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Training of students - future teachers to the use of digital technologies in professional activities

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***Abstract* — Following the Federal state educational standard of basic general education, one of the indicators of mastering the basic educational program by a graduate is the formation and development of competence in the use of information and communication technologies (ICT). In this regard, the higher educational institutions implementing the training for students in the direction of "Pedagogical education" the task is to train future teachers not only for the competent conduct of lessons, but also for the use of digital technologies in educational activities for the formation of ICT competence in school learners. The article deals with the issues of training of bachelors of pedagogical education for the use of digital technologies in professional activities through classes in the disciplines of the cycle of professional training, pedagogical practice, execution of term papers and graduation works. The selected areas of training of future teachers of mathematics and Informatics for the use of digital technologies in educational activities are built into the system and ensure the formation and development of professional competencies of students necessary for teaching mathematics and informatics in general, and for the formation of ICT competencies in school students, in particular.**

Keywords — pedagogical education, professional activity, teacher training of mathematics and informatics, ICT competence, digital technologies, information and educational environment.

I. INTRODUCTION

One of the main directions of modernization of the education system is the task of integrated introduction of information and communication technologies (ICT) of education, which is a powerful means of activating school students. The possibility of implementing e-learning and the use of distance education technologies in the educational process is provided by the readiness of teachers to apply these technologies in their professional activities. Following the professional standard of the teacher, the necessary skills of the teacher of general education include the use of modern educational technologies, including information and digital educational resources [9]. The above actualizes the special training of teachers in the field of organization and methodology of e-learning, mastering communication tools and technologies in the information and educational environment [13].

Among the academic disciplines studied in schools and institutions of higher education, physics, mathematics, informatics and other science-intensive disciplines have been and are the most amenable to computerization, the use of digital technologies [10]. The system of professional training of students – future teachers of mathematics and informatics, studying in the direction of "Pedagogical education" includes, in addition to the disciplines of the subject component, disciplines of a humanitarian nature – for example, "Methods of teaching mathematics" and "Methods of teaching informatics", which do not explicitly require computerization. And the process of introducing new digital technologies into the educational process of professional education is not an easy task [6].

The purpose of the research is to plan the system of training of future teachers of mathematics and informatics to the use of digital technologies in future professional activities, its organization and implementation in the educational process on the example of the experience of the Department of theory and methodology of teaching mathematics and ICT in education of the Federal state budgetary educational institution of higher education "Petrozavodsk State University".

II. RESEARCH METHODOLOGY

Training of students - future teachers for the use of digital technologies in the teaching of mathematics and informatics at Petrozavodsk State University is carried out in the following directions:

1. Study of disciplines (compulsory and optional) "Information and communication technologies in education", "Design and development of educational multimedia resources", "Distance learning technologies".
2. The use of digital technologies in the educational process of professional education (for example, in the study of compulsory disciplines "Methods of teaching mathematics", "Methods of teaching informatics").
3. Passing of pedagogical practice.
4. Execution of term papers and graduation works on various subjects.

The selected directions implement both theoretical (at the level of content) and practical (at the level of organization of the educational process) training for the use of digital technologies in future professional activities.

Let's consider the disciplines of the first selected direction.

The main objectives of the compulsory discipline "Information and communication technologies in education" are the formation of students:

– Knowledge of modern methods and techniques of using ICT tools during various classes, in various types of educational activities;
– knowledge of the possibilities of Web 2.0 educational services and cloud technologies for use in the educational process;
– skills to design and organize the educational process using ICT (in specific subjects - mathematics and informatics);
– skills to use opportunities of educational services Web 2.0 and cloud technologies for the formation of information educational environment;
– experience of practical implementation of training using ICT tools, development of educational resources and educational environment using educational services Web 2.0 and cloud technologies (Google services).

This discipline provides for the study of the following sections:

1. Fundamentals of ICT use in education. Learning model.
2. Pedagogical software tools. Digital educational resources. Internet technologies in education. Web 2.0 educational services and cloud technologies.

Students' activities are organized in such a way that, on the one hand, the organization and management of the educational process is carried out through the use of ICT and distance and cloud technologies, when the student acts as a learner. On the other hand, it makes it possible to implement them in their own methodological project, where students act as a teacher. This way of organizing classes allows us to consider all aspects of the use of ICT in the educational process: motivational, substantial, educational and methodical, organizational, control and evaluation. The Moodle distance learning system and Google cloud services are used to manage students' activities [3, 4].

The main objectives of the discipline of choice "Design and development of educational multimedia resources" are the formation of students:

– knowledge of modern technologies and digital means of teaching informatics and mathematics: requirements for digital educational resources and their classification; stages of design of digital educational resources; on the role of individual components (educational resources) of the educational environment in mastering the subject areas "Informatics", " Mathematics»;
– the ability to analyze the educational process in terms of the use of digital resources of the educational environment;
– skills of design and development of digital educational resources complex structure, the use of digital educational resources in the learning process.

This discipline provides for the study of the following sections:

1. Digital educational resources. Multimedia educational resources such as representatives of digital educational resources of complex structure.
2. Design and development of digital educational resources. Development tool for multimedia digital educational resources. Features of Macromedia Flash environment for multimedia digital educational resources realization.

Students' activities are aimed at developing an individual educational project - a multimedia digital educational resource of a complex structure. The theme of the educational project is chosen by students on their own on the basis of analysis of examples of educational projects, based on their interests, taking into account the possibility of implementation when teaching informatics or mathematics in school. An Important component of the project is the description of the digital educational resource from the pedagogical (purpose, type according to different classifications, age category of users, technologies used) and methodological side. For the organization of classes a distance course in the Moodle system and its own digital educational resources are used.

The main objectives of the discipline on the choice of "Distance learning technologies" are the formation of students:

– knowledge of major models of distance learning, the direction of application of remote educational technologies as modern learning technologies and diagnostics; technologies of creation of distance learning courses in the distance learning system; the basics of designing e-learning module for distance learning with the organization of group and individual activities of students;
– skills to use methods and technologies of distance and e-learning in the design of the learning process and diagnostics; to analyze the means of distance learning (LMS platform) and open educational MOOC-platform for online education and organization of independent work of students;
– skills of work on the platforms of distance learning systems on the example of Moodle; design and development of electronic educational resources (on a training topic) in the Moodle distance learning system for the organization of cooperation and independent work of trainees.

This discipline provides for the study of the following sections:

1. Distance learning and distance learning systems. Models and didactic foundations of distance learning technologies.
2. Distance learning technologies, learning management systems (LMS) and e-learning resources in distance learning systems (Moodle).

Management of students' activities is organized through an e-course on the Moodle platform. As an application of the studied material students are offered tasks of creative

orientation on the design and development of fragments of electronic educational resources on the Moodle distance learning platform. Students perform a training project in mini-groups (pairs) to develop a fragment of an electronic course (educational module) for the selected topic of the school course of mathematics or informatics.

The use of digital technologies in the educational process allows you to organize and manage the activities of students. Most of the subjects implemented by the Department of theory and methods of teaching mathematics and ICT in education have distance support on the Moodle platform. Thus students have the opportunity to make sure in practice the benefits of digital technologies. The distance courses created in support of studying of disciplines, realize all necessary components of educational process: the contents of the classes: theoretical material to lectures, tasks to laboratory and practical classes, additional material; control and measuring materials: tests, control questions, control works, etc.; the list of references; various questionnaires. Feedback support is organized.

In teaching disciplines of professional education ("Methods of teaching mathematics", "Methods of teaching informatics"), the use of ICT has recently become commonplace and allows you to expand the information field of classes, stimulates the interest and creativity of the student. The possibilities of using digital technologies in the study of these disciplines for the organization and management of students' activities are very diverse: electronic presentations, watching video lessons, using students' gadgets, distance learning; the use of ICT in project technology, technology of "inverted learning", case-study and other pedagogical technologies.

For the organization of distance support (virtual support) of pedagogical practice the Moodle distance learning system is used. This system provides ample opportunities for communication, supports the exchange of files of any format. The mailing service allows you to promptly inform all participants of the practice about current events. The forum is used for educational discussion of problems, and the chat allows you to organize a discussion in real time [7].

An important feature of the use of Moodle to accompany pedagogical practice is the creation and storage of each student's portfolio: all the submitted work, reports, assessments and comments, messages in the forum. The teacher can create and use any assessment system within the course. The marks are stored in the summary sheet. Moreover, the system allows you to control the "attendance" and activity of students, the time of their academic work in the network.

Virtual support of pedagogical practice is carried out at several levels:

– informational - the content, structure, and stages of pedagogical practice, step-by-step algorithm of its passage;

– organizational - memo-instructions for trainees, students timetables and consultations of a Methodologist, the samples of reporting forms; requirements for pedagogical practice interfaculty departments (pedagogy and psychology);

– methodical - operational student assistance through recommendations, advice, consultations of the Methodologist, group discussion of various issues on the general forum;

– psychological and pedagogical - counseling on classroom management, prevention of conflict situations with the administration, students and their parents [7].

During term papers and graduation works, students have the opportunity to develop a particular topic of e-learning, to test their developments during the period of pedagogical practice in the school during training sessions, electives or extracurricular activities. Here are examples of the topics of term papers and graduation works: "Multimedia services for education", "Methodological aspects of the organization of educational web quests", "Features of the use of infographics in lessons of various types", "Methodological features of the use of mental maps in informatics lessons", "Project management of learners with the help of Google cloud service". On the other hand, many teachers use cloud technologies (Google services) to organize and manage students' activities during term papers and graduation works.

The given system of training of students to formation of ICT competence in school learners developed as result of scientific (studying of experience of teachers of higher education institutions on a research subject, [2, 5, 8, 11, 13 - 15]) and organizational activities of the teaching staff of the Department of theory and methods of teaching mathematics and ICT in education of the Institute of mathematics and information technologies of Petrozavodsk State University. This system implemented in the work of the Department and successfully implemented in the professional training of bachelors in the direction of "Pedagogical education".

Main research methods:

– analysis of pedagogical literature on the problem of training future teachers to use digital technologies in professional activities;

– Pedagogical experiment, pedagogical observation, method of expert assessments, conversation.

III. RESEARCH RESULT

Following the requirements of Federal state educational standard of higher education in the process of professionally - pedagogical training of future teachers need to form their professional competence to use ICT in their professional activities, particularly in teaching mathematics and informatics. The following criteria were defined in the study: motivational, cognitive and activity, as well as corresponding indicators and control methods [1].

Professional knowledge is an indicator of the cognitive criteria and necessary for the teacher to use digital technologies in teaching mathematics and informatics. The values of indicators of this criterion correspond to the results of the development of disciplines "Information and communication technologies in education" (1), "Design and development of educational multimedia resources"(2) and "Distance learning technologies"(3).

The activity criterion characterized by the degree of mastering by students and the skills is necessary for the teacher of mathematics and informatics to use digital technologies in their professional activities. The values of indicators of this criterion correspond to the results of

pedagogical practice, namely: the use of ICT in conducting various types of lessons (4), in the organization and conduct of extracurricular activities in mathematics and informatics (5).

The indicators of the motivational criterion are professional interest (6) and emotional readiness to use digital technologies in professional activities (7).

Each indicator has a high, average or low degree and has numerical values from 1 (low degree) to 3 (high degree). The criteria were measured by the following methods. Knowledge was measured based on passing a test/exam in the disciplines "Information and communication technologies in education", "Design and development of educational multimedia resources" and "Distance learning technologies". Skills were assessed based on observations and the method of expert assessments. Professional interest and emotional readiness were investigated by observation and conversation. Thus, the readiness of the future teacher of mathematics and informatics to use digital technologies in professional activities can have numerical values from 7 to 21. The low level of readiness has values of 7-11, the average level is estimated at 12-16, and the high level is estimated at 17-21.

Measuring each criterion and summing up the obtained values, each student was assigned to a certain level of formation of professional competencies aimed at the use of digital technologies in teaching activities. In other words, each student was assigned to a certain level of ICT readiness: low, average and high. The distribution of students by ICT readiness levels is given in the table 1.

TABLE I. ICT READINESS LEVELS OF STUDENTS – FUTURE THEACHERS OF MATHEMATICS AND INFORMATICS

Contingent	**Levels**					
	Low		**Average**		**High**	
	n	%	n	%	n	%
75	14	19	34	45	27	36

IV. DISCUSSION OF RESULTS

The analysis of the data of the table 1 allows us to state that the vast majority of students are on average and high levels of readiness for the use of digital technologies in professional activities. In our opinion, it testifies in favor of the efficiency of the developed system of training of future teachers of mathematics and informatics to use of ICT in pedagogical activity. The dual integration of digital technologies into the professional training of future teachers at the level of content and organization of the educational process creates effective conditions for the development of relevant aspects of professional competence.

V. CONCLUSION

The system of students training of the direction Pedagogical education (profiles "Mathematics and informatics") on the organization, a method of use of digital technologies in professional activity developed in Petrozavodsk State University satisfies modern requirements to methodical training of students, promotes increase of professional competence of bachelors - future teachers of mathematics and informatics.

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