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#### INNOVATIVE PEDAGOGICAL METHODS AND COMPUTER TELECOMMUNICATIONS IN DISTANCE EDUCATION

##### ABSTRACT

**Formulation of the problem.** The problems of pedagogical system, innovative methods of education and training of specialists, use of new teaching methods based on computer information technologies and distance learning platforms, use of innovative methods and distance learning platforms in the implementation of online education are considered. According to statistical research, the effectiveness of the traditional pedagogical system is no more than sixty percent. Innovative methods of training specialists in education are the use of new methods that qualitatively increase the effectiveness of ways and means of presenting information compared to the traditional system, learning to find the necessary information independently, checking its adequacy and learnability. Such innovations and novelties can be the use of computer technology and the Internet, and, especially now, of distance learning and communication technology.

**Materials and methods.** The methods include content analysis, synthesis, comparison, description of the obtained research results, generalization.

**Results.** The existing solutions for remote learning (distance learning platforms), using computer telecommunications, were analyzed: Meet, iSpring, WebTutor, GetCourse, Google Classroom, Microsoft Teams, Moodle, Blackboard Learning System, LMS «Prometheus», The Virtual Laboratory, VirtuLab and ZILLION, video communication and conference programs: Zoom, YouTube, Viber, Skype and others. All these platforms have their own characteristics and features, and their use lies in the possibilities of application in educational institutions and personal preferences of teachers and students. All distance learning platforms are web-based and therefore the requirements for client computers are minimal. The analysis of the remote learning technologies used allows us to determine the basic necessary and sufficient set of software tools that need to be applied for the full operation of the platform in the application of distance learning technologies. Microsoft Teams is suggested as a possible platform for distance learning.

**Conclusion.** Application of remote technologies and software in creation of hardware-distance scientific-educational systems will lead to low cost of software product both for developers and customers (reduction of expenses on additional software) and will provide attraction of a wide range of users due to low system requirements and possibility of use in mobile devices. And usage of Microsoft Teams distance learning platform allows implementing a wide range of capabilities, which this platform has: video communication, different types of communication, provision of all kinds of materials, demonstration of any participant's screen during broadcast for the whole group, list of participants and attendance control, polling, possibility to record events and their further viewing, administration of all processes from the learning side, etc.

**Keywords:** innovative methods of education, computer technologies, online education, virtual hardware-remote laboratory.

## INTRODUCTION

**Problem statement.** According to statistical research, the effectiveness of the traditional pedagogical system is no more than sixty percent. Innovative methods of training specialists in education are the use of new methods that qualitatively increase the effectiveness of ways and means of presenting information in comparison with the traditional system, teaching to independently search for the necessary information, checking its adequacy and learnability. IT and software specialists are characterized by early vocational training and an early start to professional working life. As a matter of fact, knowledge and skills acquired in the last years of school and the first years of college and higher education institutions while studying fundamental disciplines in this field play a great role in the formation of a highly qualified specialist. (Tkachov&Brovchenko, 2020)

The opportunity to possess information resources stimulates the development of new information tools, reveals the horizons of information needs. Unlike the history of technology development, the new information resource does not replace the old one, but complements the existing system of information communication and learning. (Frolov&Chernitsin, 2008)

**Analysis of current research.** The use of innovative pedagogical technologies and computer telecommunications is a modern direction of development and improvement of the education system. This is especially relevant today, at a time of general quarantine restrictions and in the education system in particular.

Various platforms such as Meet, iSpring, WebTutor, GetCourse, Google Classroom, Microsoft Teams, Moodle, Blackboard Learning System, Prometheus, The Virtual Laboratory, VirtuLab and ZILLION, Zoom, YouTube, Viber, Skype and other video communication and conferencing tools are used for distance learning of specialists. All these platforms have their own characteristics and features. (Tkachov&Brovchenko, 2020)

**Purpose of the article.** The aim of the article is to convey the need for distance learning technologies, virtual online labs, and bringing together developers and users to find the best possible capacity and set of technologies when creating a software product through user feedback, queries and questionnaires, which is especially relevant today. The use of the Microsoft Teams distance learning platform is proposed to implement these ideas.

## THEORETICAL FOUNDATIONS OF RESEARCH

With modern technology, there are many forms and methods of innovative pedagogical technology and computer telecommunication to improve learning. It is necessary to support and develop students diverse thinking, experience, independent assimilation of material and ability to find the right solutions.

Innovation in education is understood as a process of improving pedagogical technologies, a set of methods, techniques and means of teaching. Nowadays, innovative pedagogical activity is one of the essential components of educational activities of any educational institution. It is innovative activity that not only creates a basis for creating an institution's competitiveness in the market of educational services, but also determines the direction of professional growth of a specialist, their creative search, and contributes to personal growth. Therefore, innovative activity is inextricably linked to the scientific and methodological activities of teachers and lecturers. (Dichkivska, 2015).

The problem of effectiveness of innovation activity of modern pedagogical science is largely a consequence of misunderstanding, distortion of the essence of the term "innovation" itself. Innovation is carried out at the expense of the resources of the system itself and is aimed at changing it. It is not limited to the negation of the generally accepted, old, conservative, and allows the purposeful nature of innovation and its focus on stability and its transition to a qualitatively new state. (Tkachov&Brovchenko, 2020).

These innovations could be the use of computer technology and the Internet. The creation of computer networks has given mankind an entirely new way of communicating. The latest advances in data transmission technology have opened up unlimited possibilities for the transmission of data to almost any part of the globe. We should also consider the fact that in the future, the computer will be one of the main means of communication between people. A positive feature of modern Internet technology is the unique experimental resources that are sometimes located on the other side of the globe.

As a perspective for the near future, we can also talk about "virtual" online laboratories, in which students conduct experiments on equipment located in a neighboring building or on another continent. A certain amount of specialized equipment must be used to conduct modern laboratory research. It is very difficult to set up such laboratories in every research center. However, in combination, several laboratories can meet the scientific needs of researchers. Therefore, it is promising to use hardware-remote research laboratories that will allow research to be carried out on real equipment by remote users, to be controlled and to obtain results via remote data transmission channels.

## RESEARCH METHODS

To achieve the goal of the study, the following methods were used: content analysis of distance learning platforms to determine the level of their compliance with the needs of students; synthesis and generalization of the conclusion on their compliance with certain requirements; description and comparison of research results for qualitative and quantitative analysis.

## RESULTS OF THE RESEARCH

To address this issue, existing remote learning solutions (distance learning platforms) were analyzed: Meet, iSpring, WebTutor, GetCourse, Google Classroom, Microsoft Teams, Moodle, Blackboard Learning System, LMS «Prometheus», The Virtual Laboratory, VirtuLab and ZILLION, video communication and conferencing programs: Zoom, YouTube, Viber, Skype. The following requirements were imposed on the platforms: the platform should preferably be free, web-oriented, multilingual, modular, intuitive; have the necessary protection against hacking and compatibility with mobile applications (Table 1). Each platform was installed and analyzed for the possibility it of using for remote distance learning. The authors have studied and tested the proposed software. Using the available materials, user feedback and based on our training experience, we made estimates and conclusions on the implementation of the provided distance learning platforms.

Table 1

Comparison of multilingual distance learning platforms

Distance Learning Platforms	License cost	Session time limits	Number of participants	Chat	Online conference	Conduction of tests	Data storage	Difficulty of use	Reliability of work
Meet	freeware	60 minutes	100	+	+	+	unlimited	+	+
iSpring	4500 \$ per year	unlimited	unlimited	+	+	+	unlimited	-	+
WebTutor	2000-3000 \$	unlimited	300>	+	+	+	unlimited	+	+
GetCourse	70-4000 \$	unlimited	1000000	+	+	+	4000 Gb	+	-
Google Classroom	freeware	unlimited	100	+	-	+	unlimited	-	+
Microsoft Teams	freeware	unlimited	unlimited	+	+	+	unlimited	-	+
Moodle	freeware	unlimited	50	-	-	+	256 Mb	+	+
Zoom	freeware	40 minutes	100	+	+	-	unlimited	+	-
YouTube	freeware	12 hours	unlimited	+	-	-	128 Gb	-	+
Viber	freeware	unlimited	20	+	-	-	unlimited	-	+
Skype	freeware	unlimited	25	-	-	-	unlimited	-	+

All these platforms are web-oriented and therefore the requirements for client computers are minimal. This makes the software product attractive from the user's point of view. (Tkachov&Brovchenko, 2020)

But there are peculiarities in each of the above platforms. For example, the duration of a session in the free version of Zoom is limited to 40 minutes (this limit has now been temporarily removed), the connection of up to 100 people, it is necessary to have and enter the conference ID and password every time, and most importantly the weak security of the software. YouTube, Viber, Skype have similar limitations, including one-way communication or a small number of people connected at the same time.

Separate consideration should be given to the use of virtual laboratories in distance learning. Such laboratories are limited in content and accessibility, and it is now almost impossible to conduct research on them. The few available virtual laboratories that exist today are limited in their functions and present virtual lab works, demonstration materials or virtual instruments. When creating hardware-based systems, the question arises as to which software tools and technologies should be used to create a user-friendly, versatile and multifunctional software platform, including robotic test rigs with remote control capabilities.

Today virtual laboratories are necessary for preparation for real laboratory works, school classes, practical and laboratory works in higher educational institutions, if appropriate conditions, materials, reagents and equipment are not available, for distance, self-study and for scientific work.

But some software packages are noteworthy, such as the Electronics Workbench or NI Multisim (fig. 1). This is a software package designed for virtual circuit simulation of digital and analogue electronic circuits. Initially it was offered as a training package. It has a well-designed interface, an extensive library of elements, mostly foreign-made. Multisim simulates digital circuits well. NI Multisim 10.0 brings together the processes of electronic device development and testing based on virtual instrumentation technology for training and production purposes. (Kyryna&Fomyna, 2015; Gololobov, 2019)

This product is essential for interactive SPICE modeling and analysis of electrical circuits used in circuit design, PCB design and complex testing. This platform links test and design processes, giving the electronic designer the flexibility of virtual instrumentation technology. The combined use of Multisim electrical circuit simulation software with LabVIEW's measurement system development environment, allows theoretical data to be compared with real data directly during the circuit design process of conventional electrical circuits, which reduces the number of design iterations, the number of errors in prototypes and accelerates the final product to market. (Kyryna&Fomyna, 2015; Gololobov, 2019)

The latest versions of Multisim include a Multicap version, making it a versatile tool for programmatically describing and immediately testing circuits.

Multisim 10.0 can be used to interactively create circuit diagrams and simulate their modes of operation. Multisim forms the basis of a virtual electrical engineering training platform comprising of prototype workstations NI ELVIS and NI LabVIEW. The package provides students with a comprehensive hands-on experience of the complete electronic design cycle. With this platform, students can easily move from theory to practice, creating prototypes and deepening their knowledge in the basics of circuit design. (Kyryna&Fomyna, 2015; Gololobov, 2019)

Distance learning platforms have their drawbacks. In general, they are whole complexes, sometimes with complex administration. For example, Google Classroom, apart from the advantages: convenience and ease of use, both for teachers and students, to understand it quite simply, the possibility of communication between teachers and students, there is a free opportunity to use, but it has a number of drawbacks: the platform does not provide the possibility of online conferences, in the free version of the service there is no opportunity to create a grade book of students, there are restrictions on the number of students.

Among the platforms for distance learning, in our opinion, it is better to use the Microsoft Teams platform (fig. 2). This is an enterprise platform that combines chat, meetings, notes and attachments in a workspace, developed by Microsoft, is part of the Microsoft 365 suite and is distributed on a corporate subscription basis. By offering affordable and secure devices, powerful educational tools and free professional development opportunities, Microsoft helps educators create an inclusive online environment for remote learning.

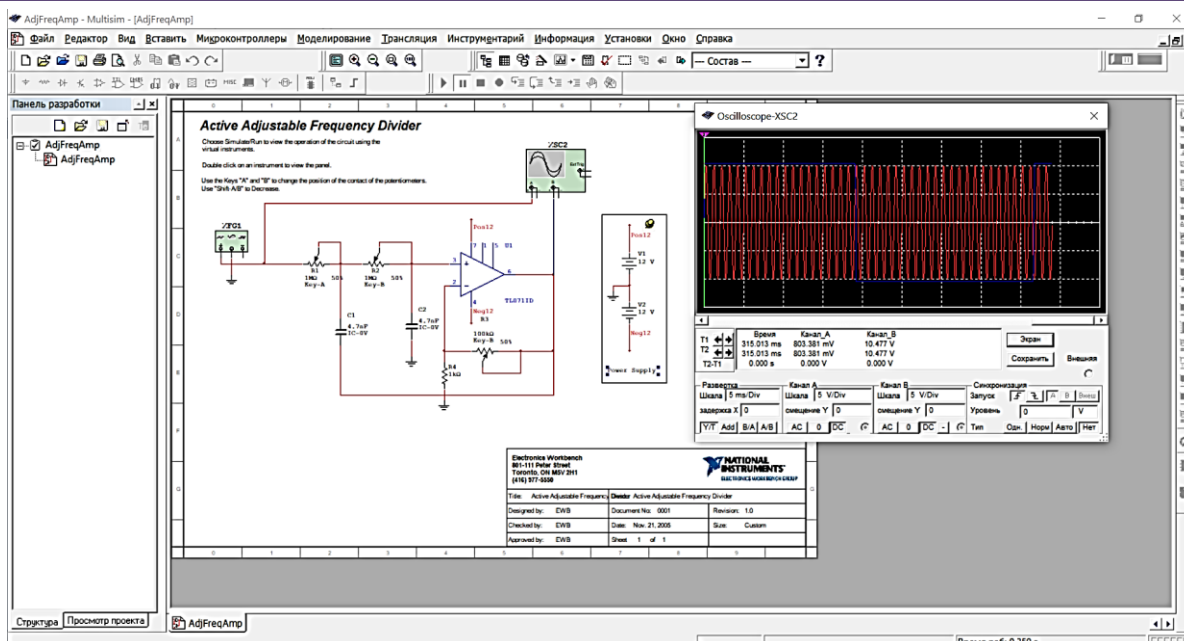


Fig. 1. Example of a research window when emulating the operation of an electrical circuit in the NI Multisim software package

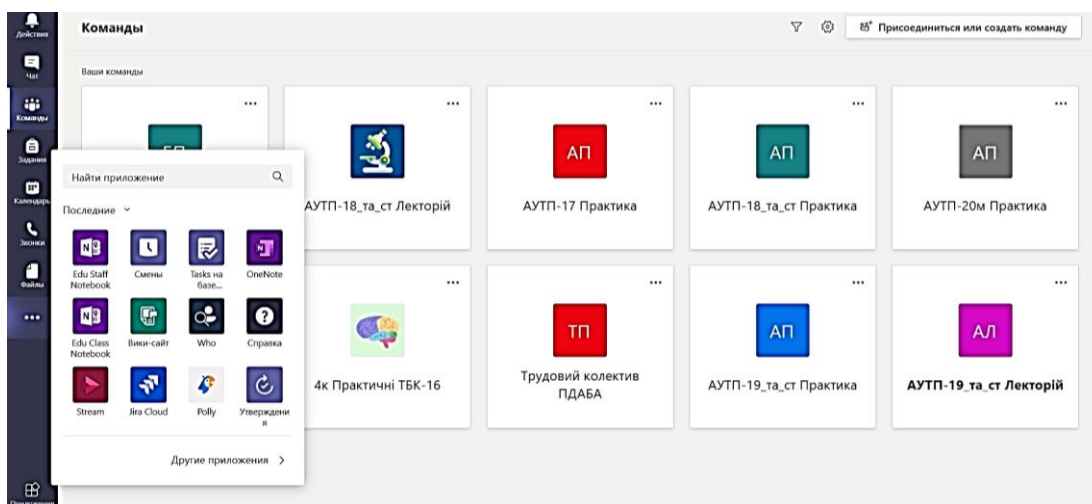


Fig. 2. Example of a command-group window created in Microsoft Teams.

This platform has a number of advantages over other platforms. Microsoft Teams, thanks to its compatibility with Microsoft 365, allows the use of all the features of the Microsoft 365 software suite (fig. 3). At the same time, without cancelling the generally available possibilities of online video communication between teachers and students, the possibility to see, discuss and comment on works between teachers and students, provides each user with unlimited space in cloud storage, access from any location and device, etc. In addition, the platform is highly secure. Each participant has their own account, verified by the administration and protected by Microsoft, and it is not possible to log in from an unverified account.

Many Internet technologies are used in design and development: web servers, hypertexts and websites, e-mail, forums and blogs, chat rooms, video conferencing, wiki encyclopedia, AJAX, Java, CSS, C++, Flash technology, image compression technology, video, audio content and others. (Frolov&Chernitsin, 2008)

The following requirements for the software system can be formulated: the platform should preferably be free, web-oriented, multilingual, modular, intuitive for the user; have the necessary protection against hacking and compatibility with mobile platforms.

Among distance learning platforms, in our opinion, the Microsoft Teams platform is the best to use. In addition to publicly available options compared to other distance learning platforms, Microsoft Teams has the following advantages of use: real-time teamwork, access to team and corporate documents, video conferencing, integration of group work results, each team member is aware of current changes, simplified workflow, usability and compatibility with all Microsoft 365 products.

Equally important to the choice of platform is the issue of privacy and security. In our opinion, the Microsoft 365 system is more secure in this matter due to the implementation of the corporate environment and the development of the software by Microsoft. That is, each institution gets its own access ID, which only registered users have. Unlike other platforms where there is link access, the advantage of such an environment is that there are certain standards by which it is easy to recognize a particular user in the process of use.

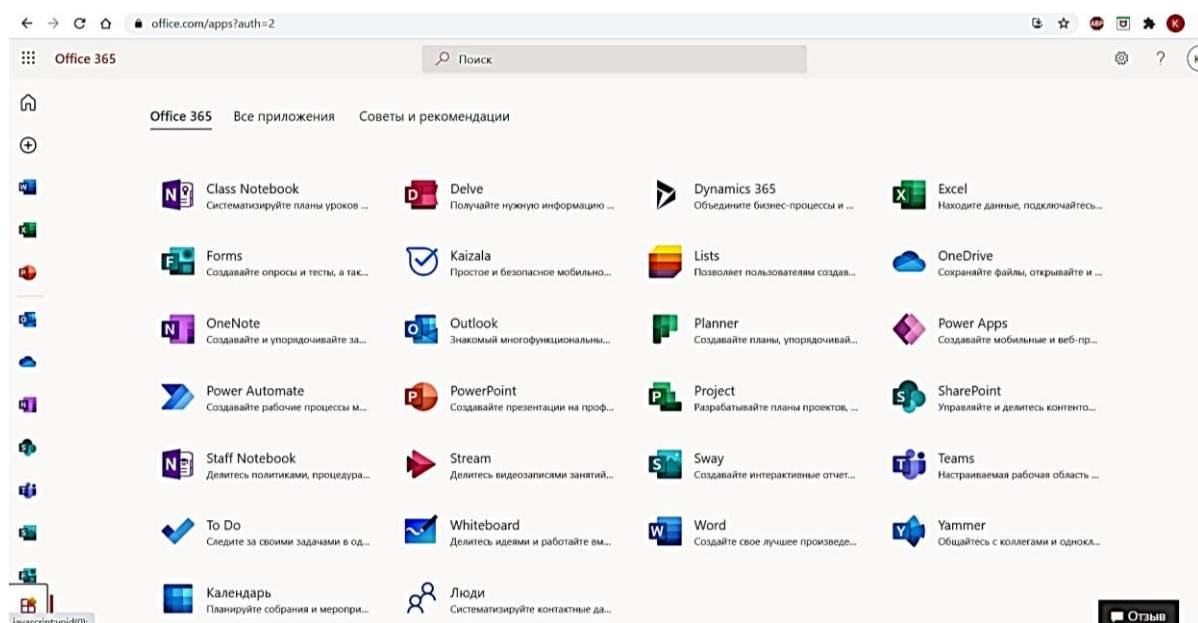


Fig. 3. General view of the Office 365 application suite window.

**DISCUSSION**

The application of information technologies in the educational process is painstaking and continuous work, but without such work, it is currently impossible to meet the information needs of teachers and students and ensure a modern level of quality of educational services.

Particular attention in today's conditions should be paid to the practical training of higher education students. Practical training of students provides continuity and consistency in its implementation, which contributes to consolidation of relevant knowledge and competencies of future professionals.

The purpose of the practical training of students is to generalize the theoretical and practical knowledge, gain professional skills and competencies, form specialists with higher education in accordance with the educational qualification level and contribute to improving the quality of training, including the use of distance learning technologies.

The use of one of the platforms for distance learning is up to the educational institution itself, taking into account the recommendations of the Ministry of Education and Science, as well as the possibility of application in each individual institution.

Preliminary preparation, analysis, structure and organization of the learning process with the possibility to implement remote learning in the given platform is necessary. Drawing up a list of participants in the platform, both students and teachers, providing them with identification data, e.g., logging in with a known email in advance with a temporary password. This password can then be changed by the client. This is a huge job that can be done using the Microsoft Teams distance learning platform. Since this platform has the ability to work from different mobile devices, as well as a mobile app, this gives additional opportunities to use this platform at any time and from different locations.

Today, we all need to understand that there will not be a return to the classical education system in the world. There will be a transition to a hybrid, distance, remote form of education with the use of computer telecommunication technologies in the learning process.

Such changes lead to adjustments in the retraining and professional development of administrative and pedagogical staff.

The training and education of new forms for both managerial staff of educational institutions at all levels and pedagogical staff should be implemented, and a policy of introducing and implementing new forms of education should be pursued. It is necessary to speak at a state level about preparation of a new type of the teacher - tutor. Tutor - is a distance learning specialist who leads individual or group sessions with the recipients of education, a coach, a mentor. (Andros, 2021; Kukharenko, 2019)

If we analyze the experience of national higher education institutions and foreign universities, we can say that in most cases the educational course developer and tutor are one and the same person. Many higher education teachers mix in-house teaching with distance learning technologies and use computer telecommunication in their innovative pedagogical methods. (Andros, 2021; Kukharenko, 2019)

**CONCLUSIONS AND PROSPECTS OF FURTHER RESEARCH**

An analysis of the technologies used allows to determine the basic necessary and sufficient set of software tools to be applied for the platform to work fully: for the application server JBOSS or Apache tomcat; for the broadcasting server Wowza Media Server or Adobe Media Server.

Intelligent communications go beyond traditional unified communications, allow for more efficient problem solving with minimal context switching, and for more productive learning activities that span the entire distance learning lifecycle of a future professional.

In summary, using the Microsoft Teams platform together with Microsoft 365 cloud technologies for education is a worthy solution for distance learning, intelligent communication for students, staff and teachers, as well as a set of custom services for collaboration and cooperation.

The perspective of the future is the use of virtual online laboratories in which specialists will conduct experiments on equipment located on the other side of the globe. Application of such technologies and software for creation of teaching methods and hardware-distance scientific-educational systems in training of technical and IT specialists will lead to reduction of the cost of software products (applications) both for developers and users and will ensure attraction of a wide range of users due to dissemination of technical means and especially possibility of use in mobile devices and applications.

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### ІННОВАЦІЙНІ ПЕДАГОГІЧНІ МЕТОДИКИ ТА КОМП'ЮТЕРНІ ТЕЛЕКОМУНІКАЦІЇ ПРИ ДИСТАНЦІЙНІЙ ОСВІТІ

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#### Анотація.

**Формулювання проблеми.** Розглядаються проблеми педагогічної системи, інноваційні методики виховання і навчання фахівців, використання нових методик навчання на основі комп'ютерно-інформаційних технологій та платформ дистанційної освіти, застосування інноваційних методик і дистанційних освітніх платформ при впровадженні on-line освіти. Ефективність традиційної педагогічної системи, згідно зі статистичними дослідженнями, становить не більше 60 відсотків. Інноваційні методики навчання і виховання фахівців в освіті це використання нових методик, які якісно підвищують ефективність способів і засобів подачі інформації в порівнянні з традиційною системою, навчання самостійного пошуку потрібної інформації, перевірки її адекватності і засвоєння. Такими інноваціями і нововведенням може стати застосування комп'ютерних технологій та мережі інтернет, а в теперішній час це особливо актуальне застосування технології дистанційного навчання та спілкування.

**Матеріали і методи.** Використано такі методи як контент-аналіз, синтез, порівняння, опис одержаних результатів дослідження, узагальнення.

**Результати.** Були проаналізовані існуючі рішення для віддаленого навчання (дистанційні освітні платформи), з використанням комп'ютерних телекомунікацій: Meet, iSpring, WebTutor, GetCourse, Google Classroom, Microsoft Teams, Moodle, Blackboard Learning System, СДО «Прометей», The Virtual Laboratory, VirtuLab u ZILLION, програми відеозв'язку та конференцій: Zoom, YouTube, Viber, Skype та інші.

Кожна платформа була встановлена та проаналізована на можливість використання для віддаленого дистанційного навчання. Авторами вивчено та досліджено запропоноване програмне забезпечення. Використовуючи доступні матеріали, відгуки користувачів та ґрунтуючись на своєму досвіді навчання нами були зроблені свої оцінки та висновки щодо впровадження наведених платформ для віддаленого дистанційного навчання.

Всі ці платформи мають свої особливості та властивості застосування, а їх використання лежить в можливості застосування в навчальних закладах та особистих уподобаннях викладачів і учнів. Всі платформи віддаленого навчання веб-орієнтовані і тому вимоги до клієнтських комп'ютерів зводяться до мінімальних.

Аналіз використовуваних технологій віддаленого навчання дозволяє визначити базовий необхідний і достатній набір програмних засобів, які необхідно застосувати для повноцінної роботи платформи при застосуванні дистанційних технологій навчання. Як можлива платформа для віддаленого дистанційного навчання пропонується платформа Microsoft

Teams.

**Висновки.** Застосування дистанційних технологій та програмного забезпечення при створенні апаратно-дистанційних науково-освітніх систем призведе до низької собівартості програмного продукту, як для розробників, так і для клієнтів (зменшення витрат на додаткове ПО) і забезпечить залучення широкого кола користувачів завдяки низьким системним вимогам і можливості використання в мобільних пристроях. А використання платформи віддаленого дистанційного навчання Microsoft Teams дозволяє впровадити широкий спектр можливостей, які має ця платформа: відеозв'язок, різномірні види спілкування, надання всіляких матеріалів, демонстрація екрану будь-якого учасника при трансляції для всієї групи, список учасників і контроль відвідування, проводити опитування, можливість запису подій і їх подальший перегляд, адміністрування всіх процесів навчання тощо.

**Ключові слова:** інноваційні методики навчання, комп'ютерні технології, on-line навчання, віртуальна апаратно-дистанційна лабораторія.

