Future Educators' Training for Project Activities Using Digital Technologies

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Abstract. The practical importance of using digital technologies in preparing future educators for project activities is considered in the article. The importance of training future educators for project activities by means of digital technologies is substantiated. The authors have identified aspects of research the problem of ICT implementation into project activity, conducted by modern foreign scientists, in particular, designing a STEAM-oriented digital school environment; training of STEM educators; information technology in project training; introduction of 3d technologies, virtual and augmented reality into the elementary school educational process; 3d, virtual and augmented reality technologies in higher education. The components of the educational environment are defined: organizational component (organizational structures; corporate standards); content component (training resources; scientific resources; methodological resources; controlling resources; reference resources); technological component (IT infrastructure; centralized services). The information and educational environment is considered by the authors as a system consisting of educational resources based on modern educational technologies, in particular, information and educational technologies; cloud learning technologies; activity-oriented technologies; case technologies. The peculiarities of a higher education institution's educational environment organization using digital technologies are analysed. It was identified on-line, multimedia services and resources that students work with during their project activities, such as: Easel.ly, Piktochart.com, Padlet, Symbaloo, Coggle.it, ThingLink, WordArt, LearningApps.org, PowToon, Prezi. The present state of future teachers' preparation for project activities using digital technologies is revealed. The model of future educators' training for the project activity with the use of digital technologies is offered. The authors analyse how to use digital technology effectively in teaching the course "Project Activities in Educational Institution" on the Moodle platform. The effectiveness of preparing future educators for project activities using digital technologies has been proved.
Keywords: Project Activities, Digital Technologies, Information Education Environment, On-line, Multimedia Services and Resources.

1 Introduction

The process of informatization of education involves the use of new digital technologies in order to realize the ideas of intensifying the educational process, improving its efficiency and quality, training future educators to acquire the experience, skills and knowledge needed in the life of modern information society.

The use of digital technologies in the educational process depends directly on the level of professional training of a teacher. The Concept of the New Ukrainian School (2016) states that a teacher should collaborate with other teachers and students by creating digital resources, presentations and projects, teaching students to be global: communicate with the world through modern digital tools [1].

Therefore, the goal is to prepare a future teacher for project activities using digital technologies.

Modern digital technologies cover the full range of desktop and mobile computers, presentation tools, online resources, social networking and communication resources. Its extend the possibilities of project activity, allow to create a virtual image of the future object, to combine its constituent components, to change the dimension, focus, functional orientation of the project.

The importance of preparing future educators for project activities through digital media is outlined in the Concept for the Development of Teacher Education (2018) [2].

At the present stage, it is possible and necessary to use digital technologies in all levels of education, beginning with pre-school education. But there are objective reasons that prevent teachers use them fully. One of the problem is the lack of teacher's competence in using digital technology in his or her professional activity. That is why the research on the preparation of future educators for project activities using digital technologies becomes relevant.

Contemporary foreign authors have explored various aspects of ICT implementation in project activities, including: STEM-based learning (Robert M. Capraro, Mary Margaret Capraro, James R. Morgan [3]); designing the school's STEAM-oriented digital environment (Chee Hoe Ng, M. Adnan [4]); training STEM educators (Virginia McCormack [5]); information technology in project training (G. Cameron [6]; Dorr Mariella [7]); introduction of 3d technology, virtual and augmented reality into the educational process of elementary school and high school (Debopriyo Roy [8]); integration of digital technology into the teaching and learning of students (Wan Ng [9]).

In domestic pedagogy, the problem of the use of project activity in the process of future teachers' professional training is presented in the works of O. M. Kobernyk [10], L. G. Kondratova [11] and others.

The works of N. V. Morze [12]; [13] are devoted to the problem of training a future educator for the use of information technologies in the educational process.

At the same time, the problem of preparing future preschool and primary education teachers for project activities using digital technologies remains relevant and underdeveloped.

Considering the above, the purpose of the article is presentation of the experience of preparing future educators for project activities using digital technologies in the

course of teaching "Project Activity in Educational Institution" on the Moodle platform.

The following theoretical and empirical **methods** were used in the research process: analysis of electronic resources and training programs, methodological manuals; method of observation, questionnaire of students to find out their attitude to different aspects of project training and digital technologies use in professional training; modelling method; an educational experiment to test the effectiveness of training of future educators for project activities using digital technologies.

2 Digital technologies as a component of a university's educational environment

The educational environment of a modern university must be effective, open, quick to update, allow students to form their own learning trajectory, meet the requirements of modern education, and develop 21st century skills.

Scientists characterize the concept of the educational environment differently.

N. V. Morze, O. H. Kuzminska and G. O. Protsenko define the following components of educational environment: organizational component (organizational structure, corporate standards); content component (educational resources, scientific resources, methodological resources, controlling resources, reference resources); technological component (IT infrastructure, centralized services, decentralized services) [12].

The educational environment is filled and functions with the help of digital technologies. Wan Ng explores digital technologies as a subset of electronic technologies encompassing hardware and software used by individuals for educational, social and entertainment purposes in a formal and informal context of their daily lives. In his view, digital technology is a type of educational technology that includes: desktops; mobile devices; digital recording devices; data logging equipment and related sensors; interactive whiteboards; Web 2.0 technologies and other resources on the Internet; educational software packages [9].

The educational environment of a university is aimed at forming the professional competencies of a future teacher, in particular, information competence. N. V. Morze and I. P. Vorotnykova offer the ICT model of teacher competency in line with the activities directions [13].

A similar structure is proposed by the European scientific community in the format of the European Framework for the Digital Competence of Educators (DigCompEdu). The document divides a teacher's digital competence into 6 main components, which in turn consist of 22 competencies. The six components are:
- professional involvement;
- digital resources;
- teaching and learning;
- evaluation;
- empowering students;
- facilitating the digital competence of educators [14].

The integration of digital technology into the educational environment of a higher education institution has three main goals: providing an open education; formation of a future teacher's information competence; support of the educational process.

Thus, the digital educational environment opens the possibility for educational institutions to access a wide range of open sources of education.

3 Current state of future educators' training for project activities using digital technologies

The quality of future educators' training for project activities using digital technologies is determined by the level of readiness for such activities.

In agreement with the approaches of modern scholars to substantiate the criteria of future teachers' readiness for project activity [10, 11] and the structural components of ICT competence, we have distinguished such components of future teachers' readiness for project activity using digital technologies: motivation and value (a cognitive interest in project activity and a desire to master digital technologies through the design process); informational and cognitive (knowledge of the project activity theory, knowledge of the educational design essence and logic of its stages construction, knowledge of computer technologies and programs, digital tools); activity-creative (a complex of projecting skills in the use of digital technologies: intellectual, creative, communicative, methodological); reflexive-evaluative (ability to analyse and self-assess project readiness to use digital technologies in educational institutions).

In order to study the state of readiness of future teachers for project activities using digital technologies at the ascertaining stage of the experiment, we conducted a survey of the master's programme students in the specialties "Preschool Education" and "Elementary Education" at Borys Grinchenko Kyiv University.

The questionnaire was aimed at studying the level of future pedagogues' motivation to project activities using digital technologies, understanding the essential characteristics of a teacher's project activity, knowledge and skills of using digital technologies in project activity; self-assessment of readiness for this type of activity.

The survey allowed us to conclude that the majority of students – 80% understand the importance of project activity in the training of future teachers. Among the factors that significantly influence the readiness for the project activity, students highlight: personal qualities of their tutors and cooperation with them (77.8%); involvement in own project activity (61.2%); independent work and cooperation with students of other groups (58.3%); subject circles, problem and creative groups, practical and seminar classes (49.7%). It is worth noting that 20.5% of respondents are interested in the development of ICT projects.

More than a half of teachers (58%) are able to think through the stages of their own project activity and point out the appropriate place of digital technologies in it. The results of the survey showed that only 5% of respondents do not support the use of information technology in the educational process. It is found that 95% of teachers use the Internet to search for training materials; 86% create or find supplies for later printing; 55% use a computer during class as a presentation interactive tool; 30%

involve children in work with Web services, creating materials by children; 23% increase the use of information technology to other forms of daily work with children (games, independent activity, individual work, observation, duty, etc.); 9% have personal blogs on pedagogical topics. As for project activity theory, only 33.3% are fully aware of the project method, 57.5% understand the specifics of project activity in educational institutions.

A half of the teachers (53.5%) constantly use project activity in the study of topics that are not covered by the educational program, 32.1% occasionally supplement the program materials with their own projects, 14.4% use only ready materials. A small number of respondents (17.5%) are interested in improving the educational environment of the educational institution through their own digital educational projects development. One-third of teachers (33%) are marked by the originality of the proposed projects, a large number of various digital tools, the rest of the respondents use several resources in the implementation of all projects.

Most of the students – 61.2% evaluate adequately the quality of their own project activity, identify the disadvantages and advantages, plan further activities with their account. A third – 37.8% – feel the need to further explore digital tools and the practice of using them in project activities. According to students' opinion, the factors that significantly affect the quality of project activity using digital technology are: 12% – technical knowledge related to digital technology; 48.5% – proper planning and methodological preparation of a project, 39.5 – the quality of previous knowledge of project participants, their number.

The results of the ascertaining experiment showed that only a third of the respondents is able to navigate the information space at a high level, receive information and operate it according to their own professional needs. Teachers are ready to carry out project activities using digital technologies, to create their own materials and to involve them in the educational process of the educational institution, but at the same time they need the skills and experience of such activities.

4 The Model of future teachers' preparation for project activity with the use of digital technologies

After analysing the modern approach of scientists to teacher's training in the field of digital technologies and the structure of ICT teacher's competence, we have developed a model of training future teachers for project activities using digital technologies. The structural components of this model are following: purpose, goals; specific principles, in particular, the connection of learning with activities, variability, flexibility of the educational environment, communication and cooperation, focus on self-education, gamification of the educational process. Stages of model implementation: determination of the necessary content of future teachers training; creation of the electronic educational courses structure, Massive open online courses (MOOC), planning of open events, webinars, conferences; experimental implementation of the model during the formative stage of the study; determining the level of the proposed model efficiency and ways to further modify it.

The model of future teachers' preparation for project activities with the use of digital technologies involves the development of electronic resources for conducting a formative experiment in two stages. At the first stage we use e-courses that form a general digital competence and prepare participants for the use of the project method, for example: "Project activities in educational institutions" and "Integrated thematic-project learning". At the second, future educators choose a variety of courses to further master specific digital tools, such as: "Using Scratch at Elementary School Lessons", "Lego-mindstorms and Arduino Research Projects", "Virtual Elementary School Classes", and "Video Blogging for educators".

Such a model should be implemented in the format of blended learning: the presentation of theoretical materials in the format of mass open online courses and practical activities for students and teachers. The result, in addition to mastering digital tools, is to support the ideas of participants about the implementation of their author's educational projects.

The structure of modern educational technologies used in the e-environment of the university is given in Table 1. This ensures the integration of such electronic resources as e-learning system, corporate accounts of participants, institutional repository, electronic publications.

Table 1. Structure of modern educational technologies

Multimedia technologies	Cloud technologies	Interactive technologies
audio-visual materials electronic aids computer educational programs	Web 2.0 educational sites and resources massive open online courses online webinars, conferences communication and shared resources storage space	project activity case study problem learning theories of solving inventive problems group work business games
Include work with text, image editors, spreadsheets and data bases, work with presentation tools, creation of multimedia educational materials	Base on the use of the Internet and electronic methods of data transmission. Envisage distribution of multimedia materials and their involvement through e-mail, video conferences, social networks, etc..	Allow to make use of multimedia and cloud technologies expedient and effective, involve participants of educational process in cooperative forms of work, close to their future professional activity.

In order future educators to acquire competency in organizing project activities in educational institutions, master the necessary skills to use digital technologies for the

development, organization and presentation of projects, we have developed a course syllabus and, accordingly, an electronic training course "Project Activities in Educational Institutions" [15].

The e-course is built on a blended learning model. It provides flexibility with respect to traditional learning, and provides the opportunity to offer training in different variations of educational material presentation.

The structure of the e-learning course includes the following blocks: information-referral; basic; monitoring and assessment. The purpose of the information-referral block is to familiarize students with the purpose of the course. The core of the course is the basic unit, which consists of training modules. The forum, chat and email make up the interactive module, ensuring interaction between participants in the educational process. These elements fulfil the motive function of participating in the learning environment to support the project activity of students, make the educational process more exciting and active. The main content of the course modules are lectures, which are structured text with hyperlinks and multimedia inserts; digital copies of prints; demo materials in the form of presentations. Practical, seminar papers include the topic, purpose, list of tasks, the form of the results and the completed work presentation, evaluation criteria and deadlines. Independent work assignments have a similar structure to practical ones, but they are orientated to each student's individual project.

The monitoring and assessment block makes possible automated assessment of students and contains both closed tests and open variation tasks. This component also contains a journal that reflects, in the form of statistics and infographics, the students' educational achievements, each student's work within the electronic course.

During the course study, students pass all stages of creating an educational project (preparation, research, technology, presentation), using digital tools [16]. The results are displayed in the relevant sections of the e-learning course. With this approach to building an e-learning course, the learning material becomes easier to perceive, the educational process is filled with elements of motivation, and the results of the course become tangible for each student.

We propose to consider three diverse projects created by students during the course. The first one, "My Country – Ukraine", envisaged the creation of a multimedia resource to inform senior pre-schoolers and younger students about the culture, history and traditions of our country. The second is an ecological project "Feed the Birds", which envisaged the development of a feeder design in accordance with the peculiarities of bird life, 3d modelling and subsequent printing of products. The third is a design project called "Art Studio", which aims to develop an educational environment in accordance with the ideas of the New Ukrainian School with further visualization using 3D graphics.

In the first phase of the project, students are asked to formulate a key problem and choose a topic for a project. After selecting a project theme, students think through and create their design using Easel.ly or Piktochart.com infographic services. The project's repository is the Google Drive folder or Padlet work board, which will be filled with project materials. The core of these materials is the Project Program Document, which contains the topic, purpose, content and workflow of a project. This allows the project to be structured and extended to other participants in the future.

It is advisable to plan the project steps and visualize its structure with the help of knowledge map editors, such as Cogle.it or Mindmaps.app. The result is that students continue to fill the project folder on Gogle Drive. This stage involves the creation of a goal tree by a student – a graphical representation of the interconnection and subordination of goals that reflects the division of mission and aims into goals, sub-goals, tasks and individual actions. To do this, we suggest using infographic editors with interactive elements: thinglink.com and WordArt.com.

In the second stage, the student must find and organize the resources and tools needed to create a project, form a list of these materials in a specific sequence, and display them as webmixes using the symbaloo.com resource. For example, the team of students working on the "Feed Birds" project has been divided into three teams. The first team was engaged into didactic filling of the project, development of lessons and adaptation of ready-made interactive materials for use in the project. A good example of such material is the STEM simulation of the worldwide bird migration of Globeofbirdmigration.com [17]. STEM games and simulations are the models of geology and atmosphere, ecology and astrophysics, and sometimes whole planets. Interacting with them, a student himself chooses a strategy for research or restructuring of the world, acting as an independent researcher, designer. The second team developed multimedia support for the classes, using the digital tools offered in the course. The third team did the work related to the realization of the final product of the project – 3d modelling and printing of feeders. The Tinkercad online editor was selected for modelling. It is a service for the development of 3D projects, electronics and codes. Unlike the "Art Studio" project, which used the 3ds Max editor, Tinkercad is focused on teaching children the basics of 3D modelling. A Prusa I3 printer capable for printing with biodegradable plastic and recycled materials was used for printing. Thus, we used the materials supporting the environmental focus of the project.

Work on a project requires its content filling, which is the task of the next stage of a project. While working on a project, students fill it with interactive visuals for children, develop methodological materials, create accompanying presentations using the services coggle.it, prezi.com. They use the Learningapps service to create tests and Powtoon for cartoons. They can combine the results as ourboox.com eBook. "Art Studio" project infographic was created with ThingLink at https://www.thinglink.com/scene/1279604063515705345.

To create cartoon presentations, students use the PowToon online service. These can be pedagogical situations, a re-enactment of a plot of a piece of fiction, mathematical tasks, etc. We offer you to see the following cartoon created for the "Feed Birds" project at https://youtu.be/PRi1n5o6hBQ.

Further work on a project involves the adaptation of project activities to the calendar-thematic planning of an educational institution. Students create a map of project implementation steps using reTime Graphics or Google calendar resources. Time Graphics helps them to reproduce the steps of project implementation on a timeline with the addition of photos, audio and video. This work prepares educators to organize their own work in the future.

The result of a project can be a movie consisting of a cut of project tasks and explanations to them. The project can be presented on social networks Facebook, Youtube, etc. One of the options for completing the course is to create an educational blog for student projects.

6 Results

The results of the summative stage of the experiment showed that only a third of the respondents are able to navigate at a high level in the information space, receive information and operate it according to their own professional needs. To solve this problem, we have developed and implemented e-learning course "Project Activities in Educational Institutions". We can now point out that the implemented e-learning course has shown positive changes in the formation of future educators' digital culture, development of project skills, development of critical thinking, creative abilities. The development and implementation of individual projects directs them to such activities, motivates the introduction of digital technologies into the learning process with greater efficiency through a practice-oriented approach.

The approbation of the described e-learning course has been going on since the end of 2019, and the projects created by the participants show both the readiness of future teachers for teaching activities and their freedom to submit project developments. Future educators gain skills related to engaging children to work with digital technology, and online resources, including social networks. The variety of described projects emphasizes the interest of future educators in the in-depth study of specific digital tools related to programming (Scratch), 3d modelling (Tinkercad) and the basics of robotics (Arduino). Currently the courses of the second phase of the experiment, able to satisfy this need, are currently being developed.

7 Conclusion

Scientific analysis of the use of digital technologies in the preparation of future teachers for project activities allowed us to conclude that in the context of society informatization, computerization and implementation of modern technologies in the educational process, the problem of digital technologies application has become a leading one in pedagogical theory and practical activity of pedagogical higher educational institutions in Ukraine.

To study the problem of preparing future teachers for project activities, interrelated methods were used: structural analysis to consider the structure of modern educational technologies; system-structural and system-functional analysis to identify the main structural components of the model of training future teachers for project activities using digital technologies; questionnaires (at the ascertaining stage of the experiment) in order to study the state of readiness of future teachers for project activities using digital technologies; description of factual information for the purpose of analytical interpretation and study of specific facts and phenomena; quantitative processing of research results.

According to the results of the ascertaining stage of the experiment, it was concluded that a third of respondents sees the need for further study of digital tools and the practice of using them in project activities. Questionnaires of respondents showed an insufficient level of awareness and application of digital technologies in the preparation of future teachers for project activities.

The study of the current state of digital technologies use in the preparation of future teachers for project activities confirmed the relevance and feasibility of the se-

lected problem studying. Analysis of the practice of creating such an environment in Ukraine and abroad allowed to develop a model of future teachers training for project activities using digital technologies in the information educational environment of the university. The stages of implementation of the model are determined: determination of the necessary content of future teachers training; creation of the electronic educational courses structure, MOOC, planning of open events, webinars, conferences; experimental implementation of the model during the formative stage of the study; determining the level of the proposed model's efficiency and ways of its further modifications.

To implement this model, a mixed-type training course "Project Activities in Educational Institutions" was created on the Moodle platform. Further expansion of the course and projects created by students as a result of its development will create a new educational resource in the E-environment of the university. It is determined that the purpose of such a resource is to create a database of educational materials that meet the programs of the new Ukrainian school, the requirements for the content and quality of the posted materials. Prospects for further research are the development of a new educational resource in the E-environment of the university, which will allow further research into the effectiveness of the proposed model of training future teachers for project activities using digital technologies. We consider the development of a new educational resource in the E-environment of the university, which will allow further research of the effectiveness of the proposed model of training future teachers for project activities using digital technologies, as a prospect for further research.

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