

DOI: <https://doi.org/10.57125/FED.2023.25.03.03>

How to cite: Humeniuk, T., & Romaniuk, P. (2023). On the Development of Information and Communication Technologies in Education of the Future: The Possibilities of Cloud Computing Technology, *Futurity Education*, 3(1), 34–44. <https://doi.org/10.57125/FED.2023.25.03.03>

On the Development of Information and Communication Technologies in Education of the Future: The Possibilities of Cloud Computing Technology

Tetiana Humeniuk*

PhD, specialty - Theory and teaching methods (technical disciplines), Associate Professor, Senior Specialist Accreditation Department National Agency for Higher Education Quality Assurance (NAQA), Kyiv, Ukraine, <https://orcid.org/0000-0003-2826-8079>

Pavlo Romaniuk

Senior Programmer/Developer, Capgemini America Inc, <https://orcid.org/0000-0003-3821-2183>

***Correspondence email:** Gumenyuktb@ukr.net.

Received: December 4, 2022 | **Accepted:** January 19, 2023 | **Published:** March 25, 2023

Abstract: Information and communication technologies have created a real revolution in various spheres of activity and the field of education is no exception. Online learning is becoming increasingly important, especially with the evolution of new information and communication technologies. Consequently, the purpose of the article is to consider the experience of using and implementing information technology in the educational process, informatization of education, the spread of cloud technology, and the popularization of the use of cloud computing technology. This IT tool is adapted for easier access to a database or services through a secure virtual space. It is also an efficient solution for storing and accessing information at any time. The growth of digital literacy is accompanied by the institutionalization of the use of information and communication technology (ICT) in education. As a result of the process of selection and verification over a large number of scientific papers involved in the topic, only the 20 most current sources from 2018-2022 were selected for this analysis. The paper used

scientific methods such as analysis and synthesis. Several examples of cloud computing technology in education were selected for analysis. The synthesis method identified the main drawbacks and The conclusion notes that digital innovation has proven its usefulness in accompanying, enriching, and transforming education, and has the potential to accelerate progress toward the goal of sustainable development for education and transforming overall access to learning. This will help strengthen the quality and relevance of learning, reinforce inclusion, and improve the administration and management of education. In times of crisis, distance learning can be used to mitigate educational disruptions and closures.

Keywords: information and communication technologies, cloud computing technologies, virtual space, education of the future, digital development.

Introduction

Cloud computing is a paradigm for large-scale distributed computing that leverages existing technologies such as virtualization, service orientation, and network computing. They offer another way to acquire and manage IT resources on a large scale. Today, cloud computing technologies are in the service of education. This is especially due to the healthcare crisis, which has multiplied the need for e-learning. The events of 2020 were decisive for the development of IT technology because of the coronavirus pandemic. The pandemic also led to the most significant crisis in education. Education was one of the sectors most affected by the pandemic (Alshammari & Aldribi, 2021). Indeed, many schools and universities have been forced to switch to an online learning format. Faced with this situation, distance learning and online exchanges became lifesavers. If the field of education was beginning to debut in the digital world, the proliferation of Covid-19 accelerated this process (Ali & Alourani, 2021). In this aspect, the use of cloud computing technology is becoming more and more in demand in education. This solution for storing and managing data has overcome various geographical and medical limitations caused by geopolitical shifts. The use of the Cloud has been revolutionary for education (Ali, 2021). The past three years have been marked primarily by the virtualization of IT resources and improved availability of educational resources. Most institutions associated with the education sector have had to adjust their cloud computing strategies in order to realize their digital transformation project (Darwish et al., 2019). The use of cloud computing solves the new requirements of the subjects of education in the digital transition. It provides an opportunity for new teaching methodologies. On the one hand, it is a way to help students learn more creatively and interactively. In addition, the use of cloud computing allows educators to monitor their students' work more closely, even remotely.

Research Problem

Since cloud computing is associated with many benefits, the problematic of this paper is to analyze the use of cloud computing that facilitates access to various educational resources. The most popular platforms for education are selected and their advantages and disadvantages are described.

Research Focus

Analyzes how information and communication technology (ICT) can affect learning, digital literacy, and the ability to integrate it into the curriculum. Emphasizes the need for some action on the use of ICT in education, including: conducting cost-benefit analyses, supporting teachers and students

to use it effectively. Aspects and digital literacy and skills are examined. Shows how these aspects of IT digital literacy have changed the way we live, work, and learn.

Research Aim and Research Questions

The work aims to investigate the development of information and communication technologies in education of the future and the possibilities of cloud computing technology. Objectives: to describe the advantages and disadvantages of using cloud computing technology in education, to describe the experience of using the platforms Coursera, EDX, Udacity, NetExplorer, Microsoft Azure for Research, Microsoft Sharepoint, OneNote, Microsoft Teams, and InTune.

Research Methodology

General Background

The study provided examples of how the literature explores the use of cloud computing. The main advantages and disadvantages of using ICT in education were identified.

Sample / Participants / Group

The complex nature of this work requires it to be divided into stages. At the first stage, the most popular European ICT platforms were identified through analysis and synthesis. In particular, their main advantages and disadvantages are identified.

Instrument and Procedures

The second stage of the study involved a comparative analysis of cloud computing platforms. The comparison was made by comparing the capabilities of platforms actively used in education, as well as by analyzing the research results cited in the scientific literature.

Data Analysis

The third stage of the study determined the advantages of using ICT in education and the advantages and disadvantages of the selected platforms Coursera, EDX, Udacity, NetExplorer, Microsoft Azure for Research, Microsoft Sharepoint, OneNote, Microsoft Teams, and InTune. The conclusions summarize the advantages and disadvantages present in all platforms.

Research Results

In education, there is a significant amount of data produced regularly. All of this digital data is completely secure in the cloud, like NetExplorer, which is very popular in French education (Siddiqui et al., 2019). The data is hosted on servers, whether it is written documents, videos, images, or others. Access to this type of platform is protected by username and password. This avoids the risk of losing or leaking information, from exam results to personal student information. This is a much better solution than archiving physical documents.

Of course, the level of data security depends entirely on the provider in question. NetExplorer ensures that its customers' databases are protected from damage. Moreover, the storage centers of this provider are ISO 27001 certified (Al-Malah et al., 2021). Speaking of the benefits of cloud computing technologies, the first thing to note is that they are a low-investment solution. They also require little infrastructure and IT resources to manage. Using this type of system does not require ultra-modern

hardware, as the software is installed on a remote server. Workstations are used only to connect to the Cloud via the Internet. No expensive antivirus is required to protect data (Iatsyshyn et al., 2019).

In addition, it is the company in charge of the Cloud that takes care of the various upgrades and server management. The cloud user only pays for what they use. The cloud is accessible from all types of devices, be it a computer, tablet, or even a cell phone, making it a particularly suitable solution for supporting distance learning and accessing educational resources during social distance (Balyer & Öz, 2018).

Regardless of the education seeker's specialization, everyone ends up looking for a variety of textbooks and resources for their learning interests. Of course, physical resources have their advantages, but these resources are available digitally and have become available through cloud technology. Each cloud has features such as personal profile information, data access, and a managed firewall. They also give the education system transparent accountability. Yes, school administrators can have access to how, by whom, and when their platform is used. But on an individual level, the cloud gives maximum privacy (Bond et al., 2018). And it doesn't stop there - the cloud stores academic data with the ability to recover from data corruption or loss. Any data corruption is detectable.

In addition to all the benefits, cloud technology contributes to an innovative education system. The education system is constantly evolving and cloud technology makes it exciting. For example, in higher education in Spain, many courses are already available on platforms such as Coursera, EDX, and Udacity. The following are some of the most important benefits. Things like overcoming language barriers, cultural differences, and a number of other benefits are also a result of cloud technologies. They are the modern driving force of the global education system and with constant innovation will only get better (Table 1).

Table 1

The Benefits of Cloud Computing for Learning

Positive characteristics	The advantage
Higher education is not necessarily available worldwide. The physical payment process is long and inconvenient. The introduction of cloud- based digital payments makes it easier to pay for funds. Paying your tuition and getting a receipt takes just a minute.	Cloud training for digital payments
Using these collaboration tools, you can instantly share your research or scholarly work. While the availability of cloud technology helps students and faculty collaborate quickly, it also helps universities. Given the presence of different bodies, they can easily deploy collaboration systems to share information across the institution. This saves everyone time and helps with global innovation.	Cloud collaboration
It's at the heart of the cloud technology powering the education industry. It leads to a variety of overall improvements, from the ease of learning to the administrators running the institution. The number of staff is decreasing.	Automation

The ability to communicate over the Internet using cloud-based platforms reduces interaction time. With online education, everyone has a separate account and content management system where everything is organized automatically. Overall, by reducing the time to communicate and automating, task completion is greatly improved.	Efficiency
The ability to communicate, share resources, and perform different tasks from anywhere (and anytime) is exciting. These are some of the main reasons why cloud technology is rapidly being adopted across all sectors of education. It brings flexibility to the higher education sector, which was impossible without cloud technology.	Cloud application flexibility
Everything is hyper-accessible. By logging into a university portal, you can access the resources you need without wasting time.	Easy access to resources
The need for physical infrastructure (and support), transportation costs, and many measures that cost money are reduced with cloud education.	Save Money
With cloud applications, the administration (or management) running the institution has access to detailed information. Understanding operational failures and reasons for success can help the dean's office make effective decisions.	Data-driven solutions
Scaling up cloud infrastructure is easier than physical expansion. Physical limitations may have limited the university's growth in the past. The institution can easily meet the demands of more and more students and resources. And all at a reduced time commitment.	Scalability
Cloud-based learning is safe. Every student, instructor, and administrator gets privacy to work on homework, questions, billing, etc.	Privacy and data protection

Source: author's own development.

Just as work is no longer tied to the office, learning is no longer confined to the classroom. Universities are creating a learning community that extends beyond the campus to help students and faculty where they are and at any given moment, with technology.

According to a review of the literature, it was found that European education predominantly uses Microsoft technology to make learning accessible to all students. Web design classes use a blended learning environment to give students access to the resources they need at any time through Microsoft Sharepoint. Instructors work via Skype and record each class as students view it. With a more flexible schedule, students who are pursuing two degrees or have work, family circumstances can study at the right time without compromising the quality of their learning.

Students use the OneNote notebook for class to collaborate remotely on different projects. This means that instructors can access OneNote and provide instant feedback even if a student is unable to attend class in person. OneNote's digital collaboration tools for classes are integrated with Microsoft Teams, a new tool that allows instructors to create a single digital hub for classes. With Teams, instructors can manage groups of projects, assign and grade tasks, invite outside speakers and embed video content from the Web, share content, and have real-time conversation topics. New tools like InTune for Education are more accessible to education. They're also easier and faster to set up and

managing hardware and new Windows 10 devices becomes easy. All of these elements allow educators to focus on learning rather than technology (Table 2).

Table 2

Advantages and Disadvantages of the Described Platforms

Platform	Advantages	Disadvantages
Coursera	Interactive platform; large selection of courses; free learning resources.	Course content is limited to academic subjects and professional skills; large membership contribution; some instructors shy away from the camera.
EDX	Nonprofit, open-ended platform; online education and promotion; new formats emerging all the time.	Passive learning; long instructional videos; mostly IT subjects certified.
Udacity	Simple design; project-based, active learning; cutting-edge content.	Pioneer in education; quite expensive; no app.
NetExplorer	Runtime - timely garbage collection; asynchronous model; the framework is robust.	Difficult to use; very many apps to the program itself; their quick "death".
Microsoft Azure for Research	Most popular among clouds; increased power and manageability; data security and retains large amounts of information.	Hybrid model, difficult for the average user; many services to support migration; need to take courses in use beforehand.
Microsoft Sharepoint	Uses fewer IT resources; personal library; low cost.	User resistance; file properties do not migrate; metadata is not stored.
OneNote	Overlaps all possible tasks; quick access to any data of arbitrary nature; has the form of notebooks organized by visual area.	Rather confusing workspace; operations to create your own notebook are complicated enough for a novice; when editing a document, there is no connection between the original document on disk and its copy in Onenote.
Microsoft Teams	Free app; easy to distribute tasks; no license required and easy to use.	Lack of notifications; similar and redundant tools; limited number of channels.
InTune	Easy to manage mobile apps from the cloud; workforce productivity; protect corporate data and integrate familiar apps into the cloud.	Unattractive interface; easily attacked by viruses; quite expensive.

Source: the table is the author's own development.

In addition to educational tasks, cloud programs are intensively used in science and ecology. For research-oriented higher education institutions, digital transformation provides the means to support influential research aimed at transforming the world. Microsoft Cloud provides researchers with

enterprise-class data storage, computing power, collaboration tools, and analytics while ensuring that they can work quickly and accurately with any combination of data sources in a secure, real-time environment, regardless of location.

With Microsoft Azure for Research, Microsoft offers free Azure storage and computing resources for innovative research projects such as the University of Oxford-led REACH initiative. The program uses Azure machine learning to help improve access to safe drinking water in Africa and Asia (Rashid & Chaturvedi, 2019).

Technology can enable students today to create the world of tomorrow. Students who are equipped by the education system today with digital skills will have brilliant careers and develop new technologies that are now unimaginable. Educators, parents, and technology companies have a responsibility to provide young people with the best education and tools to make this future a reality. Technology is the key to helping our students succeed, think creatively, and create a better world.

Discussion

In identifying the features of the platforms Coursera, EDX, Udacity, NetExplorer, Microsoft Azure for Research, Microsoft Sharepoint, OneNote, Microsoft Teams, InTune and reviewing academic sources, it is determined that the question of the power of technology to transform education is acute in academia today. According to Amani et al. (2020), if used properly, digital transformation can solve one of society's most pressing problems: the democratization of educational opportunities. According to European scholars, educational institutions need new strategic thinking, a better understanding of data, personalized services, and flexible infrastructure. The use of Coursera cloud computing programs is helping to create cognitive campuses that help teachers and students improve outcomes from kindergarten through higher education (Avidov-Ungar et al., 2022). It is solidified that this educational technology supports personalized learning, increases research capacity, and optimizes operations, leading to a greater cost-effectiveness in higher education. In the context of this paper, recall Cuellar (2002), who notes that to take advantage of digital transformation, all schools and universities must recognize that today's students learn differently than previous generations. And in this context, considers the Microsoft Azure for Research platform to be the most impactful. Bonfield et al. (2020) describe the disadvantages of using EDX specifically. Researchers consider one of the biggest challenges in using EDX for teachers to be interest and engaging the classroom because they think it is quite complex. Many educators think that using cloud computing technology "is a time- consuming process and so they try not to use it in their work, but their concerns are completely unhelpful". For a distance educator, the use of EDX documents is especially important. Cloud technologies are quite accessible to ordinary users. The basic concept of these technologies is the storage and processing of information by web servers. The user gets the result with a browser. Thanks to special web page commands, the owner can not only enter certain information but also modify it on his personal computer. For example, experience in European countries, including Ireland and Spain, where class sizes are larger than the OECD average, shows that teachers have difficulty controlling many of the factors that affect student learning. We believe that technology can improve them by encouraging more student engagement and highlighting important skills, such as creativity and collaboration, that students will need in future jobs. We agree that the power of extensive data and analytics makes individualized approaches possible in a group environment. Educational technologies such as Udacity, cloud-based hybrid computing, and data management improve learning environments, expanding learning potential, leading to better outcomes and more rewarding experiences for students (Mishra et al., 2020).

In the context of this work, note Shatri (2020) advising NetExplorer, Microsoft's enterprise-class cloud computing platform that provides computing power and analytics tools. But American scientists suggest using Microsoft Teams for education. Microsoft Teams data and educational technology allows North Carolina State University to find new solutions to help its students efficiently manage and analyze large amounts of structured and unstructured data from different sources Hawkrige (2022). Indeed, the European experience described above using additional cloud computing technologies such as Microsoft Sharepoint, OneNote, and InTune may be of interest to the modern student, it may be a way to better understand certain topics through explanatory images and videos. In addition, there is an opportunity to learn everything through the Internet and deepen your knowledge. The interactivity of certain tools allows for cognitive development. In this study, it was shown that students are able to understand a course better when it is designed through computer support and therefore promotes memorization and motivation.

There are many research papers on the benefits of using ICT and cloud technology in education. Wu and Plakhtii (2021) consider cloud technology to be especially important for schools receiving students who need an adapted educational path. This is especially true for dyslexic students who may require special attention (Holinska et al., 2019). To truly democratize education, these needs must be identified and supported by the right technology. supports this view by stating that for elementary school, Microsoft learning tools provide students with all the abilities to read independently (Mukhtoralievna & Tavakkalovna, 2022). The tool works by highlighting in real-time the words students read as they read. Although it should be noted that in some European educational institutions digital transformation is still regarded as a technology specific to themselves, but computers, electronic whiteboards, and e-books are referred to as tools only. Speaking about the benefits of ICT, Mukhtoralievna and Tavakkalovna (2022) touch on the problems of inclusiveness. Modern pedagogical technologies are aimed at improving the quality of education. Due to the development of inclusive education, teachers are required to improve their computer skills, to use different information and communication technologies for distance learning of children. In the traditional form classic e-mail is used. First, the teacher downloads the student's letter, writes it down, reads the information after running the program. Cloud technology in education allows the use of browser-based email. The teacher has the ability to download attachments, such as student tests, read emails on any computer that has access to the Web. Students have long been actively using cloud computing technology in education. For example, they upload music files and computer games to the repository. In addition, electronic aids can be placed in the virtual library. Nowadays, there are many servers to which data can be transferred with good image quality. For example, an instructor posts electronic textbooks and sends them to a student. When doing homework, he can use the video, audio clips available in the book. No more carrying textbooks in a briefcase or bringing them to the library after completing the syllabus for that discipline.

Indeed, with digital learning, educators who are fully aware of each student's situation can intervene early and provide students with the help they need to overcome barriers to learning. Computational cloud technology simplifies orientation and improves understanding of educational material. With these types of technologies, the education system can offer better and like training to educational subjects and, as a result, improve their performance at all levels. Cloud technologies, actively implemented in the educational process, allow to facilitate the work of the teacher, to increase the cognitive interest of students. Computerization of education is a prerequisite for the successful implementation of new standards and an opportunity for the personal development of a child. Thanks to ICTs, a teacher can monitor a child's development and his or her individual educational trajectory. Such technologies help overcome geographic, social, and political limitations. Currently, educators - actively use cloud storage, but many of them are still suspicious. Cloud technology has become possible

after the powerful development of hardware every day, there is an increase in the power of computer processors, upgraded multi-core architecture, increased hard drive capacity. In addition, faster and wider Internet channels are becoming available. Cloud technology in education is a set of software and hardware, through which the processing and implementation of learning objectives.

Conclusions and Implications

There is no single, universal definition of ICT, it is generally accepted that the term means all the devices, networked components, programs, and systems that collectively allow people and organizations to interact in the digital world. The main disadvantage of ICT in education is the incompetence of its implementation in the educational process or the direct lack of basic skills required to use it. Enough disadvantages of cloud computing platforms have been highlighted. Generalized disadvantages for all the platforms described above are the following: quite expensive price; certain platforms do not have applications; difficult to use; their rapid “death”; hybrid models, difficult for the average user; quite confusing workspace; easy to be attacked by viruses.

Nevertheless, cloud computing technologies go beyond the mere availability of technology because they facilitate learning and teaching. They are present in all spheres of modern life, so they play a fundamental role in the configuration of society and culture, so it is obvious that digital changes have also coincided in the educational systems of different countries, which has entailed many transformations due to the inclusion of these technologies. Among the generalized benefits are highlighted the following: they are interactive platforms with a large selection of courses; project-based, active learning; advanced content; increased power and ease of management; data security and retains large amounts of information; corporate data protection and integration of familiar applications in the cloud.

Modern education requires a reconfiguration of curricula at all levels. Digital tools as learning tools are gaining more meaning and pedagogical life depending on the curriculum in which they are introduced. Teachers are a key element of this change and therefore need to carry the innovative nature of education. Technological accessibility is much more complex than the existing knowledge for its application in teaching, so much effort is needed in developing didactic models that make original and effective use of information and communication technologies. We understand the function of modern learning as a bridge that helps to discover knowledge through information and communication technology. Among the many advantages, we highlight: convenience, automation, control, cost-effectiveness, reduced administrative burden. In addition, for students practicing multiple education at the same time or working, cloud computing technologies provide many ways to understand and process information, to explain certain concepts, and to express the acquired knowledge. Most students learn better through visual and tactile methods; ICTs can help them discover information on their own, rather than just reading and hearing. Mobile devices also offer programs (apps) that further support students with special needs with features such as simplified screens and instructions, logical menu layout and control features, illustrations combined with text, acoustic feedback, the ability to adjust speed and difficulty level, relevant and understandable information, and easy error correction. At this point, developing the appropriate use of ICT and cloud computing technology is a powerful tool for designing the education of the future.

References

- Ali, M. B. (2021). Multi-perspectives of cloud computing service adoption quality and risks in higher education. In M. Khosrow-Pour D.B.A. (Ed.), *Handbook of research on modern educational technologies, Applications, and Management* (pp. 1–19). IGI Global. <https://doi.org/10.4018/978-1-7998-3476-2.ch001>
- Ali, A., & Alourani, A. (2021). An investigation of cloud computing and E-learning for educational advancement. *International Journal of Computer Science & Network Security*, 21(11), 216–222. <https://doi.org/10.22937/IJCSNS.2021.21.11.30>
- Al-Malah, D. K. A. R., Aljazaery, I. A., Alrikabi, H. T. S., & Mutar, H. A. (2021). Cloud computing and its impact on online education. *IOP Conference Series: Materials Science and Engineering*, 1094, Article 012024. <https://doi.org/10.1088/1757-899X/1094/1/012024>
- Alshammari, A., & Aldribi, A. (2021). Apply machine learning techniques to detect malicious network traffic in cloud computing. *Journal of Big Data*, 8(1), Article 90. <https://doi.org/10.1186/s40537-021-00475-1>
- Amani, M., Ghorbanian, A., Ahmadi, S. A., Kakooei, M., Moghimi, A., Mirmazloumi, S. M., ... & Brisco, B. (2020). Google earth engine cloud computing platform for remote sensing big data applications: A comprehensive review. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 13, 5326–5350. <https://doi.org/10.1109/JSTARS.2020.3021052>
- Avidov-Ungar, O., Shamir-Inbal, T., & Blau, I. (2022). Typology of digital leadership roles tasked with integrating new technologies into teaching: Insights from metaphor analysis. *Journal of Research on Technology in Education*, 54(1), 92–107. <https://doi.org/10.1080/15391523.2020.1809035>
- Balyer, A., & Öz, Ö. (2018). Academicians' views on digital transformation in education. *International Online Journal of Education and Teaching*, 5(4), 809–830. <https://eric.ed.gov/?id=EJ1250526>
- Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O. (2018). Digital transformation in German higher education: student and teacher perceptions and usage of digital media. *International Journal of Educational Technology in Higher Education*, 15(1), 1–20. <http://www.sciepub.com/reference/358175>
- Bonfield, C. A., Salter, M., Longmuir, A., Benson, M., & Adachi, C. (2020). Transformation or evolution?: Education 4.0, teaching and learning in the digital age. *Higher Education Pedagogies*, 5(1), 223–246. <https://doi.org/10.1080/23752696.2020.1816847>
- Cuellar, N. (2002). The transition from classroom to online teaching. *Nursing Forum*, 37(3), 5–13. <https://doi.org/10.1111/j.1744-6198.2002.tb01005.x>
- Darwish, A., Hassanien, A. E., Elhoseny, M., Sangaiah, A. K., & Muhammad, K. (2019). The impact of the hybrid platform of internet of things and cloud computing on healthcare systems: Opportunities, challenges, and open problems. *Journal of Ambient Intelligence and Humanized Computing*, 10(10), 4151–4166. <https://link.springer.com/article/10.1007/s12652-017-0659-1>
- Hawkridge, D. (2022). *New information technology in education*. Taylor & Francis. <https://doi.org/10.4324/9781003312826>

- 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). <https://lib.iitta.gov.ua/717935/1/Cloud-technologies-in-art-entrepreneurship-1528-2651-22-5-457.pdf>
- Iatsyshyn, A. V., Kovach, V. O., Romanenko, Y. O., & Iatsyshyn, A. V. (2019). Cloud services application ways for preparation of future PhD. In A. E. Kiv & V. N. Soloviev (Ed.), *Cloud technologies in education : Proceedings of the 6th workshop on cloud technologies in education (CTE 2018)* (pp. 197-216). <http://ceur-ws.org/Vol-2433/paper12.pdf>
- Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International Journal of Educational Research Open*, 1, Article 100012. <https://doi.org/10.1016/j.ijedro.2020.100012>
- Mukhtoraliyevna, Z. S., & Tavakkalovna, A. G. (2022). History of information technologies in education. *Spanish Journal of Innovation and Integrity*, 6, 359–363. <http://sjii.indexedresearch.org/index.php/sjii/article/view/271>
- Rashid, A., & Chaturvedi, A. (2019). Cloud computing characteristics and services: A brief review. *International Journal of Computer Sciences and Engineering*, 7(2), 421–426. <https://doi.org/10.26438/ijcse/v7i2.421426>
- Shatri, Z. G. (2020). Advantages and disadvantages of using information technology in learning process of students. *Journal of Turkish Science Education*, 17(3), 420–428. <https://www.tused.org/index.php/tused/article/view/1099>
- Siddiqui, S. T., Alam, S., Khan, Z. A., & Gupta, A. (2019). Cloud-based e-learning: Using cloud computing platform for an effective e-learning. In S. Tiwari, M. Trivedi, K. Mishra, A. Misra, & K. Kumar (Eds.), *Smart Innovations in Communication and Computational Sciences, Volume 851* (pp. 335–346). Springer. https://doi.org/10.1007/978-981-13-2414-7_31
- Wu, W., & Plakhtii, A. (2021). E-learning based on cloud computing. *International Journal of Emerging Technologies in Learning (IJET)*, 16(10), 4–17. <https://www.learntechlib.org/p/220086/>