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Use of Modern Technologies and Digital Tools in the Context of Distance and Mixed Learning

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Abstract---Widespread use of distance learning, which is equated with conventional education, is recognised as one of the priority tasks of Ukrainian education, which implements information communication and digital technologies. The relevance of the study increases dramatically due to the fact that in the context of the spread of coronavirus and the real risk of infection growing with it, almost all educational institutions are switching to distance learning mode. The key figure in solving this problem is the qualification of the teacher and their education, the level of which greatly influences the effectiveness of the entire process of distance and mixed learning. The purpose of the study was to investigate information technologies and digital tools that could be used in educational institutions in the context of distance and mixed learning. As a result of the study, the authors were able to analyse world practice of using technologies and information resources for distance and mixed forms of learning. Systematic use of educational technologies and digital tools and tools in the implementation of curricula for training students in distance and mixed learning, with such video communication systems as Google Hangouts Meet, Webex and Zoom for the organisation of lectures and Google Classroom for practical classes, allow organising the educational process in accordance with modern requirements of teaching in higher education institutions both remotely and in a mixed form in accordance with the requirements of the Ministry of Education and Science of Ukraine and its recommendations.

Keywords---conference, educational process, information technologies, student, teacher.

Introduction

The introduction of distance education began in Ukraine in recent decades, but did not gain wide popularity and importance, because conventional education was the best option for applicants for higher education. However, as in any process, there is always a developmental stimulator. In this case, such an incentive, and unfortunately a negative one, was the global COVID-19 epidemic. Due to the spread of the COVID-19 epidemic on March 11, 2020, the Cabinet of Ministers of Ukraine has decided to introduce quarantine for all types of educational institutions. Pursuant to the Resolution of the Cabinet of Ministers of Ukraine No. 211 "On Preventing the Spread of Acute Respiratory Disease COVID-19 Caused by the SARS-CoV-2 Coronavirus on the Territory of Ukraine" No (2020), all higher education institutions switched to distance learning mode on March 12, 2020. Over time, in some regions, the epidemiological situation allowed for the educational process both remotely and in a mixed form. But the most important task has been the problem of professional application of technologies and information digital tools and means for organising the educational process (Lyakhova et al., 2020; Makarenya et al., 2020).

The solution to the problem of widespread use of technologies and digital tools of distance and mixed learning in Ukrainian practice depends on solving the problem of readiness of distance learning teachers. The problem of the study is complex and multidimensional. It comprises a number of tasks, such as identifying the psychological and pedagogical, and theoretical and methodological foundations of the system of preparation for distance learning; substantiation of the concept of designing the technology of training teachers (lecturers) of higher educational institutions for distance learning; determination of specific features of activities and developing a multi-faceted feature of a distance education teacher as a subject of the educational process; development of the content of this training and creation of a methodological complex for effective implementation of this content in training and methodological manuals and recommendations, as well as curricula; development and experimental verification of the technology of preparing teachers for work in distance learning systems; criteria identification for teachers' readiness to work in distance learning, training, research and its experimental verification (Golitsyna, 2017; Igor et al., 2015). This study scrutinises the specific features of information and digital technologies for the stage of technology for preparing university teachers for distance education. But despite the obvious importance of teachers' readiness for distance learning, the analysis of information technologies and digital means and tools of distance learning constitutes a critical task. Notably, distance learning provides the following advantages (Table 1).

Table 1 Distance learning advantages

| Advantage | Feature |
|---------------|---|
| Flexibility | The ability to present the course material taking into account |
| | students' abilities and training. This is achieved by creating |
| | alternative websites to get more detailed or additional |
| | information on unclear topics, as well as a number of hinting |
| - · | questions, etc. |
| Relevance | The possibility of introducing the latest pedagogical, psychological, and methodological developments. |
| Convenience | The ability to study at a convenient time, in a certain place, get |
| | an education on-the-job, no time limits for mastering the |
| | material. |
| Modularity | Breakdown of the material into separate functionally complete |
| | topics that are studied as they are learned and correspond to the |
| _ | abilities of an individual student or group in general. |
| Economic | The teaching method is cheaper than conventional ones due to |
| efficiency | the efficient use of training facilities, easier adjustment of e- |
| 0 1 1 11 | learning materials and multi-access to them. |
| Scalability | The ability to simultaneously use a large amount of educational |
| T / / ' ' | information by any number of students. |
| Interactivity | Active communication between students of the group and the |
| | teacher, which considerably increases motivation to learn, |
| | improves the assimilation of the material. Greater opportunities to control the quality of training, which include discussions, |
| | chats, the use of self-control, and the absence of psychological |
| | barriers. Lack of geographical boundaries for obtaining an |
| | education. Different courses can be studied in different |
| | educational institutions around the world. |
| | and a substitution of the |

Among the scientists involved in the development of research-to-practice approaches to the development of the use of information technology and digital tools in distance education and mixed learning processes, it is worth mentioning Popova et al. (2020); Rasheed et al. (2020); Thistoll & Yates (2016); Gavrilova & Katasonova (2017); Olenets (2018), and others. When considering information technologies and digital tools, the authors of the study mean particular platforms and tools (Webex, Zoom, Google Hangouts Meet, Google Classroom, Skype, Google Suite/Docs). These pieces of software and digital information resources allow teachers to communicate with students, check their tasks, monitor attendance, organiSe semester control, certification, and other educational processes in a distance learning environment. Such technologies, depending on the country, university, and discipline studied, can be integrated at any stage of the training course. The teacher's initiative to introduce such technologies, students' willingness to use them, and the technical ability of both sides to apply these technologies are important here (Mora et al., 2015; Lluch, 2011).

The purpose of the study was to investigate information technologies and digital tools that could be used in higher educational institutions in the context of distance and mixed learning. To achieve this purpose, it is necessary to solve the

following tasks: to analyse the feedback of university students on the use of distance learning technologies; to determine the attitude of students towards the educational process on the Internet; to find out the positive aspects and problems of using digital technologies at the university; to make recommendations for improving distance education (Premkumar & Roberts, 1999; White et al., 2005).

Literature Review

Before directly analysing the technology and digital tools of distance learning and mixed learning in educational institutions, and first of all higher education institutions, it is worth considering how Ukrainian practices and practices from other countries approach this issue. The digitalisation of world economic processes has had a great impact on the digitalisation of higher education (Popova et al., 2020). The idea of developing this area of educational activity is supported by many researchers who contemplate the possibility of expanding round-the-clock learning technologies for the digital generation, thereby increasing the competitiveness of the university. The study presents a critical review of the literature that covers the essence and areas of digital technology management and the basics of consumer behaviour of digital users (Figlio, 1997; Zeichner, 2005; Hanushek & Rivkin, 2006).

The scientific study indicates that the spread of coronavirus infection (Makarenya, 2020) served as the impetus for the transition of education to the era of digitalisation not partially, but completely and without exceptions. This paper describes the positive effects of this transition, which many scientists have noticed. This study also discusses distance learning methods and describes the most effective methods, such as business play, in more detail. The authors highlight the importance of focusing on personalising learning, which is possible in a digital educational environment. The study Khanna (2016), describes the structure of the good governance architecture, which will considerably improve the overall performance of distance learning institutions on a well-structured and systematic basis. The structure of good governance comprises seven basic principles, namely: effectiveness, transparency, accountability, participation, leadership, consensus orientation, and equity. The developed system will provide a significant improvement in educational and methodological activities, as well as the quality of distance learning (Roach, 2014; Markova et al., 2021; Leshchynska et al., 2021).

The study Rasheed et al. (2020), notes that mixed learning involves a combination of face-to-face and online components that are carefully intertwined to complement each other. The study aims to explore the challenges that students and teachers face upon using technology and information tools in a mixed learning environment. The conclusion suggests recommendations that an educational institution should adopt when providing appropriate technology for mixed and distance learning by determining the overall level of technological skill and competence of its teachers and students. In the study Wen et al. (2019), a cognitive learning model was developed to optimise the uncertainties and complexities that are inherent in distance learning. The proposed model takes into account the learning motivation of higher education applicants, the requirements for the learning task and the speed of changing cognitive rules, and

transforms the learning process in distance learning into a multi-purpose optimisation problem.

The article Thistoll & Yates (2016), presents a simple model of student engagement that reflects the triality between the student, the educational institution, and the external environment. When testing the study, both employees and students recognised the distance learning system as relevant and up-to-date. Research was carried out in a similar area in the studies (Al-Rahmi et al., 2018; da Costa et al., 2018). The study Gavrilova & Katasonova (2017), considers theoretical aspects of the development of distance education in Ukraine, in particular its conceptual framework. The analysis of scientific sources was carried out, which made it possible to systematise the key concepts and features of distance learning. The article examines how the basic concepts of distance learning were defined historically. The author compares the concepts of "distance education" and "distance learning". The study Yandell (2020), investigates the educational processes in distance form in England, especially when learning English.

The article Lyakhova (2020), notes that the preparation and conduct of online lectures and seminars involves not only digitising materials for study and selecting appropriate information support, but also reviewing approaches to their implementation. It is important to engage and activate students in order to get the greatest effect and assimilation of the presented material. That is why the purpose of the study was to explore the possibilities of using cloud services to support attention and receive feedback from lecture listeners when conducting lectures on the Internet. To achieve the research goal, the main method of the study was an expert survey. It was found that online lectures are accompanied by a loss of concentration and attention in students under the influence of various factors. Therefore, this study used an approach where applicants were engaged in interactive participation during an online lecture in three stages, moving from teaching lecture material to online activity using prepared interactive materials in online services. This allowed retaining the attention of the lecture audience, switching it between the phases of presentation of the material and activities in the process of group and individual interaction.

The article Sakulina (2018), analyses distance learning methods. Combined with the latest information technologies, the distance learning system allows implementing an individual approach to learning and achieve high results due to the optimal selection of the content of the training course, as well as teaching methods and tools. In this study, distance learning was considered as an alternative to other types of education: full-time, part-time, or evening training at a university; self-education using educational literature and Internet resources. The article Netanda (2017), covers the development of the distance education system in South Africa. The study reveals the problems faced by the government of the country in achieving progressive results in the country's education. When students study the material using remote platforms, it is also possible to perform independent work (Havrylyshyn et al., 2019). The article presents the procedure for performing independent work by students of higher educational institutions. Thus, based on the literature review, it can be concluded that distance and mixed forms of learning are becoming increasingly important in educational processes,

and the study of information and digital learning tools requires increasingly more attention from the academia.

Materials and Methods

The methodological basis of this study includes the main ideas of system, technological, and process approaches. To solve the tasks at hand, the study used the developments from scientific, pedagogical, and methodological literature, Ukrainian and international practices in preparing teachers for distance learning, that is, their study of technologies and information tools for distance and mixed learning in higher education institutions, as well as theoretical (identification of contradictions of this problem, analysis, synthesis, comparison, etc.) and empirical (observation, survey, testing, monitoring, etc.) research methods; diagnostic-forming experiment, statistical processing of its results. Distance learning technologies are closely related to the most common teaching methods. In the aspect of considering distance learning, there are the following methods: illustrative, reproductive, problem presentation, research, and heuristic. Figure 1 demonstrates these methods in detail.

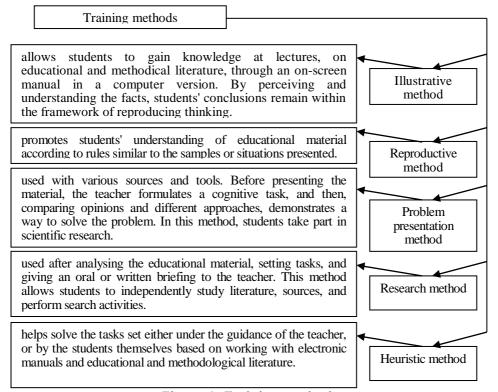


Figure 1. Training methods

The most popular information and digital means of carrying out distance learning include means that are included in groups of teleconferences, video conferences, as well as the use of the e-mail service. Teleconference constitutes a network service that allows organising a joint discussion of thousands of users of a global

computer network, and which can be presented in the form of a large bulletin board. The essence of the teleconference boils down to the fact that the user receives articles from other participants, and can send their notes to other participants. A video conference is a communication session between two or more users of the network, both corporate and global, who can be at a fairly large distance from each other, and not only hear, but also see each other. Typically, video conferences allow broadcasting desktop images, enabling the conference participants to work together. E-mail is a technology and service for sending and delivering electronic messages to computer network users. A more detailed description of possible information and digital resources for conducting various types of classes in remote form is presented in Table 2.

Table 2
Use of information and digital resources in accordance with the forms of distance learning classes

| Forms of distance learning | Information and digital resources |
|--|--------------------------------------|
| Electronic lectures | E-mail, Google Drive, Moodle, Zoom, |
| Electronic lectures | Webex, Google Classroom |
| Online seminars | Zoom, Webex |
| Practical exercises | E-mail, Google Drive, Moodle, Google |
| Fractical exercises | Classroom, Microsoft Office |
| Term papers, projects, calculation and | E-mail, Google Drive, Zoom, Google |
| graphic works | Hangouts Meet, Microsoft Office |
| Independent work of students | E-mail, Google Drive, Moodle, Google |
| independent work of students | Classroom, INTERNET |
| Test control as a form of intermediate, modular, and final control | Moodle, Microsoft Office |
| Other forms of final certification | |
| (exams, credits, state exams, defence of | Zoom, Webex, Google Hangouts Meet, |
| qualifying papers) | Skype |
| Communicators | Viber, Telegram, WhatsApp, Imo |

Each remote technology has its critical features and aspects of use, and therefore it is important, especially when conducting the educational process in quarantine, to understand the general mechanisms of using software packages and distance educational technologies. This study focuses on educational technologies used in the context of curricula and institutions that offer complete distance learning courses (Anderson & Rivera-Vargas, 2020). All education in the 21st century is digital, through which the use of networks, the creation of text and images and their editing, as well as the search for information actualise the life of almost every teacher and student. However, the context of distance education – where all interactions are mediated –creates a unique and enhanced context of digitalisation. This study focuses on two issues:

• What aspects were not completely satisfactory in the process of transition and transformation that education has undergone, from its more conventional concept based on transition to its new configuration, marked by the constant use of digital technologies and the environment.

• What future challenges does distance education have to face to support the sustainability of this teaching model?

Based on theoretical and interpretive analysis, based on the review of relevant studies and documents on distance education, the study identified the objects requiring a critical study in the use of digital technologies in distance education: limitations, shortcomings, and future problems. The authors of Shahmoradi et al. (2018), note that success in implementing an e-learning educational system as one of the main approaches to managing the knowledge and educational needs of a higher education organisation will not be achieved without identifying various skills, technical, and cultural problems. To solve this problem, it is necessary to create an information technology infrastructure and standards, use the experience of leading countries in the field of e-learning, create an appropriate culture and familiarise students and teachers with the development and use of e-learning materials.

Results and Discussion

The main purpose of using information technology and digital tools in a higher education institution should be the acquirement of knowledge, skills, and abilities by students and applicants, which are necessary for effective interaction with modern computer equipment and new information technologies and digital tools in the educational process and future professional activities. Considering the future specialty of students and applicants for higher education, in the classroom, if possible, it is necessary to link terms from information technology and digital tools with concepts from their future subject area. The functionality of each of the software programmes listed in Table 1 is quite wide, and therefore attention will be paid to the main features that will reveal the main technical possibilities of using some of the information and software resources, namely Google Hangouts Meet, Webex and Zoom, Google Classroom and for what forms of conducting classes in the remote form of the educational process they can be applied.

Google Hangouts Meet. This software solution allows taking part in a video conference from a personal computer, laptop, tablet, or mobile phone. For those who have a mobile phone or tablet running on the iOS operating system, i.e., an iPhone or iPad in the Apple Store, follow the link App Store Preview (2021), to download and install the Hangouts Meet application by Google. Then log in to the app, grant the app access to use the device's microphone and camera, and log in to your Google account. After receiving a link to the video conference, click on this link and press "Join meeting" (Figure 2).

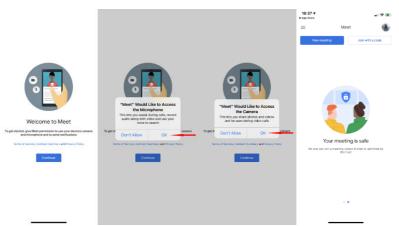


Figure 2. Joining google hangouts meet

For those who have a mobile phone or tablet running on the Android operating system, follow the link Google Play (2021), in the Play Market store to download and install the Hangouts Meet application. Then log in to the app, grant the app access to use the device's microphone and camera, and log in to your Google account. After receiving a link to the video conference, click on this link and press "Join meeting" (Figure 2). Participation in a video conference on the specified platform from a computer or laptop does not involve installation of additional software. The system works in the browser (preferably in Google Chrome), one merely needs to provide access to the microphone and camera in the appropriate tab of the browser, enter their name and click "Join meeting" or "Send a request to join". The interface is presented in Figure 3.

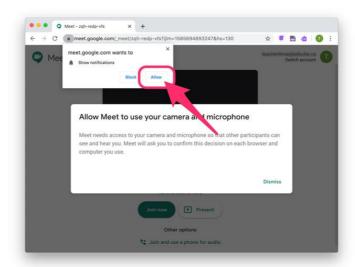


Figure 3. Google hangouts meet interface

Webex. To conduct a webinar or video lecture using Webex, one needs to register on the webex.com website Webex (2021), uses the "Start for Free" button in the

upper-right corner of the page or the "Sign up now, it's free" button in the middle of the page (Figure 4).



Figure 4. Registering with Webex

After registering, one must fill in their personal information and select a password. Please note that the password must contain at least 6 characters, including numbers, uppercase and lowercase letters (Figure 5). After registration, the website redirects the user to their Webex personal area (Figure 6). In the future, to log in to a personal account, the user needs to go to the webex.com website Webex (2021), and select the "Sign in" (Webex Meeting) option. To schedule a future video lecture or webinar, the user must press the "Schedule" button and add data to the fields. Next, the user needs to specify the title of the scheduled meeting, password, date, time, and duration of the webinar. In the "Attendees" field, one can add participants' e-mail addresses separated by commas or semicolons so that the system automatically sends them e-mail invitations. By clicking "Start", the webinar starts immediately or is scheduled accordingly.

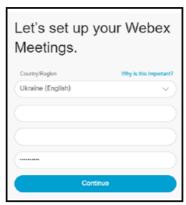


Figure 5. Entering personal information

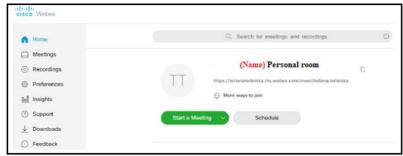


Figure 6. Webex personal account

After creating a video lecture (webinar), the user will see information to join it (link, number), which can also be provided to users by e-mail or posted in an electronic training course (ETC), social networks, etc. (Figure 7).

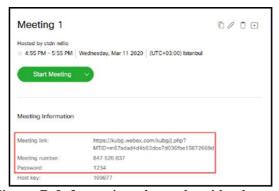


Figure 7. Information about the video lecture

Participants/students whose e-mail addresses were entered upon creating an online meeting will receive an e-mail notification with information about it. To join, the user must click "Join meeting". After clicking on the link, the user will be prompted to install the Cisco Webex Meetings software. The user can choose whether to install the software or join via the browser. For mobile phones, only the software installation option is available. To start a video lecture or webinar, the user must click on the "Start meeting" button (Figure 8). After joining, various online meeting management tools become available to the teacher-organiser of the meeting (Figure 9).



Figure 8. Starting a video conference in Webex



Figure 9. Online meeting management tools in Webex

Zoom. Zoom combines cloud-based video conferences, simple internet conferences, and group chat in platform-based conference rooms (Stechkevych, 2020). After registering or logging in, the user must click "organise a conference" – the desktop application will automatically load. Alternatively, one can click on the download link in the footer (Zoom, 2021). To log in, the user needs to just go to the site and click "Sign in". After that, one can log in using their Google, Facebook, or existing Zoom account (Figure 10).

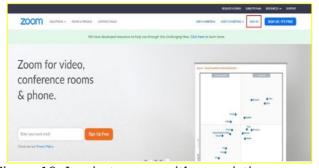


Figure 10. Log in to zoom with an existing account

If the user does not have a Zoom account, they have to click "Sign Up Free" to create a new Zoom account. The personal meeting ID (PMID) is automatically assigned to the user as a permanent personal meeting room. The user can run it at any time or schedule it for future reference. The user's PMID is part of the

personal URL (Uniform Resource Locator) of the meeting. For example, https://zoom.us/j/5551112222. If the user is on a paid plan and has a Pro license, there is an option to set up a 10-digit PCID, otherwise changes are not possible. On working with video meetings:

- To start, the user must click "Start" to commence a pre-scheduled conference included in the list of upcoming meetings.
- To edit, or update a scheduled meeting, the user can go to the "Personal Meeting Room" tab.
- To delete, the user must click "Delete", which removes the scheduled meeting permanently.

Select "Meeting" to view, start, edit, and delete scheduled meetings, meeting recordings, and the PMID (Figure 11).



Figure 11. "Meeting" functionality

To start creating a meeting, the user must click on the system button "Schedule a New Meeting". It is also important to understand how the functionality that is placed in the lower panel of the screen works when conducting a video meeting. A detailed description of the features is presented in Table 3.

Table 3
Description of the functionality placed at the bottom of the screen during the Zoom video meeting

| Functionality | Description | | |
|---------------|--|--|--|
| Mute | Turns the microphone on or off. | | |
| Start Video | Shows a video from the camera or sets a screen saver from the user's account | | |
| Invite | View and manage participants (if the user is an organiser) | | |
| Manage | Opens a window with a list of users. | | |
| Participants | | | |
| Share Screen | Allows uploading photos and images for demonstration to participants, share the screen of the user's computer. | | |
| Reaction | Allows adding an emotional response to the report. | | |
| More | Element for displaying additional parameters. | | |

To complete the Zoom video meeting, the user must click "End Meeting". The cloud-based Google Classroom platform combines useful Google services organised specifically for learning. Google Classroom features are presented in Figure 12.

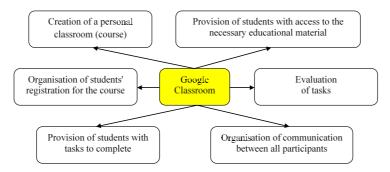


Figure 12. Google Classroom features

To get started in Google Classroom, one needs to log in to corporate mail (Figure 13).



Figure 13. Authorisation in corporate mail

Google Classroom is located in Google apps where one can select it for further work. After logging in to the programme, the user will need to select a role (Figure 14). After opening it, the programme will redirect the user to Google Classroom, where they can start creating their own course. Training courses that have been accessed by other users will also be found. To create a new Classroom (a discipline to study in Google Classroom), the user must click on "+" in the upper-right corner and select the "Create Classroom" command.



Figure 14. Creating a new course in Google Classroom

When creating and organising a course, the main tabs will be available: "Tasks", "People" and "Grades" (Figure 15).

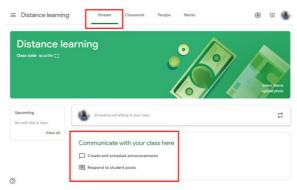


Figure 15. Working with the "Tasks", "People", and "Ratings" tabs

The "Tasks" tab allows adding training materials to the course and distribute tasks by topic and in the required sequence. When creating a "Task", the user should follow the system prompts and carefully fill in all the fields, because the interface is intuitive. In the "People" tab, the user will see a list of students who have joined the course. Users who have not yet confirmed the invitation in the system have a pale icon and are inactive. All authorised users can send individual notifications via corporate mail (the user must click on the icon and select the "Send e-mail to Student" command). In the "Grades" tab, the teacher can check tasks, give grades, and comment on answers. Going back to the "Tasks" tab, statistics for each type of work are available. In addition, most of the functionality is occupied by the student's work, but within the framework of a scientific publication on the main technologies of distance learning, this is difficult to describe in detail. Table 4 demonstrates the advantages and disadvantages of using Google Classroom.

Table 4
Advantages and disadvantages of using Google Classroom

Advantages of Google Classroom

- Setting up the course to be created is not difficult. It is possible to test students' knowledge.
- Free and affordable. There are no ads in the service.
- One can invite up to 20 teachers to conduct a training course.
- Storage of all course materials on Google Drive, including tasks completed by students.
- Ability to communicate between the teacher and students, and between students. Students can

Disadvantages of Google Classroom

- Google Classroom does not provide a webinar room, but this problem is solved quite simply. The teacher can use the features of YouTube or Google Hangouts, which allow holding an online meeting with students.
- There is no electronic journal (student report card) in the open version of the Google Classroom service. This feature is available for corporate users of Google Classroom.
- For authors who have personal

- view tasks, leave their comments, and ask questions to the teacher.
- Google Classroom has integration with Google Drive, Google Docs, Google Calendar, Google Forms, and Gmail.

accounts, there are restrictions: the number of course participants is no more than 250 and only 100 people can join the course in one day (Kolomiytsev, 2020; Olenets, 2018).

Conclusion

Systematic use of educational technologies and digital tools and tools in the implementation of curricula for training students in distance and mixed learning, with such video communication systems as Google Hangouts Meet, Webex and Zoom for the organisation of lectures and Google Classroom for practical classes, allow organising the educational process in accordance with modern requirements of teaching in higher education institutions both remotely and in a mixed form in accordance with the requirements of the Ministry of Education and Science of Ukraine and its recommendations. Furthermore, these processes will contribute to the development and maintenance of an appropriate level of competence of both the teaching staff of higher educational institutions and future specialists in the context of complex educational processes, both in the conditions of quarantine restrictions at the moment and in the aspect of introducing full-fledged distance courses in the future.

The use of distance learning and digital technologies allows reducing the cost of training (no need for renting expenses, travelling to the place of study, for both students and teachers, etc.); conducting training for a large number of people; improving the quality of training through the use of modern tools, large electronic libraries, etc.; creating a single educational environment (especially important for corporate training). Further development of the study is seen in scientific publications on the use of individual digital distance learning tools for teaching individual disciplines, because each of them may have specific teaching features that should be addressed.

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