

# The use of digital technology in general secondary education in Ukraine: current state and future prospects

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## Abstract

The use of digital technology in education is one of the most important trends in the educational process today. This article presents the results of the analysis of the current state of implementation of information and communication technologies (ICT) in the educational process of institutions of general secondary education in Ukraine. A survey was conducted among first-year students of the Zhytomyr Polytechnic State University of 2019 and 2020 years of admission. The survey consisted of 17 questions related to the use of ICT in the educational process. The results of the survey showed that the use of digital technology in education has increased in recent years. The authors propose the introduction of the discipline “Educational technologies and digital education” into the training of future information technology specialists, as well as the certification educational program “Information systems and cloud technologies in the educational process”, designed for general education teachers, educators for higher education institutions, experts in the field of additional educational services, and other professionals. The course “Application Packages” for specialties 121 “Software Engineering”, 122 “Computer Science”, 123 “Computer Engineering”, 125 “Cybersecurity”, and 126 “Information Systems and Technologies” at the Zhytomyr Polytechnic State University has been expanded to include the study of some cloud services that can serve as an alternative to the usual MS Office. The authors conclude that the positive dynamics in the use of various ICT tools in education is present. This means that teachers are increasingly turning to such tools when teaching their subjects.

## Keywords

digital technology, education, general secondary education, Ukraine, ICT, survey, educational technologies, digital education, cloud services, positive dynamics

## 1. Introduction

The Law of Ukraine “On Education” mandates the formation of information and communication competence in students [1]. The European Union recognizes digital competence as one of the

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key competencies [2]. As a result, the state program on digital literacy targets elementary schools, secondary schools, vocational schools, and higher education institutions (HEI) [3].

Digital technology is one of the most important trends in the educational process worldwide. It allows for a more qualitative and interesting learning experience by introducing different methods of working in the classroom such as project method, research and development work, educational games, etc. [4, 5, 6, 7].

The COVID-19 pandemic has disrupted the educational process around the world and emphasized the importance of ICT in education [8, 9].

The issues of computerization and informatization of the educational process are widely considered in the works of Vakaliuk et al. [10], Rashevskaya et al. [11], Kolomoiets and Kassim [12], Popel et al. [13], Zinonos et al. [14], Osadcha et al. [15], Lavrentieva et al. [16], Burov et al. [17], Kiv et al. [18], Syvyi et al. [19], Morkun et al. [20], Nechypurenko et al. [21].

Foreign scientists have also considered the issue of introducing various ICT in the educational process of educational institutions. For example:

- Shakeabubakor et al. [22] considered cloud computing services and applications to improve the productivity of university researchers.
- Almerich et al. [23] analyzed teachers' information and communication technology competences.
- Bansal et al. [24], Biswas [25], Britto [26], Dineva and Nedeva [27], Ercan [28] considered the use of cloud computing in higher education.
- Dzikite et al. [29] investigated lecturers' competencies in ICT for effective implementation of ICT-integrated teaching and learning in textiles and clothing degree programs.
- Hanson-Baldauf and Hughes [30] revealed issues in the information and communication technology competencies of students enrolled in school library media certification programs.
- Kaplan and Haenlein [31] analyzed the problem of higher education and the digital revolution.

The *purpose* of this article is to establish the current state of implementation of ICT in the educational process of institutions of general secondary education in Ukraine.

## 2. Research methods

To determine the current state of implementation of various ICT in the educational process of institutions of general secondary education, a survey was conducted among first-year students of Zhytomyr Polytechnic State University. The survey was conducted in 2019 and 2020, with 167 and 214 respondents, respectively.

The survey consisted of 17 questions related to the use of information and communication technologies in the educational process [32]. The questions were as follows:

1. Do you know what application packages are?
2. Did you study application packages at school/college?
3. What kind of application packages have you studied/reviewed?

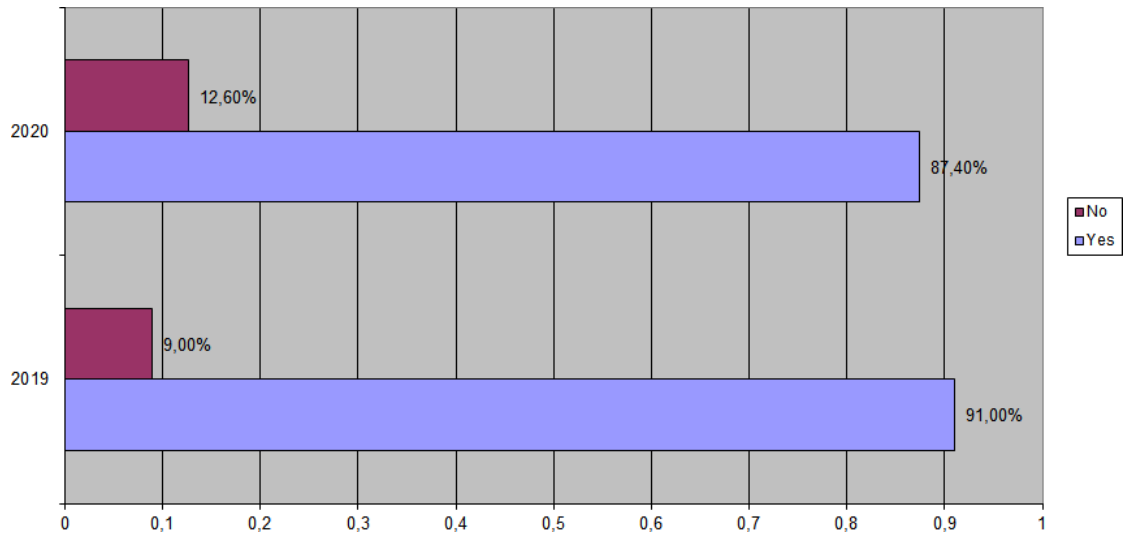
4. From which package did you study office application packages (text editors; spreadsheets; database management systems; demo tools)?
5. Do you know what “cloud services” is?
6. Which of the following programs and services is cloud-based?
7. Do you know what massive open online courses are?
8. Do you use these courses at school/college?
9. If the answer to the previous question is “Yes”, which one?
10. Have you used massive open online courses for self-study?
11. Did teachers use any other tools when studying programming in Computer Science?
12. If the answer to the previous question is “Yes”, what are the tools?
13. Did any information and communication technology tools (curricula, multimedia, simulators, games, virtual laboratories, etc.) be used in the school/college by non-CS teachers?
14. If the answer to the previous question is “Yes”, in what lessons did the teachers use such tools?
15. Which one did you enjoy the most and why (also indicate the item on which it was used)?
16. Was the teaching of this subject more interesting using a variety of tools than without using them?
17. What additional services would you like to consider and explore how to use them?

### 3. Results

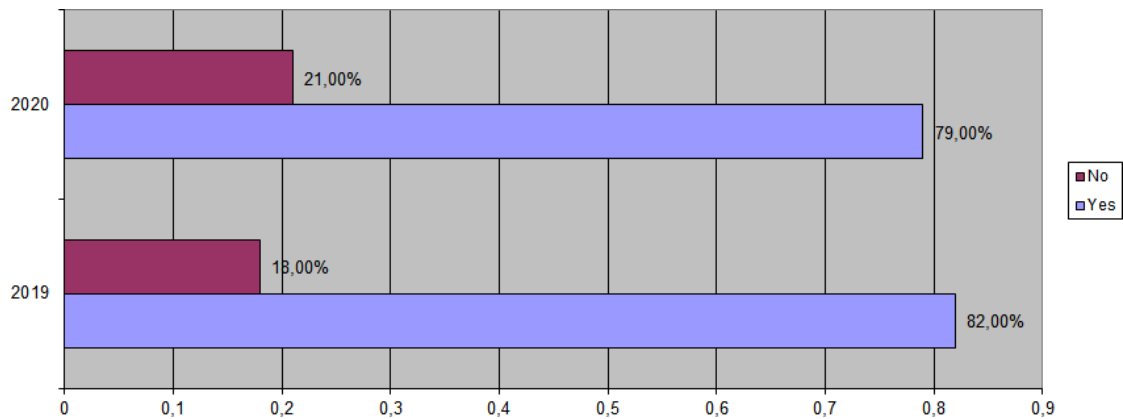
Let us analyze the answers to each question. First question “Do you know what application packages are?” the purpose was to establish whether the first-year students have basic concepts of the school course in Computer Science (CS). The results of the survey indicate that 91% of students have basic concepts, 9% do not in the 2019 year, and 2020 year – 87,4% of students have basic concepts, 12,6% do not (figure 1).

Regarding the second question, “Did you study application packages at school/college?”, in the 2019 year 18% said no and 82% said yes, and in the 2020 year 21% said no and 79% said yes (figure 2). This indicates that either the teacher did not adhere to the standard of general education, or the first-year students do not understand the basic concepts of CS.

The answer to what exactly served as this distribution of answers to the previous question is to analyze the answers to the following. In response to the question “What kind of application packages have you studied/reviewed?”, all 167 respondents in the 2019 year and in the 2020 year – all 214 chose least one of the suggested options, which means that as a student they studied everything they needed, they just did not have the necessary terminology. In this case, in the 2019 year, 88% of respondents noted that they studied text editors, 77,8% – spreadsheets, 65,3% – tools for creating demonstration material, 38,3% – database management systems, 32,3% – graphic editors, 22,2% – educational programs, 16,8% – multimedia systems and computer games (figure 3). And in the 2020 year, 93,9% of respondents noted that they studied text editors, 84,6% – spreadsheets, 74,3% – tools for creating demonstration material, 38,3% – database management systems, 51,4% – graphic editors, 23,4% – educational programs, 27,1% – multimedia systems and computer games (figure 3).



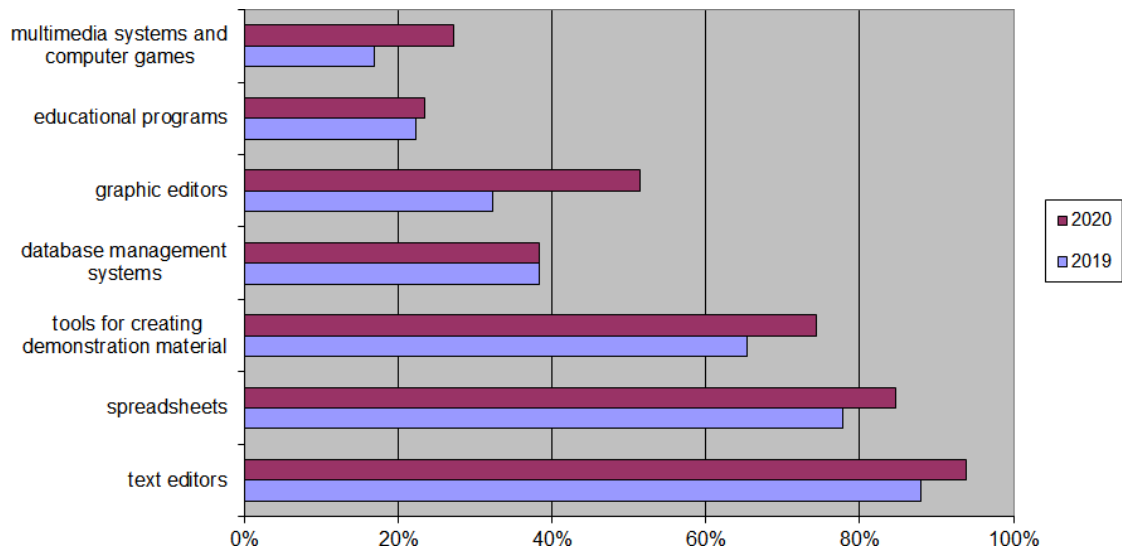
**Figure 1:** Percentage of answers to question # 1 “Do you know what application packages are?” (comparison of 2019 and 2020).



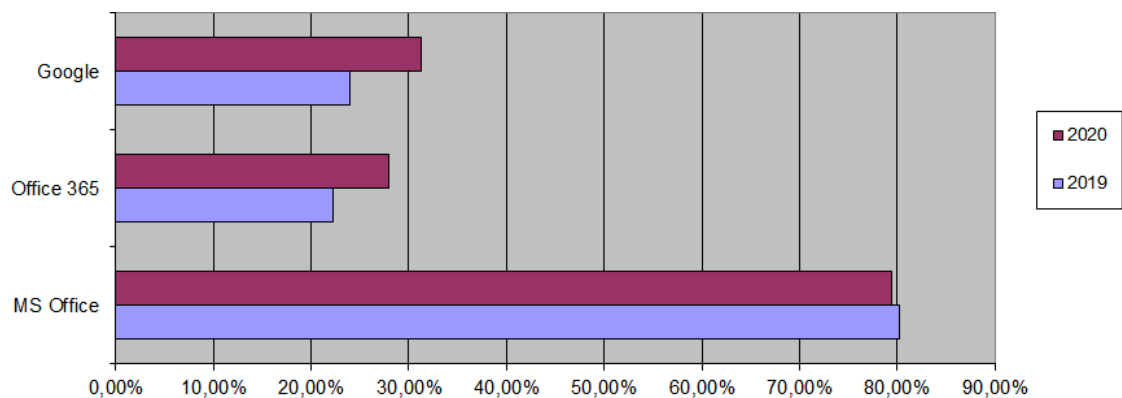
**Figure 2:** Percentage of answers to question # 2 “Did you study application packages at school/college?” (comparison of 2019 and 2020).

During the informatization of society, new ICT are constantly appearing, which are replacing the usual applications. One of such ICT is cloud technology – a service that allows remote use of data processing and storage tools [33, 34].

The next question was to find out whether schools use the standard MS Office suite, or whether some teachers use cloud services. Results of the answers to the question “From which package did you study office application packages (text editors; spreadsheets; database management systems; demo tools)?” in the 2019 year are: 80,2% of those surveyed had studied MS Office, 22,2% had studied Office 365, and 24% had studied Google services, and in the 2020 year: 79,4% of those surveyed had studied MS Office, 28% had studied Office 365, and 31,3% had studied Google services (figure 4). In particular, 59,3% (99 people) in the 2019 year and 51,9% (111 people)



**Figure 3:** Percentage of respondents' answers to question # 3 "What kind of application packages have you studied/reviewed?" (comparison of 2019 and 2020).

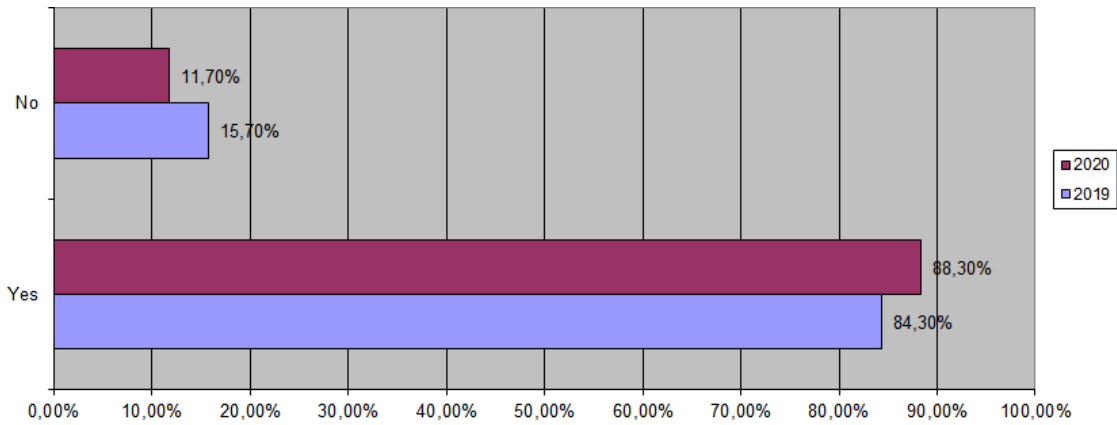


**Figure 4:** Percentage of respondents' answers to question # 4 "From which package did you study office application packages (text editors; spreadsheets; database management systems; demo tools)?" (comparison of 2019 and 2020).

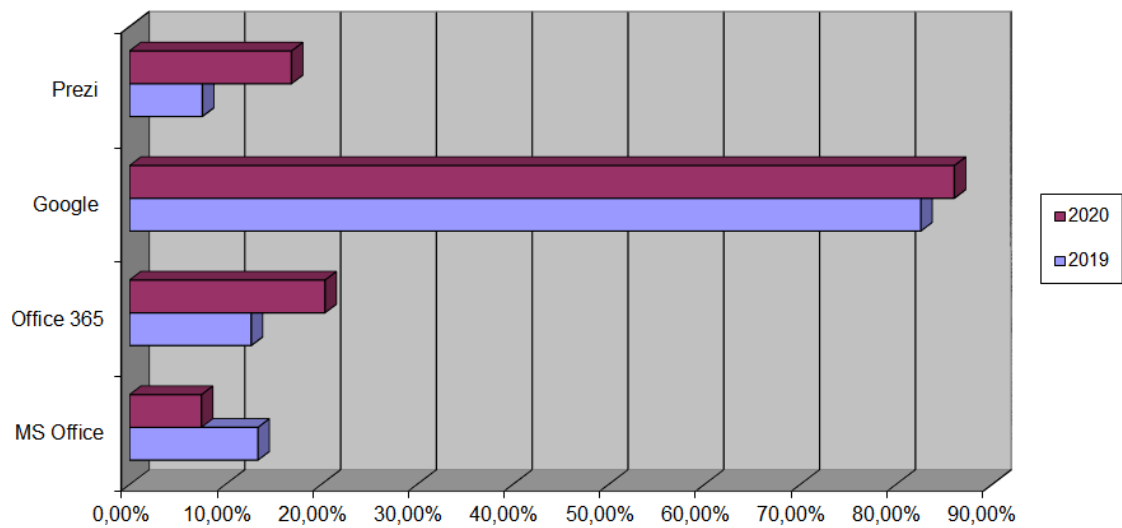
in the 2020 year of the proposed list chose MS Office only. It is worth noting that in 2020 there were isolated cases of choosing the WPS Office.

That is why the next question was "Do you know what "cloud services" is?", to which 84,3% answered "yes" and the other 15,7% answered "no" in 2019, and in the 2020 year 88,3% answered "yes" and the other 11,7% answered "no" (figure 5). Although the study of cloud services is also included in the CS curriculum, not all school teachers adhere to the relevant document.

Answers to the following question "Which of the following programs and services is cloud-based?" are quite interesting as in the 2019 year 13,4% of respondents said that MS Office is a cloud service, and in the 2020 year – 7,5% gave the same answer. Also in 2019, 12,7% said Office 365 was cloud-based, 82,6% noted Google services, and 7,6% noted Prezi, and in the 2020 year



**Figure 5:** Percentage of respondents' answers to question # 5 "Do you know what "cloud services" is?" (comparison of 2019 and 2020).

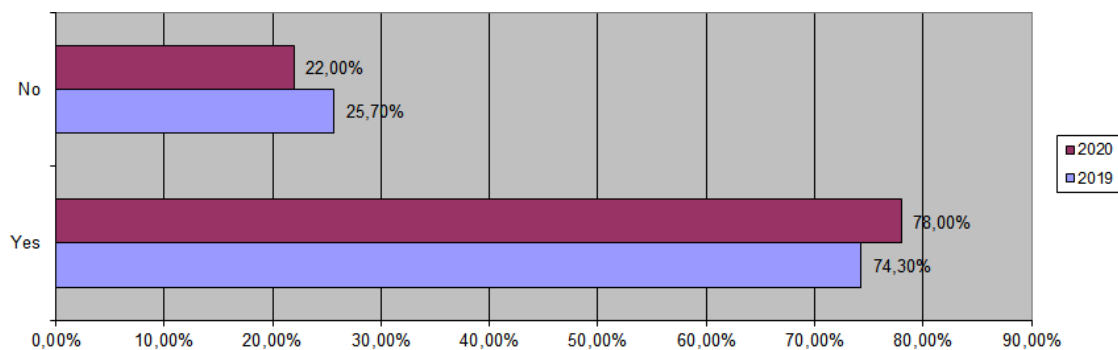


**Figure 6:** Percentage of respondents' answers to question # 6 "Which of the following programs and services is cloud-based?" (comparison of 2019 and 2020).

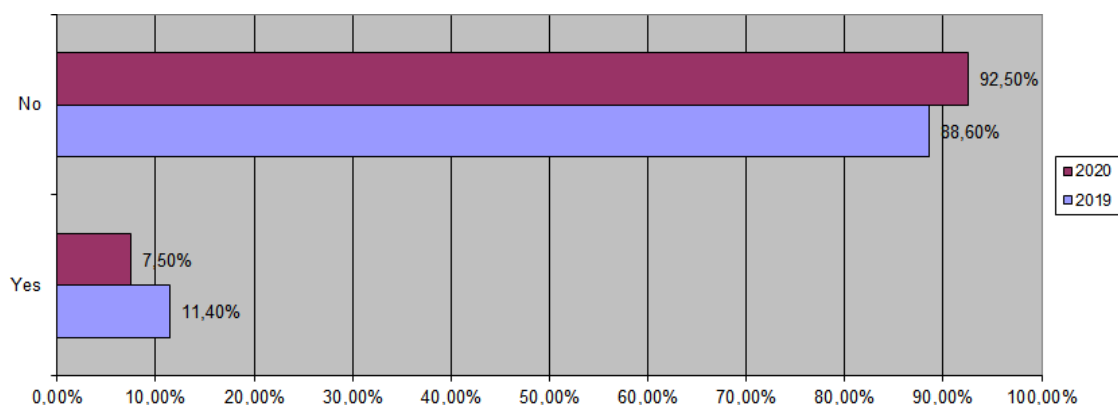
20,4% noted that Office 365 was cloud-based, 86,1% chose Google services, and 16,9% selected Prezi (figure 6). It's worth noting that Office 365, Google, and Prezi are among the cloud ones listed. The positive dynamics in the correct answers indicate that since 2020, graduates have met in the school curriculum with cloud services more often than graduates of 2019.

As Zhytomyr Polytechnic State University actively introduces massive open online courses, the following question "Do you know what massive open online courses are?". The survey results in the 2019 year indicate that 74,3% know what it is, the other 25,7% do not, and in the 2020 year – 78% know what it is, the other 22% do not (figure 7).

In doing so, in response to the question "Do you use these courses at school/college?" in the 2019 year 88,6% of students (percent of those who answered "yes" to the previous question)



**Figure 7:** Percentage of respondents' answers to question # 7 "Do you know what massive open online courses are?" (comparison of 2019 and 2020).

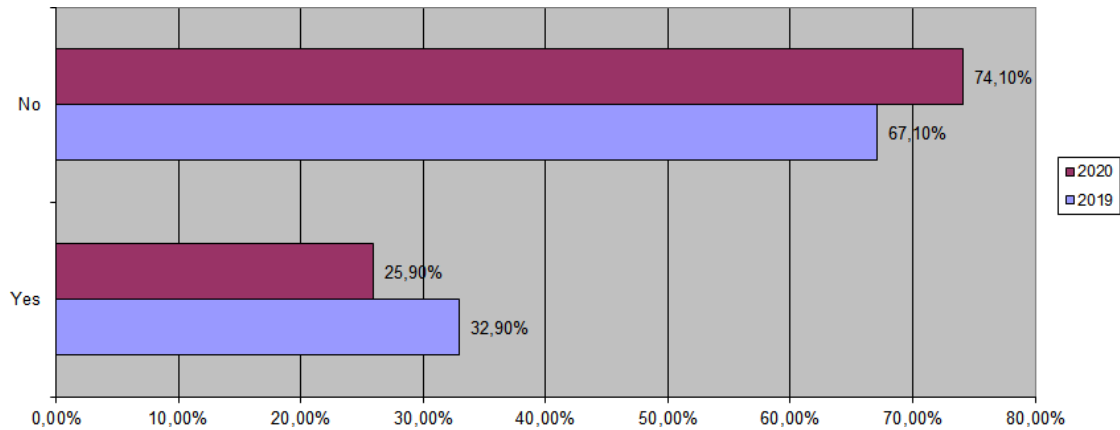


**Figure 8:** Percentage of respondents' answers to question # 8 "Do you use these courses at school/college?" (comparison of 2019 and 2020).

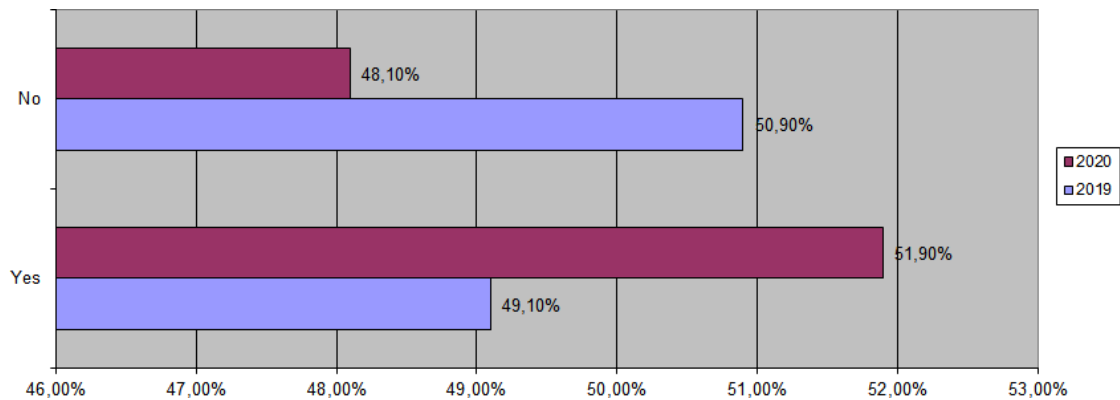
answered, "yes", and in the 2020 year – 92,5% (figure 8).

To find out what kind of open online courses are used in the educational process of general secondary education institutions, the following question was analyzed: "If the answer to the previous question is "Yes", which one?". The analysis of the results shows that in most cases 50% in the 2019 year are Cisco Academy courses, but in the 2020 year, this indicator is 23,8%. In some cases (13,6% in the 2019 year and 28,6% in the 2020 year) are Prometheus, and all others are isolated cases of other courses. It should be noted that Zhytomyr Polytechnic is closely cooperating with Cisco Academy, as a result of cooperation in the institution of higher education actively used courses of the said academy in the educational process (when studying courses "Computer Networks", "Python Programming", "Cybersecurity").

Also, to facilitate the use of massive open online courses (MOOC) in students' independent work, the following question "Have you used massive open online courses for self-study?". The results of the survey (in the 2019 year – 67,1% – yes, 32,9% – no, in the 2020 year – 74,1% – yes, 25,9% – no, see figure 9) indicate that not all students used MOOC for independent work, and therefore, before using these courses, it is worth conducting coaching for students who do not know how to use such MOOC.



**Figure 9:** Percentage of respondents' answers to question # 10 "Have you used massive open online courses for self-study?" (comparison of 2019 and 2020).



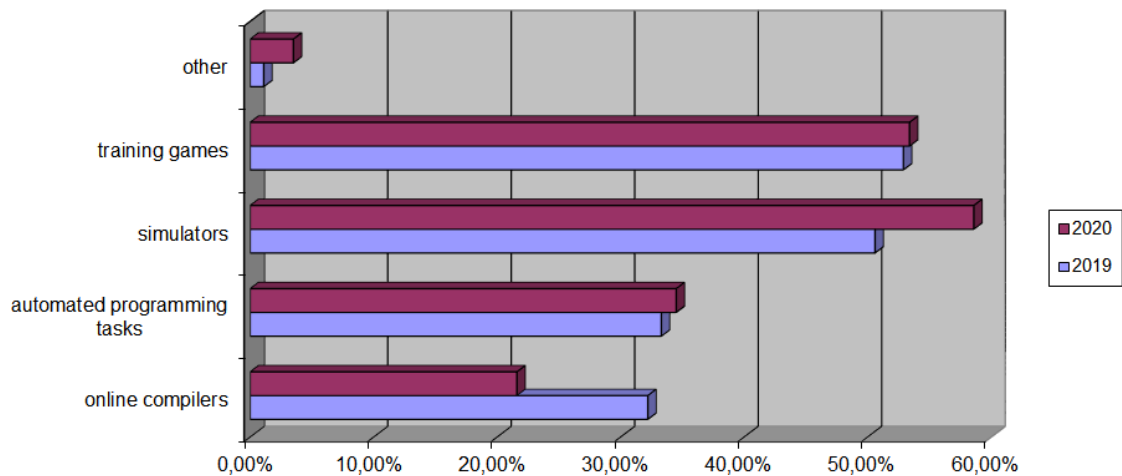
**Figure 10:** Percentage of respondents' answers to question # 11 "Did teachers use any other tools when studying programming in Computer Science?" (comparison of 2019 and 2020).

Also, an important question was, "Did teachers use any other tools when studying programming in Computer Science?", in which 49,1% said "yes, they used", 50,9% – no in the 2019 year, and 51,9% said "yes, they used", 48,1% – no in the 2020 year (figure 10).

To find out what kind of tools were still used in CS lessons, the following question was asked: "If the answer to the previous question is "Yes", what are the tools?". The results (figure 11) indicate that in the 2019 year 32,2% of the respondents worked with online compilers, and in the 2020 year, this indicator is 21,6%, 33,3% in 2019, and 34,5% in the 2020 year with automated programming tasks, 50,6% in 2019 and 58,6% in the 2002 year – with simulators, 52,9% in 2019 and 53,4% in 2020 – with training games. According to previous research [33, 34], it is with online compilers and automated systems for checking programming tasks that computer teachers want to work on in the educational process, but for some reason, they are not used yet. However, as can be seen from the studies of 2019 and 2020, teachers are beginning to use simulators more often in their work.

As ICTs can be used not only in CS lessons, the next question was "Did any information and

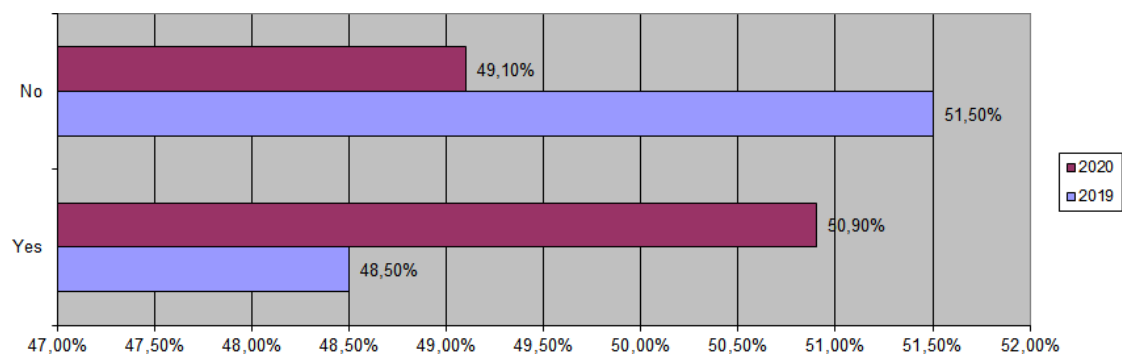




**Figure 11:** Percentage of respondents' answers to question # 12 "If the answer to the previous question is "Yes", what are the tools?" (comparison of 2019 and 2020).

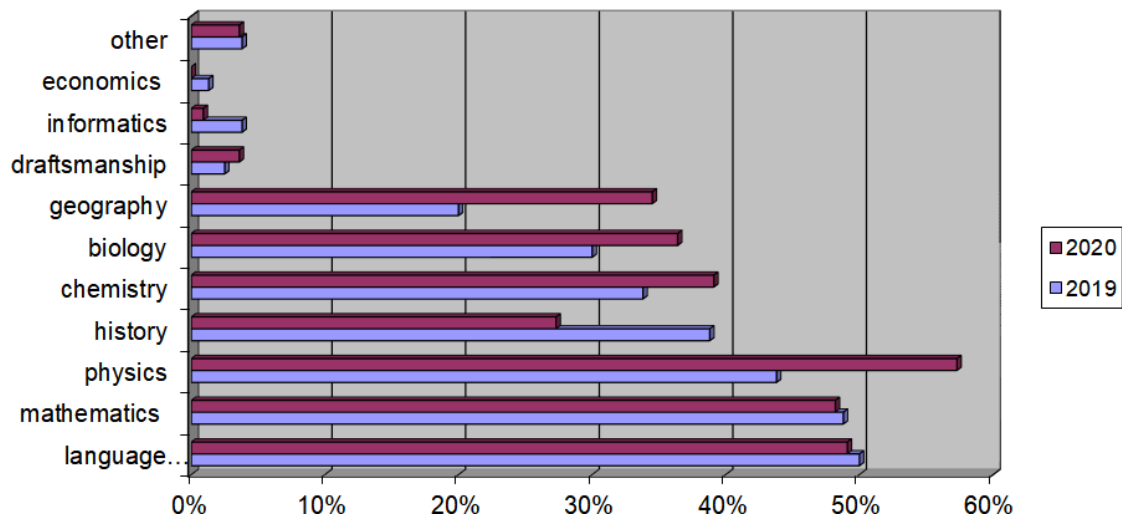
communication technology tools (curricula, multimedia, simulators, games, virtual laboratories, etc.) be used in the school/college by non-CS teachers?"

Survey results indicate that in 48,5% in the 2019 year and 50,9% in the 2020 year of cases ICT was used in other lessons, in 51,5% in the 2019 year and 49,1% in the 2020 year it was not (figure 12). This shows that even the conditions created for non-CS teachers through quarantine do not contribute to the development of their competence in the use of ICT.



**Figure 12:** Percentage of respondents' answers to question # 13 "Did any information and communication technology tools (curricula, multimedia, simulators, games, virtual laboratories, etc.) be used in the school/college by non-CS teachers?" (comparison of 2019 and 2020).

Among those who answered "yes" to the following question "If the answer to the previous question is "Yes", in what lessons did the teachers use such tools?" were distributed as follows (figure 13): 50% in 2019 and 49,1% in 2020 – ICT used in language and literature lessons; 48,8% in 2019 and 48,2% in 2020 – in mathematics lessons; 43,8% in 2019 and 57,3% in 2020 – physics; 38,8% in 2019 and 27,3% in 2020 – history; 33,8% in 2019 and 39,1% in 2020 – chemistry; 30% in 2019 and 36,4% in 2020 – biology; 20% in 2019 and 34,5% in 2020 – geography, etc.

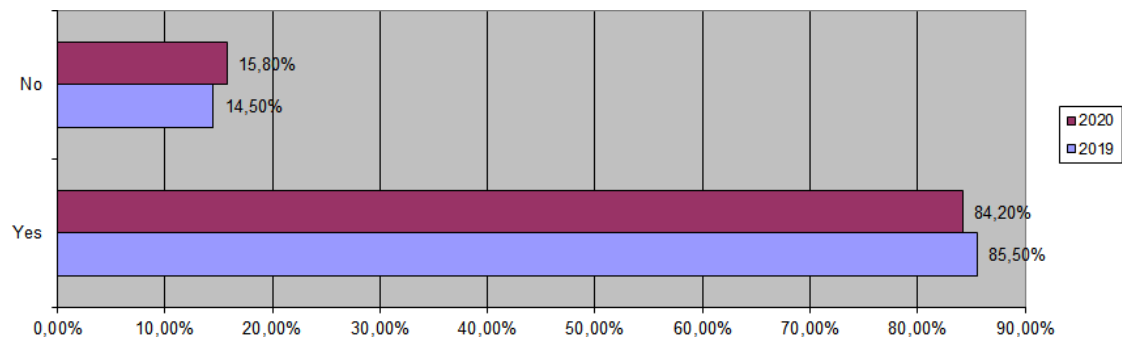


**Figure 13:** Percentage of respondents' answers to question # 14 "If the answer to the previous question is "Yes", in what lessons did the teachers use such tools?" (comparison of 2019 and 2020).

This indicates that most teachers still do not use different ICTs in their activities, although there are currently many tools that can be used in the educational process of a general secondary education institution.

The next question is, "Which one did you enjoy the most and why (also indicate the item on which it was used)?" made it possible for teachers to use the following ICT tools in their activities: multimedia, presentations, games, documentary, online quiz, educational films, simulators, and automated verification systems.

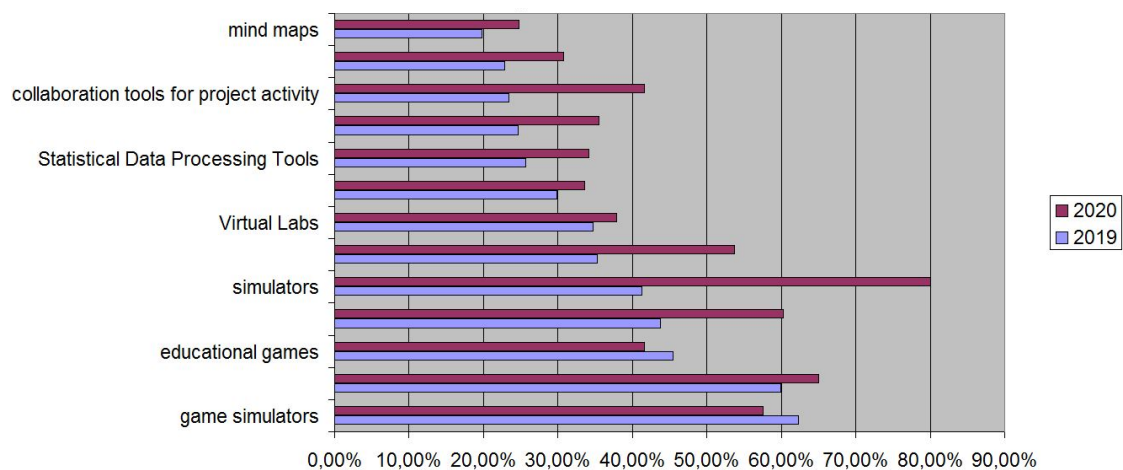
Analysis of the distribution of answers to the question "Was the teaching of this subject more interesting using a variety of tools than without using them?" (figure 14) indicate that it is still more interesting for students to use ICT in the educational process than not use in both cases.



**Figure 14:** Percentage of respondents' answers to question # 16 "Was the teaching of this subject more interesting using a variety of tools than without using them?" (comparison of 2019 and 2020).

To determine what other services could be considered with students, the answers to the question "What additional services would you like to consider and explore how to use them?"

were analyzed. The results show that students want to study game simulators in detail – 62,3% (2019) and 57,5% (2020), cloud services for collaboration on documents – 59,9% (2019) and 65% (2020), educational games – 45,5% (2019) and 41,6% (2020), tools for learning programming – 43,7% (2019) and 60,3% (2020), simulators – 41,3% (2019) and 80% (2020), computer network modeling tools – 35,3% (2019) and 53,7% (2020), virtual labs – 34,7% (2019) and 37,9% (2020), massive open online courses – 29,9% (2019) and 33,6% (2020), statistical data processing tools – 25,7% (2019) and 34,1% (2020), cloud services to build distance courses – 24,6% (2019) and 35,5% (2020), collaboration tools for project activity – 23,4% (2019) and 41,6% (2020), mathematical services – 22,8% (2019) and 30,8% (2020), mind maps – 19,8% (2019) and 24,8% (2020) (figure 15). This indicates that computer science teachers are increasingly using different ICT tools in the learning process.



**Figure 15:** Percentage of respondents’ answers to question # 17 “What additional services would you like to consider and explore how to use them?” (comparison of 2019 and 2020).

## 4. Conclusion

The course “Application Packages” at Zhytomyr Polytechnic State University has been expanded to include cloud services as an alternative to MS Office for specialties 121 “Software Engineering”, 122 “Computer Science”, 123 “Computer Engineering”, 125 “Cybersecurity”, and 126 “Information Systems and Technologies”.

The research substantiated the introduction of the discipline “Educational Technologies and Digital Education” into the training of future information technology specialists [35]. The certification program “Information Systems and Cloud Technologies in the Educational Process” was developed as a result [36]. This program is aimed at teachers of general schools, teachers of HEI, specialists in the field of additional educational services, and other professionals. The certified educational program aims to form knowledge about the peculiarities of using information systems and cloud technologies in the educational process of educational institutions, develop the ability to plan courses at the methodological and information-technical levels using modern

information systems and cloud technologies, and organize various forms of higher education by applying modern information systems and cloud technologies.

As a result, the “Cloud Technologies in Distance Learning in Quarantine” course was launched in several waves during 2020 [37]. This course aimed to raise teachers’ awareness of various IT and learning tools.

In conclusion, the use of various ICT tools in the educational process has shown positive dynamics compared to school graduates in 2019 and 2020. This means that more teachers are turning to various ICT and relevant services and tools to teach their subjects. This, in turn, promotes students’ interest in studying a subject.

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