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ARTÍCULO DE INVESTIGACIÓN

Alfabetización digital de profesores y alumnos: estrategias y métodos de desarrollo

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Volodymyr Mykolaiko *, Viktoriia Soloshchenko **, Tetiana Korshevniuk ***,
Ganna Taran **** y Yurii Pavlov *****

Resumen

Este artículo examina detalladamente el problema de la preparación de los licenciados para la enseñanza profesional, tanto desde la perspectiva de la literatura científica como de la práctica pedagógica. En particular, se enfoca en explicar el concepto de "preparación de los licenciados para las actividades profesionales y pedagógicas" en instituciones educativas que ofrecen programas de formación profesional secundaria. El artículo establece las condiciones pedagógicas necesarias para desarrollar la preparación de los licenciados en este tipo de actividades. Se presenta un modelo metodológico fundamentado en teoría para el desarrollo de la preparación de los licenciados en la enseñanza profesional en instituciones de formación profesional. Además, los autores describen el desarrollo y la implementación de un sistema metodológico para preparar a los licenciados en la enseñanza profesional, el cual incluye una serie de medidas destinadas a mejorar el nivel de preparación de los futuros profesores. En la parte final del artículo se ofrecen recomendaciones metodológicas para el desarrollo de la preparación de los licenciados en la enseñanza profesional, con un enfoque práctico en el proceso educativo. En resumen, este artículo representa una valiosa contribución al campo de la ciencia y la práctica pedagógicas al proporcionar un enfoque integral para preparar a los licenciados para una labor efectiva en el ámbito educativo. Este estudio será de utilidad tanto para profesores, metodólogos y directores de instituciones educativas, como para investigadores interesados en temas de educación profesional y formación docente.

Palabras clave: sistema educativo, condiciones de enseñanza, competencia docente, competencia en TIC.

Abstract

Digital literacy of teachers and students: strategies and methods of development

This article focuses on the study and development of a model for the formation of general pedagogical ICT competence among future teachers, taking into account the current trends of digitization and informatization of education. The research reveals the essence and structure of this competence, as well as discusses the effective pedagogical

conditions and methodical support necessary for its formation. First, the theoretical aspects of ICT competence are analyzed, including its key components and significance in the modern educational paradigm. The main attention is paid to the development of the model, which is based on the system-activity approach, and is defined as an effective tool for achieving the set goals in the process of forming ICT competence. Next, the article describes the developed methodological approaches and pedagogical conditions that contribute to the effective formation of ICT competence among future teachers. The authors provide a detailed description of the developed methodology, as well as describe its practical application in higher educational institutions. The last section of the article is devoted to the experimental verification of the effectiveness of the proposed model. This part presents the results of an experimental study that was conducted in the educational environment of a higher school, and discusses how the implementation of a system-activity approach affects the formation of ICT competence of future teachers. This article will make a significant contribution to the understanding of the process of forming ICT competence in the educational environment and will offer practical recommendations for teachers and educational institutions.

Keywords: educational system, pedagogical conditions, pedagogical competence, ICT competence.

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* Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine. ORCID ID: <https://orcid.org/0000-0002-0515-1241>. E-mail: Mykolaiko@gmail.com

** Sumy State Pedagogical University named after A.S. Makarenko, Sumy, Ukraine. ORCID ID: <https://orcid.org/0000-0002-5888-3796>. E-mail: Soloshchenko@gmail.com

*** Institute of Pedagogy of the National Academy of Educational Sciences of Ukraine, Kyiv, Ukraine. ORCID ID: <https://orcid.org/0000-0003-0430-5808>. E-mail: Korshevniuk@ukr.net

**** Kyiv National University of Construction and Architecture, Kyiv, Ukraine. ORCID ID: <https://orcid.org/0000-0003-3311-0321>. E-mail: Taran@gmail.com

***** Taras Shevchenko National University of Kyiv, Kyiv, Ukraine. ORCID ID: <https://orcid.org/0000-0002-8390-785X>. E-mail: Pavlov@gmail.com

1. Introduction

The development of the digital society makes us wonder whether teachers are ready to work in educational institutions with modern digital technologies, whether they are capable of to use digital technologies at a high level in the educational process, or at one whether they are with students, whether they can contribute to the development of students' digital competence.

Modern models of professional training of teachers require solving the problems associated with the combination of analog and digital media, with the displacement of all other technologies by digital ones, with the widespread distribution of digital services. They also need to take into account the constant and intensive process of digitization, especially when this process is accelerated due to circumstances beyond the control of teachers themselves (for example, the coronavirus pandemic, which forced education to go online; the accelerated development of digital services, the creation of a new educational policy, digitalization state and education, etc.).

The formation of a teacher's digital literacy begins with the formation of digital literacy of the individual, which can begin from childhood. Born teachers at the beginning of the XXI century. Entered the world of digital technologies almost from childhood, etc. Time of study in information, communication and digital institutions of higher education technologies were widely implemented in the process of professional training of teachers. Teachers middle-aged entered the world of digital technologies while studying in higher education institutions education and were able to improve their qualifications in the field of digital literacy technologies in the postgraduate education system. Older teachers had the opportunity enter the digital world only in the process of retraining in the postgraduate education system.

It should be noted that even young teachers, despite their early familiarization with digital technologies, will also have to be upgraded over time qualifications to improve your digital skills. So, the system postgraduate education plays an important role in the formation and development of digital teacher's literacy.

Digital literacy is important for teachers because it can facilitate increasing the efficiency of the educational process, teaching students to effectively use digital tools for educational purposes and in various spheres of life.

Digital literacy in the learning process means knowledge and ability to use a wide range of digital tools such as smartphones, tablets, computers, etc. for various educational purposes. In class, students can use these tools to explore content for different subject areas, communicate with other students about learning topics, and create their own digital content related to the curriculum they are studying. In order for the students to do this, the teacher must also have all these technologies in order to be able to help the students in case of problems. Therefore, digital literacy is important in the educational process for both teachers and students.

Thus, this problem is currently particularly relevant, since the modern education system, which has long been focused on traditional reproductive technologies, does not yet fully have developed mechanisms for developing the ICT competence of future teachers in the context of informatization of education.

Among the fundamental foundational works that determined the main directions of development of the field of informatization of education are the works: (Casas, Jennifer P., 2020) explores strategies for integrating digital technologies in the classroom and methods that promote the development of digital literacy among teachers and students, (Gardner, Howard, 2013) analyzes how digital technologies influence the way young people think and behave, including their learning and socialization.

Thus, modern requirements for a new quality of innovative information technology, communicative training of teachers and the dominance of a narrowly focused

approach to the formation of general pedagogical ICT competence of students - future teachers in educational organizations of higher education; the existing practice of forming general pedagogical ICT competence of future teachers as a system-forming component of the integral structure of professional ICT competence and the need to improve the theoretical and methodological basis for the formation of ICT competence of students in educational organizations of higher education.

2. Methodology

The methodological basis of the study was:

- A systematic approach that allows for a comprehensive study of the process of developing the readiness of bachelors for professional and pedagogical activities as an integral system;

- A competency-based approach, focused on mastering the system of professional competencies of bachelors necessary for organizing and managing the educational process in professional educational organizations;

- A synergetic approach aimed at the process of self-organization of the student's personality through self-determination, considered as an adaptation of the individual's internal needs to the conditions of the real situation, methods of various types of activities;

- An activity-based approach that ensures the orderly action of a vocational training teacher in organizing and managing various types of activities of students in the learning process;

- A personality-oriented approach aimed at the development of each subject of the educational process based on the creation of certain conditions, taking into account the individual qualities of the student's personality.

Object of the article: vocational pedagogical training students in an educational organization of higher education.

Subject of research: the formation of general pedagogical ICT competence in students based on a system-activity approach.

The purpose of the article is a theoretical and methodological substantiation of the process of developing general pedagogical ICT competence among students, pedagogical conditions for its implementation and an experimental test of their effectiveness based on a system-activity approach.

To achieve the goal, solve the assigned tasks and check based on the hypothesis, the following methods were used research:

- 1) Theoretical (study and theoretical analysis of psychological and pedagogical literature, synthesis, modeling, comparison and generalization);

- 2) Empirical (pedagogical observation, questioning, expert assessment, study of activity products, pedagogical experiment);

- 3) Mathematical (Wilcoxon test, Fisher test, method Saaty's hierarchies).

The purpose of the article is to reveal the concept of "teacher's digital literacy" and the means of its formation in the post-graduate education system of Ukraine.

Digital literacy is one of the many new forms of literacy that have been introduced and discussed in various disciplinary contexts over the past few decades. Several researchers, including D. Bawden (2001) and A. Martin, have attempted to bring analytical order to the discourse by writing comprehensive reviews of the concept of digital literacy and its relationship to other concepts such as information literacy, library literacy, media literacy and computer literacy. Literacy (Lau, 2006). D. Bawden (2008) notes that there is an observable continuum from early mentions of computer literacy and the subsequent emergence of new forms of literacy from information literacy to internet, web and digital literacy.

Proliferation of competing definitions and inconsistent references to different types digital literacy is problematic. The roots of a variety of interpretations are possible trace from the very concept of literacy. P. Gilster's idea about literacy is possible seen as a relatively straightforward extension of the traditional idea of literacy as an ability reading and writing – dealing with information using a traditional set of modern technologies (Bawden, 2008). Contrasted with this understanding is the sociocultural understanding of literacy as a set of social practices represented in concepts related to digital literacy, based on concentration of attention (Rheingold, 2020) or participatory literacy (Giger, 2006). H. Rheingold (2020) also highlights, in addition to attention, other 4 areas of literacy (participation, collaboration, network awareness, critical consumption), but believes that attention is fundamental for all other forms of literacy, the one that unites all others. He emphasizes that if to talk about the critical use of digital media, one needs to learn be smart about directing your attention online. After all, attention is the main building factor a building block of how people think, how they create tools, and how they teach each other use them, how groups socialize, and how people transform civilizations.

P. Giger (2006) notes that participatory literacy means learning to share and participate in the native world of the Internet, where participation and sharing will become an important feature of our lives. It also means being equally adept at sharing your knowledge and allowing others to share their knowledge with you, which also includes knowing when it is safe to share and when it is not. Everything between these polarities requires a certain amount of knowledge about how to share and participate in the web environment. This knowledge along with firewalls, spyware detectors and antivirus software will henceforth become necessary components of our lives.

Participatory literacy requires certain knowledge of ironic communication, hybrid identity and a sense of belonging to the contextual environment, it is learning live in the Web 2.0 / Native Web environment, which are participatory networks.

Various aspects of the development of information and communication competence are presented in the authors' studies: (Prensky, Marc, 2001, 2010) proposes specific methods and strategies for implementation in the context of digital literacy.

The study of the conceptual apparatus, structure and content, composition and technology of formation of ICT competence is reflected in scientific works: (Tapscott, Don, 2008) explores how "Net Generation" uses technology for learning, communication and development, (Turkle, Sherry, 2011) looks at the influx of digital technologies into mutually exclusive and special developments, (Mills, Kathy A., 2016) the book takes a theoretical view of digital literacy, discussing a variety of approaches to understanding how people consume and consume digital content., (Thomas, Douglas, and John Seely Brown, 2011) the authors look at how the rise of digital technologies and open source information is creating new opportunities for advancement., (Warschauer, Mark, 2004) the book focuses on the role of technology in changing social dynamics, through the increased availability of lighting and information, (Lankshear, Colin, and Michele Knobel, 2008) the authors discuss the concept of digital literacy in the context of current social and cultural practices., (Jenkins, Henry, et al., 2009) the book explores how digital culture is shaping new kinds of literacies that are necessary for effective interactions in the modern world.

At the same time, there is still a need to clarify a number of aspects at the methodological, theoretical, methodological and technological levels for the formation of information and communication competence (Tsilmak, O., Iasechko, S., Poplavska, M., Motlyakh, O., & Kabanets, O., 2022).

An analysis of the requirements of regulatory documents on education reveals the need to revise the program currently being implemented at the level of ICT training for teachers and move from the study of single, often archaic, tools and technologies to the acquisition of skills to construct an individual educational space, using and mastering the optimal means.

Thus, the introduction of a system-activity approach as a priority methodological principle in the field of teacher training in an educational organization of higher education provides for a combination of the following types of student activities: educational, research, extracurricular, etc., which are purposefully organized and coordinated for the formation of general pedagogical ICT competence.

3. Results

The article defines:

1) the concept of general pedagogical ICT competence of a teacher is clarified as a personal formation, characterized by mobilization readiness and the subject's ability to freely use special system knowledge, skills, and abilities in the educational process (competencies) in the field of information technology;

2) the process of formation of general pedagogical ICT competence of students is substantiated as a specially organized mastery by students of creative reflective subjective experience of designing and implementing professional pedagogical activities

using modern ICT and digital resources in a systemic set of subject-content, organizational, methodological and technological aspects;

3) Pedagogical conditions for the formation of general pedagogical ICT competence among future teachers have been identified and justified (dynamic personal representation in the educational environment, variable organization of educational activities, self-development of ICT competence among future teachers);

4) A model has been developed for the formation of general pedagogical ICT competence based on modern electronic information and learning environments to improve the motivational, cognitive, reflective and other components of the competence of the future teacher.

4. Discussion

Formation of digital literacy of the teacher: European experience. Scientists from Great Britain (Gruszczynska, Merchant, Pountney, 2013) developed the project "Digital Futures in Teacher Education" (Digital Futures in Teacher Education) based on the statement about the urgent need for the development of digital literacy of teachers throughout their professional activities. The project is aimed at clarifying the possibility and problem of creative and innovative use of digital literacy of teachers at school.

The project team worked with primary and secondary school teachers in Yorkshire to develop case studies of digital practices in schools which included the use of mobile devices, digital video, Web2.0 applications and school intranets. There were course teachers and students of the Faculty of Pedagogy involved in the testing and development of open digital resources that contain resources supporting effective digital literacy practice for teachers at all stages of their careers. Two key results of the project released by under the Creative Commons license, were:

1. The open textbook is an open resource on digital literacy for educators, of teachers and schools, which explores the challenges of engaging digitally literate students; includes two main elements: digital literacy in a professional context development and digital literacy for creative students. A textbook of 100,000 words, consists of 6 chapters and contains 2 "alternative" contents: key questions and digital literacy for teachers. It also has a unique Thinking Space feature,

Which allows users to like, tag, annotate and export content to a personalized open playbook.

2. Digital Bloom – in the project, it became a focus for researching intersections of digital literacy and creativity. Participants were asked to reflect on the connection between creativity and the practice of digital literacy both in formal education institutions and outside them. The central metaphor for these events was "digital flowering": an abstract concept represented by a field of flowers, where each flower represents individual understanding of digital literacy, and the field symbolizes the social layer. On in this clearing, the project team and partners reflected on digital literacy.

This project's emphasis on practice – and in particular on digital practices and the social aspects of digital literacy – was realized through a methodology that aimed to enrich practice by empowering teachers and teacher educators to reflect and critically engage with their own practice and their own communities. This has increased the potential for sharing and developing practice and experience through a system of open textbooks and learning resources packages. Regarding teacher competencies, this project was about the skills of the former level (teaching) and second level skills (learning about teaching). One of key outcomes were the development of new teacher training courses on digital literacy and the use of open digital resources for learning and teaching in formal and informal settings (Gruszczynska, Merchant, Pountney, 2013).

An interesting example is the experience of the Norwegian University of Science and Technology, where the teacher training program is an integrated postgraduate study program (Røkenes et al., 2016). Approximately 270 student teachers each year enroll in a five-year integrated teaching program or a one-year practical teaching course that qualifies them to teach. The institution has a modern technological infrastructure with wireless Internet on the campus, a learning management system for posting information about classes and assignments, as well as lecture halls equipped with projectors and television screens.

Student teachers have access to computer labs, but most of them bring their personal digital devices. The institution does not have a general technology plan, but teacher educators integrate ICT into their subject disciplines. Therefore, formal teacher training and ICT learning experiences are mainly through pre-service training, didactic (methodological) courses and during school practice (Røkenes et al., 2016).

Based on the analysis of the digital competence of teachers in Turkey, scientists İ. Keskin, T. Yazar (2015) developed the following suggestions: 1) teachers, especially older teachers, should participate in in-service training according to the teacher profile required by the 21st century; 2) universities must update their programs in accordance with the needs of the era and must teach, especially future teachers, to "learn"; 3) in this area, more detailed, more diverse studies should be conducted on larger samples, and the results should be presented, in particular, for the information of politicians.

E. O. S. Espinosa, J. A. C. Ruiz, M. T. C. Mercado (2021) describe the basic digital competencies that need to be developed at the postgraduate level based on the characteristics established by the knowledge economy. The priority is assessment, analysis and synthesis information gained in addition to creative and innovative communication in a networked environment. They developed a postgraduate course in digital of competence was created as a social community that develops innovative, scientific and technological projects as an essential activity in which information is the main thing a resource in the development of the generation of new knowledge. In research, digital competence is defined as a set of capabilities aimed at using ICT to obtain, store, organize, present and exchange information.

L. Markauskaite, L. Carvalho, T. Fawns (2023) note that a fundamental teaching ability is teachers' awareness of how digital technologies intertwine with human practice within and across different levels of the educational ecosystem. Teachers need to overcome the separation between areas of knowledge and ways of knowing, as well as learn to navigate complex contexts. They need to be attuned not only to themselves, but also to others, and to co-configure hybrid environments in ways that enable shared distributed activity. This requires a fundamental shift in how teachers' digital competencies are conceptualized, moving from person-centered views to more holistic models.

These models recognize the importance of personal knowledge, skills, dispositions and others personal resources of teachers. Therefore, digital technologies and competences cannot understood in isolation from a larger mix of tools, practices, goals, people, etc.

Analyzing the issue of digital literacy formation in the Scandinavian countries, S. Lisborg et al. (2021) state very different degrees of prescription regarding the content of digital competences. The most detailed descriptions of them are present in the Norwegian system of pedagogical education. Digital competence, skills and knowledge are described in all subjects of the national curriculum, and professional digital competence is outlined in the framework of digital competences for teachers. The Danish national curriculum for teacher education includes various digital competences from different subjects, while in Sweden digital competence in the national curriculum the program is described in general terms. In Finland, responsibility for content, including digital competences entrusted to local teacher training programmes. In Norway and Denmark, the two countries with the most detailed national regulations regarding digital competences, three types of digital programs can be identified in policy documents. The first concerns the use of digital tools for learning purposes, where digital competences are understood as the mastery of digital tools. The second concerns more critical, exploratory and creative ways of using digital technologies. The third is the development of computational thinking, where attention is paid to the creative aspects of programming, not only creating a script and algorithm, but also thinking about logic and eliminating errors. Computational thinking has recently become part of mathematics, science, arts and crafts, and music in the Norwegian national curriculum. The second and third types of programs are responses to the growing demands for the level of digital competences in teacher education. The second form of digital expansion of competencies applies to all subject areas, while a third emerges only as the content of individual subjects at the national level in Norway.

The organization of the educational process in the competency-based paradigm should ensure the formation of skills of self-education and self-realization of the individual. Along with this, modern education should focus on shaping the needs of teachers for a permanent increase in volumes and rethinking of knowledge,

modernization of skills and abilities, their strengthening and transition to a competency level.

Informatization has become a large-scale process affecting all spheres of public life, which is aimed at creating the best conditions for meeting the information needs of people.

Informatization of education is aimed at achieving goals in the field of training, education and development with a special emphasis on the use of ICT for collecting, storing, processing and disseminating information. The use of ICT in education expands the types of learning activities that can be implemented: this and information activities (search, collection, processing, analysis, archiving, broadcasting, replication), and network interaction, and modeling of objects or processes being studied, and formalization of the received educational information, as well as the creation of one's own electronic educational resource (Gardner, Howard, 2013).

Taking into account the specifics of the analyzed personal education, in the structure of general pedagogical ICT competence can be divided into the following components: motivational-value, cognitive, activity-based, communicative and reflexive-corrective. These components of general pedagogical ICT competence are closely interrelated and interdependent.

The formation of general pedagogical ICT competence among future teachers is an urgent problem that has not yet received a systematic solution in the field of higher pedagogical education. This requires a certain organizational and methodological optimization of the educational process, the direction of which is determined by a number of methodological approaches, the leading of which is the systemic activity approach.

This approach is considered in this study as a defining, strategically significant basis for building the process of developing general pedagogical ICT competence among future teachers in an educational organization of higher education (Prensky, Marc, 2001, 2010). This presupposes specially organized mastery by students of reflexive subjective experience of designing and implementing professional pedagogical activities in a systemic combination of subject content, organizational, methodological and technological aspects.

Based on the study of the essence, internal structure and dynamics of the process of developing general pedagogical ICT competence among students of pedagogical areas of training, a model was developed, the purpose of which was to increase the efficiency of this process and bring it into line with modern requirements information society.

To most effectively achieve your goal based on the modeled process, a set of pedagogical conditions for the formation of general pedagogical ICT competence in future teachers has been developed.

The first condition is the systematization, at the personal level, of the individual value system of students. The implementation of this pedagogical condition can be interpreted as a dynamic personal representation in the educational environment of the Internet for future teachers.

The demands for activity, independence and creativity associated with higher-level productive skills are particularly challenging because they involve generating one's own ideas, sharing achievements and results, and using a range of hypertext and interactive tools, participation in educational experiments and innovations (Iasechko S., Pereiaslavskaya S., Smahina O., Lupei N., Mamchur L. and Tkachova O., 2022). This also requires developed abilities and skills to analyze, generalize, classify, exercise self-control, reflection, evaluate the process and results of one's own activities, etc.

The second condition is the variable organization of educational activities to ensure a multidimensional process of developing ICT competence among future teachers in the educational process of higher education. Full-fledged variable use of e-learning, multimedia, distance learning and cloud technologies in the educational process of an educational organization of higher education (Warschauer, Mark, 2004). These technologies and tools help create a modern electronic information educational environment, which is achieved in reality, and not at the declaration level, only when they are fully integrated into the pedagogical process of an educational organization of higher education, becoming the basis for preparing future teachers for professional activities and encouraging students to actively participate in it.

The successful implementation of the above conditions in combination with the optimal configuration of approaches, principles, teaching methods, organizational and methodological support and subject-subject interaction between students and teachers will ensure the effective preparation of future teachers for professional teaching activities, as well as the productive formation of their general pedagogical ICT competence as a solid basis for further development of the subject-pedagogical component of a teacher's professional ICT competence.

The constructed model of the process of developing general pedagogical ICT competence in future teachers based on the system-activity approach is a set of blocks that are in close interaction and interpenetration: goal; methodological and methodological principles; pedagogical conditions underlying developing the process of developing general pedagogical ICT competence of students; the content of the educational process, focused on the comprehensive improvement of all components of the competence being formed; as well as a criterion-level complex that allows monitoring, evaluation and timely correction on the way to the projected result: future teachers mastering an adequate (basic or advanced) level of general pedagogical ICT competence (Tapscott, Don, 2008).

The results of activities to study indicators of the development of general pedagogical ICT competence among future teachers, identified during the ascertaining experiment, indicate that:

The motivational and value component is formed on insufficient level, which requires special work in this direction;

Knowledge and understanding of the basics of computer science and information technology among most of the participants in the experiment is at a low level;

The activity component also requires further improvement, since the use of information and communication technologies and the capabilities of Internet resources in the educational process in most cases is disordered (unstructured) in nature;

Low indicators of the communicative component of general pedagogical ICT competence. At the same time, one of the most disappointing indicators was the variability in the use of e-learning elements. In addition, the ascertaining experiment revealed that students have an insufficient level of proficiency in IT such as multimedia and cloud computing;

The reflective-corrective component, along with the communicative one, had the lowest values among the presented components.

The next stage of experimental work (formative) was aimed at developing and implementing a model aimed at developing general pedagogical ICT competence in the context of the professional culture of the future teacher.

We identify three stages in the implementation of the formation model general pedagogical ICT competence of the future teacher based on a system-activity approach.

5. Conclusion

Therefore, in the post-graduate education system of Ukraine, various ways of forming digital literacy can be introduced, namely: programs and courses aimed at forming digital literacy of teachers. The main directions of such programs may include:

- a) Mastering basic digital tools: teachers master the skills of working with simple digital technologies necessary for daily use in the educational process: skills of mastering computer, multimedia and projection equipment, operating systems, text, table and graphic editors, presentation programs, test programs, web browsers, Internet services (information search systems, e-mail, file storage, video hosting, messengers, etc.).
- b) Use of educational platforms and tools: teachers must learn use e-learning platforms, web conferencing systems, video recording programs, interactive tools, online testing tools and other digital tools to support the learning process.
- c) Digital resources for learning: teachers must be able to find, evaluate and use digital resources such as websites, video lessons, electronic textbooks, programs for self-study of students and for self-study non-formal education and improvement of own qualifications.

- d) Internet Safety: Teachers should be aware of the basic principles of cyber security and rules of conduct on the Internet to protect themselves and students from potential threats.
- e) 5. Integration of digital technologies into the educational process: teachers must learn to use digital tools and resources to improve educational process, development of interactive tasks, and promotion of collaborative learning, collective work and individualization of learning.
- f) Use of artificial intelligence technology: teachers should be aware of the capabilities of artificial intelligence and learn how to use them to improve the effectiveness of their professional activities and to prevent the use of this technology by students for an unscrupulous purpose.

The successful formation of a teacher's digital literacy can be carried out through a combination of lectures, practical classes, the use of modern digital technologies in the learning process and the acquisition of specific digital skills in real pedagogical situations. An important element is the constant updating of postgraduate education programs, taking into account modern trends in the field of digital technologies and ensuring teachers' access to relevant resources and support. Therefore, the formation of digital literacy teacher in the post-graduate education system of Ukraine is an urgent task that contributes improving the quality of education and training teachers to work in the modern digital world environment.

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