

УДК 37(063)

INNOVATIVE CLOUD TECHNOLOGIES AS A FACTOR OF ENSURING THE QUALITY OF A UNIVERSITY BASED ON TQEM

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ABSTRACT

In the context of the intensive reform of the educational system, cloud technologies in higher education made available to their branches due to their large-scale coverage and the use of virtual educational resources of the parent organization, as well as the ability to monitor the educational process. In Uzbekistan, the use of modern educational technologies based on TQEM (Total Quality Education Management) and CALS technologies in the context of information cloud technologies will have a significant impact on the quality of the educational environment in the future. Features of implementation and the main directions and tasks of the formation of such a system, considering the considered innovative and technological features of the national education system. In addition, the life cycle of education has shown how an integral part of the information system for management and monitoring of educational activities of higher education institutions based on cloud computing is considered as another better substitute for educational institutions that are experiencing a lack of budget with an eye to effectively manage their information systems without investing more into computers and network devices in the regions of the state. In this article, we will look at how cloud computing infrastructure offers tremendous opportunities in an intensively evolving educational system of the Republic Uzbekistan.

Keywords: cloud technologies, cloud computing, cloud storage, TQEM, CALS.

Introduction

Cloud computing is a concept that describes the provision of computing services as a service, enabling on-demand access to resources for devices. In other words, it allows for the accessibility of network resources from any location. Cloud computing has the potential to enhance the efficiency of shared resources.

The IT industry has undergone a revolution with the advent of cloud computing, significantly impacting various aspects of life in the early 21st century. Over the past three decades, information technology has advanced, playing a crucial role in numerous facets of human life, including robotics, artificial intelligence, and more. Information technology and the integration of artificial intelligence (AI) have influenced all spheres of human activity, including the education system.

Modern education has witnessed significant transformations, with traditional classrooms evolving into smart classrooms. This transformation has given rise to the concept of "Education 4.0," wherein higher education institutions have embraced various information and communication technologies (ICTs). In response to the globalization of educational services, the adoption of cloud technologies in higher education institutions has rapidly accelerated, leading to the deployment of private cloud systems and the utilization of institution-specific cloud services. Currently, the introduction of cloud computing has become a standard procedure, and the use of cloud systems aligns with the requirements of educational institutions.

Despite the numerous benefits and promises of cloud computing, several obstacles hinder its widespread adoption. Storing sensitive data in the public cloud is often perceived as a significant security concern in cloud computing. Additionally, cloud computing technology necessitates reliable and fast internet access, which is crucial for providing cloud services. Furthermore, the lack of standardization in adapting to different platform technologies often poses challenges for businesses seeking to transition between cloud providers. The absence of interoperability makes businesses cautious about embracing cloud computing technology. Cloud computing risks can be classified into five groups: governance failures, interoperability concerns, data leakage, software licensing difficulties, and data protection considerations. Infrastructure issues, such as network problems, fall under the fourth category of risks, while the final category encompasses project and business risks that hinder firms from adopting cloud computing.

To provide optimal business solutions in today's environment, ICTs are closely interconnected. Cloud computing is a topic that has been passionately debated and thoroughly explored, yet there is still room for improvement and further research. Most educational institutions worldwide employ learning management systems, virtual networks, and content management systems to facilitate more effective student

learning. Educational institutions employ private clouds to enhance the student experience in contemporary society. Although many institutions have successfully implemented these technologies, some still encounter delays in certain areas. The primary aim of this research is to investigate the impact of cloud computing technologies on educational institutions and administration.

In the present era, education is undergoing intensive development as the economy of Uzbekistan undergoes digitalization. Cloud technologies play an integral role in the digitalization of various sectors, particularly education, by expanding the possibilities of educational technologies and reducing time and transaction costs within the economy.

Literature Review:

One of the primary approaches to advancing innovative education towards a more integrated and high-quality level is the introduction of Total Quality Management (TQM) based on CALS technologies within the virtual space of cloud technologies. This integration will contribute to improving the overall quality of education.

The pandemic period has brought about numerous uncertainties for education and the economy. Lockdown and quarantine measures adopted in certain countries have resulted in a decline in the quality of education and forced regional universities to shift to distance learning, rendering higher education vulnerable. As part of the integrated modern higher education system, there is a need for significant transformation in the infrastructure of electronic education platforms such as "Cloudcomputing" based on CALS technologies.

The terminology of "Cloudcomputing" was initially proposed by John McCarthy in 1961, and its relevance has only grown over time. A study by J. Licklider[1] in 1963 revealed that a globally accessible network would enable individuals to access computer programs and data from any location worldwide. These early ideas have paved the way for today's network space, within which cloud computing exists as a vital factor in the comprehensive development of education.

Higher education plays a pivotal role in shaping qualified professionals for the modern economy. With rapid societal changes and the ongoing development of information technologies, universities face the challenge of ensuring the quality of education and preparing students to meet the demands of the contemporary job market. In this context, the application of innovative technologies and the implementation of TQEM become significant factors in enhancing the quality of education, particularly in the field of economic disciplines.

Research demonstrates that the use of innovative technologies in higher education can significantly enhance the effectiveness of learning and improve the

quality of the educational process. Hansen et al. (2020) explore the role of digital technologies, such as cloud computing, in the educational environment. The authors note that the integration of cloud technologies enables students to access up-to-date educational materials, collaborate with instructors and peers, and engage in interactive educational processes [2].

Additionally, the TQEM system plays a vital role in ensuring high-quality education. Brown and Johnson (2018) examine the application of TQEM in the context of higher education. The authors emphasize the necessity of developing a quality management system that includes the definition of learning objectives, the design of effective assessment methods, and continuous improvement of the educational process based on feedback from students and other stakeholders [3].

Innovative technologies and the implementation of the TQEM system play a significant role in enhancing the quality of education in economic disciplines within higher education institutions. The integration of cloud technologies allows students to access relevant materials and participate in interactive educational processes. Simultaneously, the TQEM system ensures the management of educational quality, including goal setting, evaluation of the learning process, and continuous improvement based on feedback.

Analysis

The characteristics of today's cloud computing, considering their peculiarities, are defined in the US standards as follows: self-service on demand, universal access over the network, resource pooling, elasticity and consumption measurement¹. These days, digitalization with the use of cloud technologies is becoming a more relevant.

According to Dustin Milberg [4], CTO for cloud services at InterVision, "the cloud" is seen as a journey, not a destination, and will do better in the near future. It is the use of cloud technologies based on CALS technologies in education that allows students to better master knowledge in an interactive mode using various animation tools and multimedia didactics. The use of real cloud technology, based on an iterative process of optimization and creation of a security system, meets the long-term targets of universities. Especially, the use of TQEM and CALS technologies will increase the coverage of student training, the competence of the teacher and the university administration, as well as the career growth of the graduate in the aggregate, the competitiveness of the university will be observed. Accordingly, improving the quality of education will be achieved by significantly reducing the volume of design and bureaucratic work, as well as a number of transaction costs of the educational process.

¹ Mell, P. and Grance, T., 2011. The NIST definition of cloud computing.

The introduction of innovative CALS technology based on TQEM in education involves the training of a specialist, in which the descriptions of the chain of the technological process of education, allows you to store the database in a unified format in the network server of the head university or can be rented from private companies. In addition, the database can be available to the user account of the participant, considering the level of access of the administrative staff and the student in the information base of the university, and can also be integrated into the global education network. At the same time, it greatly facilitates the solution of the problems of educational services and the employment of a graduate, depending on the requirements of the international standard and a separate standard of certain countries.

Today, in the context of intensive reform of higher education in Uzbekistan, the number of local and foreign universities and the number of students is growing. According to the State Statistics Committee of the Republic of Uzbekistan, by 2022, there will be a total of 191 Higher Education Institutions (HEIs) in Uzbekistan (Fig. 1).

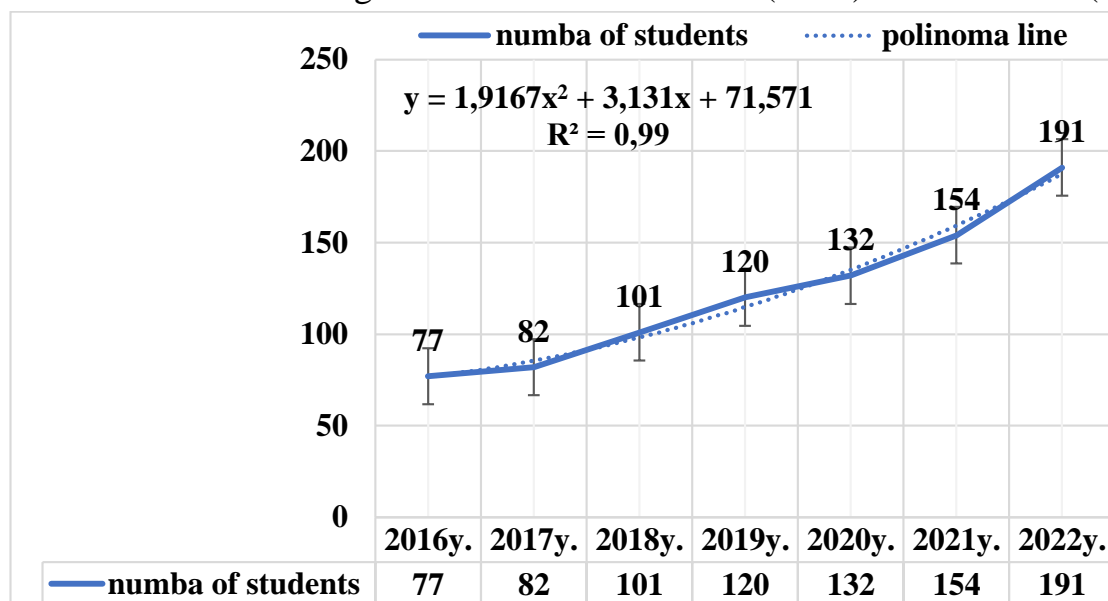


Figure 1. Dynamics of growth in the number of universities in the Republic of Uzbekistan for the period 2016 - 2022.

This indicator is not a big indicator compared to other developed countries, but the number of such HEIs in Uzbekistan will increase sharply in the next five years. growth, seriously questioning their provision of educational resources. Higher education institutions opened in the regions, especially the higher education institutions opened in remote districts, today make providing them with educational resources and information a problematic issue.

On fig. 1. Shows that the number of universities in the country with the start of intensive reforms in the field of higher education, starting from 2017, has sharply increased the number of local universities, as well as their branches in the regions of the country, has led to a sharp increase in the number of universities and, accordingly,

the question arises about providing resources for education. In addition, branches of foreign universities have opened, so that their integration with educational resources with the head university becomes relevant and the need to use cloud technologies becomes even more acute.

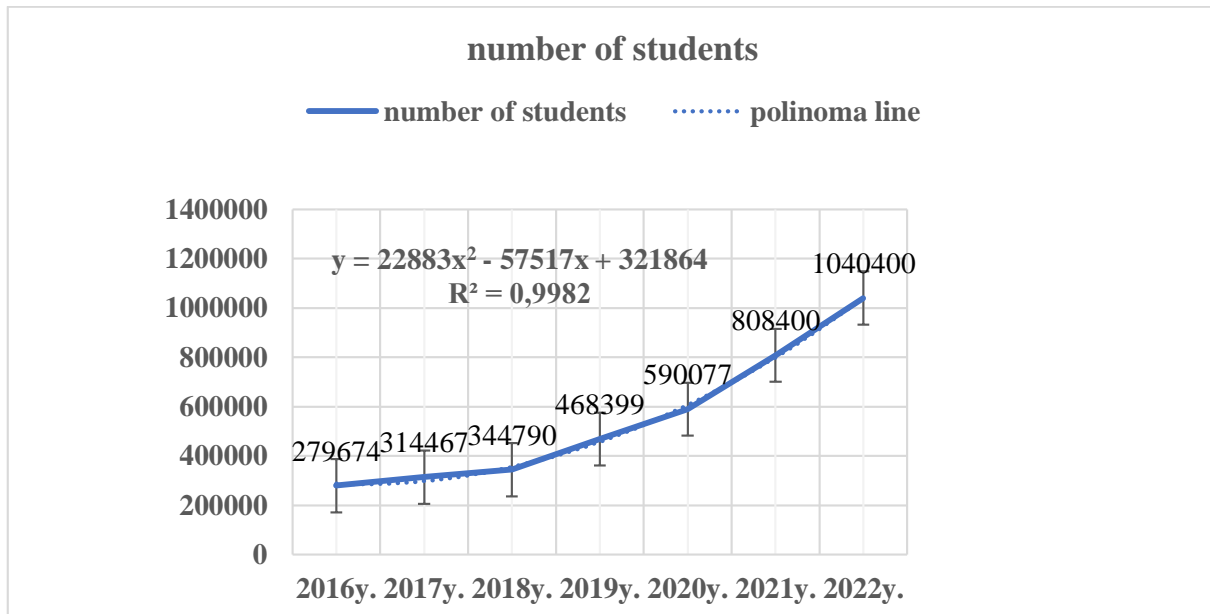


Figure 2. Dynamics of growth in the number of students in the Republic of Uzbekistan for the period 2016 - 2020.

Fig. 2 shows that between 2018 and 2022 there is a trend of a jump in the increase in quotas for education, that in universities and their branches in the region there is a demand for the resources of the educational process and the infrastructure of cloud technologies. There is also a lack of educational resources and modern technologies in the republic and the regions, the timely use of the above technologies can correct the situation in the educational process. Especially when branches of universities are opened in remote areas of the regions, the use of cloud technology and its integration based on TQEM and CALS technologies will contribute to improving the quality of education and reducing the cost of infrastructure of educational resources.

The accelerated transition to cloud technologies, which is already progressing at a great speed in the context of the pandemic, will grow sharply [5] in 2021 - 2022, which will lead to even greater demand for cloud technologies in universities and the introduction of modern technologies such as TQEM and CALS technologies and will contribute to improving the quality of education. While integrated software TQEM and CALS, technology as a service (SaaS) will continue to be the largest segment of the market for cloud IT service[6] end-user spending and is expected to grow. Therefore, it is necessary to accelerate the implementation of an integrated system of cloud

applications based on TQEM and CALS technologies. Application infrastructure services (PaaS) are also expected to grow¹ due to the growing demand for regional universities and remote consumers to access high-performance and scalable infrastructure through modernized and cloud-based applications [7]. If we consider an increase in the number of universities for the forecast period until 2025, according to the second-degree polynomial equation, it can be more than two million students, which will increase the need for university educational resources. This phenomenon only confirms the need for the transition of educational resources to cloud technologies (Fig.3).

It should be emphasized that along with the advantages, there are a number of disadvantages associated with cloud services, which is associated with the peculiarities of corporate cooperation between universities:

- the user is not the owner (unless the cloud is completely private) and does not have access to the cloud infrastructure, therefore, the safety of the data used depends entirely on the campaign providing these services;
- to receive high-quality services, you need high-speed Internet and technical support;
- lack of generally accepted standards in the field of data security and privacy in cloud computing.

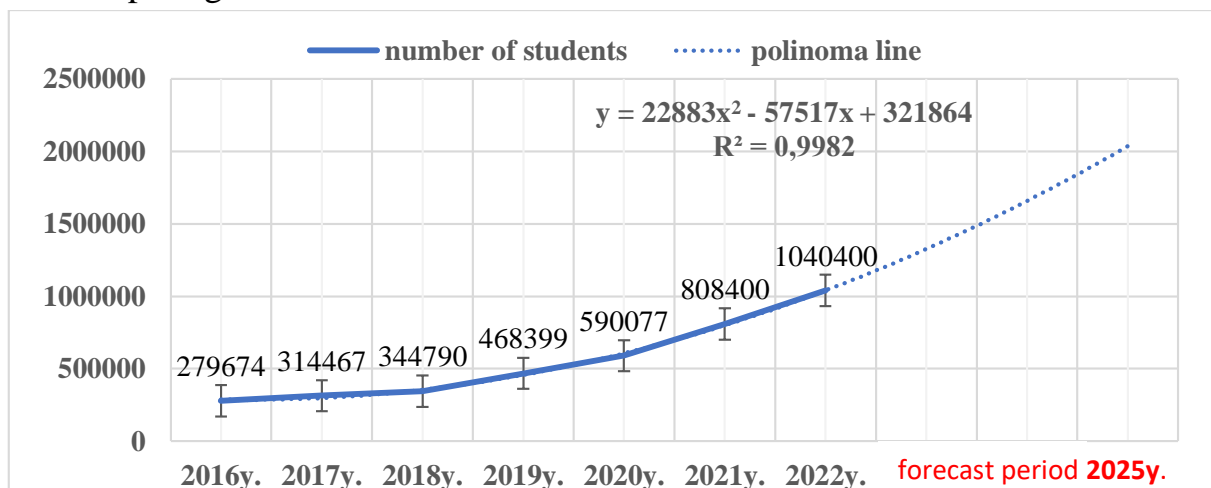


Figure 3. Dynamics of growth in the number of students in the Republic of Uzbekistan for the forecast period 2023 - 2025.

Forrester Research's forecast has boosted the number of companies willing to offer public cloud services to their customers [7]. Therefore, the use of cloud services is rapidly spreading and, in the future, it may offer educational services in the form of

¹ Goodison, D., 2021. 10 Future Cloud Computing Trends To Watch In 2021

double-degree programs¹ for corporate universities, which is associated with a number of specific points depending on the form and degree of universities.

The use of cloud computing in educational systems is carried out using special programs of cloud applications based on TQEM and CALS technologies.

When conducting educational technologies and conducting the educational process in the cloud, universities relieve themselves of the need to purchase and install infrastructures, various application programs and solutions.

Given the specifics of the delivery of cloud services, cloud providers undertake the following work: installation, maintenance and updating of hardware and software, backups and data privacy. However, in terms of legislation, confidentiality and protection of information and responsibility to the consumer of cloud computing is still a problem, since the legislation of the Republic of Uzbekistan has not yet found a full reflection of security and proper responsibility to consumers of cloud computing. In addition, the lack of special provisions on the use of cloud technologies, the provision and use of cloud products in Uzbekistan, in particular in education, raises many legal questions for all participants in the process.

Today, in Uzbekistan, international players in cloud technologies such as Selectel and Huawei, which have already firmly launched their cloud platform in Tashkent³, are building up their potential. However, these companies are not competitive with giants like Google, Amazon and Alibaba. Given this, it is necessary to expand the list of participants in the cloud technology market and contribute to the development of a competitive market environment.

In a competitive environment, university branches get access to the cloud from the head office in the following way: "remove" a software application (SaaS), platform (PaaS) or the whole infrastructure (IaaS), thereby they significantly reduce their costs and move the mobile form of the educational process. A similar scheme is applicable in the case of outsourcing of educational services, within the framework of cloud technologies. Especially during a pandemic, due to the growth of education mobility, transaction costs in universities can be significantly reduced and thus the prices for educational services will decrease.

According to E.M. Abdulina [9], the use of cloud technologies in the educational process can be in the form of: - electronic diaries, magazines - personal accounts for students and teachers - an interactive reception room - thematic forums, etc. At the same time, students can exchange information - search for information where students can solve certain educational problems even in the absence of a teacher or under his guidance - using cloud data storage.

¹ lgsu.ranepa.ru. 2021. Double diploma programs with European universities - IPACS RANEPА

For example, we can consider in the head Tashkent State Economic University in the cloud, the “subject of Economics” with all modules works equally effectively both in the branches and for the university in the data sharing mode.

Each of the other branches of the university is allocated its own data area, with which its students can work through the clouds. In this case, the only installed copy of the program is at the head university. At the same time, part of the teaching staff of the university work remotely, qualified information on the relevant discipline is sent to the regional branches via the Internet. Here we can solve the problem of the lack of professional staff in the branches of the university, which is an important factor in improving the quality of education.

Features of the application of cloud technologies are associated with the creation of space for teachers and students in cloud technology. If there is a university teacher’s website, for remote consultations, students are placed in the cloud space with educational information, lecture notes, practical and laboratory classes, as well as questions of the final control. In this case, after a preliminary study of the material located on the site, students are invited to a computer conference, organized using special or virtually formed networks, the day before the final control. At the conference, students, with the guiding role of a teacher, independently try to find answers to questions and share information about the answers they have found. Thus, a team of like-minded people is formed, focused on mutual assistance in preparing for the final control and exams using the virtual cloud. Although, in Uzbekistan, special educational platforms and networks do not yet have the ability to integrate with all the signs of "cloud" technologies, since they are not a means of depositing data, but they can play such a role if they are used to exchange information in the educational process.

Discussion

The software may not always be available in order to submit a report or enter information into a common database. In addition, not all staff, by responsibility, is not obliged to know and understand the details of the work of the software of modern technologies such as TQEM and CALS technologies. On the other hand, in cases of extraordinary situations, cloud technologies with their mobility 24 hours a day can be available and all issues related to the preparation of teaching materials and modules in subjects can be resolved from distance.

It should be emphasized that cloud technologies make convenient to control the educational activities of the branches on a daily basis, for remotely working professors and teachers due to its mobility.

The new solution to improve education through the use of interactive technologies is integrated into the "Educational Technologies" system and regular

automatic copying of the "Educational Technologies" file bases and their sending to the "cloud storage" is provided.

Users of the service can independently set the required frequency and time for starting the processes of copying and saving databases, or use the preset setting of the cloud archive. "Educational Technology: Cloud Archive of New Interactive Technologies" also provides the ability to set any number of stored copies for the InfoBase and receive a report on the operation of the service immediately upon entering the "Educational Technologies".

Service fault tolerance is ensured by distributed data storage on many servers. Distributed storage, as well as data encryption, protect them from loss and unauthorized access.

The emergence of a free cloud backup service will encourage users of the educational process of branches to enter into paid support contracts and thus expect to expand the number of subscribers to this service with students, if this service is provided for in the contract with students. Therefore, to the same principle, the service is already replenished with additional services: for example, a service for sending reports to the head university directly from the "Educational Technologies" programs, exchange of invoices and other documents from the "Educational Technologies" programs, access to the "Educational Technologies" programs via the Internet, etc. ...

The potential of using information and communication technologies for the development of educational technology systems is quite large and requires an empowerment in its role in society. Summing up the issue of cloud computing, followings are noted:

- Firstly, it is a truly revolutionary technology that has incorporated the basic principles of consolidation and virtualization, but adjusted for time.
- Secondly, it should be mentioned that at the moment this technology is poorly standardized, especially in the issue of security and integration of the global educational network of the Ministry of Higher Secondary Specialized Education of the Republic of Uzbekistan.

In this regard, in the future, the use of cloud technologies in the educational process has a chance to develop and understand what we already have now and can use it.

Conclusion

It should be noted that the use of cloud technologies based on TQEM and CALS technologies in the educational process of universities can be developed considering the following features in these areas:

- The use of public cloud technologies in the educational process alarms representatives of leading universities, as it is associated with information security and confidentiality;

- The introduction of cloud computing in leading universities is more profitable, since the transition may not involve large enough investments in building and (re)configuring the IT infrastructure;

- It is thought leading universities can own their private clouds so that they will be able to ensure the quality of information based on TQEM and CALS technologies and the required level of information security, as well as the independence of the system configuration.

To conclude, in the context of the globalization of the economy and the educational process, conducting classes in cloud systems is shown as an urgent issue, since it allows to reduce the economic costs and time of the university administration, faculty and student.

LITERATURE

1. Licklider, J. C. R. (1965). Libraries of the Future (PDF). Cambridge, MA: Massachusetts Institute of Technology. p. 1965. Archived from the original (PDF) on 2012-09-16.

2. Hansen, M., Smith, M., & Johnson, S. (2020). The role of cloud technologies in higher education. *Journal of Information Technology in Education*, 15(2), 45-58.

3. Brown, R., & Johnson, L. (2018). Application of Total Quality Educational Management in higher education. *Journal of Quality Management in Education*, 23(3), 78-92.

4. Mell, P. and Grance, T., 2011. The NIST definition of cloud computing.

5. Goodison, D., 2021. 10 Future Cloud Computing Trends To Watch In 2021

6. Gartner. 2021. Gartner Says Four Trends Are Shaping the Future of Public Cloud

7. Statista. 2021. Global cloud computing revenue by segment 2015-2020

8. Goodison, D., 2021. 10 Future Cloud Computing Trends To Watch In 2021
ibid.

9. TechRepublic. 2021. Top cloud trends for 2021: Forrester predicts spike in cloud-native tech, public cloud, and more

10. Igsu.ranepa.ru. 2021. Double diploma programs with European universities - IPACS RANEPА

11. Spot – Business, technology and innovation in Uzbekistan. 2021. Results of 2020: which foreign companies entered the Uzbek market and who to expect in 2021/
URL: <https://www.spot.uz/ru/2020/12/01/enters>

Abdulina, E.M. Cloud technologies in education. // *Young scientist*. — 2019. — № 52 (290). — C. 7-9. — URL: <https://moluch.ru/archive/290/65873/>