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# Future Teachers' Digital Skills Development Through Professional and Vocational Training in Informal Education

#### Abstract

The article updates the problem of developing digital skills in future teachers of specialized and vocational training. The possibilities of using informal education to solve this problem are identified. The need for developing modern digital skills of future teachers of specialized and vocational training based on competency-based, integrated, context-oriented and multimodal approaches is substantiated. During the experiment, a phased formation of digital skills is carried out: at the preparatory, project, training and final stages. The main task of the preparatory stage is to familiarize students with the features of using digital technologies, the structural components of digital skills and indicators of their formation. All students during their studies at the university take a course on the theoretical foundations of us-

ing digital technologies in education. At the project stage, the main task is to develop the ability of future teachers to professional self-management. Students of the experimental group additionally participate in a workshop and independently develop personal programs for the development of digital skills in the context of informal education. At the training stage, students of the experimental group implement these programs. At the final stage, students of the control and experimental groups perform creative work. Feedback on personal programs is provided by experts from among university teachers and practicing teachers. In the process of experimental work, the effectiveness of the development of digital skills in the context of informal education of future teachers is tested. The use of digital technologies is presented at three levels: household (low), user (medium), professional (high). The experiment shows the feasibility of using personal programs for informal education. Generalization of the results of the experimental work demonstrates the advantages of informal education in the formation of digital skills of future teachers of specialized and professional education.

**Keywords:** digital technologies, digital skills, informal education, training, teachers of specialized and professional training, creative works, personal programs

#### Introduction

Digital technologies are becoming increasingly important in the reform of modern education. Digitalization covers various aspects of pedagogical activity: educational environment, methodological support, teaching aids, etc.

The main provisions on the requirements for the competence of modern teachers are contained in international documents that determine the priority of digital skills. The UNESCO Competence Framework for Teachers (2017) defines the key competencies that teachers of the 21st century should possess, including skills in working with digital technologies [1]. Scientific research is aimed at developing the teachers' readiness to use digital technologies in their professional activities [2], promoting the acquisition of digital competencies by students and teachers [4], ensuring access of subjects of the educational process to high-quality digital content [3].

The requirements for future teachers of specialized and vocational education include digital literacy, digital skills, the ability to develop innovative content of specialized and vocational education, and the readiness to use digital technologies in professional activities. At the same time, higher education institutions in practice cannot always take into account the intensive digital transformations in various sectors of social production. This requires research into the possibilities of extracurricular formation of future teachers' digital skills of specialized and vocational education. Increasingly, scientists [2-4] agree that the boundaries of formal education have become too rigid to achieve the current quality of education or related educational outcomes, in particular modern digital skills. Traditional formal education cannot fully meet the needs of future teachers of specialized and vocational education, who need contextual digital skills for timely application in life or at work. The desire of the education system to meet individual needs and social order requires new approaches to the formation of digital skills and the use of opportunities for informal education.

Informal education is a type of flexible, accessible, contextual learning. It is mainly carried out outside the educational institution in various formats (courses, video lectures, training, master classes, webinars, workshops, self-education) and does not necessarily end up in obtaining a document on completion of training (diploma, certificate). Such education has increased motivation, contributes to the deepening of knowledge, the development of specific digital skills and is often perceived as an educational model based on practical training, rather than traditional teaching methods. A feature of informal education is that it does not have strict conditions for the start of training and the level of prior training. Within its framework, there is an opportunity to quickly and timely obtain the necessary knowledge and digital skills in accordance with the current needs of the individual, in particular remotely. Such activities are not regulated by state bodies, therefore there are no requirements for licensing activities, curricula and documents on education. The possibilities of informal education for the development of future teachers' digital skills of specialized and vocational education provide favorable conditions for their professional activity in the information society.

## **Research Methodology**

The need to develop modern digital skills of future teachers of specialized and professional education is justified on the basis of competency-based, integrated, context-oriented and multimodal approaches.

The competency-based approach focuses on the formation of key competencies of a teacher. As part of the project Competency framework for adult educators In teaching GCED (2019), a model of key competencies of a modern teacher has been developed. It covers four aspects of competence (outer ring) professional knowledge and skills, subject and industry knowledge, professional self-management and professional values and beliefs. These aspects of competence are divided into areas of competence (inner ring), which, in turn, are further divided into aspects of competence (middle ring). Theoretical knowledge, which is used in this context, refers to theoretical and formal knowledge (for example, professional knowledge). In the case of knowledge that tends to be more application-related and practical, it is a combination of knowledge and skills [1].

Analyzing the future of education in the era of the fourth industrial revolution [4], scientists predict that reproductive memorization will not be important in learning, and the priority will be the skills of analysis, argumentation and decision-making. Individualization and autonomy of learning will increase. Documents on formal education will lose their significance, while personal portfolios will gain popularity. Artificial intelligence tools will be used in the learning process. The main attention will be paid to the development of imagination, creativity, innovation, initiative, leadership qualities, etc. Not the knowledge of the individual itself will be valued, but the ability to transform it, new ideas and conclusions.

**The subject-matter of the study** is the development of modern digital skills of future teachers of specialized and vocational education.

The purpose of the study is the development of digital skills of future teachers of specialized and vocational education in the conditions of informal education. The task is to find out what modern digital skills are needed by future teachers of specialized and vocational education; to prove the pedagogical feasibility of using personal programs of informal education in the field of digital technologies by future teachers and the need for preparation for their development; to determine the effectiveness of means of developing digital skills in the conditions of informal education.

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A teacher's readiness to use digital technologies in their professional activities involves computer skills, the use of online instruments and platforms, the development of educational and methodological support, the creation of digital resources, the use of distance and multimodal learning strategies.

To find out what digital skills are used in education, a survey of teachers was conducted, the results of which are presented in Table 1.

Teachers' use of digital skills	I consider highly effective	I consider fairly effective	I consider insufficiently effective
Use of email services (Gmail, ukr.net, micro- soft.com,i.ua)	48.0%	50.0%	2.0%
Use of website creation services (GoogleSites, Wix, WordPress, JimDo)	4.0%	56.0%	40.0%
Use of interactive multimedia boards (Padlet, Linoit, Conceptboard, Miro)	54.0%	42.0%	4.0%
Use of feedback services (Socrative, Quizlet, Quizziz, Kahoot, Google Forms, Schoology, BrainPop)	18.0%	64.0%	18.0%
Use of video communication platforms (Zoom, GoogleMeet, MicrosoftTeams, CiscoWebex, BigBlueButton, Skype)	66.0%	32.0%	2.0%

Table 1. Effectiveness of digital skills in education

Teachers' use of digital skills	I consider highly effective	I consider fairly effective	I consider insufficiently effective
Use of screencasting services (Loom, YouTube, RecordCast, Camtasia Studio, BandiCam)	44.0%	54.0%	2.0%
Use of services for creating interactive videos (LearningApps, Learnis, EDPuzzle, H5P, Play- Buzz, TED)	24.0%	56.0%	20.0%
Use of services for creating interactive work- sheets (LiveWorkSheets, Wizer.me, Teacher Made)	28.0%	48.0%	24.0%
Use of artificial intelligence services (Khan Academy, Duolingo, Socratic, Rytr, Canva, ChatGPT, Gradescope)	44.0%	40.0%	16.0%

This diagnostic picture suggests that teachers are not sufficiently informed about the possibilities of using digital skills, in particular, about services for creating websites (40%), services for creating interactive worksheets (24%), services for creating interactive videos (20%), feedback services (18%), and artificial intelligence services (16%). The survey results show the need to form such digital skills of future teachers of vocational and professional education.

The digitalization of education encourages modern teachers to be competent in this area. Professionals try to use everything that helps them develop as a digital user. These are various ways to achieve results, in particular through formal, extracurricular and informal education. The conditions for teachers to acquire digital competencies vary from those related to formal education in a structured context and controlled by the state to independent learning processes that are managed independently. Therefore, it is necessary to create conditions for them to have the opportunity to acquire and develop modern digital skills. This is often done within the framework of non-formal education, since access to such education does not require the fulfillment of additional conditions.

An integrated approach ensures the transition of a set of elements to a new quality [2]. As for the development of future teachers' modern digital skills of specialized and vocational education, this can be an integrated result of combining different types of training. There is a strengthening of the positive aspects of formal and informal education, in particular, the integration of learning outcomes in an educational institution and informal education into comprehensive digital skills.

A context-oriented approach ensures the development of modern digital skills of future teachers of specialized and vocational education, which are relevant for performing specific tasks of their activities and implementing professional functions. Such skills are relevant for a specific educational environment and training profile. These skills are used to improve the educational process, develop educational and methodological support, create digital learning tools, etc.

A multimodal approach to the development of modern digital skills of future teachers takes into account individual styles of perception, encoding and transformation of educational information. It makes it possible to ensure the needs and preferences of everyone when developing personal programs of informal education.

Substantiating the need to develop modern digital skills of future teachers of specialized and professional education based on the considered approaches provides grounds to identify informal education as an important factor influencing the effectiveness of the use of digital technologies in education.

## Methods

During the study of the effectiveness of digital skills development, a survey of students, university teachers and practicing teachers, student testing and expert evaluation of students' creative works were conducted. Testing was conducted at the preparatory stage of the study to assess the level of students' use of digital technologies. The survey was conducted at different stages of the study. In order to find out what digital skills are used in education, it was conducted at the preparatory stage of the study. At the project stage, students were surveyed about the difficulties that arose during the development of non-formal education programs. A survey on the effectiveness of digital skills development tools in non-formal education was conducted at the final stage of the study. The level of use of digital technologies by future teachers of specialized and vocational training was determined by the results of creative work, during which students solved professional and pedagogical tasks. Student's t-test was used to verify the reliability of the results obtained. The comprehensive quantitative assessment was defined as the arithmetic means (when determining percentages) or median (when determining a rating) value according to the corresponding criterion.

#### The basis of the empirical research and its sample

The main objects of the experimental verification were future teachers of profile and professional training: students of pedagogical specialties "Professional education (digital technologies)" and "Labor training, technologies and informatics" of the Mykhailo Dragomanov Ukrainian State University. The experimental and control groups were equal and consisted of 50 students each.

Due to the testing results, students were divided into control and experimental groups. For the study, it was important to assess the equivalence of students in the control and experimental groups in terms of the level of digital technologies mastery. For this purpose, a null hypothesis was formulated by using the Student's t-test. We used this statistical method when studying the level of future teachers' digital technologies mastery, since the data have a normal distribution. The Student's test is used to compare two groups according to certain indicators, in particular to test the hypothesis H0 about the absence of differences between students in the control and experimental groups according to the results of the diagnostics of the level of formation of digital skills before the start of the experiment.

Three levels of use of digital technologies in education by future teachers were determined: household (low), user (medium), professional (high). The results are presented in Table 2.

Formation levels of the use of digital technologies in education	Experimental group	Control group
Home (low)	30.0% (15)	30.0% (15)
User (average)	52.0% (26)	50.0% (25)
Professional (high)	18.0% (9)	20.0% (10)

**Table 2.** Levels of mastery of digital technologies in education by students of the<br/>control and experimental groups

During the formation of students' digital skills in the experimental group, the emphasis was on informal education. At the formative stage of the study, an innovation was introduced: a workshop on mastering digital technologies in the context of informal education. The effectiveness of the development of students' modern digital skills was determined by the results of creative works, which involved the implementation of professional and pedagogical tasks and the contextual use of digital technologies. To assess the effectiveness of the use of digital technologies by future teachers of specialized and professional education, 3 levels were used: professional (high), user (medium), and household (low) levels. A 100-point scale was used to evaluate creative works.

In the formation of students' digital skills, the emphasis was on extracurricular learning. At the formative stage of the study, an innovation (active factor) was introduced for students in the experimental group: a workshop on mastering digital technologies in the conditions of extracurricular learning. The workshop program provided for familiarizing students in the experimental group with new models of forming modern digital skills. During the workshop, role-playing simulations of typical situations of using digital technologies in education were conducted.

The effectiveness of the formation of students' digital skills in the control and experimental groups was determined by the results of creative work, which involved solving professional and pedagogical tasks and the contextual use of digital technologies. A 100-point scale was used to evaluate creative work.

As experts, university teachers and practicing teachers participated in the examination of personal programs of extracurricular education and the evaluation of creative work.

#### **Research Results**

The development of future teachers' digital skills of specialized and professional education took place in stages: at the preparatory stage, project, training and final stages. At each stage, certain tasks were to be performed.

The main task of the preparatory stage was to familiarize students with the theoretical foundations of the use of digital technologies in education, the essence of digital educational services, the content and indicators of the formation of digital skills, etc. Such work allowed us to obtain the necessary knowledge to prepare students for the next stage and understand the details of the use of digital technologies in education.

During their studies at the university, students took a theoretical course on the use of digital technologies in education. After completing the course, testing was used to assess the level of students' use of digital technologies and divide the students into both control and experimental groups respectively (Table 2).

The next project stage was intended for future teachers of specialized and professional education to develop individual trajectories of digital skills formation. Students of the control group were determined independently. Students of the experimental group were asked to develop personal programs for digital skills development.

Students in the control group used the recommendations they received during their university classes. Students in the experimental group also had these recommendations as well as additional experience gained during their participation in a workshop on mastering digital technologies in an extramural study environment.

At the project stage, the main task was to develop the ability of future teachers to professional self-management. Students in the experimental group de-

veloped personal programs for informal education of digital technologies. The programs themselves were not evaluated, but students were surveyed about the difficulties that arose during the development of the programs and what helped them overcome these difficulties. The results are presented in Table 3.

Table 3. Effectiveness of assistance in developing personal programs for informal
education of digital technologies (in%)

What helped you in developing a program for informal education of digital technologies	Effectively helped	Partially helped	Slightly helped
Workshop on mastering digital technologies in in- formal education	44.0% (22)	30.0% (15)	26.0% (13)
Independent search on the Internet	40.0% (20)	32.0% (16))	28.0% (14
Help from a teacher-practitioner	30.0% (15)	50.0% (25)	30.0% (15)
Use of artificial intelligence	30.0% (15)	34.0% (17)	36.0% (18)

Regarding the ranking of the importance of assistance factors during the development of individual programs for informal education of digital technologies, we found out that students ranked participation in a workshop on the development of digital technologies in informal education in the first place: 44.0% (22 people) defined it as "effectively helped", 30.0% (15 people) – "partially helped", 26.0% (13 people) – "insignificantly helped". It was found that students do not rely enough on the help of artificial intelligence: 30.0% (15 people) defined it as "effectively helped", 34.0% (17 people) – "partially helped", 36.0% (18 people) – "insignificantly helped".

At the training stage, students in the experimental group implemented personal programs. At this stage, each student had the opportunity to use digital technology techniques and tools.

At the final stage, students of the control and experimental groups presented the results of their work, discussed the individual methods of using digital technologies in education, and demonstrated their creative works. During the discussion, there was discussed the effectiveness of factors of assistance during their development of personal programs of extramural study in the field of digital technologies Particular attention at the final stage was paid to the process of self-diagnosis, reflective analysis, optimization of the process of formation of digital skills of vocational training teachers.

The results of the effectiveness of digital skills development tools in non-formal education are presented in Table 4.

What helped in the formation of digital skills in non-formal education	Effectively helped	Partially helped	Slightly helped
Demonstration of working with the Internet service	66.0%(33)	32.0%(16)	2.0%(1)
Instruction on working with the Internet service	56.0%(28)	42.0%(21)	2.0%(1)
Methodological instructions for working with the In- ternet service	46.0%(23)	48.0%(24)	6.0%(3)
Template for working with the Internet service, created by artificial intelligence	36.0%(18)	50.0(25)	14.0%(7)

**Table 4.** Effectiveness of digital skills development tools in non-formal education (in%)

Regarding the effectiveness of digital skills development tools in informal education, we found out that most students prefer demonstrating work with the service: 66.0% (33 people) defined it as "effectively helped". Traditional methodological recommendations are losing their positions, 46.0% (23 people) defined them as "effectively helped". It was found out that students still do not rely enough on the help of artificial intelligence: 14.0% (7 people) used very little of it, and 36.0% (15 people) chose it in the category "effectively helped".

At the final stage, students in the control and experimental groups performed creative work. Based on the results of the creative work, the levels of use of digital technologies were assessed. To verify the reliability of the results obtained, the Student t-test was used. A typical calculation algorithm was used: finding the average value of the use of digital technologies; calculating the variance; finding the degrees of freedom; finding the value of the normalized deviation of the mean values; the obtained calculation results were compared to confirm that the changes are significant. The dynamics of the levels of mastery of digital technologies in education by students in the control and experimental groups are presented in Table 5.

**Table 5.** Dynamics of the levels of mastery of digital technologies in education bystudents of the control and experimental groups (in%)

Levels	Experime	ntal group	Dynamics	Contro	l group	Dynamics
	At the beginning of the ex- periment	At the end of the ex- periment		At the beginning of the ex- periment	At the end of the ex- periment	
Home (low)	30.0% (15)	18.0%(9)	-12.0	30.0% (15)	24.0%(12)	-6.0

Levels	Experimental group		Dynamics	Control group		Dynamics
	At the beginning of the ex- periment	At the end of the ex- periment		At the beginning of the ex- periment	At the end of the ex- periment	
User (average)	52.0% (26)	58.0%(29)	6.0	50.0% (25)	52.0%(26)	2.0
Professional (high)	18.0% (9)	24.0%(12)	6.0	20.0% (10)	24.0%(12)	4.0

The results of the experiment showed an increase in the number of students with professional (high) (18.0% - before the beginning of the experiment and 24.0% – after its completion) and user (average) (52.0% – before the beginning of the study and 58.0% - after its completion) levels of use of digital technologies. In the experimental group, the number of students who belonged to the household (low) level of use of digital technologies also significantly decreased (30.0% - before the experiment and 18.0% - after its completion). In the control group, there are also positive changes at the professional (high) level (20.0% - before the experiment and 24.0% - after its completion). But the dynamics of positive changes in the control group is much lower. At the user (average) level, the ratio between the indicators of the use of digital technologies before the beginning of the study and after its completion did not change significantly (50.0% – before the beginning of the study and 52.0% – after its completion). Students in the experimental group demonstrated a desire to continue participating in informal programs. A comparison of the results of creative work in the control and experimental groups allows us to conclude that variability in the use of digital technologies is observed in the experimental groups.

The statistical significance of the results was confirmed using the Student's t-test. The deviation and error rates after the completion of the formative stage of the experiment are presented in Table 6.

Indicators	EG	CG
Scores	89.53	79.00
Error values (M1, M2)	1.27	1.73
Deviation ( $\sigma$ 1, $\sigma$ 2)	6.37	8.81
Square deviation ( $\sigma$ 21, $\sigma$ 22)	1.61	2.99

**Table 6.** Indicators of deviations and errors in the study of students' mastery of digital technologies in education in the control and experimental groups

The comparison of the critical (tcr = 0.52) and actual (tf = 4.92) values of the Student's t-test showed that the null hypothesis (H0) was rejected under the condition tcr < tf.

Testing the null hypothesis (H0) demonstrated differences between the samples for a confidence level of 0.05, which indicates the effectiveness of the development of profile and professional training of digital technologies of future teachers in the conditions of informal education.

Students in the experimental group demonstrated the desire to continue participating in extramural programs of digital technologies.

## **Conclusion & discussion**

The study focuses not on the future teachers' subject knowledge of specialized and vocational education acquired during their studies at the university, but on the ability to independently master modern digital skills. These abilities are developed during the implementation of personal programs of informal learning. Therefore, the competency-based approach to the development of digital technologies by future teachers of specialized and vocational education remains without alternatives both in university education and in the conditions of informal education.

The workshop on the development of digital technologies in the conditions of informal education was aimed at integrating the results of formal and informal education of future teachers into complex digital skills. In addition, the preparation of students' creative works also involved the integration of cross-subject knowledge. An integrated approach became the basis for conducting a workshop on the development of digital technologies by future teachers of specialized and vocational education in the conditions of informal education.

In the study, the key role was played by the implementation of creative works, during which students solved professional and pedagogical tasks. When evaluating them, experts paid attention to the use of digital technologies. The context-oriented approach was aimed at preparing future teachers of specialized and vocational education to perform specific tasks of their activities and implement professional functions.

A study of the effectiveness of digital technology teaching tools showed that informal education takes into account the individual style of each student. The multimodal approach is decisive in extracurricular activities. It provided the opportunity for future teachers of specialized and vocational education to choose their own programs and effective means of mastering digital technologies. We presented the use of digital technologies by future teachers of specialized and vocational education at three levels. The household level was determined as the lowest, because today it is difficult to find a person who does not have any digital technologies at all. But the students who were assigned to this level did not use most of the Internet services necessary for the work of a future teacher. At the user level of mastering digital technologies, students used many Internet services in a patterned manner for their own needs and work. Students who creatively used and mastered new capabilities of Internet services necessary for performing professional and pedagogical functions were attributed to the professional (high) level of use of digital technologies.

It was found that future teachers of specialized and professional training need to pay attention to the development of modern digital skills regarding services for creating websites, Internet services for creating interactive worksheets, Internet services for creating interactive video, feedback internet services, and artificial intelligence services.

The effectiveness of means for developing digital skills in informal education was determined, in particular, students prefer to demonstrate work with the Internet service. Traditional methodological recommendations are losing their positions. It was found out that students do not rely enough on the help of artificial intelligence yet.

The pedagogical feasibility of using personal programs of informal education of digital technologies by future teachers and the need for preparation for their development were proven. The generalization of the results of the research and experimental work indicates the positive impact of personal programs of informal education of digital technologies on the level of mastery of profile and professional training of digital technologies in education by future teachers.

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