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Digital Technologies as a Means of Forming Subject-Methodical Competence Future Primary School Teachers

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Abstract. The article updates the problem of the application of digital technologies in various professional methods and their integration in the educational process of institutions of higher pedagogical education. According to the authors, the formation of subject-methodical competence of future primary school teachers is not possible without the formation of abilities: navigate in the information space, use existing and, if necessary, create new electronic resources; use modern digital technologies in the educational process. For the formation of professional skills and abilities in students of pedagogical specialties, the quality of educational content of a methodological nature, created by means of digital technologies, is essential. In accordance with the purpose of digital technologies and their application in professional teaching methods, the most effective sets of programs and applications were determined for students to create educational and methodological support for the educational process in primary school. Such as: mind maps (summary diagram of interactive lessons), presentations (demonstration of educational materials), comics (visualization of educational information in frames-pictures), word clouds (visualization of educational content in keywords), infographics (visualization and structuring of a large amount of educational information), virtual boards (coordination of work in groups in class, during the web quests, organization of student communication), interactive tasks and online tests (creation of exercises to acquire skills, development of tasks and tests to reveal knowledge and skills).

Keywords: Digital Technologies, Subject-methodical Competence, Information-Digital Competence, Professional Training, Future Primary School Teachers.

1 Introduction

At the current stage of development, humanity is experiencing complex processes of globalization and integration, which lead to radical changes in all spheres of life. The methods of distribution and the volume of information have changed, the virtual E-environment is rapidly modernizing, which affects the reformatting of the educational space. The introduction of innovative technologies in education, the development of students' critical thinking and emotional intelligence and at the same time avoiding their overload, orien-

tation towards a happy child who actively learns about the world and prepares for successful socialization - conceptualize both the education of the European standard and the new Ukrainian school. The recommendations of the European Parliament and the European Council on competences for lifelong learning identify a number of important aspects within the Reference Framework, such as: critical thinking, creativity, initiative, problem solving, risk assessment, decisiveness and constructive management of feelings [1].

Teacher training of the New Ukrainian School must meet the requirements of the times and be based on the principles of the competency approach emphasized in the paradigm of modern education [2]. The professional standard for the professions «Teacher of primary classes of a general secondary education institution», «Teacher of a general secondary education institution», «Primary school teacher (with a diploma of a junior specialist)» embodies a modern approach to the definition and description of professional competencies of a teacher, in the list of which one subject-methodical competence is among the most important. Subject-methodical competence involves: «The ability to model the content of learning in accordance with the mandatory learning outcomes of students, in particular, to apply modern methods and technologies for modeling the content of learning students' subjects (integrated courses)». Also, «The ability to form and develop in students key competencies and skills common to all competencies; the ability to select and use modern and effective methods and technologies of teaching, education and development of students, in particular, to apply innovative learning technologies; the ability to develop students' critical thinking; the ability to evaluate and monitor the results of student learning based on the competence approach» [3].

The formation of subject-methodical competence in future primary school teachers is not possible without the formation of the ability to navigate in the information space, use existing and, if necessary, create new electronic resources; use modern digital technologies in the educational process. Modern youth prefer using of electronic textbooks, and interactive information technologies that combine text, sound, images, video, graphics, and augmented reality. The harmonious combination of traditional teaching tools with the use of digital technologies in the form of presentations, videos, mind maps, interactive exercises, etc. significantly increases the effectiveness of forming students' readiness for future pedagogical activities in new life conditions.

Therefore, the problem of activation of digital technologies in industry methods and their integration in the educational process of institutions of higher pedagogical education is relevant in modern pedagogical science.

2 Literature Review

Research by R. Gurevich, L. Konoshevskiy, and N. Opushko [4] is devoted to the problems of digitalization of modern education and its impact on the educational environment, which contributes to the improvement of the quality of training of future teachers and the convergence of education with science. The study of T. Vasilieva, Yu. Petrushenko, O. Kryklii [5] is devoted to theoretical, methodological and applied approaches to the organization of distance learning in higher educational institutions.

The authors in the collective monograph also present the developed practices of using digital technologies and the results of innovative educational activities.

Also, the work of Yu. Zhuk, O. Sokolyuk, N. Dementievska, O. Pinchuk [6] is dedicated to the organization of educational activities in a computer-oriented educational environment. In the research of L. Sushchenko, O. Andryushchenko, P. Sushchenko [7], the theoretical foundations of the process of digital transformation of higher education institutions in the conditions of digitalization of society were revealed, the organizational and pedagogical conditions for the formation of digital competence of future teachers were defined and scientifically substantiated.

The study is about the reorientation of the modern teacher to his deep awareness of competitively oriented requirements for his professional activity: readiness for the maximum use of digital tools that increase the efficiency of the educational process; introduction of distance educational innovations based on new possibilities of digital technologies; learning new teaching methods; creation of digital space – an environment with a powerful potential for ensuring the educational activity of an individual. The authors claim that information technologies are aimed at developing the competencies of future teachers, giving them competitive advantages: dynamism of cognitive activity; motivation (encouragement of students of higher pedagogical education to independently learn new things); the availability of information that simplifies the learning process; interdisciplinary content.

Of particular interest in our research are studies related to ways of introducing effective visualization in the creation and use of immersive storytelling [8, 9, 10]. A number of works are devoted to the analysis of gamification of artificial intelligence activities to improve cognitive skills among primary school students [11]. Separate studios [12, 13] consider the use of Pixton Bitstrips, Graphix Comic Builder, Comic Life, Cartoon Maker software for creating thematic electronic comics and consider tools for analyzing their use in the educational process.

The problems of using web technologies in the process of psychological and pedagogical training of future primary school teachers were considered by Yu. Kulimova [14], L. Nezhyva [15], Ogier, K. Ghosh [16], J. Catalá, J. Scorer [17], the peculiarities of using comics in the pedagogical practice of the New Ukrainian School were determined by N. Rudenko [18]. The ideas of the analyzed studies indicate that digital technologies influence the improvement of teaching and assessment methods, and their use positively changes the process of acquiring knowledge, skills, and abilities, and contributes to the development of the competencies of education seekers. According to scientists, digital transformations are based on such trends as efficiency, competitiveness, and the creation of new values.

3 The Aim of the Research

The development of digital technologies affects the reformatting of all areas of the educational system. In the process of reforming Ukrainian education, digital trends are gaining credibility. The latest information technologies are being actively implemented in educational institutions, in particular, in the educational process of training future primary

school teachers. At the Faculty of Pedagogical Education at the Borys Grinchenko Kyiv University, the educational process is carried out taking into account modern digital trends. The content of the Educational and Professional Program 013.00.01 Primary Education at the first (bachelor) level of higher education, work programs of educational disciplines in the specialty 013 Primary Education, and the development of educational and methodological support provide for the active use of modern digital technologies. The information technology content of the disciplines is constantly being improved.

For example, in the content of the educational discipline «Native language education», which consists of two blocks «Ukrainian language with teaching methods» and «Children's literature with teaching methods», the use of the following digital tools are provided: a virtual online board Padlet, on which methodological problems are discussed; mind maps Bubbl.us for creating interactive lesson plans; various infographic platforms for making didactic material; LearningApps for developing interactive exercises and Kahoot! For the development of online tests, etc.

The purpose of this article is to substantiate the prospects of using digital technologies in the process of forming the subject-methodical competence of future primary school teachers.

4 Research Methodology

To implement the study, the following methods were used: theoretical (analysis and synthesis of pedagogical and methodological sources, handbooks, programs, systematization and generalization of theoretical material; study of the experience with the research problems; clarification of the basic knowledge of the studied problem), empirical (pedagogical observation, interviews with students and questionnaires, formulating conclusions).

The study was conducted based on Borys Grinchenko Kyiv University, during October – to December 2022. The study was attended by 64 students of the specialty «Primary Education» of 2 – 3 years of study. The research was performed within the framework of a complex scientific topic of the Faculty of Pedagogical Education of Borys Grinchenko Kyiv University «System of training of primary school teachers for professional activity in the context of the reform «New Ukrainian School»» state registration No. 0121U113726 and the framework of a complex scientific topic the Department of Mathematics and Physics of Borys Grinchenko Kyiv University "Mathematical methods and digital technologies in education, science, technology", DR No 0121U111924.

5 Discussion and Results

Subject-methodical competence is mostly formed in classes on multi-disciplinary professional methods, which provide for the formation of special (professional) competence (SK-2 under the Educational and Professional Program 013.00.01 Primary Education at the first (bachelor) level of higher education). The ability of the future teacher to model the content of learning in accordance with the mandatory learning outcomes of students, to apply modern methods and technologies for modeling the content of learning students of subjects (integrated courses) requires integration with another important professional

competence, namely: information and digital. This competence, according to the Professional Standard, involves the formation of «the ability to navigate in the information space, to search and critically evaluate information, to operate with it in professional activities; the ability to effectively use existing and create (as needed) new electronic (digital) educational resources; to use digital technologies in the educational process» [3].

A modern graduate who graduated from an institution of higher pedagogical education becomes competitive in the labor market only under the condition of education, mobility, mastery of new information tools, and readiness to act in a programmed environment. Undoubtedly, it is necessary to provide methodological tools and at the same time computer literacy, media literacy, and media culture of future primary school teachers.

Undoubtedly, it is necessary to provide methodological tools and at the same time computer literacy, media literacy, and media culture of future primary school teachers. Under this condition, the digital component of subject-methodical competence contributes to the formation and development of future teachers' knowledge about the possibilities and advantages of digital technologies in primary education. The ability to work with digital devices and educational resources, the skills of digital communication and interaction, the ability to present educational material in an interesting way, to create educational and didactic tools in a digital educational environment, to use innovative technologies to evaluate the results of student learning. Thanks to this knowledge, skills and abilities, future primary school teachers have the opportunity to organize the educational activities of primary school children with the greatest efficiency. The skillful use of digital technologies diversifies the possibilities of modeling lessons and conducting them, creating digital content, educational and methodological support, and developing formative assessments.

For the formation of subject-methodical competence, the quality of educational content of a methodological nature, created using digital technologies, is essential. This is reproduced in Table 1.

Table 1. Digital educational technologies and their application in professional teaching methods in primary school

The purpose of digital technology	E-resources	Application in professional methods
Mind maps (Mind Map, Mind Mapping)	MindMeister FreeMind Bubbl.us	Structuring of interactive lessons; creation of educational schemes to activate the creative thinking of primary school children
Presentations	PowerPoint Google презентації Prezi	Demonstration of educational materials
Comics	Comic Master Pixton Storyboardthat MakeBeliefsComix Write Comics Witty Comics	Visualization of educational topics, concepts, rules, experiments, plots of works, actions of heroes, communication situations, etc. in frames-pictures

Word clouds (visualization of thematic content in key-words)	WordArt	Word clouds: according to the topic of the lesson; on the basis of the artistic work; according to the characteristics of the image; according to the topic of written student work; to the concept and so on
Infographics (visual elements and minimal text, providing an easy understanding overview of the topic; structuring complex, large-scale information)	Canva Piktochart ThingLink	Didactic media products for primary school in the form of schemes
Virtual boards (coordination of work in groups during the lesson; organization of students' communication)	Padlet Trello Whiteboard	Interactive lesson plan; the plan of the web quest; discussing the school project
Interactive tasks and online tests (creation of interactive tasks, exercises, online tests)	LearningApps Kahoot!	Interactive training exercises; online tests; crossword puzzles, quizzes.

On the basis of the Faculty of Pedagogical Education of Borys Grinchenko Kyiv University, we conducted a study of the content of regulatory documents (professional standard; work programs of educational disciplines integrated with professional methods; programs of pedagogical practices) on the subject of digital literacy development and the improving of skills in the use of e-resources during the practice. We also conducted a survey of intern students regarding the frequency and ease of using digital platforms for solving educational tasks at the New Ukrainian School. Investigating the possibilities of using the digital resources described above by future primary school teachers, a questionnaire was conducted among students of the specialty 013 Primary education of the first (bachelor) educational level of the Faculty of Pedagogical Education of Borys Grinchenko Kyiv University. The survey was conducted in order to find out the priority of using digital technologies during the performance of practical tasks on professional methods for the preparation and use of educational and methodological support in the educational process in the New Ukrainian School (primary). 64 2nd and 3rd year students participated in the survey (see Fig. 1.).

In the process of carrying out practical tasks on professional methods, students learn to select digital resources: for presentation and visualization of educational material; for the organization of students' performance of various exercises and game activities during the lessons; to provide formative and summative assessment. Also, students of higher pedagogical education learn to evaluate the functionality and effectiveness of digital resources for the implementation tasks of practical teaching methods in primary school. In accordance with the purpose of digital technologies and their application in professional teaching methods, the most effective sets of programs and applications were determined for students to create educational and methodological support for the educational process

in primary school. Mind maps (creation of mind maps of interactive lessons), presentations (demonstration of educational materials), and comics (visualization of educational information in frames-pictures). We also used word clouds (visualization of educational content in keywords), infographics (visualization and structuring of information), virtual boards (coordination of work in groups in class, on web quests, organization students communication), interactive tasks and online tests (creation of exercises for acquiring skills, tasks and tests development to identify knowledge and skills).

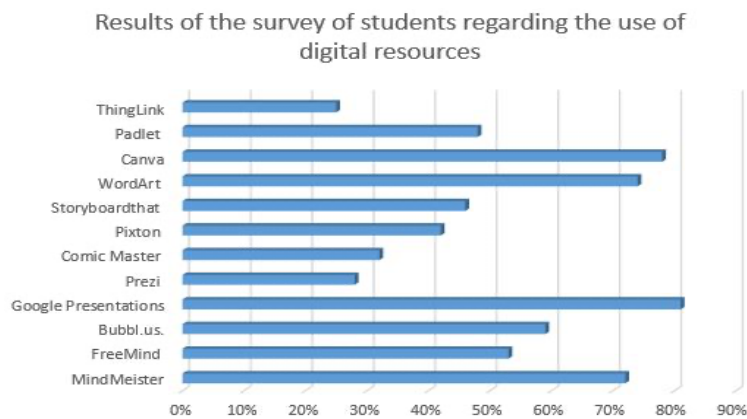


Fig. 2. Results of the survey of students regarding the use of digital resources in the professional methods classes.

Judging by the analysis of students' answers, students of higher pedagogical education are aware that using of mental maps of interactive lessons in primary school improves the perception of educational material. The most popular platforms for creating mental maps among surveyed students are MindMeister (72%), FreeMind (53%), Bubbl.us. (59%). Among the advantages of MindMeister for the organization of educational activities of junior high school students, the respondents mentioned: the ability to organize teamwork, organize online brainstorming, plan projects, create strategies, as well as presentations. With the help of a mental map, it is convenient for the teacher to reproduce the content of the lesson, display it graphically and present it in a clearly structured form. Intelligence maps of interactive lessons contain the subject of the lesson, from which the stages of the lesson are displayed by triggers. At each stage, textbook pages with the necessary material, tasks, exercises, calls to audio fragments, videos from various information resources can be placed. Mind maps of interactive lessons during distance learning has gained particular popularity, as their use facilitates the perception of information thanks to visualization, allows you to quickly process a large amount of material, improves the understanding of concepts, processes thanks to the activation of associative thinking, etc. Also, in the survey, students noted that during pedagogical practice, mind maps were used as a way of organizing the creative thinking of primary school children with the help of schemes. In particular, the mental map of a simple plot problem contributes learning the structure of the problem (condition, question), facilitates students' understanding of numerical data, the strategy of solving and finding the answer. The mind map of the story

helps to remember the plot; it can display the plan of the work, main events, characteristics of the characters, etc. According to this map, primary school children successfully retell the work, analyze the images, determine the main idea of the work, etc.

To create presentations, students use traditional methods Power Point from Microsoft. However, it should be noted that Google Presentations (81%) and partially Prezi (28%) are gaining more and more popularity among the respondents. In the student practice of preparing future primary school teachers for professional activities, comics are gaining relevance. Students use e-resources to create comics (Comic Master (32%), Pixton (42%), Storyboardthat (46%)). During the classes on professional methods, students are offered to create comics in order to present any topic in the form of an interesting story in pictures. Students learn to use comics in a variety of subjects. Thanks to them, you can visualize: basic concepts, rules; show the course of experiments and experiments, depicting their algorithm on several frames; the plot of the work of art. Moreover, it is possible to create scenes with the participation of the main characters in order to observe their characters and actions; dialogues between students and outstanding scientists, writers, travelers, artists; life situations of communication; speech constructions, etc.



Fig. 2. Infographics created by students in the program Canva.

The WordArt program becomes popular among students (74%). Future primary school teachers skillfully create and use word clouds in professional techniques as a visualization of thematic content in key words. A separate study by the authors of the article [15] is devoted to this problem. According to the results of the survey, it was found that respondents mainly use the Canva platform (78%) to create infographics addressed to primary school children. It is a graphic design platform that allows users to create graphics, presentations, posters and other visual content for social networks. The service offers a library of templates, a large bank of images, fonts and illustrations. Among Canva's advantages, students noted ease of use; the possibility of saving your works in jpg and pdf formats; convenient interface, attractive design. Students consider the Canva platform to be the most relevant for visualizing and structuring complex, extensive educational information in primary school practice. Respondents name various topics of creating infographics and

their purpose. This is a visualization, a graphic representation of interesting facts, a comparison (of subjects, objects, facts), an explanation of a concept (of educational material), a scheme of work, a structure of educational material. Infographics can be designed to help primary school children understand educational material, remember information, and complete educational tasks. In classes on professional methods, students check the created infographics in an academic group. During the presentation, group mates find out whether the presented information is clear, what questions arise when viewing it, whether additions or explanations of the existing content are needed. Didactic infographics are being improved according to the comments of group mates and the lecturer. Examples of student infographics created for primary school children of the New Ukrainian School are presented (see Fig. 2).

Answering about using platforms to create virtual whiteboards, students preferred Padlet (48%) due to its wide range of features. Students of higher pedagogical education are aware that it is appropriate to use a virtual interactive whiteboard during distance learning. This network resource as a learning tool is used to coordinate group work with various content with the possibility of joint editing, communication in the lesson in real time. Thanks to the interactive online board, it is possible to combine text, images, video, audio in an interactive format. Students noted the advantages of the Padlet interactive board in the work of a primary school teacher. This is convenient for the location of educational information, which the teacher can prepare in advance according to the topic of the lesson. Thanks to this property of the virtual board, future teachers can organize the educational process using interactive methods. When students solve educational tasks, it is enough to activate the corresponding block and the algorithm of actions will appear on the Padlet wall. Also, it is convenient to place completed tasks of students on the virtual board for joint discussion (see Fig. 3).

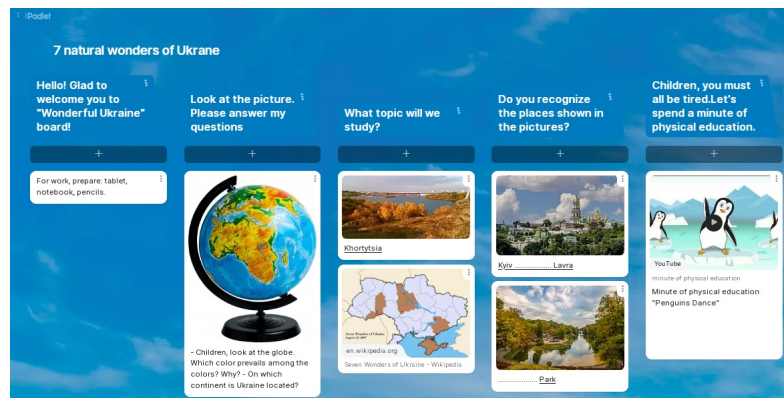


Fig. 3. An example of using a virtual interactive whiteboard in a primary school.

The described digital technologies are used less for the organization of quests. Padlet, ThingLink (25%) are used to develop and conduct web quests. Creating a web quest is a rather complex and difficult task, as it requires the use of several digital resources at once: a virtual whiteboard, infographics, programs for creating tasks, etc. But creating

and conducting an educational web quest is an interesting and creative process that covers all the subjects of the educational process and provides casual anchoring during gaming activities. Webquest is a powerful educational technology. This is a mental and dynamic game, which consists in teams of participants going through certain stages of the «route» (developed with the help of mental maps or virtual boards) with the performance of special tasks (using QR codes to perform them). The tasks at each stage correspond to a specific learning goal. Texts, images, photos, video files and calls to e-resources with tasks are placed on the interactive whiteboard. It is possible to move elements, adjust the background image and organize joint activities with other users. A ready-to-use board can be published on social networks, embedded in a website, exported in various formats.

To the question of which of the programs is optimal for creating interactive tasks and online tests for students, students chose the following applications: LearningApps – 89 %. Kahoot! – 71 %, Liveworksheets – 43%. Students named the convenient free LearningApps platform as the undisputed leader in use for creating a database of interactive tasks for primary school children. Among the advantages of using this service for professional activities, students named: a variety of templates for creating tasks, including multiple choice, filling in the blanks, assigning a pair, determining the sequence, filling in the form, quiz, crossword, filling in the table, etc. They also mentioned the ability to add text, images, sound, and video to the author's exercises; the ability to get a web link for placing interactive exercises on an educational platform, website, or teachers' blog; availability of ready-made exercises that you can apply in your activity.

6 Conclusions and Prospects for Further Research

In the course of the conducted research, it was found that the work programs of educational disciplines integrated with the methodology contain tasks and recommendations for working with digital platforms. However, teachers should pay more attention to the development of technological skills to use digital resources for the educational and methodological support of the education of primary school children.

The results of the study confirm students' understanding according to the importance of using digital tools for the implementation of practical tasks in professional methods. Graduates of higher pedagogical education showed readiness to choose and use convenient free digital resources, taking into account their multi-functionality.

Based on the results of the survey, the most popular digital technologies among future primary school teachers were determined, which are effective for the implementation of methodical tasks: creation of intelligence maps of interactive lessons – MindMeister; presentations of educational material – Google Presentation, Power Point. Visualization of the educational topic, concepts, rules, experiments, plots of works, actions of heroes, communication situations, etc. in frames-pictures of comics – Comic Master, Storyboardthat; visualization of thematic content using a word cloud – WordArt. Creating didactic tools for teaching primary school children using infographics – Canva; organization of educational activities, communication between students, preparation of web quests using a virtual board – Padlet, preparation of interactive tasks – Learning Apps, online tests - Kahoot!.

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