

## DEVELOPMENT OF TEACHER'S DIGITAL COMPETENCE IN DESIGNING A CLOUD-BASED DISTANCE LEARNING ENVIRONMENT FOR BIOLOGY

## ФОРМУВАННЯ ЦИФРОВОЇ КОМПЕТЕНТНОСТІ ВЧИТЕЛЯ ЩОДО ПРОЄКТУВАННЯ ХМАРО ОРІЄНТОВАНОГО СЕРЕДОВИЩА ДИСТАНЦІЙНОГО НАВЧАННЯ БІОЛОГІЇ

Quarantine restrictions in place from 2020 to 2022 necessitated a societal shift, including in the education system, towards remote interaction. The experience gained in organizing educational activities during prolonged quarantines was successfully leveraged to implement distance learning in secondary education institutions, especially under geographical constraints during times of martial law. Over the past years, school teachers have embraced the use of cloud technologies in distance learning. However, during the lengthy quarantines in 2020, the use of such services was somewhat limited. Teachers chose cloud applications and messengers depending on their didactic goals and the technical capabilities of educational process participants.

The article presents the project "Cloud-Oriented Environment Design Technologies for Biology Distance Learning," which represents an innovative, methodologically, and scientifically grounded study aimed at developing modern approaches to biology education in a distance learning format. The main organizational forms of the project include workshops, training sessions, master classes, case studies, distance courses, and experience sharing on the Viber social network. The methods used in scientific and methodological work with teachers are aimed at creating effective distance learning; workshops are conducted on the following topics: "Microsoft Office 365 Resources for Distance Learning," "Interactive Boards for Distance Learning," "Designing a Cloud-Oriented Environment for Distance Learning in Biology," "Knowledge Control Using Microsoft Forms," "Designing Digital Content with Augmented Reality." Informal education for teachers in the chosen direction takes place within the framework of a distance course on the Microsoft Teams platform "Microsoft Office 365 Resources for Organizing Distance Learning." The conduct of seminar workshops involves interpreting the knowledge gained by teachers, creating a product of activity such as designing elements of the distance learning environment, developing methodological recommendations for project implementation, determining the project algorithm, diagnostic materials, developing criteria for a cloud-oriented distance learning environment, etc.

**Key words:** distance learning, cloud services, educational space, informal education, methodological recommendations.

Карантинні обмеження, що діяли у період з 2020 по 2022 роки, викликали необхідність переходу суспільства, включаючи систему освіти, на дистанційну форму взаємодії.

Досвід, набутий в організації освітньої діяльності протягом тривалих карантинів, було успішно використано для впровадження дистанційного навчання у закладах загальної середньої освіти, особливо в умовах географічних обмежень під час воєнного стану. Протягом останніх років вчителі шкіл приєдналися до використання хмарних технологій у дистанційному навчанні. Однак під час тривалих карантинів у 2020 році використання таких сервісів було децю обмеженим. Вчителі вибирали хмарні додатки та месенджери залежно від їх дидактичних цілей та технічних можливостей учасників освітнього процесу.

В статті презентовано проєкт «Технології проєктування хмаро-орієнтованого середовища для дистанційного навчання з біології», який представляє собою новаторське, методологічно та науково обґрунтоване дослідження, спрямоване на розвиток сучасних підходів до вивчення біології у дистанційному форматі навчання. Основними організаційними формами проєкту є практикум, тренінг, майстер-клас, кейс-метод, дистанційний курс та обмін досвідом у соціальній мережі Viber. Використані методи науково-методичної роботи з педагогами спрямовані на створення ефективного дистанційного навчання, практикуми проводяться за темами: «Можливості ресурсів Microsoft Office 365 для дистанційного навчання», «Інтерактивні скіли для дистанційного навчання», «Проєктування хмаро-орієнтованого середовища для дистанційного навчання з біології», «Проведення контролю знань засобами Microsoft Forms», «Проєктування цифрового контенту з доповненою реальністю». Інформальна освіта вчителів з обраного напрямку відбувається у рамках дистанційного курсу на платформі Microsoft Teams «Можливості ресурсів Microsoft Office 365 для організації дистанційного навчання». Проведення семінарів-практикумів передбачає інтерпретацію отриманих вчителями знань, створення продукту діяльності, такого як проєктування елементів середовища дистанційного навчання, розробка методичних рекомендацій з реалізації проєкту, визначення алгоритму проєктування, діагностичного матеріалу, розробка критеріїв хмаро-орієнтованого середовища дистанційного навчання тощо.

**Ключові слова:** дистанційне навчання, хмарні сервіси, освітній простір, неформальна освіта, методичні рекомендації.

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Effective learning is greatly dependent on direct interaction between teachers and students. However, due to martial law conditions, distance learning has become the priority for general secondary educational institutions in Ukraine. Since 2020-2021, Ukraine has been following the epidemiological situation, and the

quarantine has made it challenging for educational institutions to provide classroom learning. As a result, participants in the educational process have acquired skills in distance learning, which has made it possible to provide education to Ukrainian children during the war quickly and regardless of their location. The

Ukrainian education system has ensured the safety of students and teachers by organising the educational process in the form of distance learning.

Recently, a study conducted by the State Service for Ensuring the Quality of Education [1] revealed concerning results regarding the quality of education in secondary schools during the war in Ukraine. The study found that 30% of students need consistent access to education, and teachers must be adequately equipped to teach via remote learning. Students' psychological well-being has also been impacted, and educational institutions need more resources and technical support. Due to the war, around 800,000 students have had to switch from in-person to remote learning, resulting in severe consequences for the education system and society as a whole. However, there are innovative approaches that educators can take to mitigate these losses and provide quality education during the war. This involves creating engaging educational content, mastering information and communication technologies, and designing effective remote learning environments.

So, in the context of the quarantine related to COVID and education during the war, digital technologies are considered a means of learning for students and teachers in remote mode. This is confirmed in the project of the Concept of Digital Transformation of Education and Science, where it is noted that it is digital technologies that provide the possibility of distance learning, because "today, more and more professions require the acquisition of a high level of digital competences and mastery of the latest technologies, as the consequences of the coronavirus pandemic have exacerbated the problem of development and mastering technologies in the education system to ensure people's rights to quality education" [2].

*Analysis of recent research and publications.* After analysing the latest research on teacher qualifications, it has become clear that several key competencies stand out. One such competency is informational competence, which requires mastery of information technologies and digital tools, the ability to process different types of information from various sources, and designing an educational environment that aligns with the goals and objectives of the pedagogical process. In the scientific works of V. Yu. Bykova, S.G. Lytvynova, O. V. Ovcharuk, N. V. Soroko, and M. P. Shishkina, the theoretical and practical aspects of improving the digital competence of the teacher, the components of improving the qualifications of teachers regarding the implementation of distance learning were investigated. The attention of researchers is focused on the study of the process of formation and development of a teacher's pedagogical competence both at the stage of training in a higher educational institution and at the stage of post-graduate pedagogical education, in particular in the context of improvement and development of digital

competence. We agree with the opinion of O.O. Hrytsenchuk, O.V. Ovcharuk, and S.I. Trubacheva [3] about the extreme importance of a teacher's ability to use digital tools in professional activities and personal development.

According to domestic researchers, it is imperative for educators to continuously enhance their qualifications to effectively navigate information and communication technologies and implement cutting-edge tools such as cloud technologies in their teaching methodologies. This approach is believed to enhance the overall educational experience for students and promote better learning outcomes. V. Ovcharuk defines IC competence as "the confirmed ability of an individual to autonomously and responsibly use information and communication technologies in practice to meet their own individual needs and solve socially significant, in particular professional, tasks in a certain subject area or type of activity" [4].

V. Yu. Bykov, O. M. Spirin, and M. P. Shishkina identify the existence of a gap between scientific research and its implementation in pedagogical practice as one of the urgent problems of forming the educational environment of an educational institution. One of the ways to solve this problem is to bring the network of teaching staff training centres to the actual process of performing scientific and pedagogical works and implementing their results in pedagogical practice. An additional way to increase the IR competence of participants in the educational process regarding using a cloud-oriented educational environment is to conduct master classes, trainings, etc. [5].

Today's teachers are expected to possess ICT competencies that enable them to use technology both in their personal activities and in their interactions with students, parents, and the public. The integration of ICT in teaching facilitates the effective and efficient delivery of innovative educational content, promotes inter-disciplinary connections, provides practical examples of subject-specific knowledge application, enables heuristic and problem-based learning, and visualizes complex natural processes. According to S.G. Lytvynova's research, ICT competence is defined as the ability of subject teachers to navigate the information space and to utilize ICT technologies in a manner that aligns with the educational needs and requirements of modern high-tech society. [6]

Accordingly, the design of a cloud-oriented environment for distance learning of biology requires the provision of effective scientific support and a methodical system of teacher training for such activities. It is necessary to pay special attention to the organisation of distance learning in the natural sciences since in order to develop the natural and scientific thinking of students, and it is necessary to carry out observations, perform laboratory and practical work, and solve tasks of an experimental and creative nature.

When designing a cloud-based distance learning system, it is crucial to consider various factors such as regulatory, organisational, scientific-methodical, informational, material-technical, and personnel support. The system should consist of methodical and didactic components to facilitate educational activities and assess outcomes. It must also allow for storing, processing, and transmitting visual, sound, and text information, as well as enable seamless communication among participants. Access to diverse sources of information and cloud services is essential. All components should align with the methodology of their use in the educational process. The Ministry of Education and Science of Ukraine has developed methodological recommendations for the organisation of distance learning in schools during emergencies, such as martial law [7] and the COVID-19 pandemic [8], aimed at supporting general secondary education institutions, where the priority task is the choice of an online platform, organisation and introduction of training using distance technologies.

Therefore, the implementation of cloud services for the creation of a distance learning system of biology in general educational institutions should consist of the following stages:

- choosing a platform for distance learning;
- development and testing of elements of distance learning, such as electronic textbooks, presentation programs, lecture notes, online boards, test systems for knowledge control, simulators, educational applications, simulators, augmented reality applications, etc.;
- creating an educational environment for distance learning, including hardware, telecommunications, software, and informational and methodological support.

Several factors contribute to the quality of education in an educational institution. These include the efficient organization of the learning space, the competence of teachers, and the selection of a suitable distance learning platform. As V. Yu. Bykov explains, a distance learning platform is a form of remote learning where participants mainly engage in individualized educational interaction through electronic transport systems for delivering educational materials and information objects, using both synchronous and asynchronous methods [9].

We suggest choosing a platform for the organization of distance learning in an institution of general secondary education according to the following criteria:

- technological, by which we understand the set of features and properties related to the necessary physical storage infrastructure and the functioning of the software;
- operational, by which we understand the set of signs and properties related to the general conditions of using the corresponding software, in particular, interface languages, payment, etc.;

– functional, by which we understand the set of features and properties related to the direct organization, implementation of the educational process by distance learning, its monitoring, as well as the preparation of appropriate educational content, etc [10].

As per the methodological recommendations of the Ministry of Education and Culture of Ukraine [8], it is advisable for general secondary education institutions to utilize the most prevalent and accessible educational platforms, namely Moodle and Google Classroom. Moodle is a course management platform (Learning Management System, LMS) that is intended for creating and managing online courses and distance learning. This platform offers a vast range of features, including the ability to create courses using various content formats, such as text, video, and images, create assignments, conduct assessments, and track student progress. Google Classroom is a free web service developed by Google for educational institutions to organize the design, distribution, and assessment of assignments in electronic format. The primary purpose of this service is to expedite the exchange of files between teachers and students. Google Classroom integrates tools such as Google Drive for creating and sharing assignments, Google Docs for writing documents, Gmail for communication, and Google Calendar for planning. Students can be invited to join a class using a private code or login automatically from the school website. Each class creates a separate Google Drive folder where students can submit their work, which the teacher can grade and return with comments. Mobile apps for iOS and Android enable users to take photos and attach them to tasks, share files from other apps, and access information. Teachers can track each student's progress and provide feedback on their work. The set of functions available in both platforms for distance learning facilitates the development of educational materials, the conduct of video conferences, and the assessment of students' knowledge levels. However, a survey of biology teachers in the city of Dnipro in September 2022 revealed the need for training classes on mastering cloud services for organizing an educational environment (37% of respondents), organizing joint work of students (27%), conducting video conferences, and organizing chats (14%) (Table 1).

Teachers who are seeking to develop their digital skills can achieve their requests through the implementation of a methodical model of teacher training. This model is designed for the creation of a cloud-oriented environment for distance learning in biology, using Microsoft Office 365. Microsoft's digital product is a comprehensive solution that offers ample opportunities for creating a cloud-oriented distance learning environment. With the cloud platform, teachers can effectively organize the process of distance and

Table 1

**Determining the needs of biology teachers in the city of Dnipro in learning cloud services**

Identifying the need for biology teachers to master distance learning services	Number of respondents	Percentage
Services for organising the educational environment	19	37
Services for checking and correcting knowledge	6	27
Services for organising student collaboration	14	14
Services for video conferencing, chats	7	12
Services for the practical part of the programme	5	10

mixed learning, create digital content, and ensure digital communication and collaboration.

By designing a cloud-oriented environment for distance learning in biology, teachers will be able to gain access to the modern possibilities of digital tools, which will ultimately have a positive effect on the quality of knowledge acquisition by students within the framework of distance learning. The learning tools in the distance learning environment are formed in accordance with pedagogical goals and practical needs. This approach aligns with S. G. Lytvynova's concept of "designing a cloud-oriented environment" [11], which is an activity aimed at realizing the idea in the learning process, taking into account the pedagogical idea, didactic regularities, principles, concepts, possibilities of use, individual and typological feature personality development.

The Microsoft Office 365 platform offers a list of tools for ensuring communication between participants of the educational process in synchronous and asynchronous modes. These tools include Microsoft Teams, Outlook e-mail, Microsoft Whiteboard, Microsoft Forms, Microsoft PowerPoint, Sway, One Drive, and SharePoint. Teachers can use these tools to create a comprehensive and effective learning environment that meets the needs of their students. Microsoft Teams is a platform for teamwork and communication, which is designed to organize collaboration within teams and has features such as chat, video conferencing, joint editing of documents and integration with external distance learning systems. Teams lets you chat, share files, schedule meetings, and coordinate work in real-time. Microsoft Teams is an essential tool for remote work, collaboration and project management, providing convenient and effective interactive interaction. This is a powerful tool for distance learning, within the framework of which interactive interaction of participants in the educational process is implemented, access to educational resources is provided, and projects are planned and organized.

The main components of an environment for the safe and effective use of Microsoft Teams for distance learning of biology include:

- video conferencing: Teams has a built-in video communication feature that allows you to conduct online lessons, lectures and discussions in real-time. Teachers can communicate with students in synchronous mode, show presentations and educational

materials, and record classes for further asynchronous collaboration;

- chat: in Teams, participants of the educational process can exchange messages, files, tasks and comments. They can work on joint projects, edit documents simultaneously and interact in real-time;

- material repository: Teams allows you to store all learning materials, assignments and documents in one place. Teachers can create and organize resource catalogues, which facilitates navigation and access to information sources;

- assessment and reporting: Teams has tools for creating and assessing tasks. Teachers can create tests, tasks with answers and the ability to attach files of various formats. In addition, the platform allows you to keep statistics and reports on the success of students, the percentage of completed tasks and average marks in subjects;

- integration with other services: Teams integrates with other popular Microsoft services, such as OneDrive, SharePoint, Outlook, Forms, Planner, Sway, PowerPoint, Word, and others. This means that users can conveniently collaborate on documents, exchange emails, save files in cloud storage and use various Office tools to create and edit materials;

- security and privacy: Microsoft Teams has a level of security that meets the standards and ensures the protection of confidential information. It includes data protection, encryption of data transmission and the ability to manage access rights to resources.

Overall, Microsoft Teams is a powerful and intuitive tool for organizing distance learning. The platform allows effective communication of participants in the educational process, synchronous and asynchronous cooperation in the online environment, and ensures teamwork in the class.

The main purpose of current and formative assessment of students in the conditions of distance learning is not to check and control but to provide feedback from the teacher to the students. Therefore, in the organization of the daily educational process, priority should be given to evaluation, which involves providing support to students, adjusting learning tools and methods in case of their inefficiency [12].

An analysis of the possibilities of using Microsoft Office 365 services for the organization of a cloud-oriented distance learning educational environment is presented in Table 2.

**Analysis of the possibilities of using Microsoft Office 365 services for organising a cloud-based educational environment for distance learning**

<i>Microsoft Office 365 service</i>	<i>Possibilities of using distance learning for organising a cloud-based educational environment</i>
Microsoft Teams	Implementation of a unified platform for distance learning, providing opportunities for video conferencing, messaging, teamwork on documents, assignments and assessments, and integration with learning management systems
Outlook	Provides email, calendar, task and workflow management, and document collaboration functions
Microsoft Whiteboard	Provides the ability to work collaboratively with a shared digital whiteboard, add images and text, annotate, and display simultaneously on multiple devices
Microsoft PowerPoint	Create presentations, use animations, visual effects, collaborate, and annotate
Microsoft Forms	Create surveys and tests, collect and analyse the results, and integrate with Microsoft Teams and Microsoft SharePoint
Sway	Create interactive stories and presentations, use built-in multimedia elements
OneDrive	Store and synchronise files, collaborate on documents, access files from any device
SharePoint	Share documents, create and manage websites, and collaborate on projects
Blippar	Creating interactive and augmented environments, virtual tours where students can explore virtual models and get additional information about specific places, biological objects or scientific concepts.

Therefore, Microsoft Office 365 services satisfy teachers' requests regarding the organization of the educational process in a distance format, and the method of designing a cloud-oriented environment for distance learning in biology will contribute to improving teachers' access to modern cloud-oriented tools and increasing the quality of knowledge acquisition by students in the framework of distance learning. Learning tools such as e-mail, Microsoft Teams, Microsoft Whiteboard, presentation programs (Microsoft PowerPoint, Sway), augmented reality applications (Blippar), traditional learning tools (video demonstrations, lab sets, digital microscope) and monitoring tool (Microsoft Forms), will help ensure effective communication and training of participants in the educational process. Cloud services are important tools for organizing the educational process, in particular, Microsoft Office 365 services are gaining more and more popularity among educational institutions. However, to successfully use these services, teachers must have the appropriate knowledge and skills. Training teachers to use these services has several important advantages:

- teachers who have skills in working with Microsoft Office 365 services can effectively use these tools to create interactive lessons, use multimedia materials, organize group work, etc. This allows you to make learning more interesting and involve students in active participation in the educational process;
- the educational process, with the help of cloud services, becomes more collective and interactive. Teachers who have been trained in the use of Microsoft Office 365 will be able to effectively organize the joint work of students on projects, tasks and discussion of materials in real-time;
- Microsoft Office 365 services provide secure storage and backup of data in cloud storage. Teachers

who have sufficient qualifications to work with these services can provide access to educational materials from any place and device, which contributes to the flexibility of learning and teaching;

- improving the efficiency of administrative processes: Microsoft Office 365 also provides tools for classroom management, assessment of student knowledge and communication with parents. Teachers who have the skills to use these services can automate some administrative tasks, for example, posting grades to the electronic journal, etc.;

Enhancing teachers' qualifications in using Microsoft Office 365 services is crucial for successfully implementing a cloud-based learning environment for biology distance education. These services offer abundant opportunities for creating interactive and collaborative learning materials, enhancing teamwork, and providing access to learning resources. The proficiency and expertise of educators in the use of these services will assist in improving the efficiency of the educational process, facilitating communication among the participants, and supporting administrative functions.

In January 2022, we presented the "Technologies of Designing a Cloud-Based Environment for Biology Distance Learning" project in collaboration with the Communal Institution "Center for Professional Development "Educational Trajectory" of the Dnipro City Council. The objective of this project is to elevate the methodological and practical levels of the professional competence of biology teachers, instil skills in the use of distance learning technologies, and enhance the methodological and theoretical competence of teachers in designing a cloud-based distance learning environment. The "Technologies of Designing a Cloud-Based Environment for Biology Distance Learning" project is a scientific investigation

that integrates the pedagogical environment designing methodology with the use of cloud technologies, focusing on the biology subject area. The main characteristics of this project are presented in Chart 1.

Within the scope of the “Technologies for designing a cloud-oriented environment for distance learning in biology” project, a series of workshops were conducted for biology teachers in the city of Dnipro. These workshops included topics such as “Possibilities of Microsoft Office 365 resources for distance learning”, “Interactive schools for distance learning”, “Cloud design oriented environment for distance learning in biology”, “Knowledge control using Microsoft Forms”, and “Designing digital content with augmented reality”. Additionally, a methodological resource was created in the form of a Microsoft Teams team named “Informative and methodological resource for distance learning”.

The aim of these workshops was to equip biology teachers with the necessary competencies for distance learning through informal education. Teachers were able to choose practicums based on self-analysis of their professional competencies. As per the Resolution of the Cabinet of Ministers of Ukraine No. 900 of August 21, 2019, after completing professional development through informal education, teachers are required to submit a report on the results of their professional development or creative work. This report should include an electronic educational resource that was completed during the professional development process and published on the website of the educational institution and/or in the electronic portfolio of the pedagogical or scientific-pedagogical employee (if available) [13].

In order to select an appropriate practicum, it is advisable for teachers to create an individual

educational trajectory which considers their personal needs and motivations for professional growth. This trajectory is tailored to the teacher’s abilities, interests, opportunities, and experience and encompasses the types, forms, and pace of post-graduate education that they wish to undertake. It also takes into account the educational programs, academic disciplines, and complexity levels that the teacher is interested in, as well as the methods and means of education that they prefer. The trajectory is implemented through an individual professional development plan. The individual educational trajectory enables teachers to define and analyse their goals and assess their progress. Self-assessment is an important component of this process, as it allows teachers to evaluate their actions, behaviours, and competencies and identify areas for further development. The purpose of this assessment is to track the dynamics of personal development, quantify and qualify the effectiveness of the teacher’s activities, and demonstrate progress over time [14].

The principle of **differentiation** is a crucial aspect of effective biology teaching. It involves tailoring the pace of learning and level of difficulty to suit the individual needs of students, whether they are advanced learners or in need of additional support. This can be achieved through the use of computer programs, interactive boards, and online resources, which not only make the subject more interesting and engaging but also provide students with greater access to information.

Another important aspect of effective biology teaching is **practicality**. This involves providing opportunities for students to apply their knowledge in real-life scenarios, such as through home research or practical tasks. By doing so, students are able to see

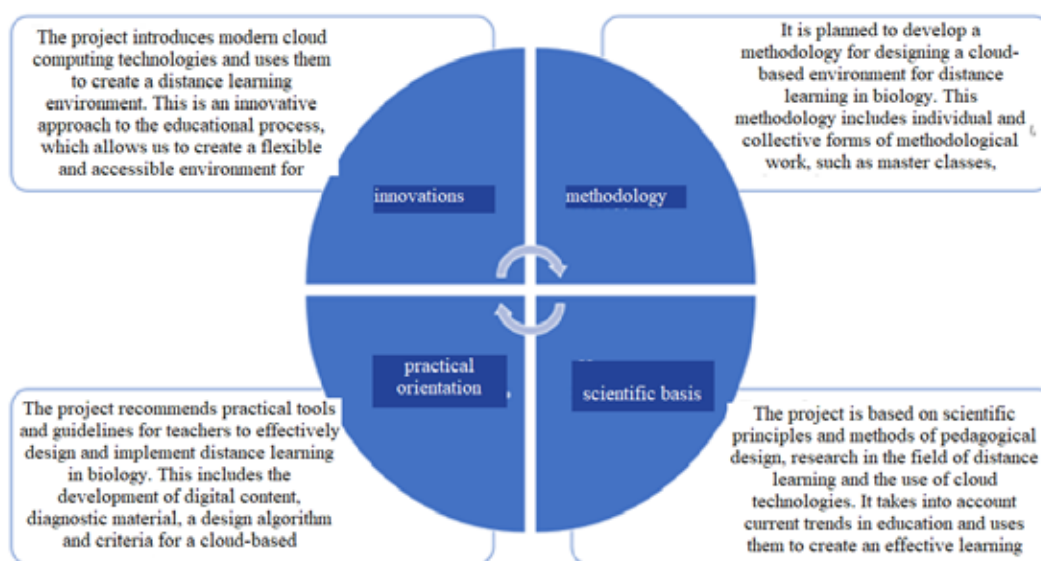


Chart 1. Main characteristics of the project “Technologies of designing a cloud-oriented environment for distance learning in Biology”

the relevance of what they are learning and develop a deeper understanding of the subject matter.

Finally, **adaptation to individual learning styles** is key to ensuring that all students are able to learn effectively. This might involve using a variety of methods, such as visual aids, audio recordings, moving games, or exercises, to cater to the different learning styles of students. By doing so, teachers can help students to better understand and retain the material, ultimately leading to better learning outcomes.

The project “Technologies of designing a cloud-oriented environment for distance learning in biology” is a scientifically based study that contributes to the development of modern approaches to teaching biology in a distance form. Teachers are provided with opportunities to learn about the basics of pedagogical design of a cloud-oriented distance learning environment through a variety of methodological commissions, master classes, creative workshops, trainings, seminars, workshops, and conferences. Workshops are held on various topics such as “Possibilities of Microsoft Office 365 resources for distance learning”, “Interactive skills for distance learning”, “Designing a cloud-oriented environment for distance learning in biology”, “Knowledge control using Microsoft Forms”, and “Digital content design with augmented reality”. The project also involves the use of informal education, including a distance course on the Microsoft Teams platform “Microsoft Office 365 resource possibilities for distance learning organization”. The seminars-workshops are focused on the interpretation of the knowledge gained by teachers, the creation of an activity product, and the development of methodological recommendations for the implementation of the project. The main product of the proposed model is the formation of teachers’ competencies in developing their own educational environment projects using Microsoft Office 365 services. The project aims to organize distance learning by developing criteria for a cloud-oriented distance learning environment and diagnostic material.

#### REFERENCES:

1. Дослідження якості організації освітнього процесу в умовах війни у 2022/2023 навчальному році/ Державна служба якості освіти України. URL: <https://sqe.gov.ua/wp-content/uploads/2023/04/yakist-osvity-v-umovah-viynu-web-3.pdf> (дата звернення 20.05.2023).
2. Проект Концепції цифрової трансформації освіти і науки/ МОН. URL: <https://mon.gov.ua/ua/news/konceptsiya-cifrovoyi-transformaciyi-osviti-i-nauki-mon-zaproshuye-do-gromadskogo-obgovorennya> (дата звернення 20.06.2022).
3. Гриценчук О.О., Овчарук О.В., Трубачов С.І. Ефективність використання інформаційно-цифрового навчального середовища як засобу розвитку громадянської компетентності учителів. *Інформаційні технології і засоби навчання*. 2021. № 6. URL: <https://journal.iitta.gov.ua/index.php/itlt/article/view/4665> (дата звернення 20.06.2022).
4. Овчарук О. В. Розвиток інформаційно-комунікаційних компетентностей учнів засобами ІКТ. *Інформаційні технології і засоби навчання*. 2012. № 6 (32). URL: <https://journal.iitta.gov.ua/index.php/itlt/article/view/757/567> (дата звернення 18.02.2023)
5. Биков В.Ю., Спірін О.М., Шишкіна М.П. Корпоративні інформаційні системи підтримання науково-освітньої діяльності на базі хмаро орієнтованих сервісів. Проблеми та перспективи формування національної гуманітарно-технічної еліти: збірник наукових праць. Київ, 2015. 178 – 206 с. (дата звернення 18.02.2023)
6. Литвинова С.Г. Інформаційно-комунікаційні компетентності вчителів загальноосвітніх навчальних закладів. *Комп'ютер у школі та сім'ї*. 2011. № 5. URL: [http://nbuv.gov.ua/UJRN/komp\\_2011\\_5\\_3](http://nbuv.gov.ua/UJRN/komp_2011_5_3) (дата звернення 18.02.2023)
7. Про деякі питання організації здобуття загальної середньої освіти та освітнього процесу в умовах воєнного стану в Україні: Наказ Міністерства освіти і науки України від 28 березня 2022 р. № 274 URL: <https://mon.gov.ua/storage/app/uploads/public/624/200/1c5/6242001c570a8380605603.pdf> (дата звернення 18.02.2023)
8. Методичні рекомендації «Організація дистанційного навчання в школі/ Міністерство освіти і науки України. 2020. [Електронний ресурс]. URL: [https://rada.info/upload/users\\_files/41919831/4c6d4edbb7e057a3ecea236cc72d989d.pdf](https://rada.info/upload/users_files/41919831/4c6d4edbb7e057a3ecea236cc72d989d.pdf) (дата звернення: 06.05.2023).
9. Биков В.Ю. Дистанційна освіта: актуальність, особливості і принципи побудови, шляхи розвитку та сфера застосування. Інформаційне забезпечення навчально-виховного процесу: інноваційні засоби і технології : колективна монографія. Київ: Атіка, 2005. 77-92 с.
10. Олійник В.В., Грабовський П.П., Коновал О.А., Критерії та показники добору цифрової платформи електронного навчання для закладу загальної середньої освіти. *Інформаційні технології і засоби навчання*. 2022. № 4.19 – 31с.
11. Литвинова С.Г. Теоретико-методичні основи проектування хмаро орієнтованого навчального середовища загальноосвітнього навчального закладу : дис. доктора пед. наук: 13.00.10./ Інститут інформаційних технологій і засобів навчання. Київ, 2016. 602 с.
12. Водоп'ян Н.І. Організація оцінювання навчальних досягнень учнів в умовах дистанційного навчання засобами Microsoft Forms: Використання системи комп'ютерного моделювання в умовах дистанційного навчання : збірник матеріалів за заг. ред. С.Г. Литвинової, О.М. Соколюк. Київ: ФОРМ-Ямчинський О.В.2020.195с.
13. Деякі питання підвищення кваліфікації педагогічних і науково-педагогічних працівників: Постанова Кабінету міністрів України від 21.08.2019 р. № 800. URL: <https://zakon.rada.gov.ua/laws/show/800-2019-%D0%BF#Text> (дата звернення 20.05.2023)
14. Когут У.П., Сікора О.В., Вдовичин Т.Я. Формування індивідуальної освітньої траєкторії вчителя з розвитку цифрової компетентності. *Інформаційні технології і засоби навчання*. 2022. № 91. 186–204 с.