One of the Aspects of Math Teacher Training to Use the Cloud Technologies in Professional Activity*

Elena P. Linnik [1] [0000-0002-1742-5940], Marina V. Ovchinnikova [1] [0000-0002-5070-8061], Lyubov I. Shilova [1] [0000-0003-4817-132X], Irina N. Zinenko[1]

[1] V.I. Vernadsky Crimean Federal University, Simferopol, Russia

aplinnik@mail.ru

Abstract. The article briefly describes the possibilities of implementing cloud technologies into the professional-pedagogical training of future mathematics teachers. The results of implementing a specially developed methodically oriented system of teaching the disciplines of the mathematical and methodical cycle are presented. Based on the personal orientation in the process of training of future mathematics teachers, specifically used cloud-based learning technologies as an integral part of information and communication learning technologies. The experimental work was carried out after an ascertainable stage of the experiment, which was carried out to identify the level of readiness for the use of cloud technologies in professional activities. At this stage of the experiment working teachers of mathematics and teachers of mathematical disciplines, as well as students of the same specialty, were involved. An ascertainable stage of the experiment showed that in educational institutions of secondary, professional, and higher education, Yalta and Alushta, cloud technologies as a didactic tool are used only by 7.5% of respondents. At the same time, 86% of respondents consider it necessary to be specifically trained for the use of cloud technologies.

In the article, one of the methods of forming the skills of using cloud technologies in the professional training of a future mathematics teacher was described. This is the application of cloud technology in the teaching of all disciplines of the mathematical and methodological-mathematical cycle based on the principles of personal orientation and professional-pedagogical orientation. The results of the experiment allowed to improve the quality of professional and pedagogical training of future mathematics teachers.

Keywords: cloud technologies, teacher training, mathematics teacher, personal orientation of the learning process, professional and pedagogical orientation of the study of mathematical and methodological and mathematical disciplines.

1 Introduction

The process of making the education of students in the training direction 44.03.01 "Pedagogical education" ("Mathematics") fundamental is provided by many conditions, one of which is the refocusing of basic professional training to the ability to use rapidly changing modern educational technologies based on the integration system of various components of the formation of professional competencies of a future teacher [1].

The use of cloud technology by the teacher is a must and necessary condition in the modern learning process. The teacher must know not only the practical but also the theoretical foundations of their use as a didactic tool. The theoretical foundations of the use of cloud technologies in the professional and pedagogical training of a future teacher can be studied at various levels: from elementary to advanced.

Practical aspects of their application in the educational process should be formed at the level of special competence. For a teacher of mathematics and a teacher of mathematical disciplines, the ability to use cloud technology as an effective methodological tool is necessary. In-depth knowledge of cloud technology theory is also welcome.

In the context of a scientific research topic being developed at the Department of Mathematics, Theory, and Methods of Teaching Mathematics "Integration of the educational and research activities of future teachers of mathematics in the context of their personality-oriented professional training" (registration number R&D AAAA-A18-118041190060-7 of 04/11/2018), the teaching of all disciplines assigned to the department is carried out using their methodological potential. The use of cloud technology as one of the methodological tools is also illustrated in the classes in these disciplines.

2 Task setting

The work of many researchers is devoted to the problem of using cloud technologies in the process of training future teachers. S. Zenkina, T. Suvorova, O. Pankratova, L. Filimanyuk [2] E. Konopko, O. Pankratova, E. Nersesyan, J. Abdullaev [3], M. Ovchinnikova, L. Shilova, E. Linnik [4], M. Astafieva, D. Bodnenko, V. Proshkin [5] and others. The works of O. Markova, S. Semerikov, A. Striuk, H. Shalatska, P. Nechypurenko, V. Tron [6], O. Pankratova, E. Konopko, O. Mezentseva, R. Nemkov [7], V. Taran [8], O. Markova, S. Semerikov, M. Popel [9] and others are considered and analyzed in the training of teachers of computer science and IT specialists. Also, some of the works are specifically devoted to the process of the future Teaches of mathematics [4; 5] and others.

This way, the research examines [5] some aspects of the training of a mathematics teacher. The authors obtained the following results: "The expediency and the possibilities of cloud-oriented learning technologies (based on SCM) are grounded for forming the skills of the XXI century for future mathematics teachers. It has been established that computer support of the developed pedagogical technology is effectively provided by cloud-oriented learning technologies and SCM GeoGebra, which has all the abovementioned capabilities. The analysis of the results of the introduction of the developed technology based on the theory of fuzzy sets confirmed the feasibility of using cloud-

oriented technologies (based on SCM) for developing the skills of the XXI century for future mathematics teachers" [5].

Research performed by M. Ovchinnikova, L. Shilova, and E. Linnik describes a methodology for teaching Discrete Mathematics to future mathematics teachers, which is based on a combination of traditional and cloud (basic and additional) study guides. Google Apps for Education, Wolf-ram / Alpha, Moodle Cloud were used as learning tools in the cloud. Using this technique allowed future mathematics teachers to be involved in professionally oriented educational and cognitive activities [4].

Various academic disciplines can be used to master the theoretical part of cloud technology. For example, the curriculum provides for the study of the scientific foundations of computer science. An important role is given to computer modeling and computational experiment, which are the methodological basis of computer science and teaching methods at the same time. Modern studies show that mathematical informatics is one of the effective means of making the professional training of future teachers fundamental [9].

In the considered training, mathematical informatics is included in theoretical computer science and it also studies the use of information systems and technologies for applied problem-solving. The basic models, methods, and algorithms for solving problems arising in the field of intellectualization of information systems are studied, and the problems of using information, including mathematical, models and information technologies to study them are considered. But, as the experience shows, the mastery of cloud technology just a didactic tool in the desired amount only when studying this discipline does not occur.

3 Method Development

When developing the didactic foundations of using cloud technologies in teaching mathematics and implementing it into the educational process as one of the means of digitalization of learning, we used the standard scheme of psychological and pedagogical research: an ascertainable stage of the experiment, identifying theoretical and practical components, organizing and conducting a forming stage of the experiment, and summarizing.

To find out the possibilities of independent formation of competencies associated with the use of cloud technologies in professional activities, we analyzed the existing basic educational programs, both in pedagogical universities, and the proposed additional educational programs for teachers (a total of 25 programs of continuing education courses). At the same time, we took into account the availability of additional educational programs based on various parameters: content, course structure features, training form (full-time–distant), presentation style, price (paid –free-of-charge), etc.

Let's consider just some of them, which the most accessible.

The all Russia educational portal "ICT for educators" (https://edu-ikt.ru) is a portal for modern teachers, the main purpose of which is to familiarize teachers with new information technologies, help in the development and formation of new competencies

in the field of ICT. Out of the twelve six-hour training courses ("Audio-visual technologies in training"; "Use of modern information and communication technologies in the work of a teacher"; "Effective use of programs and Internet services to create educational interactive posters"; "Safe work on the Internet"; Online services to help educators; etc.), only two contain topics related to cloud technology. Moreover, these topics cover only the use of ten cloud storage services (Google Drive, Microsoft OneDrive, Dropbox, Mega, Cloud@mail.ru, Yandex.Disk, Amazon Web Services, pCloud, iCloud Drive, 4shared). The lecture analyzes the cost of services, advantages, and disadvantages, the level of data protection, and privacy). Which, in our opinion, is not sufficient. The form of training is distant/online. Education is free, with only a certificate being paid for.

The PEDAGOGI.ONLINE portal provides access to the online store of webinars for educators (http://www.web-school-detsad.ru/). Retraining courses on this portal are presented in the form of a webinar system. On average, each of the webinars costs about 300 rubles. From a large number of topics, the topic of our research covers a cycle of three webinars "Teacher and Information Technology. Easy about the complex", in which the existing cloud services are not analyzed. And the webinar "Learning to Create Google Docs. Super help in planning and reporting! Accessible to all". As the names suggest, the topics mostly affect the use of Google features and do not consider other cloud services. The form of training is online.

We found the proposal for the project "Digit to the Regions" (http://digital.naukavregiony.ru/math) to be a very interesting one, which is carried out by ANZhT P.L. Kapitsa Physics-Technical Sciences Lyceum, with the support of the Ministry of Education and the Development Fund for Physics -Technical Sciences Schools. Further education courses for teachers in the subject areas "Mathematics", "Computer Science" and "Technology" are conducted at the Moscow Institute of Physics and Technology and Physics-Technical Sciences Lyceum for teachers from regional schools. The main difficulty is that only 20 teachers in each subject area are selected for these free courses based on the test results. Training is funded by a grant from the Ministry of Education. Full-time form of education.

Within the framework of these courses, it is planned to hold seminars on the use of various services by a mathematics teacher to increase the efficiency of students learning the material and to improve their knowledge control, open lessons of teachers of the Physic-technical Lyceum for project participants, masterclasses from teachers of the ZFTSh for conducting circles and distance learning.

In the above-mentioned examples, as it had been planned, we analyzed publicly available refresher courses, with the help of which a mathematics teacher can use the skills of using cloud technologies. Almost all of them only in passing concern this aspect. This fact allowed us to conclude that it would be quite difficult for a mathematics teacher who does not own the skills of using cloud technologies in professional activities to independently form these skills.

Also at an ascertaining stage of the experiment, a questionnaire devoted to the relevance of organizing special training for the use of cloud technologies in the learning process and the future professional activities of future mathematics teachers was developed and offered to be completed (Table 1).

Table 1. Questionnaire on how relevant the special training for future mathematics teachers to use cloud technologies in the learning process is

Questionnaire Dear Colleagues! Please answer the following questions	
Question 1.	Do you use cloud technology in teaching mathematics? - yes, if necessary - sometimes - not using If your answer is "Yes, if necessary," please go to question 3. If your answer is "Sometimes", please go to question 2. If your answer is "I don't use", please answer question 2, 3, 4 and send us a questionnaire
Question 2.	If you do not use cloud technology in the process of teaching mathematics or do it infrequently, please indicate the reason (you can choose several answer options or offer your option) - I think that this is not necessary at all (distracts students, interferes with studies, does not develop students' mathematical thinking, etc.) - preparation for classes using cloud technologies takes a lot of time from a teacher - I do not know enough about cloud technology - there is no appropriate methodological support to the use of cloud technologies in the teaching of mathematics - other:
Question 3.	Would you like to use cloud technology in your math teaching process? - Yes - no - I find it difficult to answer
Question 4.	Is the need for methodological support for the use of cloud technologies in the process of teaching mathematical disciplines relevant (in the form of methodological recommendations, an electronic training course, aids, etc.)? - Yes - no - I find it difficult to answer
Question 5.	What is the purpose of you using cloud technologies in the process of teaching mathematics? - required by the school authorities - I try to make the lesson as useful as possible - I find it difficult to answer - your option
Question 6.	What software and cloud services do you use in the process of teaching mathematics most often?
Question 7.	What difficulties do you encounter in the process of using cloud technologies (can you choose several answer options or offer your option)? - not sufficiently familiar with the software functionality - not all students or students have a sufficient level of digital competency - lack of appropriate software or hardware in the classrooms - the use of cloud technology in the class takes a lot of time - other
Thank you for your help and we invite you to scientific cooperation! Sincerely, the staff of the Department of Mathematics, Theory, and Methods of Teaching Mathematics.	

4 Results

The questionnaire was conducted online using https://docs.google.com/forms. 132 teachers of mathematics and teachers of mathematical disciplines of colleges and universities of Yalta and Alushta took part in it. Here we provide the main results that allowed us to conclude that special training is necessary.

Out of all the respondents, only 10 people (7.58%) use cloud technology (sometimes if necessary), while the remaining 122 respondents (92.42%) do not. Out of these, 7 respondents (5.74%) do not see this as a necessary part of the class. As a reason, 18 respondents (14.75%) indicate that preparing for classes using cloud technology takes too much time. 23 respondents (18.85%) noted that they do not have sufficient knowledge and expertise about digital technology. 74 respondents (60.66%) complained about the lack of appropriate methodological support for using cloud technologies for teaching mathematics. Other reasons indicated is the lack of technical equipment in the institution 53 respondents (43.44%).

105 respondents (86.06%) confirmed the relevance of the need for methodological support for the use of cloud technologies in the process of teaching mathematical disciplines.

Questions 5–7 were answered only by 10 respondents (7.58%). All of them indicated that they use Mail.ru and Google services. The main difficulties in using cloud technologies were attributed to the lack of appropriate software or hardware in classrooms.

An analysis of the results of the ascertainable stage of the experiment showed the insufficiency of the existing opportunities for independent formation of competencies in mathematics teachers related to the use of cloud technologies. This has confirmed the need to focus on special training in the use of cloud technologies in education. The findings are also confirmed in a study on the development issue of Electronic Advanced Training Courses for the Development of Information Competence of the Teacher [10]. When developing our courses, we also rely on 4 basic principles applied by the authors: the principle of functional completeness of the course; the principle of modular construction of the course; the principle of hierarchy of didactic elements of the electronic course; the principle of synergy.

In the methodological system for the use of cloud technologies in the professional activities of future teachers of mathematics and teachers of mathematical disciplines, it is necessary to identify the goals and content of teaching the basics of using cloud technologies for distance (online) learning of future teachers of mathematics, as well as the development of an appropriate teaching methodology aimed at implementing interdisciplinary connections and integration as well as a systematic approach to the training of future specialists. Since the considered system lives and develops in a didactic environment, the environment-oriented approach becomes mandatory in training, in which the learning tools are transferred to the cloud (a specially created environment that covers all aspects of the use of cloud computing in the organization of education of students of all categories in different forms and models of learning [11]).

Methodologically sound use of network technologies in the process of teaching the basics of using cloud technologies of future mathematics teachers should help the or-

ganization of individual and collective educational activities of students in a cloud environment to actively, consciously use and master the relevant models and teaching methods.

5 Discussion

The methodology of using cloud technologies in the education of future mathematics teachers is currently in the process of creation and intensive development. However, in the process of this system development, research for other pedagogical specialties cannot be ignored. Most often, this is the training of computer science teachers for whom cloud technologies are both the content of instruction, and the means of instruction, and forms of instruction.

T.P. Kobylnik [12] proposed the main components of a computer-oriented methodological training system (based on mathematical informatics) for students of a pedagogical university. Based on general laws and principles, modern approaches and concepts of pedagogy and psychology of higher education, the possibility of using computer mathematics in the study of mathematical informatics and some mathematical disciplines at a pedagogical university is substantiated, personality-oriented teaching technologies (project method, situational, problem, module rating training), the feasibility of their use in teaching mathematical informatics is also substantiated.

Comparison of the content of computer science training for future teachers of mathematics and computer science showed that for teachers of mathematics there is no study of separate sections of artificial intelligence systems, and all other components of the content of computer science training in pedagogical universities are included in the content of the training. Besides, individual blocks of mathematical informatics are studied by future teachers of mathematics in the form of separate disciplines: discrete mathematics (set theory, graph theory), the theory of algorithms. In the training of the future teacher of mathematics, the study of the theory of the use of cloud technologies implies only an introductory level. The focus is on utilitarian issues. For example, the study of cloud technology application models, which are initially considered as one of the varieties of services. Future teachers get acquainted with the history of the subject. Without this, students cannot get a holistic picture of the material being studied. Technological changes on the Internet led to the emergence of the network (primarily social) Web 2.0 services, which began to provide opportunities for using open, free-of-charge, and free electronic resources in the learning process, self-creation of online educational materials, the formation of educational communities, etc. The evolution and convergence of Web technologies have led to the emergence of the concept of cloud computing and related technologies to support training and research, primarily cloud Web-SCM (computer mathematics systems) [13-16]. In the future, models of cloud services and the possibilities of their use by a mathematics teacher directly in professional activities are considered.

Authors P. Mell, T. Grance [17] distinguish three such models of providing cloud services:

a) Cloud Software as a Service (SaaS), in which the service provider provides the consumer with software tools running in the cloud infrastructure. Programs must be accessible from various client devices through a browser interface. The consumer does not control the cloud infrastructure itself (networks, servers, operating systems, storage systems, some program-specific features, etc.) in which the program runs. In some cases, the consumer may be allowed to access some user settings;

b) Cloud Platform as a Service (PaaS), in which the consumer is provided with the opportunity to deploy on the cloud infrastructure user-created or acquired programs developed using the tools and programming languages supported by the service provider;

c) Cloud Infrastructure as a Service (IaaS), in which the consumer is provided with data processing, storage, network access, and other basic computing resources on which the consumer can deploy and execute arbitrary software, including operating systems and applications. The consumer does not control the cloud infrastructure itself, but it can control the operating systems, storage facilities, hosted programs and, possibly, have limited control over some network components.

O. Markova, S. Semerikov, and others [6] suggest implementing the above-mentioned models of using cloud services in the training of computer scientists. "The analysis of educational and professional training programs for specialists in information technologies has been provided with an opportunity to determine the model of the cloud services provider that is appropriate to use in the process of studying the educational disciplines of mathematical cycles, natural science, professional and practical training for future information technology specialists:

– SaaS – "Higher Mathematics", "Theory of Probability and Mathematical Statistics", "Algorithms and Computing Methods", "Discrete Mathematics", "Ecology", "Computer Logic", "Database Organization";

– PaaS – "Physics", "Theory of Electric and Magnetic Circuits", "Computer Electronics", "Programming", "Computer Circuitry", "Parallel and Distributed Computing", "Software Engineering";

– IaaS – "Computer Architecture, "System Programming", "System Software", "Technology of Computer System Design", "Computer Systems", "Computer Networks", "Computer Systems Information Security" [6].

In our opinion, the introduction of only the SaaS model is sufficient in the training of a mathematics teacher. Although the use of other models is also possible.

Let's note the features of cloud access models that need to be considered by a future math teacher.

Cloud access is regulated by four deployment models:

- a private cloud, in which the cloud infrastructure operates entirely to serve one organization. Infrastructure can be managed by the organization itself, a third party, or any combination of them and can exist both on the consumer side and at the external service provider;

- community cloud, in which the cloud infrastructure is used by a limited community of consumers from several organizations that have common principles (for example, mission, security requirements, rules, requirements). The infrastructure can be managed

by the organizations themselves, by a third party, or any combination of them, and can exist both on the consumer side and at the external service provider;

- public cloud, in which the cloud infrastructure is created as public. Such infrastructure is deployed by a cloud service provider and may be owned and operated by firms, training or government organizations, or any combination thereof;

- a hybrid cloud, in which the cloud infrastructure is a composition of two or more clouds (private, public, or community clouds) that remain unique entities, but combined through standardized or proprietary technologies that transfer data and programs between the clouds.

Using the basics of using cloud technologies in the professional and pedagogical training of future mathematics teachers helps to ensure making the process of training fundamental and the methodological orientation of the training as well. At the same time, future teachers are forming the corresponding competence for using cloud technologies, which is closely related to "Information competence of a teacher – their readiness and ability to independently use information and communication technologies in his professional activity" [2].

To illustrate the possibilities of using cloud technologies in the teaching of mathematical and methodological-mathematical disciplines, we used the following didactic opportunities: expeditious delivery of educational materials without territorial binding of the user to the place of provision; the ability to create, share, use and comment on documents of various formats; organization of joint work in various formats; organization of interactive classes; organization of various forms of control; organization of independent work in conditions of both synchronous and asynchronous operation.

Some emphasis on the use of cloud technology is analyzed in the work of O. Bondarenko, O. Pakhomova, V. Zaselskiy, S. Mantulenko, A. Pikilnyak [18; 19]. The authors offer a selection of online services that can contribute to the effective acquisition of geographical knowledge in higher school. The publication describes such cloud technologies as Gapminder, DESA, Datawrapper.de, Time.Graphics, HP Reveal, MOZAIK education, Settera Online, Click-that-hood, Canva, Paint Instant. There is also made some theoretical generalization of their economic, technical, technological, didactic advantages and disadvantages. Visual examples of application are provided in the article. The authors make notice that in the long run, the technologies under study should become a valuable educational tool for creating virtual information and education environments connected into common national, and then global, educational space. Authors also share their experience with using Google Classroom as a tool of support of blended learning for geography students [18; 19].

We relied on the data of this study to familiarize ourselves with the possibilities of using cloud technologies in education. We oriented students to the analysis of didactic features of the use of these tools.

Besides, we asked students to analyze the experience of teaching mathematics at various stages of training (from primary to higher). This is because the methods of teaching mathematics are interpenetrated and interconnected. As an example, we give the experience of significantly improving the quality of education in elementary school using various environments and applications. This experience can be used in teaching mathematics in grades 5-6. "Tools and apps feature the ability to provide real variability

of tasks, uniqueness of exercises, operative assessment of correctness in each task, adjustment of task difficulty, ability to provide a shade of competitiveness and gaming to the exercises». They use Microsoft Office package, GeoGebra (http://www.geogebra.org), Learningapps.org (http://learningapps.org), Zondle (http://www.zondle.com), Classtools.net (http://classtools.net), Studystack (https://www.studystack.com) and others. "Tools and apps can be created by the universal software tools, such programs that are part of an integrated Microsoft Office package or special designing environments. The capabilities of the tools and apps are covered, which ensure successful acquisition of knowledge, for developing young schoolchildren's skills. Considered tool kits enable a teacher-to-be to design independently author's apps that meet the needs of a particular lesson, enable to achieve the lesson goal with the peculiarities of the educational process in primary school" [20].

Then we introduce students to the experience of using the capabilities of web-based software for teaching mathematics in a primary school. For example, in [21], a study has described the problem of developing web-based software to support the teaching of mathematics from grades 5-6 of the basic school. The authors propose the use of adaptive software on the topic "Fractional numbers"[21].

In high school practice, there are all the possibilities of organizing a special cloud-based environment. Using reviewed tools and apps in the practice of Math education must be based on some principles: developed apps should generate learners' interest; apps should be visually presented to create pleasant emotional background; problem definition should involve learners into a critical analysis of input data as for their adequacy, redundancy, actuality; apps should allow learners to operate free, for example, to perform transformations of geometric solids (rotate, drag, resize them) [20].

Following the standard grading system adopted at CFU, such levels of cloud computing ownership as methodological tools by future mathematics teachers were considered (Table 2).

Table 2. The distribution of points on the possession of cloud technology as a methodological toolkit for future teachers of mathematics

Levels	Points
research	90-100
tall	82-89
middle	74-81
sufficient	64-73
satisfactory	60-63
low	35-59
zero	0-34

The experimental group included students who studied using cloud technologies according to the developed methodology (61 respondents), the control group included students who studied according to the traditional methodology without using cloud technologies (53 respondents). Comparative results of the forming experiment are shown in table 3.

Table 3. Comparative Formative Experiment Results

Levels	Before conducting a formative experiment				After conducting a formative experiment			
	control group		experimental group		control group		experimental group	
	quantity	%	quantity	%	quantity	%	quantity	%
research	3	5,66	4	6,55	3	5,66	7	11,47
tall	6	11,32	4	6,55	6	11,32	10	15,87
middle	12	22,64	16	26,23	10	18,87	19	30,16
sufficient	9	16,98	14	22,95	11	20,75	14	22,95
satisfactory	14	26,42	13	21,32	16	30,19	7	11,47
low	6	11,32	7	11,48	6	11,32	3	4,92
zero	3	5,66	3	4,92	2	3,77	1	1,58

The analysis of experimental data showed that 4.92% and 9.32% of students in the experimental group of research and high level, respectively. And in the control group, they remained unchanged. Moreover, in the experimental group, there was also a transition from a satisfactory level to a sufficient level of 9.85%.

6 Conclusion

The study confirmed that the implementation of the following conditions makes it possible to increase the efficiency of the use of cloud technologies by mathematics teachers:

1. the use of cloud technologies to provide a methodological orientation for teaching future mathematics teachers;
2. the inclusion in the learning content of the basics of using cloud-based learning technologies;
3. selection of freely available cloud-based learning technologies;
4. development and implementation of the methodology for using cloud technologies as a means of teaching the basics of the methodology of teaching mathematics, aimed at increasing the level of their knowledge.

The first condition was realized in the process of designing the content component of the methodological training system for future mathematics teachers, the second condition was in the design of its technological subsystem.

The relevance of the study is confirmed by the fact that in the context of the digitalization of the economy, with the introduction of distance learning elements in schools and universities, school teachers and higher education teachers are faced with the fact that there is an urgent need to know the technologies of organizing education in these conditions.

References

1. The Concept of Development of Mathematical Education in the Russian Federation (approved by the order of the Government of the Russian Federation of December 24, 2013 No. 2506-p). Moskow (2013).
2. Zenkina S., Suvorova T, Pankratova O., Filimanyuk L. The Method of Design of Electronic Advanced Training Courses for the Development of Information Competence of the Teacher. Proceedings of SLET-2019 - International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research, Stavropol - Dombay, Russia, 20-23 May 2019. pp. 366 - 375. DOI: http://ceur-ws.org/Vol-2494/paper_35.pdf
3. Konopko E., Pankratova O., Nersesyan E., Abdullaev J. Training of Teachers for Professional Activity in the Digital Environment of the Educational Space. Proceedings of SLET-2019 - International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research, Stavropol - Dombay, Russia, pp. 205-212. DOI: http://ceur-ws.org/Vol-2494/paper_18.pdf.
4. Ovchinnikova M. V., Shilova L. I., Linnik E. P. Using Means of Cloud Technologies of Training in the Study of Discipline "Discrete Mathematics" in the Professional-Pedagogical Training of Math Teachers Information Systems and Technologies in Modeling and Control 2019: Selected Papers of the IV All-Russian scientific and practical conference with international participation "Information Systems and Technologies in Modeling and Control" (ISTMC'2019) Yalta, Crimea, May 21-23, 2019. http://ceur-ws.org/Vol-2522/paper15.pdf
5. Astafieva, M., Bodnenko, D., Proshkin, V. Cloud-oriented training technologies as a means of forming the XXI century skills of future mathematics teachers // ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume I: Main Conference Kherson, Ukraine, 2019. http://ceur-ws.org/Vol-2387/20190507.pdf
6. Markova, O.M., Semerikov, S.O., Striuk, A.M., Shalatska, H.M., Nechypurenko, P.P., Tron, V.V.: Implementation of cloud service models in training of future information technology specialists. In: Kiv, A.E., Soloviev, V.N. (eds.) Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE 2018), Kryvyi Rih, Ukraine, 2018. CEUR Workshop Proceedings 2433, 499–515. http://ceur-ws.org/Vol-2433/paper34.pdf
7. Pankratova O., Konopko E., Mezentseva O., Nemkov R. The Preparation of a Modern Computer Science Teacher with the Help of Resource-Saving Technologies and Green IT Implementation. Proceedings of the 2018 multidisciplinary symposium on computer science and ICT. Stavropol, Russia, October 15, 2018. http://ceur-ws.org/Vol-2254/10000222.pdf.

8. Taran V. N. Use of Elements of Augmented Reality in the Educational Process in Higher Educational Institutions. CEUR Workshop Proceedings. In 2019 International Conference on Innovative approaches to the application of digital technologies in education and research SLET-2019 http://ceur-ws.org/Vol-2494/paper_28.pdf
9. Markova O., Semerikov S., Popel M. CoCalc as a Learning Tool for Neural Network Simulation in the Special Course "Foundations of Mathematic Informatics [Electronic resource] // ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer 2018: Proceedings of the 13th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume II: Workshops (ICTERI, 2018). – P. 388-403. (CEUR Workshop Proceedings (CEUR-WS.org), Vol/ 2104). – Access mode : http://ceur-ws.org/Vol-2104/paper_204.pdf
10. Zenkina S., Suvorova T., Pankratova O., Filimanyuk L. The Method of Design of Electronic Advanced Training Courses for the Development of Information Competence of the Teacher. Proceedings of SLET-2019 - International Scientific Conference Innovative Approaches to the Application of Digital Technologies in Education and Research, Stavropol - Dombay, Russia, 20-23 May 2019. pp. 366 - 375. http://ceur-ws.org/Vol-2494/paper_35.pdf
11. Lytvynova, S.H. et al. Cloud-oriented learning environment of secondary school // Proceedings of the 5th Workshop on Cloud Technologies in Education (CTE 2017), Kryvyi Rih, Ukraine, 2017. CEUR Workshop Proceedings 2168, 7-12. http://ceur-ws.org/Vol-2168/paper2.pdf
12. Kobylnyk T.P. Methodical system of teaching mathematical informatics in pedagogical university: dis. ... cand. ped. sciences: 13.00.02 - theory and methods of teaching (computer science) / Kobylnyk Taras Petrovich; M.P. Drahomanov National Pedagogical University. - K., 2008. 279 p.
13. Architecting Low Latency Cloud Networks: Arista Whitepaper [Electronic resource] / Arista. – 5 p. – Available at: https://www.arista.com/assets/data/pdf/CloudNetworkLatency.pdf.
14. McKendrick J. 10 steps to avoid cloud vendor lock-in [Electronic resource] / Joe McKendrick // ZDNet. – July 12, 2013. – Available at: http://www.zdnet.com/article/10-steps-to-avoid-cloud-vendor-lock-in/.
15. Cloud Service Level Agreement Standardisation Guidelines [Electronic resource]. – Brussels. – 24/06/2014. – 41 p. – Available at: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=6138.
16. Google Security Whitepaper [Electronic resource] // Google Cloud Platform. – May 26, 2015. – Available at: https://cloud.google.com/security/whitepaper.
17. Mell P. The NIST Definition of Cloud Computing : Recommendation of the National Institute of Standards and Technology [Electronic resource] / Peter Mell, Timothy Grance. – Gaithersburg: National Institute of Standards and Technology, September 2011. – III, 3 p. – (Special Publication 800-415). – Available at: http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.
18. Bondarenko, O.V., Pakhomova, O.V., Zaselskiy, V.I.: The use of cloud technologies when studying geography by higher school students // Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE 2018), Kryvyi Rih, Ukraine, 2018, http://ceur-ws.org/Vol-2433/paper25.pdf

19. Bondarenko, O.V., Mantulenko, S.V., Pikilnyak, A.V.: Google Classroom as a Tool of Support of Blended Learning for Geography Students // Proceedings of the 1st International Workshop on Augmented Reality in Education (AREdu 2018), Kryvyi Rih, Ukraine, 2018. CEUR Workshop Proceedings 2257, pp. 182-191. http://ceur-ws.org/Vol-2257/paper17.pdf
20. Olefirenko N. E- et al. learning resources for successful math teaching to pupils of primary school // Proceedings of the 6th Workshop on Cloud Technologies in Education (CTE 2018), Kryvyi Rih, Ukraine, 2018. CEUR Workshop Proceedings 2433, pp. 443-458 http://ceur-ws.org/Vol-2433/paper30.pdf
21. Petrova, M.Ye., Mintii, M.M., Semerikov, S.O., Volkova, N.P.: Development of adaptive educational software on the topic of “Fractional Numbers” for students in grade 5 // Proceedings of the 1st Student Workshop on Computer Science & Software Engineering, Kryvyi Rih, Ukraine, 2018. CEUR Workshop Proceedings 2292, 162–192. http://ceur-ws.org/Vol-2292/paper19.pdf.