







The Current Level of Competence of Schoolteachers on How to Use Cloud Technologies in the Educational Process During COVID-19 and the Russian-Ukrainian War

Tetiana A. Vakaliuk^{1,2,3}^a, Oleg M. Spirin^{4,2}^b, Dmytro S. Antoniuk¹^c, Mariia O. Medvedieva⁵^d,
Olha O. Osova⁶^e and Inesa V. Novitska⁷^f

¹Zhytomyr Polytechnic State University, 103 Chudnivsyka Str., Zhytomyr, 10005, Ukraine

²Institute for Digitalisation of Education of the NAES of Ukraine, 9 M. Berlynskoho Str., Kyiv, 04060, Ukraine

³Kryvyi Rih State Pedagogical University, 54 Gagarin Ave., Kryvyi Rih, 50086, Ukraine

⁴University of Educational Management, 52A Sichovykh Striltsiv Str., Kyiv, 04053, Ukraine


⁵Pavlo Tychyna Uman State Pedagogical University, 2 Sadova Str., Uman, 20300, Ukraine


⁶Kharkiv Humanitarian Pedagogical Academy, 7 Rustavelli Str., Kharkiv, 61001, Ukraine


⁷Zhytomyr Ivan Franko State University, 40 Velyka Berdychivska Str., Zhytomyr, Ukraine, 10008


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Abstract: During the period of total lockdown, teachers had to move to distance learning to organize a continuous educational process, which is not possible without the active use of modern information and communication technologies, including cloud services. Because of this, at the beginning of the pandemic, Zhytomyr Polytechnic State University conducted several free distance online courses for teachers, which included studying the possibilities of using cloud technologies in teaching in a pandemic. Somewhat later, some secondary schools in Zhytomyr expressed a desire to take the same courses, but in person. 98 teachers of schools of the city of Zhytomyr were covered by training on courses “Cloud technologies in the educational process in the conditions of quarantine”. After face-to-face courses, teachers in Zhytomyr schools have significantly increased their competence in the use of cloud technologies in the educational process in the context of the COVID-19 pandemic. Not only has their level increased in general, but the horizons regarding the variety of cloud services that should be used in distance learning have expanded. Course training, organized according to scientifically sound methods, helps to increase the motivation of students (teachers) to self-study, as well as to the future use of cloud technologies in the educational process. The two-year pandemic and the start of a full-scale war between Russia and Ukraine contributed to the fact that teachers of secondary schools began to actively engage in self-education and self-development. If earlier (at the beginning of the pandemic) it was difficult for teachers to switch to online learning, then with the outbreak of war, teachers were already ready to use various online tools in their practice. As the study showed, all the interviewed teachers continued their self-education in different ways, studied a large number of services that can be used in the educational process, and provided the authors with ideas for further expanding the courses according to their desires, which should be used in the educational process. It should be noted that it is important that all the respondents unanimously approved that they use the acquired competencies in their professional activities during the period of Russian aggression. In addition, in additional comments, teachers noted that among their acquaintances there are many teachers who want to take such courses since at one time they had no desire or motivation.

^a <https://orcid.org/0000-0001-6825-4697>

^b <https://orcid.org/0000-0002-9594-6602>


^c <https://orcid.org/0000-0001-7496-3553>

^d <https://orcid.org/0000-0001-9330-5185>

^e <https://orcid.org/0000-0001-7316-1196>

1 INTRODUCTION

With the spread of COVID-19, the educational process of foreign and domestic educational institutions

^f <https://orcid.org/0000-0003-0780-0580>

is undergoing significant changes. During the period of total lockdown, teachers had to move to distance learning to organize a continuous educational process, which is not possible without the active use of modern information and communication technologies (ICT), including cloud technologies and services. Many teachers had to simultaneously increase their competence in using such services and teach students to do it. Students and teachers had to cope with many challenges for the proper and effective use of cloud services in the organization of such training.

With this in mind, at the beginning of the pandemic, Zhytomyr Polytechnic State University conducted a series of free distance online courses for teachers, which included studying the possibilities of using cloud technologies in teaching in a pandemic. A scientifically sound methodology was developed, which contained a semantic component with a list of topics and features of forms, methods, and means of conducting such courses were described in the previous work (Vakaliuk et al., 2021b). 1,500 teachers were registered for the course, and 816 people completed the course. Therefore, some institutions of secondary education in Zhytomyr expressed a desire to go through the same courses, but full-time mode. It was decided to hold such courses for schoolteachers. Before starting the courses, it was necessary to find out the current level of their competence in the use of cloud technologies in the educational process in the context of the COVID-19 pandemic. The courses were held at Zhytomyr Polytechnic State University in August 2020 full-time.

2 THEORETICAL BACKGROUND

Throughout the pandemic, scientists from around the world have raised questions about the use of different information and communication technologies in the educational process, the introduction of distance and blended learning, and more.

In particular, Nagaraju et al. (Nagaraju et al., 2021) analyzed the effectiveness of online learning during the COVID-19 pandemic and studied adapting teaching and learning in times of COVID-19. According to an online survey of 683 respondents (teachers and students), 38% did not even start such training, although it is inevitable in such a situation.

Falfushynska et al. (Falfushynska et al., 2021) identified various ICT tools for the implementation of distance learning, including Zoom, Moodle, Google Meet, BigBlueButton, and Cisco. The study showed the satisfaction of subjects and their positive attitude to distance learning, satisfaction with the quality of

such tools. During the pandemic, the readiness of students and pupils to organize independent learning becomes especially important, which requires them to be motivated to learn, keep track of time, can use modern ICT, self-discipline, and control.

Korobova et al. (Korobova et al., 2019) created an educational environment uses Google's cloud services, the use of which allows taking into account the individual characteristics of students in education, the geographical region of their residence, etc.

Korobeinikova et al. (Korobeinikova et al., 2020) show an example of the use of cloud services in their activities as a means of improving student learning and teaching disciplines, in particular Google Classroom, which allows you to manage the independent work of students while studying disciplines. The authors emphasize that when organizing the educational process using cloud technologies, it is necessary to move to the application of the model of blended learning in universities.

The analysis of domestic and foreign experience in the use of cloud services for the formation of professional competence of future teachers is demonstrated by Shyshkina and Marienko (Shyshkina and Marienko, 2020). Particular attention is paid to the development of the professional competence of future mathematics teachers. Researchers have defined this competence and identified two components: digital and subject competence. Emphasis is placed on the feasibility of using cloud services in the formation and development of this competence, in particular, the prospects for using the CoCalc cloud service are described.

The issue of professional training of teachers for the organization of learning with the help of cloud services was studied by Velychko et al. (Velychko et al., 2021), who conducted a survey of mathematics teachers on the use of ICT in the educational process. The authors found that 82% of mathematics teachers who participated in the survey use cloud services in education, implement on their basis modern methods and forms of teaching, use a variety of modern cloud services to teach mathematics.

The connection between the concepts of cloud systems and cloud learning environments is covered in the study of Popel and Shyshkina (Popel and Shyshkina, 2019). The authors define the cloud learning system as a component of such an environment. Scientists consider approaches to defining the cloud learning system – the first approach is based on the definition of such a system as a set of cloud services or technologies, the second – defines the cloud learning system as a separate type of cloud service (Popel and Shyshkina, 2019).

The use of cloud services in the organization of training affects the quality of training of future professionals. Such practical experience is described in (Volikova et al., 2019). It is emphasized that it is impossible to build a new educational environment without cloud services as a means of learning, which is a powerful tool for mastering new competencies of both teachers and students in the study of fundamental disciplines.

Markova et al. (Markova et al., 2019) dealt with the research of cloud learning technologies, cloud-based learning environment, provision of cloud educational services for the organization of professional training of future IT specialists, who concluded that it is advisable to use different models of cloud services (SaaS, PaaS, IaaS), as well as the possibilities of new tools for parallel programming.

In (Astafieva et al., 2019) the expediency of using cloud learning technologies for the formation of skills of future teachers of mathematics of the 21st century, in particular critical thinking, is emphasized. The authors consider forms and methods of teaching based on the GeoGebra computer system and cloud technologies. To evaluate the effectiveness of this approach, the methods of fuzzy set theory are used.

The professional competence of a teacher according to European standards is described by Morze and Glazunova (Morze and Glazunova, 2019), which presents a model for the development of this competence of information technology teachers, consisting of stages, subjects, and resources. The authors emphasize the need to use existing e-CF and ISTE standards to develop this competence in teachers.

In the conditions of the introduction of cloud services and means of distance learning in the educational process of modern secondary education institutions, one of the main competencies of teachers becomes information and communication competence. The methodology for the development of this competence in teachers of the military education system is presented in (Yahupov et al., 2020), in particular, the main tasks of its development are identified. Teaching aids have been identified, among which ICT tools are mandatory: computer-based educational systems in the multimedia versions; laboratory remote workshops; simulators; electronic libraries with remote access, etc. In addition, the expediency of the introduction of active learning methods, which are implemented through the use of computer networks, audio-video, and other telecommunications, including the Internet.

In (Moiseienko et al., 2020) one of the modern competencies is considered – digital, as one of the factors of formation of the information society in

Ukraine. Based on the analysis of the definition of digital competence, its interpretation is given, the didactic conditions of its formation are singled out.

It is also worth noting that a number of authors have studied the development of digital competencies associated with the use of cloud services. Basilotta-Gómez-Pablos et al. (Basilotta-Gómez-Pablos et al., 2022) study a systematic literature review for teachers' digital competencies in higher education; Findeisen and Wild (Findeisen and Wild, 2022) research general digital competences of beginning trainees in commercial vocational education and training; Spada et al. (Spada et al., 2022) explored problems are universities ready to deliver digital skills and competences. Tzafilkou et al. (Tzafilkou et al., 2022) are development and validation of students' digital competence scale. In particular, Vakaliuk et al. (Vakaliuk et al., 2021a) also studied the formation of digital competence of CS bachelors in the use of cloud-based learning environments, and Morze et al. (Morze et al., 2022) researched systems for digital professional development of university teachers.

According to Spirin (Spirin, 2019), any individual can move faster in learning a new profession through online courses. Because with such training there is a possibility to combine online and offline courses. Various platforms have recently been used to conduct online courses, such as Coursera, MIT OCV, Prometheus, Udemy, edX, Udacity, Stanford online, etc. The author pays special attention to course aggregators. In particular, Course Buffet is an aggregator that allows you to choose a specialization from a certain set of courses. This specialization will correspond to the number of credits in the specializations of different universities around the world. As a result, it is possible to study according to the same subject load as at the university, where the educational process takes place according to traditional teaching.

In the conditions of quarantine in March-April 2020 in Ukraine in general secondary education institutions, the use of the web service Zoom for conducting video lessons in combination with Google Classroom became widely popular. However, the use of the latter imposes some requirements and restrictions, in particular:

- participants must have a Google account;
- the system must be registered as an educational institution, otherwise, the teacher's own disk space is used, which is limited for an individual user;
- Google's children's profile is limited to 13 years for the free use of resources, including no access to videos used for educational purposes on YouTube.

In addition, as of the end of December 2022, the most popular (in terms of trust rating and a number of downloads from Google Workspace Marketplace) digital video conferencing services, webinars, and organizers are: Zoom, Yamm, and MS Teams (Google, 2022).

That is why the purpose of the article is to determine the current level of competence of schoolteachers on how to use cloud technologies in the educational process during COVID-19 and the Russian-Ukrainian war.

3 RESULTS

The purpose of training on the courses “Cloud technologies in the educational process in quarantine” was to get acquainted with the basic methodologies of using cloud technologies in education; a general overview of existing cloud technologies and consideration of the main provisions of cloud technologies for use in the educational process. The course was completely identical to the course conducted in the period March-April 2020 (Vakaliuk et al., 2021b). The main difference was that teacher training was conducted traditionally – in the classroom.

98 teachers of schools of the city of Zhytomyr were covered by training on courses “Cloud technologies in the educational process in the conditions of quarantine”. At the beginning of the course, a survey was conducted to clarify general issues. To the question “Do you have a computer (laptop) at home?”, 98.98% of respondents answered in the affirmative.

The same answer was given to the question “If you have a computer at home, is it connected to the Internet?” and “Can you find the information you need on the Internet?” (figure 1a). Interestingly, 100% of respondents indicated that “the Internet is necessary for his / her professional activity”.

These general questions are also important because, unfortunately, nowadays not all teachers (including those from villages) have their own computer or access to the Internet.

In response to the question “Are you able to choose and use software to optimally present the different types of materials needed for the learning process?”, 63.92% of respondents indicated that they know how to choose and use software for optimal presentation of different types of materials, necessary for the learning process, while all the others answered that they do not know how (figure 1).

The next question of the general unit was whether teachers have their website or blog. In response to this question, only 23.71% of respondents answered that

there is, and 76.29% do not (figure 2). At the same time, 96.91% of respondents indicated that they had a website for their school, and only 3.09% said no (figure 2).

The following questions were about whether the course participants know what cloud technologies and services are, to which 60.82% of respondents answered in the affirmative, 39.18% answered “no” (figure 3). At the same time, only 44.9% used cloud technologies in teaching their subject before taking the courses, and 55.10% did not use them before taking the courses (figure 3).

The following questions served to establish the competence of teachers on the use of cloud technologies in the educational process during COVID-19 and were studied before and after the courses that included the acquisition of basic competencies for working with cloud technology in the educational process in the conditions of a pandemic.

When finding out what motives motivate teachers to use cloud technologies in the educational process (table 1 and figure 4), it was found that more than 50% of respondents in both cases chose the need to be able to use different cloud technologies (at the end of the experiment respondents who chose this type of motive increased by 4.2%), the need for self-study using various cloud technologies at the beginning of the experiment was chosen by 25.54% of respondents, at the end – 22.10%. Regarding the other two motives – there was an interesting dynamic: the need to be acquainted with cloud technologies before the experiment chose 10.2%, after – 5.81%, when choosing the need to study the main types of cloud technologies – the situation was the opposite – at the beginning of the experiment 6.12%, at the end – 11.63%. Accordingly, at the beginning of the experiment 2.04% and at the end of 1.16% of respondents did not see the need to use cloud technologies in the educational process in general.

In general, according to the results of the survey, after the courses, the motivation of teachers to use cloud technology in the educational process has increased.

Determining which of the proposed motives motivate teachers to self-study using cloud services, it was found that 76.54% (before the experiment) and 69.88% (after the experiment) of respondents chose the need for self-improvement and self-development in future professions; the need to understand the significance of the acquired skills before the experiment was chosen by 12.24% and after – 16.87%; the need to understand the significance of the acquired knowledge was chosen by 10.2% and 7.23%, respectively (table 2 and figure 5).

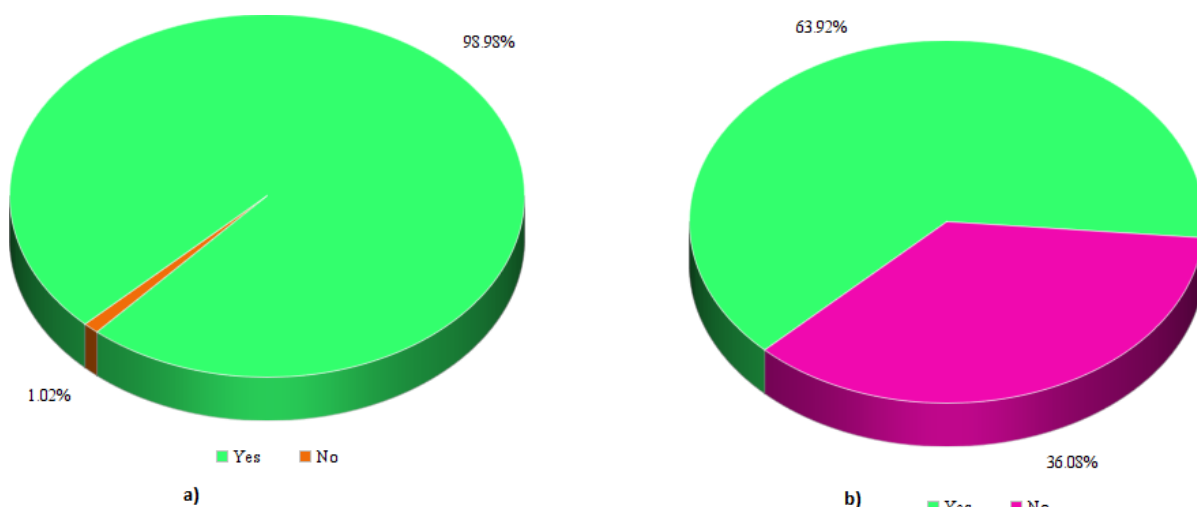


Figure 1: Survey results to the question “If you have a computer at home, is it connected to the Internet?”, “Can you find the information you need on the Internet?”, and “Are you able to choose and use software to optimally present the different types of materials needed for the learning process?”.

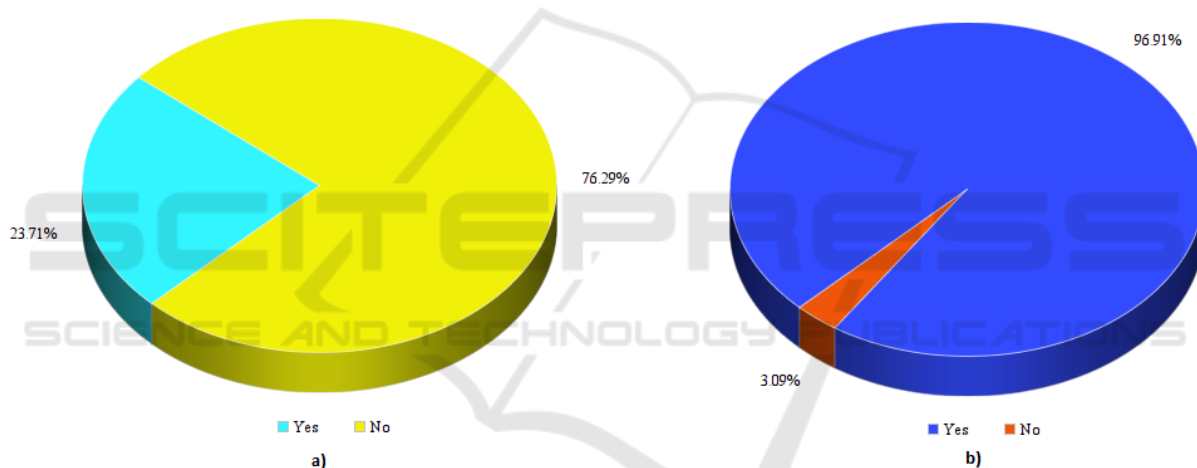


Figure 2: Survey results to the question “Are you have their website or blog?” and “Are you have a website for your school?”.

Table 1: Respondents’ answers to the question “Which of the following motives motivate you to use cloud technologies in the educational process?”

	At the beginning of the experiment	At the end of the experiment
The need to be able to use different cloud technologies	55.10%	59.30%
The need for self-study using various cloud technologies	26.54%	22.10%
The need to get acquainted with cloud technologies	10.20%	5.81%
The need to study the main types of cloud technologies	6.12%	11.63%
I do not see the need to use cloud technologies in the educational process	2.04%	1.16%

The need to be a leader was not a priority, and some respondents did not see the need for self-study at all.

Regarding the level of teachers’ knowledge of cloud technologies, at the beginning of the experiment, 51.02% of respondents only knew what cloud technologies were (while after the experiment the

share of respondents was 9.64%), at the end of the experiment 53.01% of respondents already knew basic cloud services that can be used in the educational process (at the beginning of the experiment, this percentage was 24.49%). It should be noted that 17.35% did not hear about cloud technologies at the beginning of the experiment, while this figure decreased to

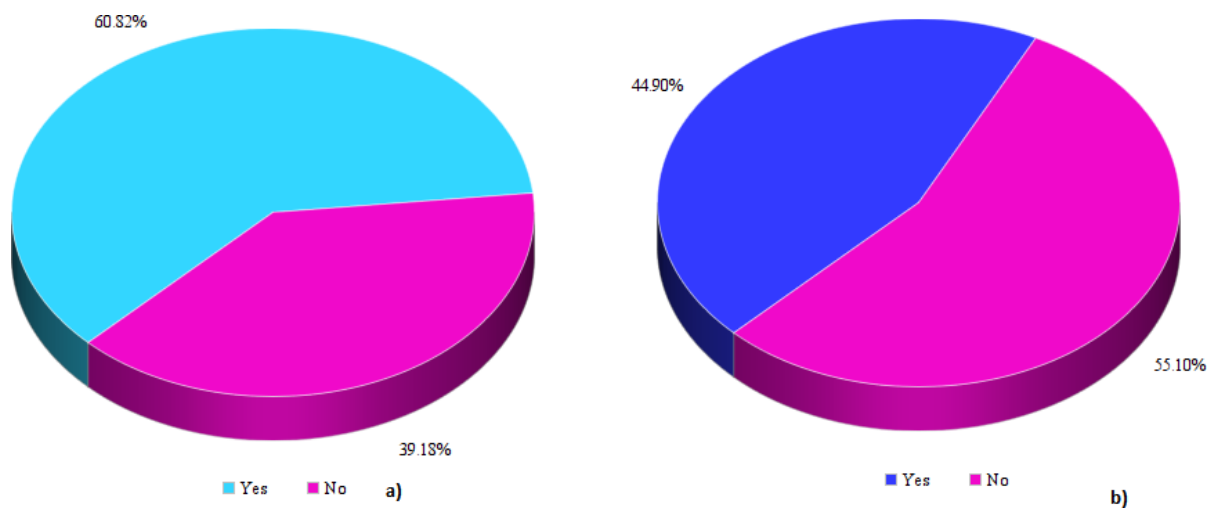


Figure 3: Survey results to the question “What is cloud technologies and services?” and “Do you used cloud technologies in teaching your subject?”.

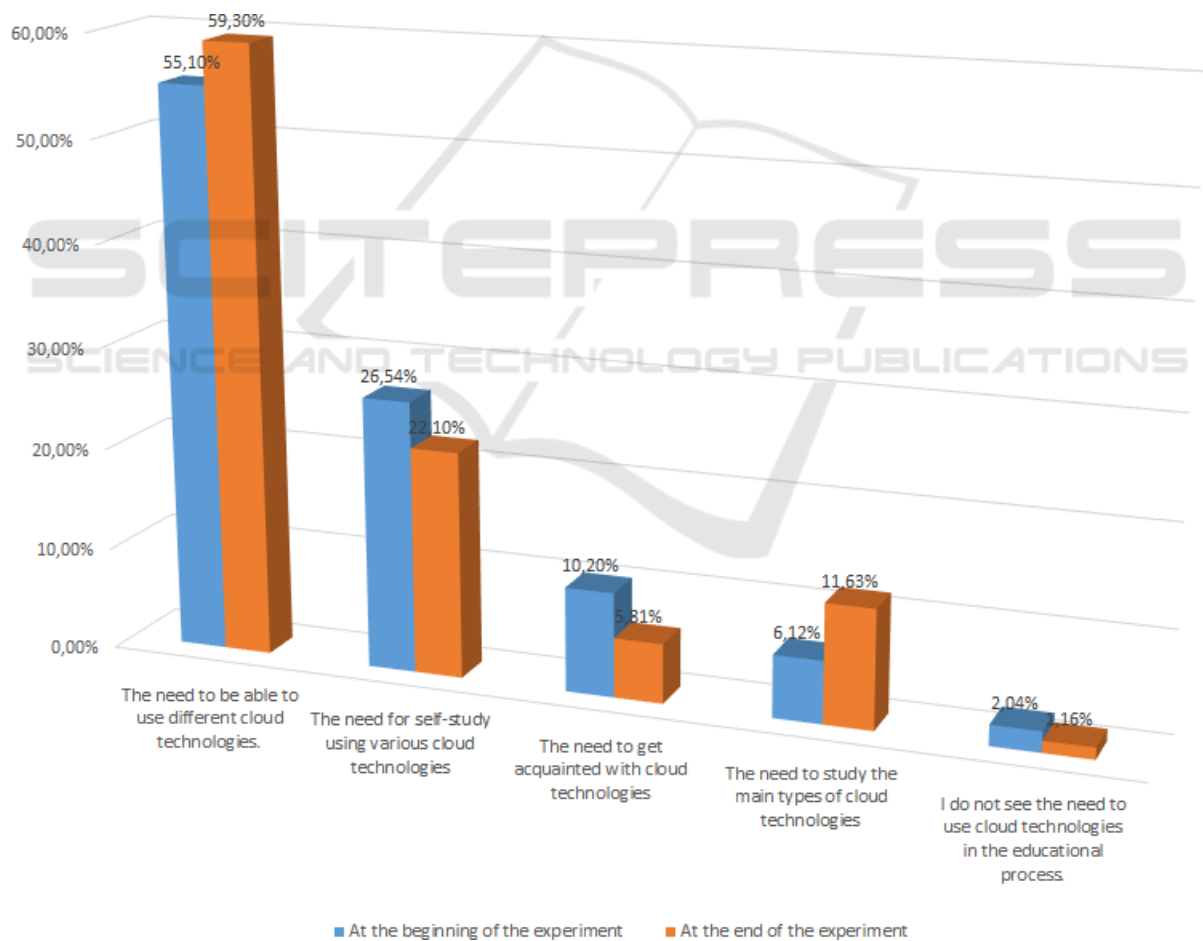


Figure 4: Respondents’ answers to the question “Which of the following motives motivate you to use cloud technologies in the educational process?”

2.41% at the end of the experiment (table 3 and figure 6).

Regarding the level of teachers’ mastery of the ability to use cloud technologies, the following was

Table 2: Respondents' answers to the question "Which of the following motives motivate you to self-study using cloud services?"

	At the beginning of the experiment	At the end of the experiment
The need for self-improvement and self-development in future professions	76.54%	69.88%
The need to understand the significance of the acquired knowledge	10.20%	7.23%
The need to understand the significance of the acquired skills	12.24%	16.87%
The need to be a leader	1.02%	3.61%
I do not see the need for self-study at all	0.00%	2.41%

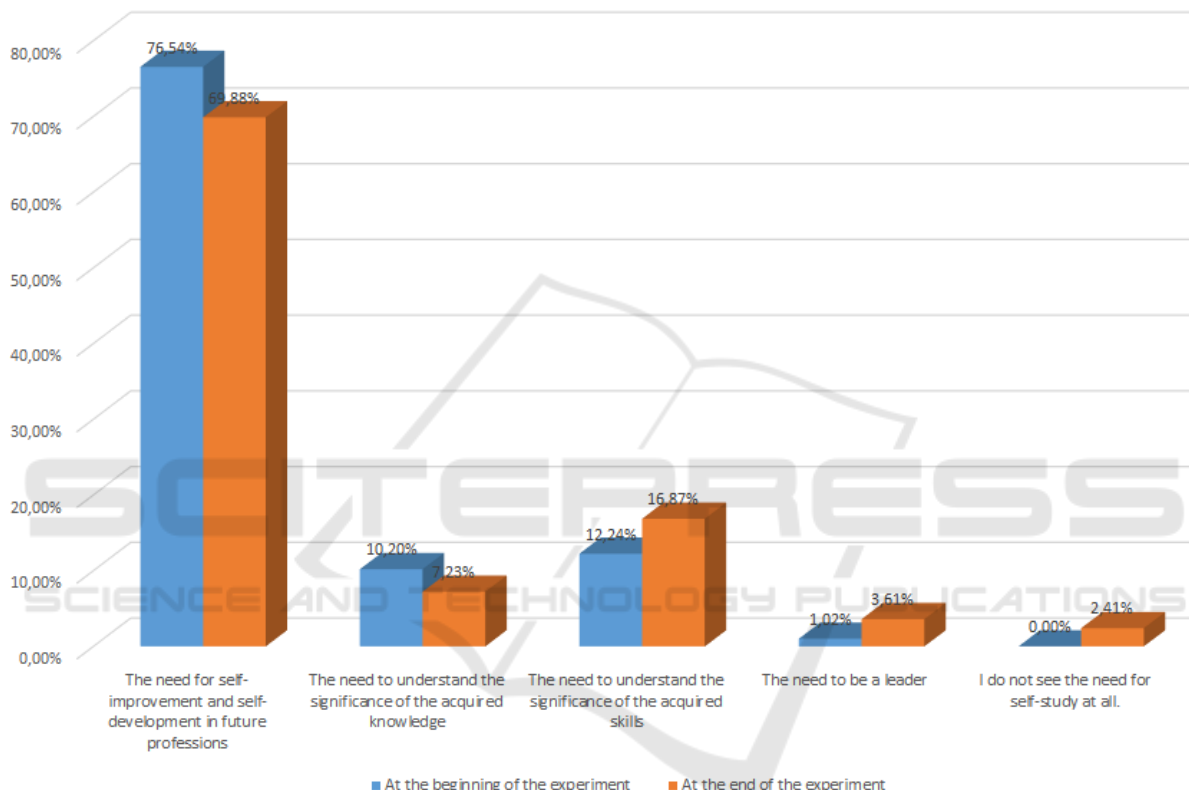


Figure 5: Respondents' answers to the question "Which of the following motives motivate you to self-study using cloud services?"

Table 3: Respondents' answers to the question "What is the level of your mastery of cloud technology knowledge?"

	At the beginning of the experiment	At the end of the experiment
I haven't heard of cloud technology at all	17.35%	2.41%
I know what cloud technology is	51.02%	9.64%
I know the difference between cloud computing, cloud technology, and services	4.08%	7.23%
I know the basic cloud services that can be used in the educational process	24.49%	53.01%
I know the peculiarities of using different cloud services, and ways to choose the best cloud service	3.06%	27.71%

found: 53.01% of teachers after the courses (compared to 14.29% before the courses) can work with cloud technologies, while at the beginning of the

course 48.98% only knew what cloud technology was; from 5.1% to 19.28% increased the number of teachers who can use cloud technology for self-study.

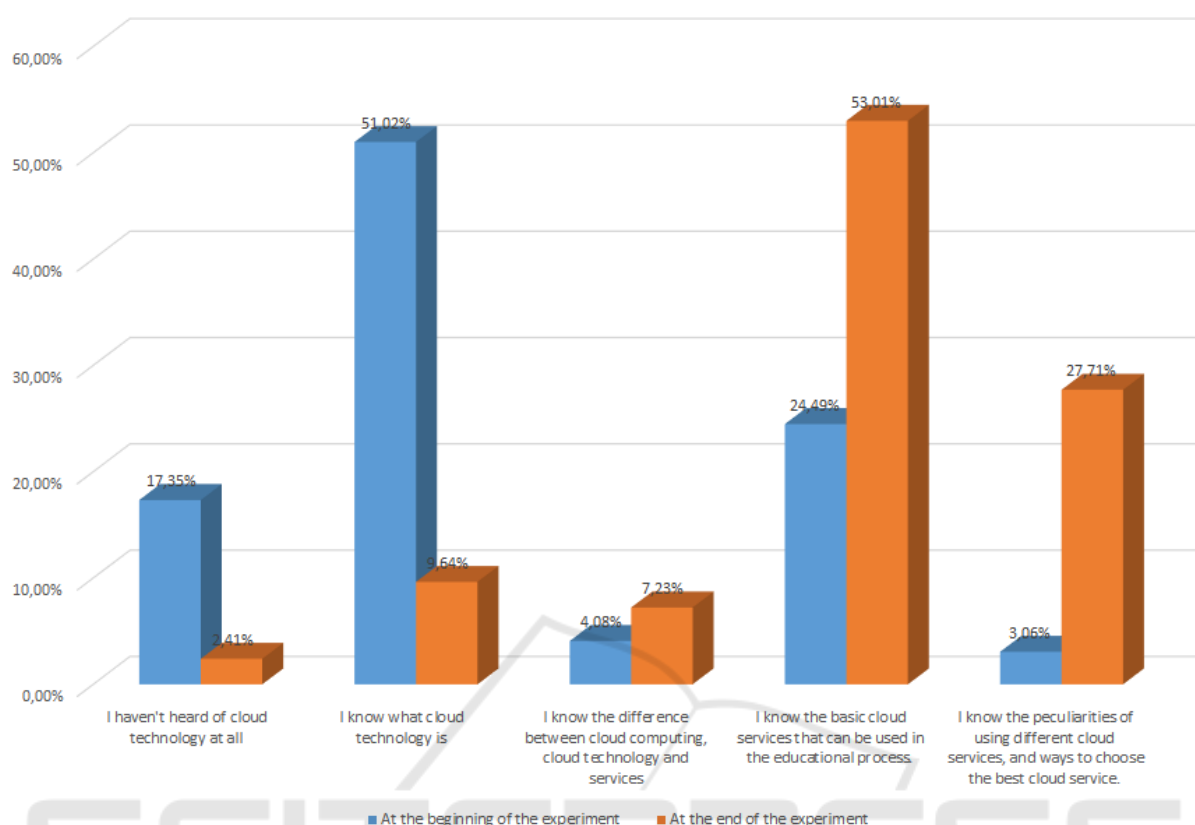


Figure 6: Respondents' answers to the question "What is the level of your mastery of cloud technology knowledge?"

It is worth noting that the percentage of those teachers who do not know what cloud technologies are and what they are used for has decreased from 20.41% (before the courses) to 2.41% (after the courses).

A detailed presentation of the level of teachers' mastery of the skills to use cloud technologies is presented in the table 4 and figure 7).

Since in the course of the courses attention was paid to certain types of cloud tools, it was important to ask how many teachers have learned to use different tools in the learning process. In particular, the level of teachers' mastery of the ability to use cloud-based mind maps in the educational process can be described as follows. They did not know at all what mind maps were and what they were used for – 51.02% at the beginning of the experiment, and this percentage dropped to 1.2% after the experiment; 41.84% of respondents knew what mind maps were before the courses, and there were isolated cases of knowledge of different cloud-based mind maps, skills to work with cloud-based mind maps and the ability to use cloud-based mind maps for self-study. After the experiment, the number of those who knew different cloud-based mind maps increased from 2.04% to 12.05%, as well as those who knew how to work with

cloud-based mind maps – from 3.06% to 48.19%. The percentage of those who were able to use cloud-based mind maps for self-study increased from 2.04% to 19.28%. A detailed presentation of the level of teachers' mastery of the ability to use cloud-based mind maps is presented in the table 5 and figure 8).

Working on a joint project plays an important role in distance learning, as well as in blended learning. Therefore, establishing the level of mastery of teachers' ability to work on a joint project in the use of cloud technologies was also important. As a result, it was found that 42.86% of teachers (at the beginning of the experiment) did not know what a joint project was and how to work on it in the conditions of using cloud technologies, and after that, the percentage significantly decreased to 1.20%. Among teachers, 42.86% also knew what a joint project was before the courses.

The percentage of those who knew different cloud services to work on a joint project, knew how to choose different cloud services to work on a joint project, and knew how to use different cloud services to work on a joint project, even in self-study, was too small at the beginning of the experiment (9.18%, 3.06%, 2.04%, respectively). At the same time, after

Table 4: Respondents' answers to the question "What is the level of mastery of your skills to use cloud technologies?"

	At the beginning of the experiment	At the end of the experiment
I do not know what cloud technology is and what it is used for	20.41%	2.41%
I know what cloud technology is	48.98%	10.84%
I know different cloud technologies	11.22%	14.46%
I can work with cloud technologies	14.29%	53.01%
I can use cloud technologies for self-study	5.10%	19.28%

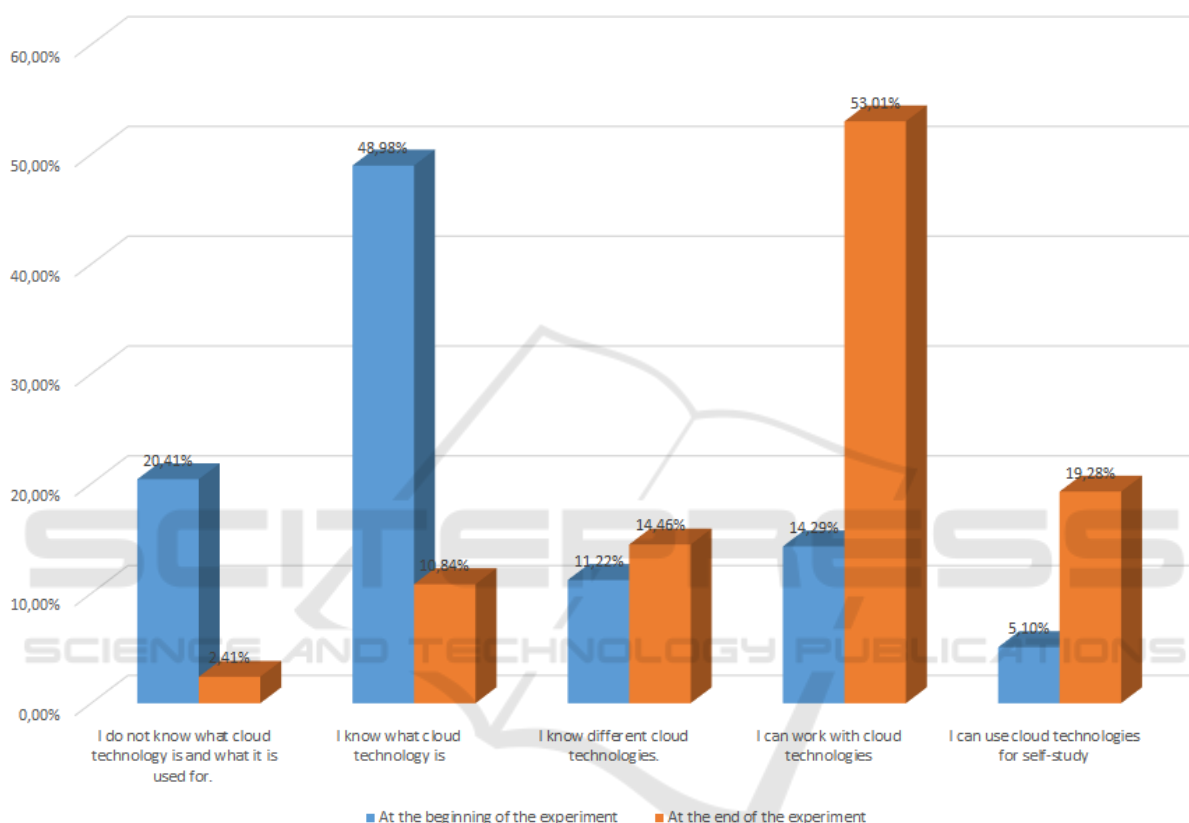


Figure 7: Respondents' answers to the question "What is the level of mastery of your skills to use cloud technologies?"

Table 5: Respondents' answers to the question "What is the level of mastery of your skills to use cloud-based mind maps in the educational process?"

	At the beginning of the experiment	At the end of the experiment
I do not know at all what mind maps are and what they are used for	51.02%	1.20%
I know what mind maps are	41.84%	19.28%
I know different cloud-oriented mind maps	2.04%	12.05%
I can work with cloud-based mind maps	3.06%	48.19%
I can use cloud-based mind maps for self-study	2.04%	19.28%

the courses, these indicators increased significantly – 14.46%, 37.35%, and 30.12%, respectively.

A detailed presentation of the level of mastering the skills of teachers to work on a joint project in the use of cloud technologies is presented in the table 6 and figure 9).

The next indicator that was evaluated was the level of teachers' mastery of the skills of using cloud-based learning management tools. Again, before the courses, 44.9% did not know what cloud-based learning management tools were and what they were used for, while after the experiment, this percentage

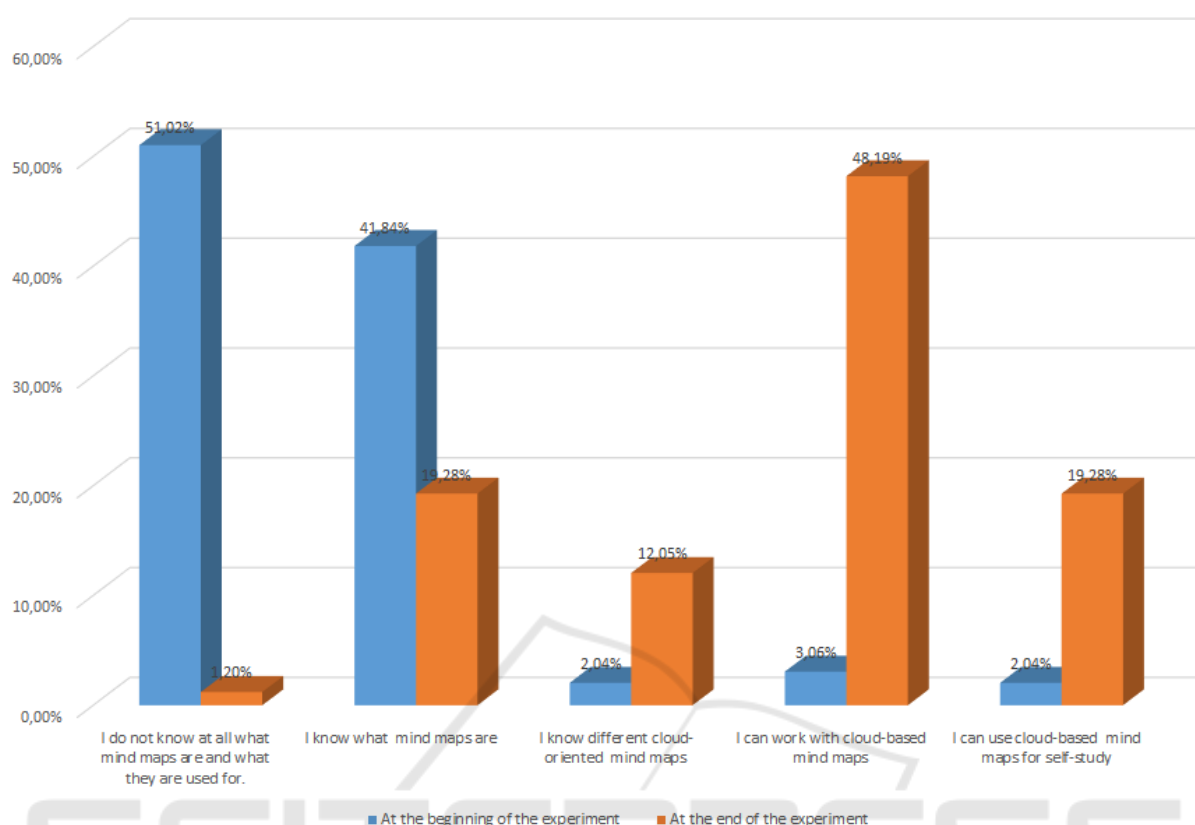


Figure 8: Respondents' answers to the question "What is the level of mastery of your skills to use cloud-based mind maps in the educational process?"

Table 6: Respondents' answers to the question "What is the level of mastering your skills to work on a joint project in the use of cloud technologies?"

	At the beginning of the experiment	At the end of the experiment
I do not know at all what a joint project is and how to work on it in the conditions of using cloud technologies	42.86%	1.20%
I know what a joint project is	42.86%	16.87%
I know different cloud services to work on a joint project	9.18%	14.46%
I can choose different cloud services to work on a joint project	3.06%	37.35%
I can use various cloud services to work on a joint project, even with self-study	2.04%	30.12%

dropped to 2.41%. At the beginning of the experiment, 32.65% of teachers knew what cloud-based learning management tools were, and there were few cases when teachers knew different cloud-based learning management tools (15.31%), we're able to work with cloud-based learning management tools (7.14%). At the same time, no teacher was able to use cloud-based learning management tools for self-study before the experiment. After the courses, 46.99% of teachers knew different cloud-based learning management tools, 19.28% were able to use cloud-based learning management tools for self-study.

A detailed presentation of the level of mastering by teachers of the skills of using cloud-based learning management tools is presented in the table 7 and figure 10).

The level of teachers' mastery of the skills of using cloud-based means of presenting educational materials after the courses have significantly increased (table 8 and figure 11).

Also, the level of mastering by teachers of skills of using cloud-oriented means of communication has significantly increased, which is presented in the table 9 and figure 12).

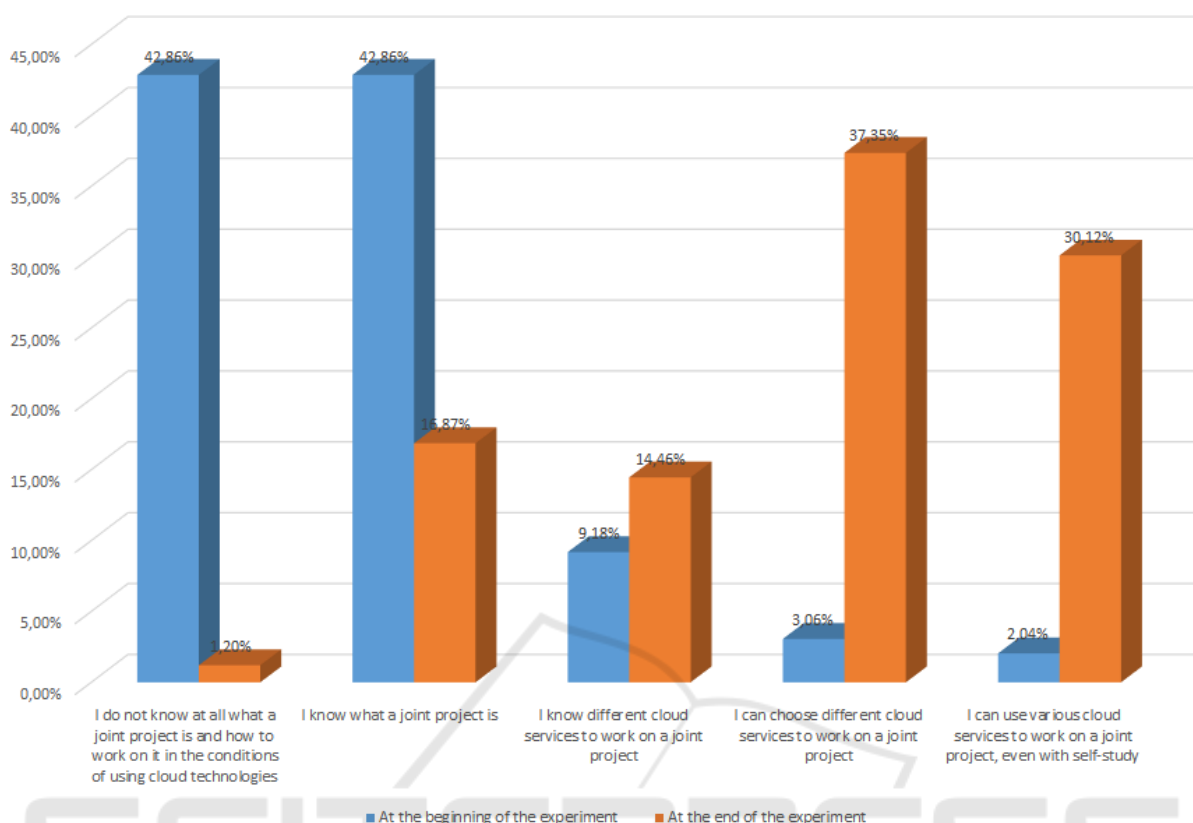


Figure 9: Respondents' answers to the question "What is the level of mastering your skills to work on a joint project in the use of cloud technologies?"

Table 7: Respondents' answers to the question "What is your level of mastery of the skills of using cloud-based learning management tools?"

	At the beginning of the experiment	At the end of the experiment
I do not know at all what cloud-based learning management tools are and what they are used for	44.90%	2.41%
I know what cloud-based learning management tools are	32.65%	20.48%
I know various cloud-based learning management tools (electronic journal, calendar, placed in the cloud)	15.31%	10.84%
I can work with cloud-based learning management tools	7.14%	46.99%
I can use cloud-based learning management tools for self-study	0.00%	19.28%

Table 8: Respondents' answers to the question "What is your level of mastery of the skills of using cloud-based teaching materials?"

	At the beginning of the experiment	At the end of the experiment
I don't even know what cloud-based learning materials are	39.80%	1.20%
I know what cloud-based teaching materials are	30.61%	12.05%
I know various cloud-oriented tools for presenting educational materials (electronic library, presentations, video files, electronic textbooks placed in the cloud, cloud data warehouses)	21.43%	25.30%
I can work with cloud-oriented tools of presenting educational materials	7.14%	38.55%
I can use cloud-based tools for presenting educational materials for self-study	1.02%	22.89%

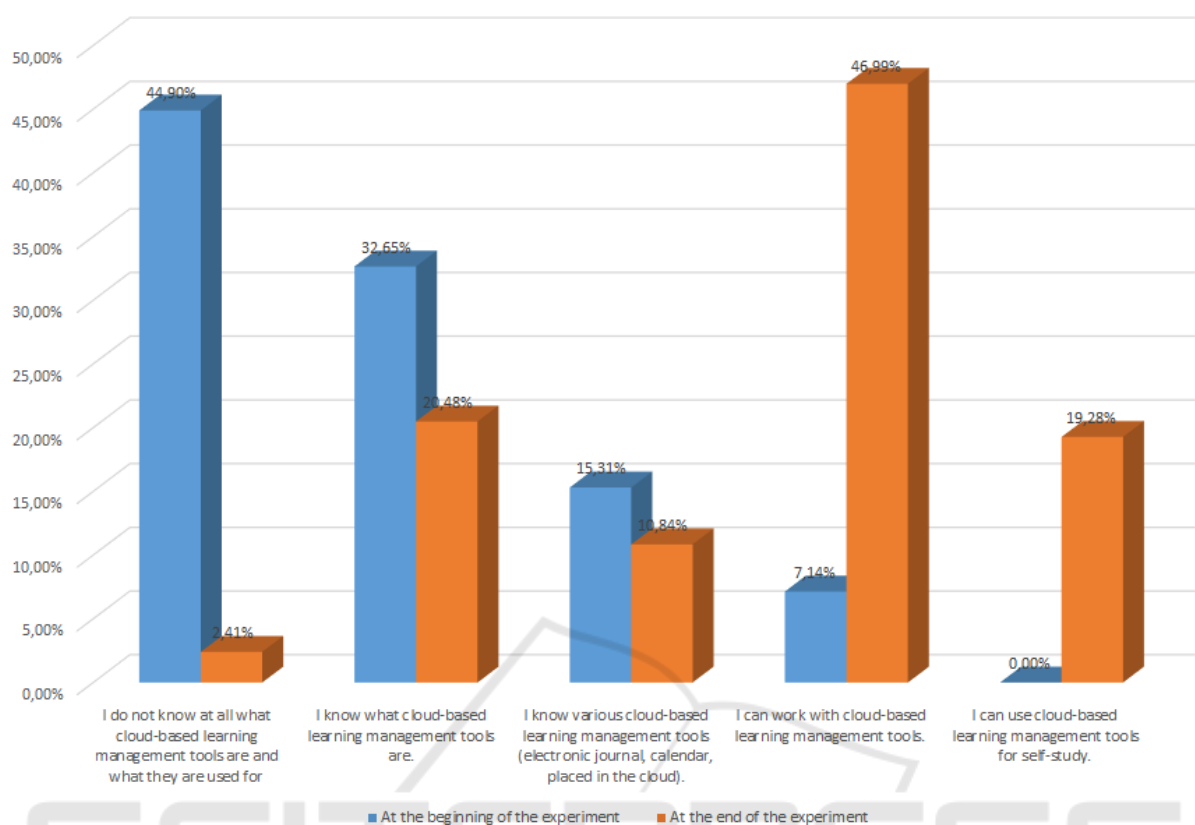


Figure 10: Respondents' answers to the question "What is your level of mastery of the skills of using cloud-based learning management tools?"

Table 9: Respondents' answers to the question "What is your level of mastery of cloud-based communication skills?"

	At the beginning of the experiment	At the end of the experiment
I don't even know what cloud-based communication is	37.76%	0.00%
I know what cloud-based tools of communication are	34.69%	12.05%
I know various cloud-based tools of communication (discussion, chat, on-line consultations, webinars)	18.37%	21.69%
I can work with cloud-based tools of communication	7.14%	42.17%
I can use cloud-based communication tools for self-study	2.04%	24.10%

After face-to-face courses, teachers in Zhytomyr schools have significantly increased their competence in the use of cloud technologies in the educational process in the context of the COVID-19 pandemic. It is worth noting that not only their level, in general, has increased, but also the horizons regarding the variety of cloud services that should be used in distance learning have expanded. Course training, organized according to scientifically sound methods, helps to increase the motivation of students (teachers) to self-study, as well as to the future use of cloud technologies in the educational process.

Finally, it should be noted that the advantages of full-time education include: clarity, accessibility, comprehensibility, and the advantages of distance

learning include: mass, no need for classrooms, no need to transfer university teachers, and school teachers' classes.

The continuation of the COVID-19 pandemic and the beginning of Russian aggression in Ukraine prompted the authors of the article to determine how useful the competencies acquired by teachers were and whether they improved them over the past 1.5 years.

Accordingly, a questionnaire was prepared and sent to all participants who were involved in the described courses, which included the following questions:

1. How useful were the competencies you received?

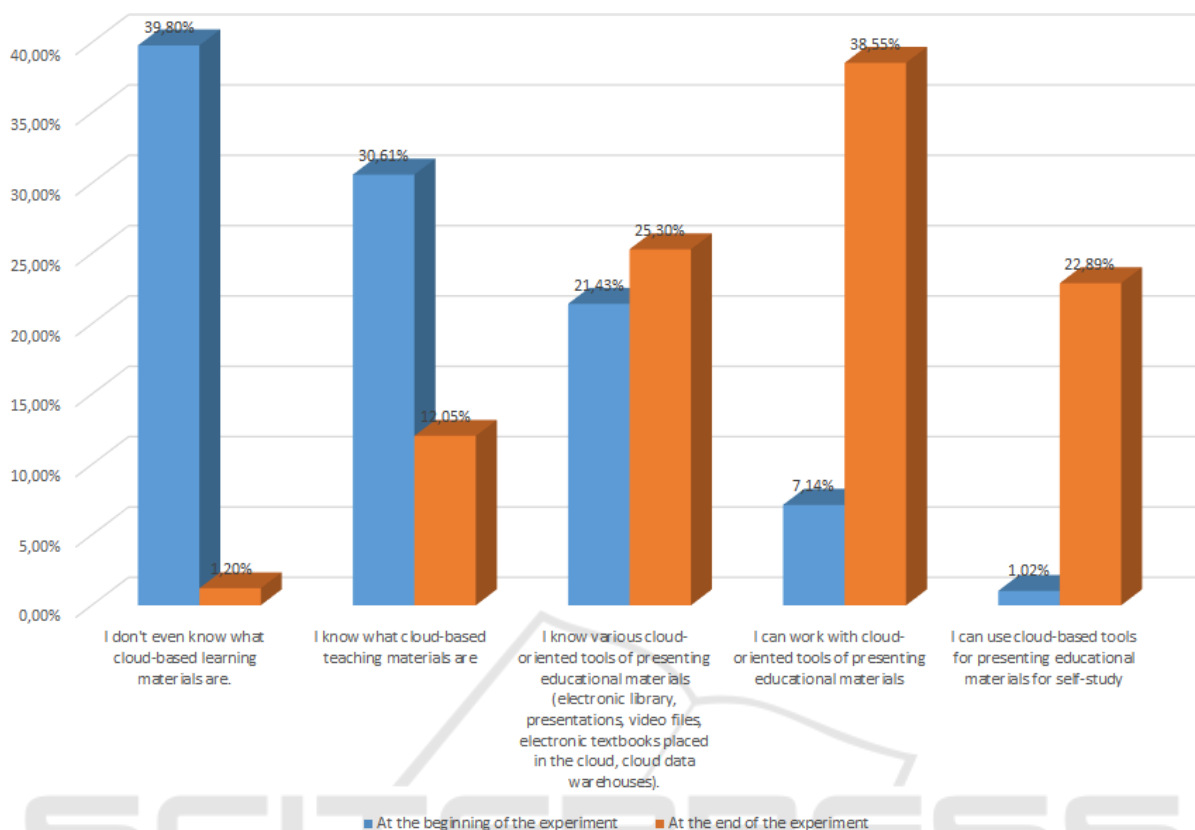


Figure 11: Respondents' answers to the question "What is your level of mastery of the skills of using cloud-based teaching materials?"

2. Do you use acquired competencies in your professional activities during the period of Russian aggression?
3. What cloud services are you currently using?
4. Did you improve your level of ICT competence in the period September 2020-May 2022?
5. If the answer to the previous question is yes, how?
6. What purpose of massive open online courses did you use to develop your competence?
7. Which ICTs that you have become familiar with during this period do you use in your activities?
8. Which ICTs that you have become familiar with during this period would you recommend to other teachers?
9. What other services would you like to get acquainted with in the future for effective professional work?

As a result, the survey involved 90 school teachers in the city of Zhytomyr, previously involved in the courses (which is 92%). For certain reasons, not all teachers could complete the proposed survey (the lack of the ability to view any information via the Internet,

the absence of the Internet itself, lack of any technical means (laptop, tablet, personal computer), etc.).

When answering the first question, 100% of respondents indicated that the acquired competencies were useful to them, of which 77% indicated a high level of usefulness, and 23% – medium.

All the respondents unanimously approved that acquired competencies in professional activities were used during the period of Russian aggression. Also, in additional comments, teachers noted that among their acquaintances there are many teachers who want to take such courses because at one time they had no desire or motivation.

When asked what services you currently use, 80% chose all the services they learned during the courses, 15% chose most services (except for one, each had their own), and 5% of respondents chose only services. Google Classroom and Google Meet. This indicates that the services we have chosen for training have not lost their relevance over time.

The next question was about the development of teachers in the period 2020-2022. Namely, the question was whether teachers improved their level of ICT competence in the period September 2020-May 2022.

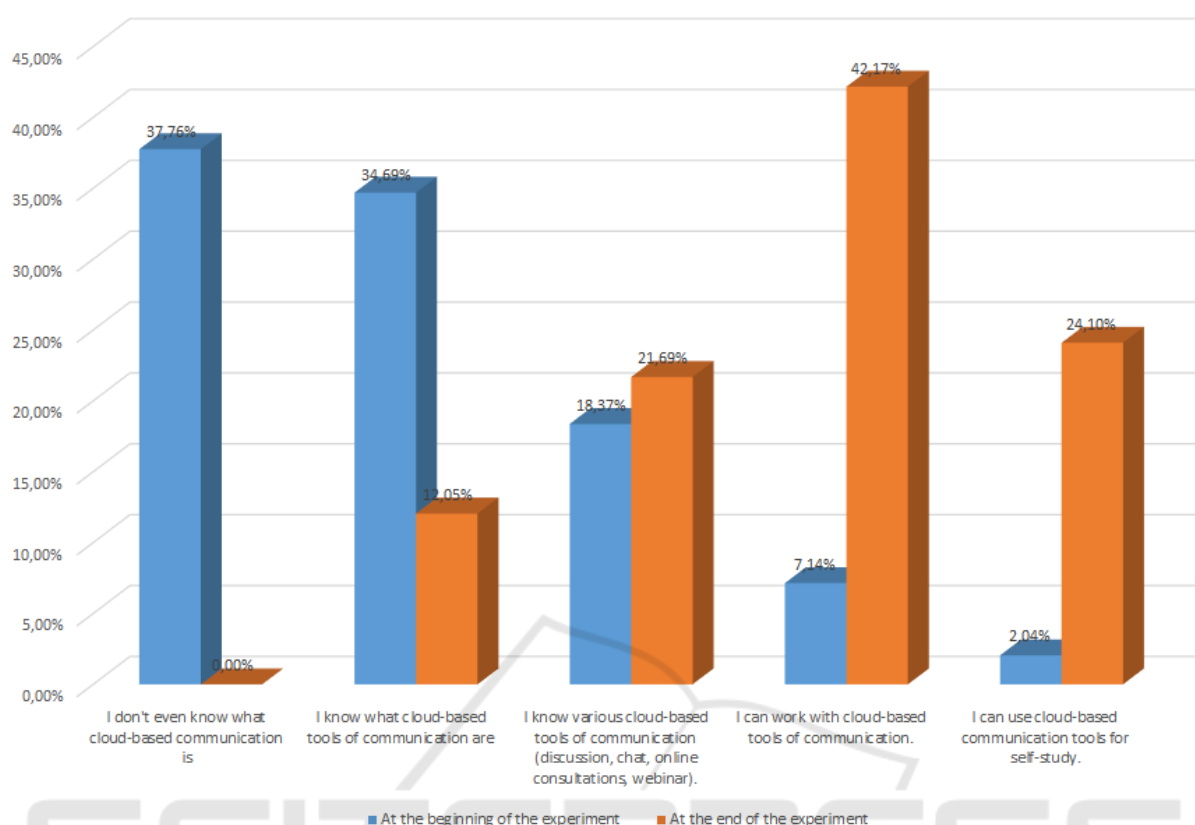


Figure 12: Respondents' answers to the question "What is your level of mastery of cloud-based communication skills?"

At the same time, 70% of teachers answered yes to this question. At the same time, the majority of these 70% (89%) chose self-study as a means for their own professional development, 63% chose advanced training courses, and 71% indicated massive open online courses.

When determining which massive open online courses teachers preferred, it was found that 67% of those who chose massive open online courses went through MOOC related to the use of various ICTs in the educational process, 44% chose massive open online courses to improve their foreign language proficiency, and 22% chose massive open online courses to improve their knowledge native language.

It is worth noting here that the Prometheus platform turned out to be the most common for passing massive open online courses, since the platform itself is Ukrainian-language, and most of the courses on this platform are Ukrainian-language. In particular, teachers noted that on this platform, most of the respondents were interested in the Science of Education course: "What the leader of an educational startup should know" (<https://courses.prometheus.org.ua/courses/course-v1:PCSC+SL101+2019.T3/about>). This course is designed for 30 hours, which can

be completed in 3 weeks. The teachers were most interested in the fact that among the questions to study there are such as: for whom digital education is needed, what is the essence of the educational project, digital security and privacy during online learning, psychological support for online project participants, etc. As a result of taking this course, teachers noted that they improved: their own knowledge of modern trends in the development of education; features of the processes of teaching and learning of schoolchildren; the specifics of digital education and understanding of what it is intended for, improved their own skills (creativity, initiative, critical thinking, etc.), improved the ability to work with digital educational online tools and improved the method of teaching their subject, taking into account the psychological characteristics of all participants in the educational process.

Mathematics teachers also singled out such a service as: Learning with passion (<https://novatika.org/uk/>). This service includes a range of simulators for learning mathematics from grades 1 to 8. The specificity of this service is that the simulators are divided not only by classes, but also by sections and topics.

All teachers, not only in mathematics, answered

that they often use ready-made online tests in their own subjects in their practice. There are a lot of such tests on the Internet now, so there is a choice. The only thing that the teachers emphasized was that each time before using any tests, they should be reviewed by themselves and checked for relevance to the topics being studied. The use of such tests ensures the interest and stimulation of students and promotes the development of creativity, initiative, creativity, independence, and other qualities necessary in the educational process.

All teachers surveyed unequivocally answered that they recommend all the services they have read to their colleagues.

The last question was creative and included the establishment of what services teachers would like to get acquainted with in the future for effective professional work. As a result, the following was established.

Biology teachers noted that in their educational activities it is advisable to use augmented reality applications to familiarize students with individual topics for study (human anatomy, animal structure, etc.), as well as various game services to interest and motivate students.

Geography teachers noted that they would also use augmented reality applications in their activities to familiarize students with the features of different types of terrain, different countries, modeling processes, and phenomena.

Computer science teachers noted that in their activities there are many online tools for use in the educational process (online compilers, automated systems for checking solutions to programming problems, massive open online courses, diagramming tools, etc.), but they became more familiar with gaming programs for learning languages and simulators for studying the structure of a computer.

Chemistry teachers noted that there are few different tools in their educational activities, and they would prefer any specialized tools to improve their own teaching methods.

English teachers noted that it would be advisable to get acquainted with additional services for learning English (by the level of knowledge, by grades, by topic), including game services for primary schools since learning English in most schools in Ukraine starts from 1 class.

Physical education teachers noted that there are no services at all for teaching their subject, except for watching various videos on the YouTube channel. For them, this issue is quite relevant and requires a separate study.

All teachers agreed that online learning lacks a

quality service that would replace a regular blackboard at school. Although there are a large number of online boards on the Internet, however, ordinary teachers are not fully functional enough to be used in the educational process.

Also, all teachers unambiguously agreed that everything they studied in the previous courses is useful to the present. Since now the use of cloud services for distance learning has become an even more urgent problem.

4 DISCUSSION

Here it should be noted that the reason for the self-development of teachers is of their own free will, namely the situations that have developed in the world in general and in Ukraine in particular. The global pandemic caused by the COVID-19 virus was only the beginning of this. The full-scale offensive of the Russian troops was a second impetus for even greater awareness of the need to master the skills of using various information and communication technologies when teaching their subject. After all, in such periods it is necessary not only to teach your subject in a quality manner but to use various information and communication technologies to motivate and interest students, as well as to take into account the psychological characteristics of all participants in the educational process in such a difficult time.

In addition, not the possibility of learning in the classroom simply requires the teacher to master all the means of information and communication technologies, including cloud services, to improve and conduct classes in general. In this regard, those positions are advantageous when teachers have mastered some means of teaching either on their own or with the help of certain courses. And it is cloud services that are a means of providing distance learning in the conditions that have arisen before Ukraine.

As for the teachers who chose massive open online courses to improve their native language skills, this, in our opinion, is connected with the beginning of Russian aggression against Ukraine. After all, part of the population of Ukraine spoke Russian, and for them, the transition to their native language became important only after the start of a full-scale invasion.

The massive open online courses for the study of foreign languages is also connected precisely with the need to consider the possibility of moving to another country after the start of a full-scale invasion of Russian troops into the territory of Ukraine.

It should be noted that in additional comments to the survey, some teachers indicated that during the

war they lost the opportunity to use technical means in connection with a forced quick move to another area (village, another region, another country). Some of the respondents indicated that some teachers lost their technical equipment, which was in the occupied territories. As a result, we have that not all teachers can perform their functional duties in such conditions. Here we can only state that during the development of our state in the post-war period, the Ministry of Education and Science of Ukraine should provide the possibility of purchasing technical equipment for teachers who suffered as a result of a full-scale war.

5 CONCLUSIONS

The two-year pandemic and the start of a full-scale war between Russia and Ukraine contributed to the fact that teachers of secondary schools began to actively engage in self-education and self-development. If earlier (at the beginning of the pandemic) it was difficult for teachers to switch to online learning, then with the outbreak of war, teachers were already ready to use various online tools in their practice.

As the study showed, all the interviewed teachers continued their self-education in different ways, studied a large number of services that can be used in the educational process, and provided the authors with ideas for further expanding the courses according to their desires, which should be used in the educational process.

It should be noted that it is important that all the respondents unanimously approved that they use the acquired competencies in their professional activities during the period of Russian aggression. In addition, in additional comments, teachers noted that among their acquaintances there are many teachers who want to take such courses since at one time they had no desire or motivation.

It is also important that all teachers expressed their desire to study in the future with a division into subjects of study. Therefore, here it should just be emphasized that it is important for teachers to study certain methods of using various information and communication technologies in the educational process.

In the future, we plan to develop a continuation of the courses, the specifics of which will be the distribution into separate groups according to the subjects of teaching for a more detailed study of the methods of using various specific services within the framework of the study of individual disciplines (physics, mathematics, chemistry, biology, geography, foreign language, computer science, etc.). Also, in further research, we see the use of other practice-oriented meth-

ods to determine the level of formation of teachers' competence.

Also, since this was not the object of this study, in the future we see the prospects for studying teachers' digital competence levels depending on their age.

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