>-Web-SCM Sage software which allows integration of main types of software in a single environment</li> <li>-Online integrated programming environments such as Eclipse, Heroku, Code9</li> <li>-Virtual Education Laboratory (VEL) Service</li> <li>-Services for creating virtual machines</li> <li>-Database services (Cloud SQL, phpMyAdmin, DB2 DBMS, Azure SQL Database)</li> <li>-Storage Services</li> <li>-Amazon Web Services (Amazon EC2, Amazon SimpleDB, Amazon RDS, Amazon SQS, Amazon FPS, Amazon S3, Amazon CloudFront, Amazon SNS, Amazon VPC, Cloud Watch</li> <li>-Software for creating a virtual</li> </ul>	Yes

						laboratory (“Agapa” System) -Parallel programming tools	
4	2019	[21]	Cloud services application ways for preparation of future PhD	Higher education	SaaS, PaaS, IaaS	<u>Proposed:</u> -Tools like G Suite for Education, Microsoft Office 365, ThinkFree Online, Google Cloud Services, Amazon Web Services, Microsoft Azure services -CoCalc cloud service in learning of mathematical disciplines -SAGE Web SCM -Storage services: One Drive, Google Drive -VMware cloud-based virtualized environment -Cloud services for training purposes: -Services such as Maple, MATLAB, MapleNet, MATLAB web-server, WebMathematica, Calculation Laboratory -Cloud based corporate services (Xen, VMWare)	Yes
5	2019	[27]	The group methodology of using cloud technologies in the training of future computer science teachers	Primary and Secondary education	SaaS, PaaS, IaaS	<u>Proposed:</u> - Google Suite, Microsoft Office 365 -Application software of cloud platforms -System virtualization services - Apache CloudStack and Proxmox platform services - Windows Azure Web Sites product - Google Cloud Platform (GLP) cloud services (Google App Engine standard environment, Google Cloud SQL, Google Cloud Datastore, Google Cloud Storage and Google Cloud Pub)	Yes
6	2019	[29]	Practical use of cloud services for organization of future specialists professional training	Higher education	SaaS	<u>Proposed:</u> - Cloud services to create online questionnaires, interactive tasks, and electronic courses	/
7	2020	[13]	Cloud technologies for STEM education.	/	SaaS	<u>Proposed:</u> - SaaS applications related to Robotics - PaaS platforms for programming robotic systems	Yes
8	2020	[17]	Methods of using cloud technologies in Islamic	Higher education	SaaS, PaaS, IaaS Other:	<u>Proposed:</u> - Picasa service for image processing - Cloud services that offer	/

			education institutions		DaaS (Desktop as a Service), CaaS (Communications as a Service)	infrastructure - Storage services - Application development platforms - Hosted applications in the cloud (Microsoft Office, Google Docs, Google Classroom) - Using services like Dropbox, Yandex and Google Drive	
9	2020	[25]	Cloud technologies as a tool of creating Earth Remote Sensing educational resources	Primary and Secondary education	SaaS	<u>Used:</u> - Cloud platform for geospatial analysis: Google Earth Engine, Land Viewer, EOS Platform	/
10	2020	[31]	Learning free software using cloud services	Higher education	SaaS	<u>Proposed:</u> - OffiDocs Cloud services -RollApp Cloud Service	/
11	2020	[32]	Cloud technologies in informational and methodological support of university students' independent study	Higher education	SaaS	<u>Proposed:</u> - Zoho, Microsoft, and Google's cloud services - Google Calendar - Google Drive, OneDrive, Dropbox	/
12	2020	[34]	Cloud security challenges: implication on education	Secondary and Higher education	SaaS, PaaS	<u>Proposed:</u> -Microsoft Office 365 -Services for creating Massive Open Online Courses -Other Microsoft Cloud Services (Office 365 for Education (formerly Microsoft live@edu), Business Productivity Online Suite (BPOS), Exchange Hosted Services, Microsoft Dynamics CRM Online and Office Web Apps)	/
13	2020	[36]	Application of cloud educational technologies for teacher competence development.	Higher education	SaaS	<u>Used:</u> -Google Apps for Education Edition services - OwnCloud service	/
14	2020	[38]	Cloud technologies for enhancing communication of IT-professionals	Higher education	SaaS	<u>Proposed:</u> - synchronous communication tools – iMessage, Facebook Messenger, Firebase Cloud Messaging, Google Cloud Messaging, etc.; - asynchronous communication tools – Office 365, G Suite, Zoho Workplace;	/



						<ul style="list-style-type: none"> <li>- collaboration tools – ezTalks Cloud Meeting, Yammer, Evernote, Prezi, Office 365.</li> <li>- OneDrive for Business, SharePoint Online, Microsoft Teams, Yammer, Skype for Business, Outlook Online boards</li> </ul>	
15	2021	[16]	Some applications of cloud technologies in mathematical calculations	/	SaaS and IaaS	<u>Used:</u> <ul style="list-style-type: none"> <li>-Web based SaaS tool for organization of servers (Proxmox)</li> <li>-Ulteo OVD for <u>open virtual desktop</u></li> </ul>	Yes
16	2021	[23]	Features of distance learning of cloud technologies for the organization educational process in quarantine	Secondary and Higher education	SaaS, IaaS	<u>Used:</u> <ul style="list-style-type: none"> <li>- Google services</li> <li>- Cloud storage services</li> <li>- Document management cloud services</li> <li>- Services for creating Internet surveys by cloud-based tools</li> <li>- Services for creating presentations by cloud-based tools</li> <li>-Cloud based mind maps</li> <li>-Tools for creating sites</li> <li>-Cloud based learning management systems (Google Classroom)</li> </ul>	/
17	2021	[30]	Implementation of web resources using cloud technologies to demonstrate and organize students' research work	Higher education	SaaS	<u>Proposed:</u> <ul style="list-style-type: none"> <li>- Google Apps Education Edition</li> <li>-Google Sites</li> </ul>	/
18	2021	[39]	Leveraging Cloud Technologies to Enhance Student Academic Performance	Higher education	SaaS	<u>Proposed:</u> <ul style="list-style-type: none"> <li>-Cloud based tools for data analysis</li> <li>- Cloud based Learning Management Systems (LMS)</li> <li>- Cloud based student assessment software</li> <li>-Cloud storage services</li> <li>-Cloud based collaboration tools</li> <li>-Usage of Artificial Intelligence (AI) and Machine Learning (ML) services to personalize learning experiences for students</li> <li>- Google Drive and Microsoft One Drive</li> </ul>	/

19	2021	[40]	Creation of open educational resources during educational practice by means of cloud technologies	Secondary education and Higher education	SaaS	<u>Proposed:</u> - Whiteboard cloud services: Padlet.com Linoit.com Idroo.com Miro.com Whiteboardfox.com Jamboard.google.com NoteBookCast.com free Conceptboard.com freemium Groupboard.com freemium Classroomscreen.com  - Infographics cloud services: Easel.ly Infogram.com Canva.com Crello.com Genial.ly Chartblocks.com Piktochart.com Venngage.com Vizzlo.com Adioma.com  - Google Docs - Zoho Office Suite - Office Online - ONLYOFFICE	/
20	2021	[41]	Cloud resources use for students' project activities	Primary, Secondary and Higher education	SaaS	<u>Proposed:</u> - Tinkercad cloud platform - Google Classroom - Cloud interaction tools	/
21	2022	[11]	Use of cloud technologies in education	/	SaaS, IaaS	<u>Proposed:</u> - SaaS applications - Storage services	/
22	2022	[14]	Formation of Students' Competence in the Use of Cloud Technologies	/	SaaS, IaaS	<u>Proposed:</u> - SaaS applications - Processing and Data Storage Services	/
23	2022	[20]	Cloud technologies for basics of artificial intelligence study in school	Primary, Secondary and Higher education	SaaS	<u>Proposed:</u> - DALL-E service that create images from text captions - Services for recognition of emotions - Services for images recognition such as Google QuickDraw that are cloud-based - Makeblock(it has five AI	/

						<p>tools: mental services, machine learning, text-to-speech conversion, and translation)</p> <ul style="list-style-type: none"> <li>- PictoBlox (it has has tools for Computer Vision, Face Recognition, Optical Character Recognition, Language Recognition, Machine Learning, Ethics in AI, Internet of Things)</li> <li>- Teachable Machine (It is a service from Google. It can recognize images, voice commands, human movements)</li> <li>- Kaggle service</li> </ul>	
24	2022	[22]	The Problem of Training Future Engineer Personnel on the Basis of Cloud Technology in Technical Specialties of Higher Education	Higher education	IaaS	<p><u>Proposed:</u></p> <ul style="list-style-type: none"> <li>-Services for distributed data storage and processing systems</li> </ul>	/
25	2022	[26]	The current level of competence of schoolteachers on how to use cloud technologies in the educational process during COVID-19	Secondary education	SaaS, IaaS	<p><u>Proposed:</u></p> <ul style="list-style-type: none"> <li>- Google Classroom</li> <li>- Cloud storage services</li> <li>- Cloud services for creating documents</li> <li>- Cloud services for creating Internet surveys</li> <li>- Cloud services for creating presentations</li> <li>- Cloud services for creating smart maps</li> <li>- Cloud services for creating websites;</li> <li>- Cloud-based learning management systems</li> </ul>	/
26	2022	[28]	The didactic potential of cloud technologies in professional training of future teachers of Ukrainian language and literature	Higher education	SaaS, IaaS	<p><u>Used:</u></p> <ul style="list-style-type: none"> <li>-Data storage services</li> <li>- Google Apps and Dropbox</li> <li>- <u>GoogleWorkspace for Education</u></li> <li>- <u>Google Classroom e-learning environment</u></li> </ul> <p><u>Proposed:</u></p> <ul style="list-style-type: none"> <li>- Cloud-based services for creating MindMaps (iMindMap Cloud, MindMeister, Mind42 and Goggle)</li> <li>- Prezi cloud-based presentation service</li> <li>- Google Docs</li> <li>- OneDrive</li> <li>- Google Drive</li> </ul>	/
27	2022	[33]	Educational Aspects of using	Higher education	SaaS, PaaS, IaaS	<p><u>Proposed:</u></p> <ul style="list-style-type: none"> <li>- Google Doss, Google Apps,</li> </ul>	/

			Cloud-Based Network Services in Training Future Engineers			Office Online, Office 365, Zoho Office - Force.com, Salesforce.com, Microsoft Azure, Google Arr Engine, Cloud Foundry, VMWare, Oracle PaaS Platform - Amazon Web Services, Rackspace Cloud Terremark, gandi.net, GoGrid, Scalaxy - Google Apps -Microsoft Office 365 - Programming services, storage services, database services, graphics services, virtual desktop services, cloud-based antivirus software, cloud-based learning management systems - Microsoft Office 365 - G Suite for Education - OneDrive, Google Drive -Other Google and Microsoft cloud applications	
28	2022	[35]	The results of the use of cloud technologies in the educational process of pedagogical universities in a pandemic.	Higher education	SaaS	<u>Proposed:</u> -Microsoft Office Apps -Google Drive -Moodle cloud based LMS -Classroom -iLearn -Flipgrig -Canva -Zoom, Meet -Padlet -Kahoot	/
29	2023	[37]	Developing professional stability of future socionomic specialists using cloud technologies in blended learning	Higher Education	SaaS	<u>Used:</u> - Google Workspace for Education services (Gmail, Classroom, Drive, Calendar, Vault, Docs, Sheets, Forms, Slides, Sites, Meet)	/
30	2023	[18]	Methods and Advantages of Using Cloud Technologies in Practical Lessons	/	SaaS	<u>Used:</u> - Google Drive  <u>Proposed:</u> -Dropbox -Google Docs -SalesForce – CRM and ERP systems	/
31	2023	[24]	Cloud technologies of augmented reality as a means of supporting educational and	Secondary education	SaaS	<u>Used:</u> - Cloud services for augmented reality such as A-Frame and AR.js  <u>Proposed:</u> -WebAR	/

			research activities in chemistry for 11th grade students				
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