

Forming of Research Competence of Students on the Basis of Information Technologies

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Abstract: This article describes the formation of research competence of students based on information technologies. Targeted formation of research competence of future teachers of mathematics in accordance with the modern model of education in Kazakhstan in conditions of the development of information technologies requires: improving the research training of students; readiness for effective work in school and participation in social, economic and political life of the country; implementation of innovative forms and methods of training in educational process of pedagogical universities. The aim of the study is to identify methods of application of modern information technologies in educational process of the pedagogical universities contributing to the improvement of training of the future teacher for research activity in the conditions of the usage of information technologies. The research methods are: analysis of scientific-methodical and special literature on a research problem; study and analysis of: curricula and standards of professional pedagogical disciplines; the curricula, textbooks and teaching materials for scientific research; pedagogical observation, interview, questionnaires and testing. As a result, students showed a willingness to use information technologies when performing a research work. The paper identifies the methods of the usage of information technologies and illustrates their application in the research activities of natural science and humanities. The article proposes to solve the problem of the development of research competence of students using the methods of information technologies.

Keywords: research competence, methods, information technologies, university education.

Introduction

Currently, one of the leading directions in the education system is the development of research competence of students. It develops not only cognitive activity, but also provides autonomy, independence of judgment, flexibility, critical and systemic thinking. A specialist needs the mentioned qualities in every activity. The modern teacher must be able to formulate independently and solve research tasks, but he/she should be proficient in information technologies. They help to carry out activities efficiently such as searching, processing and use of information in research activities of future teachers.

President N. Nazarbayev in his address to the nation on the modernization, noted the "importance of training of highly qualified personnel and the need for policy review in education" (Mukanova, 2017).

Currently, many teachers in schools do not know how to manage the research projects and how to apply information technologies in the learning process. They are limited only by use of the interactive whiteboard.

In this regard, the formation of research competence of students by usage of the methods of information technologies has become a topical direction of modern education. But the level of formation of skills using information technologies in the pedagogical university has not yet fully meet the modern requirements of improvement of pedagogical education. The previous studies covered the content and essence of the research competence of students of pedagogical university and pedagogical conditions of formation and development of interactive methods were identified (Kaskatayeva, 2014; Kaskatayeva, 2017). During the experiment it was found that in the University not enough attention is paid to formation of research competence on the basis of information technologies. Despite the pedagogical science approaches to understanding of essence and structure of competence conditions of its formation in the educational process are such that there is a lack of technology of formation of research competence of students of pedagogical universities on the basis of information technologies.

Therefore, it is possible to formulate a contradiction: schools need highly qualified teachers, able to lead research projects, but at the same time they lack the implementation of innovative information technologies.

Revealed contradiction gives rise to the problem of forming research competences of future teachers of mathematics on the basis of information technologies to improve the preparation of students to organize and conduct research work with pupils in the school. Therefore, the issue is relevant and has an innovative advantage. The subject of the study is the use of information technology for the formation of

research competence of the students. The aim of the study is to substantiate the development of ways of usage of modern information technologies in educational process of pedagogical universities contributing to the improvement of training of the future teacher for research activity. Used research methods are: analysis of scientific-methodical and special literature on the research problem; analysis of the curricula and professional pedagogical standards, and textbooks and instructional materials; pedagogical observation, interview, questionnaires and tests.

Methodology

Methodological basis of the study is the fundamental work in the field of: pedagogy and psychology; professional preparation of teachers in teacher education; theory and methods of teaching at the pedagogical university; research in the field of natural science and humanitarian subjects; the concept of competence-based education; research in the field of the usage of information technologies (IT) in education. To achieve the purpose of the study the following hypothesis is put forward: the introduction of modern IT in educational process of pedagogical universities will increase the level of readiness of students to research activities as there is increased independence and cognitive activity of the student, and experimental work is carried out during the practice. Students wrote a thesis and their scientific ideas were introduced directly to the school. At the end of the internships there were organized interviews. The students reported on their academic work and practice with pupils on the formation of scientific skills in the final conference. The results of their work and reports were assessed at the end of each semester. The students of the experimental group showed the better ability to prepare reports, presentations, participation in research projects and in applied projects and coursework.

Results and Discussion

The formation of students' research competence contributes to the creation of a competitive, fully developed personality. Research competence is formed on the basis of innate quality of called research behavior, as well as a range of elements that make up various educational key competences (Slastyonin, 1998).

The relevance of the study on scientific and theoretical level is determined also by the materials of the United Nations Educational, Scientific and Cultural Organization (UNESCO) scientific research where the expected result of modern education, based on the competence approach, are constructs of universal and professional competences. Aspects of the competence approach in education are researched such scientists like A.H. Arenova B. Briede, A.I. Suciu, L. Mata and many other scientists in Western and Eastern Europe, and other parts of the world. A.H. Arenova (2012) article studies approaches, definitions and interpretations of professional competence analysing a pedagogue's professional competence as well. B. Briede (2009) studies the components of competence and defines the components of professional competence. A.I. Suciu, L. Mata (2011) divide two broad categories of pedagogical competences in accordance with current approaches: general pedagogical competence and special pedagogical competence.

Competence approach is an attempt to make personal meaning into the educational process. Personal knowledge and personal understanding helps a person to make decisions to meet the social needs of society in terms of applied direction of education. In this regard, the competence approach in the educational activity meets the requirements of the socio-political life of the country. Future teachers must possess the following qualities: independence, initiative, ability to overcome stereotypes. It is worth mentioning that the teacher has to be able to generate ideas and not to wait for them from outside.

Thus, the research competence is the "key", the basis for the development of other more specific and subject-oriented competences, as it helps the student to learn, allows to become more flexible, competitive, helps to be more successful in later life that determines the significance of its formation.

The UNESCO Institute for Information Technologies in Education (IITE) strives to attain the Organization's strategic objectives targets at strengthening national capacities in ICT application in education in Member States in order to build inclusive knowledge societies and create prerequisites for sustainable development in all countries. Such topics as future learning contexts for open content, future curricula, the future of validation of learning outcomes, the future role of teachers and faculty and the changing role of HE institutions were studied to implement open Educational Resources and Massive Open Online Courses (Knyazeva, 2016).

In Kazakhstan the use of information and communication technologies (ICT) in the education system, including universities, is a part of the state policy of introduction of IT in society and education the processes of usage of information technologies are closely related to the processes in education where the processes of improvement and massive propagation of modern information technologies are going on. Such technologies are used extensively for transmission of information and provision of interaction of the teacher and learner in the modern systems of open and distance education. The modern teacher must not only possess knowledge of it but to be an expert on their use in their professional activities.

The use of information technologies in educational process investigated by A. Doering, C. Scharber, C. Miller and G. Veletsianos shows how the model *Technology, pedagogy, and content knowledge* (TPACK) can be used to evaluate teachers (Doering et al., 2009).

In the works of M.J. Koehler and P. Mishra are described the complex interaction of learning content, pedagogy and technology (Koehler, Mishra, 2009). Theoretical and practical interaction of these sets of knowledge produces successful integration to obtain high-quality knowledge.

M.L. Niess (2005) investigated the preparation of teachers of mathematics to integrated learning with information technologies throughout the program.

The main functions of information technologies are:

- 1) development of the individual student, preparation for independent productive activities in the information society through:
 - the development of a constructive, algorithmic thinking, due to the peculiarities of communication with the computer;
 - development of creative thinking by reducing the proportion of reproductive activities;
 - the formation of information culture, abilities to process information (when using spreadsheet, databases);
- 2) the implementation of social order caused by the usage of IT in modern society: training of trainees by means of information technologies to independent cognitive activity;
- 3) motivation of educational process:
 - improving the quality and efficiency of the learning process through the implementation of possibilities of information technologies;
 - identify and adopt incentives for the intensification of cognitive activity.

The use of information technologies in the process of research is much more efficient than the explanatory-illustrative and reproductive methods. Students working in project groups develop a joint action plan, find sources of information, ways of achieving goals, and roles are put forward and discuss ideas. All students are involved in a cognitive activity. Cooperative learning allows to master the elements of a culture of communication and control in a team.

Performing research work (term papers, theses and project work) with the application of information technologies allows: to increase the motivation for learning; to expand creative potential; to promote development of the student's personality: intellectual abilities, independence, responsibility, abilities to plan, make decisions, evaluate results; to create the conditions in which the student, on the basis of joint developments, conducts an independent search, identify ways of action, applies them to address new versions of training; to facilitate the acquisition of experience in solving real problems in their future independent life; get pleasure from research activities, fostering creative and active people, able to make informed decisions and to be independent throughout life (Lebedkova, Shushakova, 2012).

Information and communication technologies make research work more effective and enhance the work of students. When discussing the results of the work done presentation allows you to organize visual material: to show fragments on a big screen, highlight the most important parts of performance, increase individual part to enter the animation, use colours. When preparing for the seminar a presentation allows you to teach students how to create control charts and reports in a more comfortable communication mode. Form of presentation allows to place the material aesthetically.

One of the methods of research is a technique of an information resource. Students work with the book, reference, popular scientific and educational literature in didactics is considered one of the most important research methods. Currently, these sources can fully add and electronic publications and resources. The main advantage of this method is the possibility for the student to process the necessary

information in an accessible pace and at a convenient time repeatedly. Educational literature and multimedia tools successfully perform all of the didactic functions: search, train, develop, educate, motivate, control and correct. The greatest distribution of work with information resources meets individual work because it is possible to find the necessary material for research much easier. The method of information resource contributes to the consolidation and expansion of theoretical knowledge and to satisfy cognitive needs.

A computer is a technologization of educational process in the broadest sense - the development and introduction computer and information research models, combining a human and machine. In the preparation of reports for seminars or writing project, term papers and dissertations students use the method of information resource. For example, the students of the Faculty of Philology performed design work on the topic: "The Main literary movements of the New time. Romanticism" (Lukacs, 1964). There are several key areas to use the method of information resource:

- a visual representation of the world with the romantics - national and individual invariants;
- the study of German, English, French and American romanticism;
- the study of the theme: "From romanticism to realism. Merimee, Stendhal, Balzac, Dickens, Thackeray".

At the Department of mathematics, we use the software package "Investigation functions". The use of algorithmic regulations in the process of working with the package teaches the optimal search strategy for solving the training problems and develops logical thinking style. The package's "research functions" are used by students in the course and diploma works.

During the special course «Selected questions of a school course of geometry» usage of the projector significantly enhances the cognitive activity of students by increasing clarity and emotional intensity (animation, sound, video, and other multimedia effects). For example, the definition of second-order curves (ellipse, hyperbola, parabola) is given by using animation (Figure1, 2, 3).

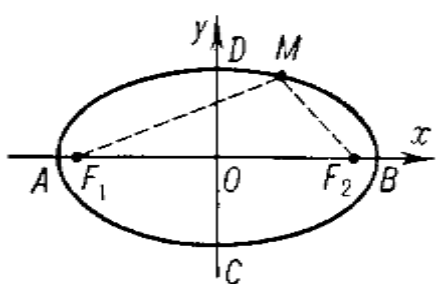


Figure 1. Ellipse

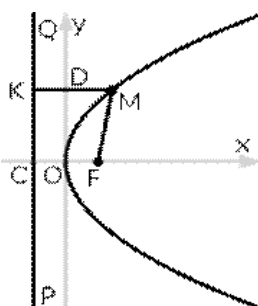


Figure 2. Parabola

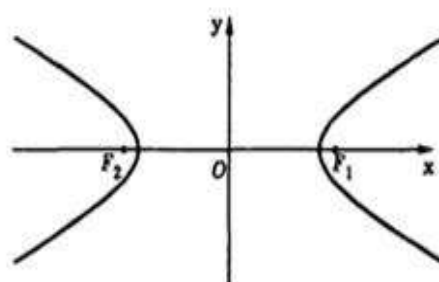


Figure 3. Hyperbola

The second order curves in the plane called the line of intersection of a circular cone with planes not passing through its vertex. If a plane intersects all the generators of one cavity of the cone, the section turns out an ellipse at the intersection of the generatrices of the two cavities is hyperbole, but if the secant plane is parallel to any generatrix, the cross section of the cone is a parabola (Konev, 2009). The set of all points in the plane for which the sum of the distances to two fixed points a constant value, is called an ellipse. When you animate point, M moves in the plane and describes a curve (Figure 1) for which the sum of the distances to two fixed points is a given constant. For any ellipse, we can find a Cartesian coordinate system such that the ellipse described by the equation (canonical equation of an ellipse):

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad (1)$$

where a - the semimajor axis of the ellipse;
 b - the semiminor axis of the ellipse;
 $0 < b \leq a$

Let us prove (1). It describes an ellipse with centre at the origin whose axes coincide with the coordinate axes. The number a is called the semimajor axis of the ellipse, and b is its minor radius.

$$MF_1 + MF_2 = 2a \quad (2)$$

$$MF_1 + MF_2 \geq F_1F_2 \quad (3)$$

where $F_1F_2 = 2c$, $a \geq c$; $a > c$;

$$MF_1 = \sqrt{(x+c)^2 + y^2} \quad (4)$$

$$MF_2 = \sqrt{(x-c)^2 + y^2} \quad (5)$$

(4) and (5) substitute in (2)

$$\sqrt{(x+c)^2 + y^2} + \sqrt{(x-c)^2 + y^2} = 2a \quad (6)$$

$$x^2 + c^2 + y^2 = a^2 + \frac{c^2}{a^2}x^2 \quad (7)$$

where $|x| \leq a$;

$$\left| \frac{cx}{a} \right| \leq c < a;$$

$$a \pm \frac{cx}{a} > 0.$$

Of the (7) have $\frac{a^2 - c^2}{a^2}x^2 + y^2 = a^2 - c^2$; $\Rightarrow \frac{x^2}{a^2} + \frac{y^2}{a^2 - c^2} = 1$; $b^2 = a^2 - c^2 \leq a^2$.

then we have: $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

Similarly, students on the basis of the definition of self-derive the canonical equation of the parabola and the hyperbola. The use of computer makes the proof of the canonical equations more visual, understandable and memorable. It describes an ellipse with centre at the origin whose axes coincide with the coordinate axes. The number a is called the semimajor axis of the ellipse, and b is its minor radius. Similarly, is determined by the parabola and the hyperbola.

The widespread use of a computer makes learning more visual, understandable and memorable. It can be argued that new technology increases the self-searching activity of students. The truth gained through one's own efforts, is of great cognitive value. And, accordingly, information technologies - the system of procedures of information processing with the purpose of its formation, organization, processing, dissemination and use. Using IT in independent work the students will optimize the learning management system, improve the efficiency and objectivity of the research process with considerable savings of time and motivate themselves for research. The student becomes an active participant in seminars. As a result, the students search new ideas. They discuss them with the teacher and relationship between the student and teacher turns into partnership. Thus, increases the intensity of practical and seminar classes. In this case, the computer acts as a means of intensifying the research process. The use of modern technical means of training allows to achieve a desired result of enhancing the cognitive activity of the students.

Conclusions

The use of modern technical means in education helps to achieve the desired result of enhancing cognitive activity of students. The widespread use of IT makes learning more visual, understandable and memorable. It can be argued that new technology increases the self-searching activity of students. The truth gained through their efforts is of great cognitive value. The application of information technologies in educational process helps to form students' research competence and the effective organization of educational-cognitive activity. The use of IT makes independent work attractive and really modern. The individualization of learning, monitoring and summarizing are objective and in a timely manner.

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