

# Developing digital competence of teachers in postgraduate education using Google Workspace for Education

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**Abstract.** Digital competence is a key skill for teachers in the era of distance education. However, developing digital competence requires appropriate forms and training methods that utilise the available technologies and tools. In this article, we explore how Google Workspace for Education, a cloud service that offers various digital education tools, can foster digital competence among teachers in postgraduate education. We draw on our experience organising and conducting distance learning courses for university teachers at the Department of Open Educational Systems and Information and Communication Technologies of the Institute of Postgraduate Education. We present the theoretical background of competence, digital competence, and distance education and the educational opportunities that Google Workspace for Education provides. Using Google Classroom as the main platform, we describe the effective ways of developing digital competence in distance learning. We analyse the participants' learning outcomes and the benefits of collaborative learning. We also report the results of our research on developing teachers' digital competence based on selected criteria and indicators. We highlight the promising trends and challenges in developing teachers' digital competence in distance education.

**Keywords:** digital competence, postgraduate education, distance education, Google Workspace for Education

## 1. Introduction

The transition from the industrial to the information society is a global trend that affects many aspects of human life, including education. In Ukraine, as in many other countries, the digitalisation of education is a priority task for developing the information society, as stated in the document "Digital Agenda for Ukraine 2020" [15]. However, the digitalisation of education requires not only the use of digital technologies in education but also the development of digital competence of the educational actors, especially the teachers who are responsible for delivering

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quality education to their students [23]. Digital competence is recognised as one of the key competencies for lifelong learning by the European Parliament and the Council of the EU [14], as well as by various national regulations related to education. In this context, distance and blended learning [4, 64], based on educational innovations and supported by digital tools, become increasingly popular and relevant in the world, especially in the situation of pandemic and quarantine measures [8, 56].

The quality of education is a crucial factor for the well-being and development of individuals and society. The theory of human capital, developed by Schultz [60] and Becker [3], shows a direct correlation between the level of investment in education and economic and social prosperity. Migala-Warchol and Pasternak-Malicka [39] also demonstrate that the level of development of science, technology and education is related to the indicators of socioeconomic development. Therefore, investing in human skills (education) is the most effective way to increase the competitiveness of the economy, accelerate the pace of economic development, and improve the standard of living of a population.

The Ministry of Education and Science of Ukraine has identified the issue of ensuring the quality of education as its priority activity based on scientific research. According to the Ministry, ensuring the quality of higher education should be implemented according to the following main directions:

- alignment with European standards in education development;
- adoption of a new understanding of the content and procedures of quality assurance;
- implementation of the directions of education reform approved by the government;
- improvement of the quality assurance system.

Information technologies are considered essential for supporting highly efficient education systems and as a tool for ensuring their quality and control.

The issue of education informatisation [16] is consistent with the government's policy regarding transferring most public services into the virtual environment "government in a smartphone" and is increasingly addressed to the ability of ICT to ensure the corresponding quality of education.

The quality of education is a complex and multifaceted issue that can be evaluated from different perspectives, such as:

- economic impact;
- communication risks (analysis of the effect of transferring educational communication to the virtual space; understanding of the characteristics of subject-object interaction between the participants of educational communication);
- the content and technologies of the quality assessment system (what is assessed and what criteria are used; algorithm of examination) etc.

Distance and blended learning are alternative modes of education that differ from traditional face-to-face learning. In the current situation, more and more educational institutions are adopting these modes of education, using the latest approaches and technologies [5, 17, 30, 38, 40, 68, 71]. By applying distance education programs, teachers can improve the forms and methods

of collaborative activities of all participants in the educational process and develop their digital competence. Distance learning, usually understood as an individual process of transferring and acquiring knowledge, skills and methods of human cognitive activity, allows the implementation of all educational tasks based on specialised information educational environments and distance-learning platforms through indirect interaction between distant participants. Considering the challenges of our time, each educational institution chooses the educational environment and distance-learning platform that best suits their educational needs and allows them to demonstrate the final results of the educational process. However, one of the current tasks of European and domestic higher education is to create a unified educational environment in educational institutions of different types, where teachers can have access to a shared database, regulatory and working materials, collaborate on shared documents, exchange information, create common means of visualisation of educational content, etc. The main advantage of such an environment is the presentation of didactically unified and formalised educational material and the creation of favourable conditions for its use, regardless of time, location and mode of education of students.

The *aim* of this article is to summarise the experience of developing teachers' digital competence in postgraduate education in the context of distance learning based on Google Workspace for Education cloud services.

The *objectives* of this article are:

- to review the process of developing the digital competence of teachers during the training course in distance learning based on Google Workspace for Education cloud services;
- to identify the basic technical skills that teachers should acquire during the training courses on organising distance learning based on Google Workspace for Education cloud services;
- to identify the most effective forms and methods of training teachers in developing digital competence in the context of postgraduate education in distance learning based on Google Workspace for Education cloud services;
- to outline future directions of developing digital competence of teachers in distance learning in the context of postgraduate education.

## 2. Literature review

The works of Anderson [1], Karnishyna et al. [20], Kostikov et al. [22], Kramarenko, Bondar and Shestopalova [24], Sumlennyi [63] are devoted to the problems of distance learning. Contemporary concepts of information society development substantiating informatisation's socio-cultural essence and its impact on the education system are thoroughly presented by Kremen [25], Kremen and Bykov [26], Kyrychenko [34], Striuk, Striuk and Semerikov [62].

Theoretical and practical research related to pedagogical workers' digital competence development was conducted by Morze et al. [42]. Various aspects of formation and development of digital competence of school teachers in frames of the system of postgraduate pedagogical education are considered by Bondarchuk et al. [6], Kalinga and Ndibalema [19], Kuzminska et al. [32, 33], Morze, Kuzminska and Protsenko [44], Prokhorov et al. [58], Vakaliuk, Spirin and

Kontsedailo [70]. The works of Morze et al. [43], Vorotnykova [74] are devoted to the problem of determining the conditions for the formation of digital competence of a teacher in frames of postgraduate education.

Kukharenko et al. [28], Kukharenko, Rybalko and Sirotenko [29], Lyakhotska [36], Oliynyk [48], Spirin [61] can be considered as the founders of distance learning at the present stage of its development, including postgraduate education. Valerii Yu. Bykov laid the foundations for developing open education systems and the conceptual foundations of distance learning organisation in his works [7, 9–11]. Volodymyr M. Kukharenko's works [18, 27, 31, 67] reveal the issues related to technologies of the development of distance-learning courses, theory and practice of blended and e-learning. Research conducted by Viktor V. Oliynyk reveals actual problems of distance learning organisation in the conditions of postgraduate education, upgrade training in distance learning [49, 50].

The works of Liakhotska et al. [35], Oliynyk [51, 52], Oliynyk, Gravit and Antoshchuk [53] are devoted to the problem of scientific support for distance education, organisational and pedagogical fundamentals of distance learning and the introduction of distance learning in the practice of postgraduate education institutions.

Oliynyk, Gravit and Antoshchuk [53] laid the theoretical foundations of distance learning in postgraduate education institutions, forms, and methods of organising upgrade training courses. Liakhotska et al. [35] raise the issues of theory and practice of organisation of education in a mode of blended learning, development of digital competence of pedagogical workers according to distance learning technology, etc.

Actual problems of pedagogical workers' digital competence development are revealed by Morze et al. [42].

Problems, tendencies and perspective ways of introduction of cloud technologies in the organisation of educational and scientific systems were addressed in the works of Nechypurenko, Selivanova and Chernova [45], Nechypurenko, Semerikov and Pokhliestova [46], Oleksiuk and Oleksiuk [47], Papadakis et al. [54, 55], Popel, Shokalyuk and Shyshkina [57], Tarasenko et al. [65], Vakaliuk et al. [71], Velychko et al. [72], Vlasenko et al. [73].

Taking into account the significant pedagogical potential and the novelty of existing approaches to the organisation of distance learning based on cloud services of Google Workspace for Education and training of highly qualified specialists in higher education institutions, these issues still require theoretical and experimental research, refinement of approaches, models, methods and techniques, possible ways of implementation.

### 3. Results

The notion of competence is interpreted as acquired during the learning integrated ability of the individual, which consists of knowledge, experience, values and attitude that can be fully implemented in practice. We agree with the definition of the notion of “digital competence”, which was formulated by Valerii Yu. Bykov: “Digital competence of the teacher is knowledge and skills in the field of ICT and the ability to apply them in professional activities” [12].

According to the European Commission's science and knowledge service of the EU Science Hub, digital competence is manifested in society's conscious and critical use of digital

technologies during work, leisure time and communication [75]. Kartashova, Bakhmat and Plish [21] emphasise that digital competence cannot be a permanent unit and is derived from the notion of “informatisation of society”, so it certainly has a dynamic essence. The authors emphasise that the digital competence of an educator presupposes his/her ability and knowledge to systematically and logically use ICT, which provides access to the application and, possibly, the development of modern pedagogical technologies. That is why the digital competence of educators is perceived as the creation of information and an educational electronic environment (e-environment) of the institution, which is an electronic prototype (e-prototype) of the educational institution which ensures the development of accessibility and continuity of a quality education [21].

Avshenyuk, T. M. Desyatov and L. M. Dyachenko [2] define competence as a complex integral characteristic of a personality, detailing it through “the ability to solve problems and typical problems that arise in real life situations, in various fields based on applying knowledge, learning and life experience per the acquired system of values”. According to scientists from the Institute for Pedagogical and Adult Education of the National Academy of Educational Sciences of Ukraine, competence is the result of a person’s acquisition of competencies that allow him/her to perform work functions in a quality manner, successfully acquire knowledge, interact with other people in different situations, quickly adapt to changes in professional activities, gain social independence [2].

We agree with the researchers’ opinion regarding understanding competence due to the acquisition of competencies. Acquired competencies have the active quality of summarised skills in combination with subject skills and knowledge in specific areas (situations). They are manifested in the ability to make choices according to adequate self-assessment in a particular situation and are connected with motivation for continuous self-educational activities.

Lytvynova, Spirin and Anikina [37] notes that information and communication competence provides that a person has abilities to apply digital technologies in education and everyday life, to use a computer and computer tools rationally when solving tasks related to information processing, its search, systematisation, storage, presentation and transmission, to build information models and study them with the help of digital technologies, to evaluate the process and the achieved results of technological activities. The UNESCO ICT-CFT approach makes it possible to fully reflect the components of ICT competence while acquiring them at all levels of improvement. These include understanding and realising the role and importance of ICT for work and lifelong learning, the use of ICT tools to improve basic/subject literacy, the practice of applying ICT knowledge and skills in the ICT field for personal, social, professional and educational purposes, the choice and effective use of technical and ICT software at different stages of the teaching and educational process, etc. [69].

Resolution No. 800 of the Cabinet of Ministers of Ukraine, dated August 21, 2019, establishes the procedure, types, forms, scope (duration), frequency, and conditions of qualification upgrading pedagogical and scientific-pedagogical workers of educational institutions. Among the main areas of qualification upgrading, the document highlights the development of digital competence and orientation of the training of pedagogical workers towards the use of information and communication and digital technologies during the educational process, including e-learning, information and cyber security etc. [13].

The experience on issues concerning scientific and methodological support for the intro-

duction of distance learning in postgraduate education in Ukraine has been formed for two decades by the Department of Open Educational Systems and Information and Communication Technologies of the Central Institute of Postgraduate Education of the National Academy of Educational Sciences of Ukraine. Scientists of the department developed the organisational and pedagogical fundamentals of distance learning in postgraduate education, determined the requirements for qualification upgrading of senior management of educational institutions in the field of distance learning, identified the requirements for the organisation of distance learning in postgraduate education, developed regulatory foundations for distance education and proposed effective technologies of qualification upgrading of pedagogical workers in the conditions of postgraduate education.

Nowadays, the experience gained by the Central Institute of Postgraduate Education is successfully applied during the training courses for pedagogical workers, in particular for using digital technologies in the management of educational institutions, developing generating new digital technologies and ICT tools for professional development of educators and developing the ability to use the newest digital tools during online learning and preparation of distance tasks, etc.

Today's distance-learning education is in the process of active development. As the domestic experience proves, new forms of qualification upgrading of pedagogical workers in distance learning have recently appeared. Mastering the newest digital programs and web services during qualification upgrading in distance learning is actively spreading, and the experience of introducing digital technologies in education is gradually forming. All forms of distance learning for scientific and pedagogical workers are oriented toward developing professional competencies, among which digital competence occupies an important place.

The Department of Open Educational Systems and Information and Communication Technologies purposefully studies the use of ICT in education and the problems of distance learning in educational institutions. We conducted surveys among course participants and colleagues regarding the impact of distance-learning technologies on the quality of education. These studies were conducted to assess the quality of knowledge acquired in frames of distance-learning systems and assess the significance of the main advantages and disadvantages of distance-learning education to identify directions for improving the use of ICT in the system of distance-learning education in postgraduate studies.

The results obtained were influenced primarily by the respondents' ability to use ICT in educational activities.

The survey was conducted in six regions of Ukraine: Poltava, Vinnytsia, Rivne, Zaporizhzhia, and Kyiv. The respondents were employees of vocational (vocational and technical), professional pre-higher, postgraduate and higher education institutions. Most of the respondents were employees of higher education institutions.

All respondents stated that they use distance learning education technologies in their activities. However, almost half of them constantly need help with technical support for this mode of education. The most common problem is the speed of the Internet and its stability.

The second problem pointed out by the respondents is the quality of educational materials submitted for making available on the distance-learning platform.

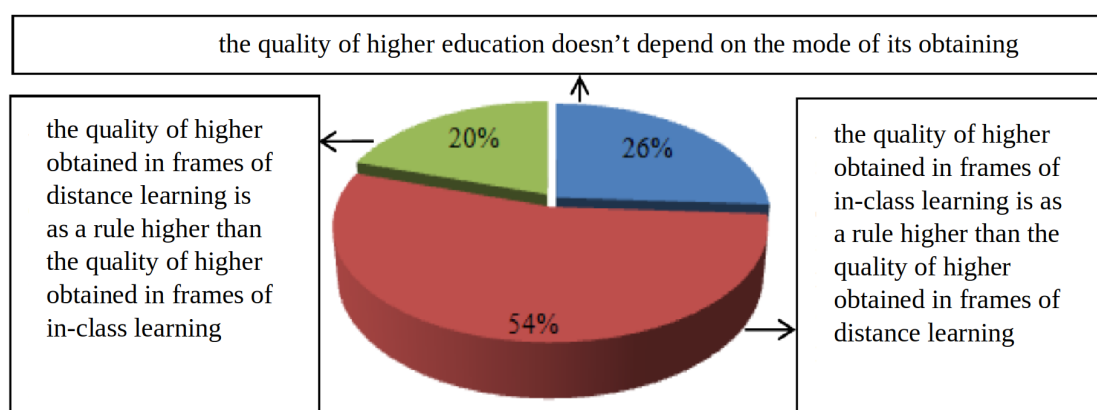
Answering the question concerning the assessment of the effectiveness of different technologies in distance learning, respondents noted that the use of presentations and educational

videos is the most effective, and the use of audio recordings is the least effective.

The survey showed that a few educators still use contemporary communication technologies such as educational sites and blogs, virtual boards, and virtual laboratories.

For comparison, we analysed the results of surveys of students of Baltic International Academy (Riga, Latvia) and the Institute of International and Comparative Education of Beijing Pedagogical University (Beijing, China). Surveys of Kharkiv, Poltava, and Sumy students and the parts of Donetsk and Luhansk regions controlled by Ukraine were also conducted. We used the results of the [41] for analysis.

One of the most important questions of the survey questionnaire was the assessment of the quality of higher education, which was obtained in frames of in-class learning and distance-learning modes, i.e. respondents were asked to compare the quality of higher education obtained in frames of the corresponding modes. The results of the expert assessment are shown in figure 1.



**Figure 1:** Students' assessment of the quality of distance learning.

This survey indicates the lack of stable traditions in Ukraine concerning the functioning of the distance-learning education system and the lack of readiness among society to adopt distance-learning mode at the same level as other traditional modes of learning.

At the same time, considering that 26% of respondents believe that the quality of higher education does not depend on the mode of its obtaining, i.e. 46% of respondents are loyal to distance-learning education.

Among the most important reasons for the lack of popularity of distance learning among students obtaining higher education is the lack of a culture of independent and systematic work of students to acquire knowledge and develop professional skills through ICT. In other words, most students obtaining higher education need constant instructor support. In addition, researchers emphasise that students need more motivation to acquire professional knowledge. In frames of in-class learning mode of education, the low level of student motivation is usually compensated by an instructor's pedagogical skills and his/her ability to constantly maintain the interest of the students obtaining higher education both towards the specific subject and towards obtaining a corresponding speciality.

The interesting results of the study were obtained during a survey on "Attitudes towards distance-learning education and assessment of its quality":

- the opportunity to learn at a comfortable pace – the final percentage of the significance of this factor is 25%;
- the possibility of obtaining professional knowledge in those higher education institutions, where education in frames of the traditional forms of educational communication is not available, for example, due to the cost of education or territorial remoteness of a particular higher educational institution – the final percentage of this factor is 20%;
- the ability to minimise the risk of bias of the subjects of educational communication (the subject of current and final control of knowledge) toward the student obtaining higher education – the final percentage of the significance of this factor is 18%;
- the possibility of mastering the curriculum at a convenient time and in a comfortable environment for a student obtaining higher education – the final percentage of the significance of this factor is 20%;
- the possibility of influencing the curriculum configuration within the chosen speciality (providing an individual approach) – the final percentage of the significance of this factor is 17%.

Taking into account the specified information, we can make the following conclusions:

Firstly, the most significant advantage of distance learning, according to respondents, is the freedom a student has in obtaining higher education and choosing the pace of learning the educational material. In other words, by combining education at a higher education institution with a job, a student often has to choose between attending classes and performing work assignments directly at his/her workplace.

Secondly, among the advantages of distance-learning education, the lowest level of significance was determined for the ability of a student obtaining higher education to influence the configuration of the curriculum and reduce the risk of bias of the subjects of educational communication (17% and 18% accordingly).

Thirdly, the high level of significance among the advantages of distance learning in the assessments of respondents the following factors received: the opportunity to obtain higher education in those higher education institutions, where it is not impossible for a particular person in frames of the traditional forms of organisation of educational process (high cost of education or territorial remoteness from the place of permanent residence) and the opportunity to study at a convenient time.

Respondents' answers concerning the assessment of the significance of certain disadvantages of distance learning were distributed as follows:

- imperfection of the system of motivation of the object of educational communication, as well as the insufficient level of his/her self-organisation and responsibility – the final percentage of the significance of this factor is 24%;
- imperfection of technology and methods of receiving/transmitting educational information (knowledge), as well as of procedures for evaluating learning outcomes – the final percentage of the significance of this factor is 15%;
- limitation of distance learning for the formation of practical skills (lack of opportunity to provide so-called live practice) – the final percentage of the significance of this factor is 21%;

- inability to timely influence (correct) wrong actions of the object of educational process (duration of time between completing the task by the object of educational communication and receiving comments from the instructor on its assessment) – the final percentage of significance of this factor is 23%;
- the risk of correctly identifying the object of educational communication, especially when passing exams or performing current tasks – the final percentage of the significance of this factor is 17%.

Taking into account the specified information, we can make the following conclusions:

Firstly, the most noticeable, in terms of their influence, disadvantages of distance learning are positioned at the level of the student obtaining higher education (higher, individual, socio-psychological and physiological characteristics of a person and the qualitative characteristics of his/her job opportunities) – 24%, as well as at the organisational and methodological level of educational program (impossibility to correct wrong actions of a student obtaining higher education in time) – 23%. Entirely unexpected for the authors of the survey was the result of experts' assessment of the significance of the factor of limitation of distance learning for the formation of practical skills at the level of only 21%. It was expected that this disadvantage of distance learning would be identified by respondents at the most powerful level in terms of its manifestation.

Secondly, among the disadvantages of distance education, experts identified the imperfections of technology and methods of knowledge retransmission and the risk of incorrect identification of the object of educational communication as having the least power of influence, 15% and 17% correspondingly. Considering that these factors are related to the level of the development of ICT in distance learning, the latter does not constrain the dynamics of distance learning development. Therefore, the focus of professional attention on distance learning management subjects should be beyond content issues and methods of applying relevant technologies.

Taking into account the practical experience of organising the interaction between educational process participants in distance learning and blended learning forms based on Microsoft Office 365, MobiSchool, and Google Workspace for Education, we conducted a preliminary comparative analysis of technical characteristics, functionality, convenience, ease of use, financial conditions for providing educational services, which resulted in the choice in favour of Google Workspace for Education as a primary platform for research.

We assumed that the educational environment of Google Workspace for Education has many opportunities for distance learning; moreover, Ukrainian public educational institutions can receive access to all Google Workspace tools for free. This educational environment is a set of services from Google through which the educational institution can conveniently organise the distance learning process. Using digital tools, teachers can broadcast and make video calls, store unlimited files and documents, publish and check assignments, create tests and presentations, share anything and have discussions using online boards, etc.

In addition, the advantages of digital services of Google Workspace for Education in the organisation of distance learning include the establishment of collective joint educational activities through digital tools, the ability to effectively monitor learning, organisation of joint interaction and information exchange, discussions in a group and chat, and also the distance learning based on Google Classroom, online conferencing, testing, correspondence, etc.

Digital services such as Google Calendar, Google Forms, Google Sheets, Google Docs, Blogger, and Google Sites are convenient for online learning, event planning, keeping class schedules, scientific and methodological support for the organisation of scientific and methodological work of pedagogical workers, educational process management, etc.

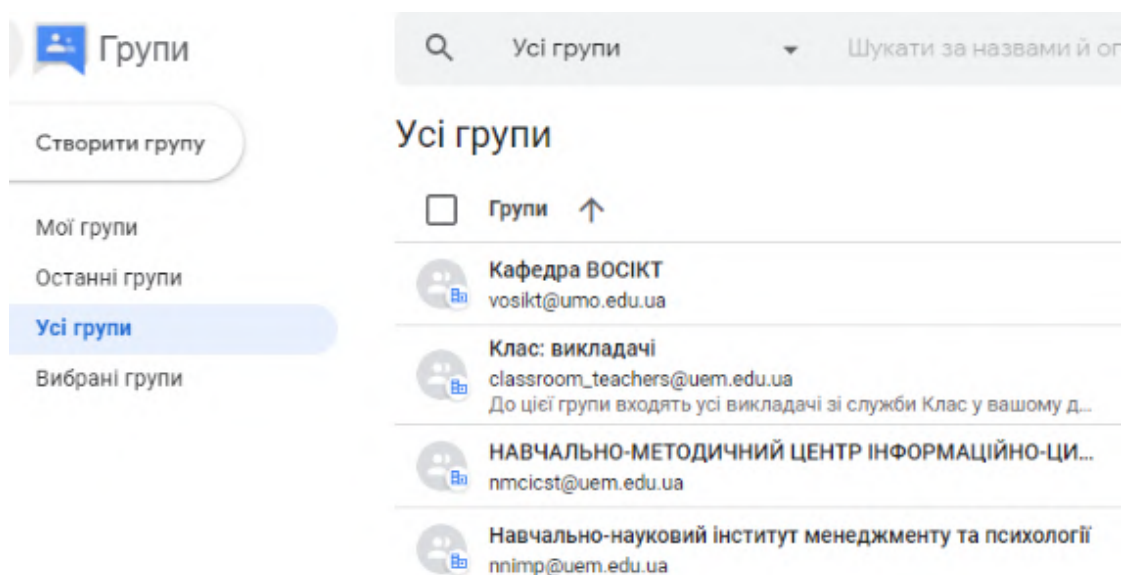
The analysis of previous research has revealed several additional advantages of Google Workspace for Education compared to other cloud services, including high quality of development that ensures stability, hacking resistance, compliance with contemporary web standards, correct display in different browsers, regular updates of cloud services, no advertising, security, constant availability, easy, simple and convenient use [66], as well as the ability to send via e-mail large attachments, automatic storage of all drafts in one file on disk, return to earlier versions of documents for further finalising.

The use of the educational environment of Google Workspace for Education in distance learning allows one to improve one's qualification in the use of digital tools to develop digital competence in the field of practical and joint work in Google Workspace with the help of newest learning methods, allows all educational process participants to work with shared Google documents in synchronous and asynchronous modes in editing, suggesting, and commenting modes, create shared Google slides, use shared Google sheets to gather information and generalise research, to use educational opportunities based on the virtual board Google Jamboard, to store necessary shared learning materials for distance learning organisation on shared disks. In addition, many educational opportunities are provided by using the Google Classroom application to organise distance learning in the G Suite educational environment. Every teacher of the education institution has the opportunity to create a Google Classroom, to join all colleagues or students, to publish announcements and to create educational tasks using Google Forms, shared virtual boards, to publish educational videos, materials for lectures, workshops, seminars, conferences, etc. Of great practical importance is the use of Google Meet for online meetings in distance learning; moreover, there is an opportunity to join a video meeting based on Google Meet, etc., in each Google Classroom in the educational environment of Google Workspace.

The rapid introduction of distance learning in March 2020 has posed new challenges to the educational community, particularly to the University of Educational Management staff. In order to improve the organisation of distance learning in the University of Education Management based on the Order "On experimental implementation of distance learning services", it was decided to urgently deploy a single educational environment of Google Workspace for Education based on the Educational and Scientific Institute of Management and Psychology (June 2020). As a result, the experiment was technologically supported quickly: a new domain name for the university and corresponding user accounts were created, an application for registration was submitted to Google, corporate mail was deployed and the necessary actions were taken to administer Google Workspace for Education.

The effectiveness of the interaction between educational process participants immediately manifested in a wide range of educational opportunities for created groups in the Google Workspace environment, the use of chats, discussions, the use of Google Meet for online meetings, etc. (figure 2).

Currently, the Department of Open Educational Systems and Information and Communication Technologies of the Central Institute of Postgraduate Education provides scientific and



**Figure 2:** Groups in Google Workspace for Education of the State Higher Educational Institution “University of Education Management” of the National Academy of Educational Sciences of Ukraine.

methodological support for the experimental implementation of the educational environment of Google Workspace for Education. In order to ensure the quality of the educational process and the development of the digital competence of research and pedagogical staff of the University of Education Management, the working group of the department, consisting of Serhii P. Kasian, Nataliia I. Gushchyna and Liudmyla H. Kondratova, developed the Program of qualification upgrading of managerial and pedagogical personnel at educational institutions “The use of Google Workspace for Education services for the organisation of distance and blended learning”. When planning the course, we relied on achieving the following expected results:

- 1) understanding the place and role of digital technologies during the organisation of distance learning;
- 2) the ability to organise interactive interaction during distance learning in the environment of Google Workspace for Education;
- 3) knowledge of the procedure for creating a Google Classroom, the organisation of effective interaction between teachers and students;
- 4) knowledge of digital tools for conducting video meetings, Google Meet, and the ability to organise and conduct them;
- 5) mastering:
  - practical skills in organising joint work using Google Drive editors;
  - knowledge and understanding of the algorithm for creating questionnaires and tests using Google Forms;
  - practical skills in creating and designing a personal site using Google tools;
  - mastering participants of skills to transform structural elements of in-class learning into an online format;

- application of skills of joint online activity and interaction, creation of own online resources;
- 6) a values-based attitude to the process of self-improvement lifelong learning, as well as understanding the relevance and opportunities of effective use of digital technologies.

Research and pedagogical staff was focused on improving/acquiring integrated, psychological and pedagogical, managerial and administrative and digital competencies, such as:

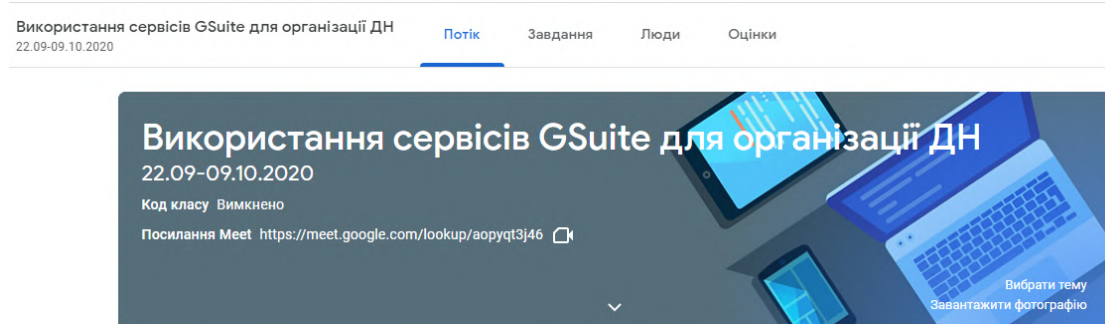
- ability to find new approaches to solve problems of professional activity,
- ability to make reasoned decisions and argue their position, identify, formulate and solve problems,
- mastering the skills to learn independently and develop personal potential;
- developing the ability to apply knowledge and skills when conducting distance learning; knowledge of typical technical problems that may arise during the distance learning and the algorithm for their correction; applying the acquired knowledge in practice; understanding the place of digital tools in distance learning;
- ability to develop new skills technologies, develop didactic tools, creatively use practical experience, develop the ability to organise the educational process in the information educational environment of the educational institution Google Workspace for Education and manage the development of digital competence of pedagogical workers.

When planning the types of educational activities, we used the approach proposed in the Recommendations for introducing blended learning in institutions of professional pre-higher and higher education [59].

We have transformed the usual types of classes into interactions between the subjects of study, which can be carried out synchronously and asynchronously, as well as into the organised independent work of a student obtaining education. All suggestions offered during the course were conditionally assigned to one of two categories: contact hours (online) – which provides for a direct interaction between learning process participants with each other and a teacher in the video meeting room of Google Meet, and online activity – provides for an indirect interaction between educational process participants with each other and with the content in the classroom or outside it through online technologies of Google Classroom (figure 3).

Google Classroom allows the use of effective forms and types of works for developing digital competence of students obtaining education: different types of tasks, testing, video tutorials, chat, work on a shared document or presentation, self-assessment, reflection and organise effective feedback by setting up a notification system, submission of works, receiving private consultations for each task.

The purpose of the practical classes was to learn the principles of functioning of the educational environment Google Workspace for Education at the university and master the digital tools of this environment in the educational process. All participants were invited to complete practical tasks in Google Classroom. The content of the training consisted of ten main topics of the course. During the study of the introductory topic, course participants familiarised themselves with digital technologies in the organisation of distance learning. They considered the place and role of digital technologies in the organisation of distance learning in the conditions



**Figure 3:** Google Classroom of the course participants

of a pedagogical university. During the online classes, all participants considered the possibility of organising distance and blended learning using Google digital tools within the subjects they teach to institute students.

The issue of using the educational opportunities of the Google Workspace for Education educational environment for the organisation of qualification upgrading training courses, thematic and authors' courses, master classes, training seminars, etc., was explicitly addressed.

An essential aspect of the course was familiarising with the possibilities of transforming the structural elements of face-to-face classes into an online format.

While studying the topic "Organisation of interactive interaction during the distance learning in the environment of Google Workspace for Education", students of the course were informed thoroughly about the educational environment of Google Workspace for Education, its digital tools and educational opportunities. During the online classes, all participants discussed additional learning opportunities using Google Workspace for Education, organisation of work with shared Disks, using shared chats, interactions in groups, exchanging information, event planning using Google Calendar tools, etc.

Practice-oriented topics had a critical practical significance with their initial stage of work in the environment, with an overview of the technology of sharing disk files and joint work using Google Drive during distance learning.

Pedagogical workers had the opportunity to master the technology of creating questionnaires and tests using Google Forms and consider the possibility of analysing learning outcomes using Google tools.

During the studies, according to the course program, there was an in-depth study of the Google Classroom educational environment for the organisation of distance learning and the technology of creating educational tasks and educational process planning.

Using the digital tools of Google Sites, each participant had the opportunity to create a personal website, develop his/her e-learning course in the subject they teach, and gain practical skills in creating educational tasks of various types using Google digital tools.

The educational opportunities of digital tools for conducting online classes based on the Google Meet service aroused great interest during the training.

During the final classes of the course, there was a general presentation of students' digital products posted on the personal website of each distance-learning course participant.

In order to receive feedback, we gained experience in individual counselling and conducting instructive online classes and reflections.

In order to identify the level of development of digital competence of course participants, the testing was conducted at the beginning and end of training. The general educational achievements of the educational process participants are presented in a shared table of digital materials prepared by all participants.

The course participants demonstrated the acquired practical skills in working with Google Docs, creating interactive Google slides, and organising personal Google Sites. Listeners of the courses gained experience in creating tests and questionnaires using Google Forms and organising group discussions using shared Google Jamboard boards. A significant achievement of the course participants was gaining experience in conducting online meetings using Google Meet and creating and filling their own Google Classroom.

During our research, in order to determine the level of development of digital competence of each participant of the course “Using Google Workspace for Education services for organising distance and blended learning”, we developed criteria and indicators for measuring the level of the development of digital competence and identifying experience in the use of cloud services in distance learning.

Among the main criteria for assessing the digital competence of a modern research and pedagogical worker, we have identified the following: motivational and values-based, cognitive-digital and activity-performance.

Motivational and values-based criterion is crucial during the development of digital competence, as they reveal pedagogical workers’ main motives and interests to master the educational opportunities provided by cloud services during the organisation of distance and blended learning aimed at developing the digital competence of all training participants.

In the frames of our research, measuring the level of digital competence according to motivational and values-based criteria allowed us to determine (both at the beginning and the end of the experiment) the existing level of need for digital competence using cloud services Google Workspace for Education for the organisation of distance and blended learning, as well as the current level of awareness of the personal meaning and significance of digital technologies in the contemporary postgraduate educational process and the desire of course participants for professional self-improvement in the field of mastering the newest digital opportunities.

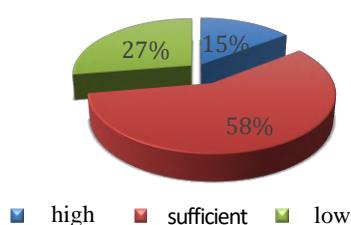
The cognitive-digital criterion provides an opportunity to measure the quality of new knowledge on the use of digital technologies and cloud services during the educational process, awareness of their importance in pedagogical activities, the level of knowledge on educational opportunities of cloud services of Google Workspace for Education for organisation of the distance and blended learning and the level of knowledge on their use during the educational process. The development of a pedagogical worker’s digital competence according to the cognitive-digital criterion was measured based on the test tasks of the course at the beginning and the end of the training.

The received results of the study according to cognitive-digital criteria helped to obtain information characteristics of the research and pedagogical workers – the course participants, such as completeness, depth, systematic knowledge about the use of digital technologies and the level of knowledge about the features of cloud services of Google Workspace for Education for the organisation of distance and blended learning.

Based on the measurement of the level of digital competence development according to the activity-performance criterion, we recorded the capacity of research and pedagogical workers for independent practical skills in using digital technologies and cloud services during the educational process. The activity-performance component demonstrated the level of practical digital skills, the level of practical skills in creating their digital products, the level of operational practical skills to work with shared documents and the general level of readiness to work with cloud services of Google Workspace for Education during distance and blended learning organisation.

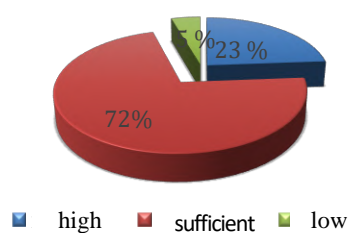
In total, 273 participants in the experiment were pedagogical and research-pedagogical workers from the State Higher Educational Institution “University of Education Management” of the National Academy of Educational Sciences of Ukraine, representatives of different university departments. We measured the results of our study according to all selected criteria at high, sufficient and low levels.

These levels of development of digital competence of course participants at the beginning of the study are recorded in the following chart (figure 4).



**Figure 4:** The level of development of digital competence of course participants at the beginning of training.

As a result of the conducted research experimental work, positive changes in the development of digital competence of all training participants were obtained. The dynamics of the development of digital competence of course participants is presented in the chart (figure 5).



**Figure 5:** The level of development of digital competence of course participants upon completion of training.

The results of research and experimental work showed a high level of digital competence development among participants among 17.9%

The positive dynamics of research and pedagogical workers’ high level of digital competence were particularly evident. In contrast, the indicators of low level determined the most significant

positive dynamics. The statistical significance of the differences between the indicators of the control and experimental groups was determined using Student's t-test and Fisher's F-test.

The statistical analysis results confirmed the significance of the difference of all indicators in measuring the digital competence of course participants. The analysis of research data showed that as a result of the conducted work, there were qualitative and quantitative changes in the indicators of levels of digital competence development among research and pedagogical workers – training participants.

The effectiveness of the research and experimental work was confirmed by generalised data from the final section of the levels of digital competence development among training participants. Histogram data showed that positive changes occurred according to all criteria and levels of digital competence development among training participants. The low-level indicator decreased significantly by -13.6%. Significant differences between indicators are observed at high and middle levels. Thus, the percentage of the participants of middle level increased by 14%, and the percentage of the participants classified as high-level – by 9.1%.

The obtained analytical data testify to the correctness of the chosen strategy and tactics of research and pedagogical support for training course participants regarding mastering educational opportunities of Google Workspace for Education cloud services during the organisation of distance and blended learning in the conditions of postgraduate education.

The reflection and final testing of the course participants provided an opportunity for teachers to identify the positive experiences of teachers, allowing them to trace the dynamics of the development of digital competence of each training participant.

Thus, if, in the beginning, the level of digital competence of pedagogical workers was predominantly sufficient, then upon the completion of training, it manifested itself at high and sufficient levels.

During the training period of the course program, 273 pedagogical and scientific-pedagogical workers successfully increased their level of digital competence.

The results of the research, according to the motivational and values-based criterion, allowed us to determine the high level of need for the development of digital competence using cloud services of Google Workspace for Education for organising distance and blended learning to identify a sufficient level of awareness of personal meaning among all distance-learning course participants. In general, pedagogical workers identified the importance of digital technologies in the contemporary postgraduate educational process at a high level. They showed a high and sufficient level of desire for professional self-improvement in mastering the newest digital opportunities through Google Workspace for Education.

The survey of training participants according to cognitive-digital criterion revealed completeness and depth of knowledge about using digital technologies at a sufficient level. Practical types of work helped to assess and identify a sufficient level of knowledge about the features of the use of cloud services of Google Workspace for Education in the organisation of distance and blended learning.

The presentation of digital materials by all training participants allowed them to assess practical skills in creating digital products, which manifested at a sufficient level. During online classes and in the process of performing individual tasks in the environment of Google Classroom supervisors-tutors could assess the level of operational practical skills in working with shared documents, which manifested at a sufficient level. According to the activity-

performance criterion, the results of the course participants’ final questionnaires revealed a generally sufficient and high level of readiness among all course participants for the organisation of distance and blended learning using the cloud services of Google Workspace for Education.

In general, research and experimental work revealed the dynamics of digital competence development, which amounted to 12.23%

The indisputable result of the training was the general table of digital materials, which is presented in the Google Sheets (figure 6).

№	ІІБ учасника	Папка в Google Диск	План заняття для студентів в Google документах	Тест та таблиця з результатами занування в Google Формам	Сайт-портфоліо	Google Клас	Відеозстріч в Google Meet
1		папка на диску	план заняття	тест	сайт	Клас	посилання на ві
2		папка на диску	план заняття			Google Клас	
3		папка на диску	план заняття	Тест, таблиця	Site	Гугл клас	
4		папка	План заняття	тест, таблиця	сайт	Гугл Клас	Зустріч
5		папка на диску	план заняття	тест і таблиця	сайт	Google Клас	Зустріч
6		папка на диску	план заняття	тест	Сайт-портфоліо	Google class	таблиця
7		папка на диску	план заняття	тест	site	Google Клас	
8		<a href="https://drive.google.com">https://drive.google.com</a>	план заняття	тест	сайт	Клас	
9		папка на диску	план заняття	тест, таблиця	Сайт-портфоліо		
10		папка на диску	план заняття	тест, таблиця	Сайт-портфоліо	Google Клас	Google Meet
11		Матеріали для заняття	План заняття	тест, таблиця	сайт	Google Клас	
12		папка на диску	план заняття	тест, таблиця	сайт		
13		Матеріали до заняття	План-конспект	тест, таблиця	Сайт-портфоліо	Google-клас	Google-meet
14		Папка	план заняття	тест, таблиця	сайт	Google Клас	
15		Матеріали до заняття	План заняття	Тест, Таблиця	Сайт-портфоліо	Google-клас	
16		Матеріали для заняття	План заняття		сайт	Google-class	
17		Матеріали до заняття			сайт	Гугл Клас	
18		Матеріали для заняття	План заняття	Тест, Таблиця	Сайт		
19		Моя папка	Охорона довкілля		сайт	Клас	Зустріч
20		Матеріали для заняття	план заняття	тест, таблиця	сайт	Клас	
21		Матеріали для заняття	план заняття	тест, таблиця	Сайт	Гугл Клас	
22		Папка	план заняття	тест, таблиця	сайт-портфоліо	Гугл Клас	Зустріч
23		Матеріали для заняття	План заняття	Тест Таблиця	Сайт	Google Клас	

Figure 6: General table of learning outcomes of course participants in Google Classroom.

The group’s supervisors and tutors evaluated the learning outcomes obtained. All participants had an opportunity to view and comment on their colleagues’ digital educational materials.

#### 4. Conclusions and future work

This paper encapsulates our journey of enhancing the digital competence of postgraduate teachers through distance learning, leveraging Google Workspace for Education cloud services. We have detailed the execution and outcomes of a thematic course designed to familiarise teachers with the Google Workspace for Education environment and boost their digital competence. The quality of education in a distance learning setting, along with its pros and cons, has also been deliberated.

Our findings indicate that while distance learning provides flexibility and convenience, it also presents challenges such as ensuring assessment reliability, keeping students motivated and engaged, and promoting effective communication and collaboration. We advocate for the principle of freedom in selecting the mode of education and structuring the interaction within synchronous distance learning.

The primary technical skills acquired by teachers during the training course include using Google editors (documents, sheets, slides), managing Google Classroom, developing educational tasks, and organising video meetings via Google Meet.

Our ongoing study underscores the significant interest and necessity for digital competence development among teachers in a distance learning context. The encouraging results motivate us to continue implementing diverse teacher training forms, including qualification upgrading courses, scientific seminars, organisational meetings, individual consultations, etc.

Our experience reveals that our thematic course effectively prepared teachers to operate quickly within the Google Workspace for Education environment while enhancing their digital competence. The most effective training methods included small group work, issue discussions, brainstorming and collective discussions, generalisation and comparison, and educational projects.

Looking ahead, we plan to continue developing digital competence among postgraduate teachers through distance learning. This includes conducting thematic and author courses and special courses on mastering cloud services of Google Workspace for Education and Microsoft Office 365. We also propose creating a unified educational environment across different educational institutions. This would allow teachers to access a shared database and regulatory and working materials, collaborate on shared documents, exchange information, create common visualisation of educational content, etc. Also, we plan to explore the opportunities provided by Google Workspace for Education for organising distance learning and developing a methodology for deploying and using a unified digital cloud-based management system and support system for training Masters and PhDs.

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