The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

https://dx.doi.org/10.15405/epsbs.2018.09.26

IFTE 2018
4th International Forum on Teacher Education

INFORMATION AND COMMUNICATION TECHNOLOGIES COMPETENCE FORMATION OF THE FUTURE TEACHER OF PHYSICS

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Abstract

The task of training teachers possessing a certain scope of knowledge in their subject area, skills of using new educational technologies in the future professional work is gaining significant value within the framework of transition to the Federal State Educational Standards of the third generation and to the new Professional teacher's standard. The scientific and technical development of the modern society requires the teacher to have the skills of active use of information and communication technologies at all stages of the teaching and learning process. The purpose of the article is to review the possibility of the online course application for the development of ICT competence of the future physics teacher.

The main methods of the research are the theoretical analysis of the problem status on the basis of the literature and the study of normative documents, observation, conversation, and interview.

At present, the objective needs of the society require introduction of new educational technologies in education. Innovations in education are associated with computer technologies, the use of which is the most effective tool that contributes to improving the quality of teacher training.

The research results are in the development and testing the online course 'Methodology and innovative technologies for teaching physics' as a means of fostering the ICT competence of future physics teachers. The authors of the article took into account the participants' views when approving the final variant of the online course materials and determining the prospects for further practical application of the course materials.

Keywords: Online course, ICT competence, ICT technologies, teaching physics, pedagogical education.

https://dx.doi.org/10.15405/epsbs.2018.09.26
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eISSN: 2357-1330

1. Introduction

Changes taking place in the Russian educational system in recent decades affect all levels of education. One of the planned results in new educational programs of basic and secondary general education is the formation of meta-subject results, including ICT competence. In accordance with this, general user, general pedagogical, subject education ICT competences relevant to the modern level of information culture of the society have been introduced in the professional standard of 'Teacher' in the section of the teacher's professional functions.

The problems of ICT tools application in the subject area are investigated in the research works of Boronenko, Kaysina and Fedotova (2017), Gotskaya and Kotova (2014) and others. The methodical foundations of using computers at the lessons of Physics are studied in the works by Laptev (2003), Panyukova (2010). There is a small number of works dedicated to the possibilities of a theory and methods of teaching Physics, in which attention is paid to the problems of preparing a teacher of Physics with the skills to use ICT in the classroom and after-hour activities of students (Smirnov & Smirnov, 2012; 2014; Lozovenko, 2013; 2014a; 2014b; 2015).

2. Problem Statement

The analysis of psycho-pedagogical and sociological research results, as well as a real school practice shows that teachers are not fully ready to use ICT technologies in their work which meets the requirements of general secondary education modernization. In particular, this may occur due to the insufficient maturity of ICT competence of the modern teacher or due to their mentality. This fact substantiated the research problem, its essence being the determination of the theoretical foundations and identification of practical ways for the development and maturity of information and communication competence of undergraduate students – future teachers of Physics in educational institutions of various types.

3. Research Questions

The following are the research questions:

1. Literature review of the questions on forming ICT competence of Physics teachers, development and implementation of online courses in the educational process of 'Pedagogical Education' degree.

2. Consideration of requirements and recommendations for online courses development.

3. Development and approbation of an online course fostering the ICT competence progress of the future Physics teacher.

4. Purpose of the Study

The purpose of this study is the development and approbation of the online course fostering the ICT competence of the future Physics teacher.

5. Research Methods

The authors used the following research methods: theoretical analysis of the problem status on the basis of methodological, didactic, psychological and special literature study, PhD thesis research works on

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the current problem; materials of conferences on ICT application in education, normative documents determining the structure and content of the professional ICT training of the Physics teacher in a teacher training university, study and generalization of teaching experience; observation, conversation, questioning, interviewing, pedagogical experiment.

6. Findings

During the literature review on the research topic, observations, interviews with students and teachers, questioning it was found that the problem of the ICT skills maturity in the educational process still remains relevant at present.

One of the ways to form ICT competence of the future teachers is to include new forms in the learning process involving information technologies, in particular elements of online learning.

Online learning (e-learning, distance learning) is a method of obtaining new knowledge via Internet in a real time mode. At the moment, the e-learning industry is one of the fastest growing technologies in the world of education. The undoubted advantages of online distance learning courses are:

- Opportunity for the trainee to build a training schedule independently, as well as determine the classes duration;

- Availability, regardless of the geographical location and time, for a student to access educational resources and course materials;

- Adaptability in the educational process of the latest achievements of information and telecommunication technologies.

The goals of online courses included in the educational process:

1. Quality of education improvement and updating the content of educational programs through the online courses of leading teachers and experts in the field of training application;

2. Expansion of educational opportunities offered by educational institutions to their students, ensuring accessibility of training content;

3. Providing opportunity for a student to design an individual educational schedule;

4. Optimizing the classroom learning volume, increasing flexibility of planning the learning process;

5. Expansion of opportunities for students, including persons with disabilities, for mastering educational programs;

6. Optimization of costs for organization and implementation of the learning process.

The Kazan Federal University (KFU) arranges training of Physics teachers at two levels: the Bachelor's degree educational program is implemented by the Institute of Physics (the degree of ‘Pedagogical Education’, specializing in ‘Physics’, ‘Physics and Mathematics’, ‘Physics and Informatics’), the Master's degree educational program is implemented by the Institute of Psychology and Education (the degree of ‘Pedagogical Education’, specializing in ‘Education in the field of Physics’). Information and communication technologies inclusion are essential in educational process of any educational institution. Therefore, ICT competence is a very important component characterizing the professionalism of future school teachers.

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The authors of the article have developed the online course 'Techniques and innovative technologies for teaching Physics'. They are aimed at developing the competence necessary for designing and organizing the educational process using modern educational technologies and computer tools for teaching Physics.

The total labour content of the online course comprised 3 credit units, the number of training weeks – 9, the average academic load per week – 12 hours.

As a result of mastering the online course, the learner is expected to:

- Know how to use computer technologies in theoretical information and practical instrumental activities of students;
- Be able to find and structure information on Physics in the form needed when using computer technologies;
- Possess skills of designing lessons of Physics using computer tools.

The course consists of modules, each of which is separated into different topics. Each topic contains materials, which are mandatory for studying: video lectures of 10-25 minutes each and materials for self-study (in the form of links to materials and sources for additional study, which are attached to each part of the module's lectures). Each topic is supplied with tasks of a practical nature.

The structure of the online course:

Module 1. INNOVATIONS IN THE SYSTEM OF SCHOOL EDUCATION IN PHYSICS.

Lecture 1. Innovations in school education in Physics.

Part 1. The teacher of Physics in the modern world.

Part 2. Innovative activity of the teacher of Physics.

Module 2. MODERN EDUCATIONAL TECHNOLOGIES OF LEARNING PHYSICS.

Lecture 2. Basic classifications and approaches.

Lecture 3. Technologies on the basis of students' activity promotion and intensification.

Part 1. Technology of problem-based learning.

Part 2. Game technologies.

Part 3. Technology of learning intensification on the basis of schematic and symbolic models of educational material.

Lecture 4. The use of computer technology in teaching Physics.

Part 1. ICT as a means of visual aids.

Part 2. ICT as a means of laboratory work arranging and monitoring the learning outcomes.

Lecture 5. The method of projects.

Lecture 6. Case technology.

Lecture 7. Technology of critical thinking development.

Module 3. FINAL EVENT OF THE ONLINE COURSE.

Presentation of the portfolio.

The numbering scheme of the first two modules of the online course is conventional. Mastering of these modules can be arranged in any order. In Module 2, a nonlinear motion is possible, which involves studying of lectures topics in an arbitrary order.

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The online course studying is accompanied by the implementation of practical tasks contributing to the consolidation of the studied material and the formation of skills in implementation of ICT technologies in professional pedagogical activity. In particular, these embrace such tasks as development of:

- the didactic game project in Physics applying electronic means of teaching,
- tasks for students on the use of ICT in laboratory work on Physics,
- multimedia case in Physics.

Online training, as well as any training, should include the system for evaluating the results of training, which allow determining the level of competencies acquired during the course. The system for the results assessing regarding the online course 'Techniques and innovative technologies for teaching Physics' provides for various forms of current and final control of practice-based nature. As an example, see the criteria for evaluating one of the creative tasks of the current control 'Designing a technological map of the lesson in Physics involving modern teaching technologies, including ICT':

- Diagnostic ability to assess the lesson's objectives;
- Compliance of the technological map of the lesson content with the main goal and objectives of the lesson;
- Conformity of chosen educational methods for the pupils' activity organization with the set goals and objectives of the lesson as well as the technology of training used at the lesson;
- Conformity of chosen educational forms for the pupils' activity organization with the set goals and objectives of the lesson as well as the technology of training used at the lesson;
- Disclosure of students' learning activities motivation to a certain topic of the lesson;
- Disclosure rate of students' learning activities at the stage of the topic actualization for a certain lesson;
- Organization of cognitive activity of students at the lesson;
- Organization of independent activities of students at the lesson;
- Use of didactic materials;
- Use of ICTs and visual aids;
- Effectiveness of the elements used in modern educational technologies;
- Implementation of inter-subject communications at the lesson;
- Means of control are chosen efficiently and are determined by the result of students' activity in mastering competencies;
- Effectiveness of the selected methods of reflection.

Presentation of the e-portfolio is the form of the online learning course final control. It includes all practical tasks performed during the online course teaching.

The developed online course 'Techniques and innovative technologies for teaching Physics' was tested with students studying for the degree of 'Pedagogical Education'. The number of participants was 50. To identify the attitude to the online course and the process of its study, the participants were asked to answer the following questions:

1. Have you achieved the goal by studying this course?
   - Yes 90%
   - No 0%

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- I do not know 10%

2. Were the conditions for successful learning developed?
   - Yes 84%
   - No 6%
   - I do not know 10%
3. Are you satisfied with the level and quality of the learning?
   - Yes 90%
   - No 2%
   - I do not know 8%
4. In your opinion, will your skills and knowledge be useful in your future work?
   - Yes 86%
   - No 0%
   - I do not know 14%
5. Video lectures of the course were:
   - Interesting 90%
   - Not very interesting, but useful 10%
   - Not interesting 0%
6. Tasks for independent work were:
   - Interesting 72%
   - Not very interesting, but useful 20%
   - Not interesting 8%
7. Interest in the profession after studying the course
   - Increased 88%
   - Remained at the same level 12%
8. Was there enough time to learn the course?
   - Yes 58%
   - No 30%
   - I do not know 12%
9. Do you think that this online course contributes to the formation of ICT competence of future Physics teachers?
   - Yes 82%
   - No 8%
   - I do not know 10%

During the online course approbation, conversations, interviews with the participants, the developers obtained results, which characterize the online course as one of the means contributing to the formation of ICT competence.

7. Conclusion

The online course ‘Techniques and innovative technologies for teaching Physics’ generally meets the goals and objectives of electronic communication development in pedagogical education and

educational results corresponding to the professional standard of the teacher. Theoretical and practical components of the online course are balanced. The sequence of course elements is systemic, and their interrelationship is stable.

Currently, the Scientific and Pedagogical department of the Institute of Physics under the Kazan Federal University is implementing the results of the research work presented in the article in the training process of Bachelor's and Master's degree students specializing in 'Pedagogical Education'.

Acknowledgments

This study has been performed according to the Russian Government Program of Competitive Growth of Kazan Federal University

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