

## ANNOTATION

**to the dissertation thesis of Nurgozhayev Shynggys Bolatuly “Didactic conditions for the use of information and communication technologies in teaching mathematics in college”, submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D010900 “Mathematics”**

### **Relevance of the research.**

One of the urgent problems of modern education is to solve the problem of formation of students' personal qualities, erudition, ability to apply the acquired knowledge in life, as well as the use of new pedagogical and information technology in the education system that would meet the requirements of the modern society. The problem urgency is determined by the tasks of the education system specified in the Law of the Republic of Kazakhstan “On Education”, which stipulates “creation of necessary conditions for getting quality education aimed at formation, development and professional perfection of personality on the basis of national and general civil values, science achievements and practice, implementation and effective usage of new educational technologies, including modular-credit, distance and part-time, and information and communication technologies that would encourage quick adaptation of vocational educational programs to changing needs of the society and labour market”. Large-scale problems, such as the introduction of new learning technologies, computerization of education and access to international global communications networks, have been taken as conditions for realization of these objectives.

At the present stage of implementation of the state educational policy, taking into account the Republic of Kazakhstan's integration into the global educational space, the state standard of technical and professional education requires competence-based reconstruction of the educational content and entire methodical system of education. In the frameworks of the national project “Quality Education “Educated Nation” there is a task to provide accessible and high quality technical and professional education in the period of 2021-2025.

In order to ensure quality education, it is crucial to implement information and communication technologies in the field of education. The aim of application of information and communication technologies is to strengthen the intellectual capacity of an individual within the new information society, and to improve the quality and intensify learning at all stages of the education system. Therefore, every teacher is required to independently improve innovative training and make extensive use of new methods and techniques in the classroom. However, a number of obstacles arise in the use of information and communication technologies, some of which are functional. Although information and communication technologies are quite advanced, they are only technical tools, and a certain part of the limitations in their use are being eliminated by development of science, computer and other technologies.

Nowadays, for the purpose of training competitive in the labour market qualified specialists ready to their professional growth, there is a necessity in use

information and communication technologies during the process of formation professional skills and basic competences.

Various aspects of the problems of using information and communication technologies in education are covered in the research works of Gershunsky B.S., Vagramenko Y.A, Ershov V.A., Lapchik M.P., Mashbits E.I., Robert I.V., which shows the need to use ICT in order to improve organizational forms and methods of teaching, education, ensuring development of students, formation of skills for implementation of independent educational activities to collect, processing, transmission of information about the studied objects, phenomena, processes, etc.

Theoretical aspects of information and communication technologies have been considered in the works of Branovsky Y.S., Bekmoldayeva R.B., Ershov A.P., Kuznetsov A.A., Lapchik M.P., Dalinger V.A., Kaplunovich I.Y., Yakimanskaya I.S., Penkov A.V., Mashbits E.I., Monakhov V.M., Robert I.V., Talyzina I.F., Abisheva A.P., Daiyrbekov S.S., Baidybekova A.O., Abdykerimova E.A., Malikbekova M.S., Kerimbayev N.N., etc.

In the works of domestic scientists, the problem of training using ICT in education was considered by: Nurgaliyeva G.K., Karayev J.A., Bidaibekov Y.Y. (new information technologies); Zhusibaliyeva D.M. (distance learning on the basis of new technologies); Kurmanalina Sh.Kh. (electronic methodic system); Bekturganova R.C. (influence of information technologies on research work); Alzhanov A.K. (training on the basis of information and communication technologies); Bekbolganova A.K. (methods to improve applied direction of learning mathematics in technical college using information and communication technologies); Zhiembayev J.T. (methods to use applied software in improving training in algebra and basics of analysis); Baidildinov T.J. (improving efficiency of teaching algebra and basics of analysis in 10-11 grades by using personal computers); Chaklikova A.T. (informatization of professional system); Tanatarov K.A. (solving applied tasks in mathematics at school using a computer), Amanzholova N.I. (application of computer technologies in teaching general mathematics), Shuakbayeva R.S. (teaching solution of multilateral tasks using a computer), etc.

The necessity of using ICT in teaching mathematics is emphasized in the works of Glaser G.D., Kapustina T.V., Kravtsov S.S., Robert I.V., Abylkassymova A.Y., Babayev D.B., Smagulov E.J., Seitov S.M., etc. It should be noted that these studies are mainly aimed at automation the processes of controlling the results of learning activities, graphing various functions, conducting primary computational operations, construction of individual geometric shapes. However, they do not pay due attention to use of ICT tools taking into account the specifics of learning mathematics at the secondary and senior levels of education, as well as improving the quality of learning through use of ICT capabilities.

In the work of Branovsky Y.S. [8] software and methodological aids were developed for effective use of a personal computer as a tool for teaching sections of algebra and basics of analysis in a school course. It also specifies criteria for selecting mathematics teaching material for which a PC can be used. In addition,

methodological problems of using computers as tools and problems of computer modelling in teaching were considered.

Doliner L.I. investigated psychological features of pedagogical effectiveness of teaching students mathematics using ICT, and substantiated effective methods of organizing students' learning and cognitive activity when using a computer.

A.V. Yakubov in his work described the methodology of using ICT as a teaching aid in systematising and generalising students' knowledge in the process of teaching mathematics.

L.L. Jakobson's work outlines the psychological and pedagogical requirements for the process of creating polyhedron graphical images, provides instructions for their use at different stages of this process, defines the role and place of pedagogical software in the process of creating polyhedron graphical images and shows their connection with other teaching tools.

The problem of teaching mathematics in college using ICT was considered in dissertation studies by Tarbrin O.A., Kuzmin K.A., etc. Considering the value of these studies, it should be noted that they are mainly aimed at implementing professional orientation of the mathematics teaching process using information technologies.

The abovementioned works have considered implementation of information and communication technologies in the process of teaching mathematics in schools or universities, but few studies have paid attention to the specifics of teaching mathematics in college. In particular, Akamova N.V. in her research examines the use of ICT for proving theorems, solving problems, as well as in lecture classes in college.

The works of Medyankina E.L. and Sitnikova M.A. are devoted to the problem of using information and communication technologies in organizing students' independent work in the college education system.

The dissertation thesis of Kydyrbayeva G.T. is devoted to the methodology of using e-learning complex in the independent activity of college teachers.

The dissertation thesis of Bekbolganova A.K. is devoted to methods of improving the applied nature of mathematics teaching in college on the basis of the use of information and communication technologies.

In addition, when analyzing the above-mentioned works, we have identified a number of contradictions between the need of the modern society and insufficient scientific and methodic justification of ICT using in teaching mathematics in college, need of use ICT tools by teachers in their professional activity and not sufficient level of their training; didactic conditions of use ICT tools and absence of the methods establishing connection with the ways of their implementation.

The established contradiction defines the research problem.

**The problem of the research** is to develop the content of mathematics teachers training for using information and communication technologies in teaching mathematics, as well as to determine the didactic conditions of ICT application in mathematics education and necessity of their implementation.

The identified problem was the reason for choosing the topic of the dissertation work “**Didactic conditions for the use of information and communication technologies in teaching mathematics in college**”.

**The purpose of the research** is to identify the didactic conditions for the use of information and communication technologies in teaching mathematics in college, and practical justification of their implementation.

**The object of the research** is the process of using information and communication technologies in teaching mathematics in college.

**The subject of the research** is didactic conditions for the use of information and communication technologies to improve the learning process.

**Scientific hypothesis of the research:** if didactic conditions of systematic application of information and communication technologies in teaching mathematics in college are determined and their realization is grounded, **then** theoretical and practical level of learning increases, quality of knowledge increases, **because** visibility of mathematics learning increases, students understand better how to use ICT in real conditions, motivation for mastering mathematics increases.

In order to achieve the goal and prove the scientific hypothesis, the following **tasks** have been defined:

1. Determine the psychological and pedagogical foundations of the use of information and communication technologies in the process of teaching mathematics;

2. Development of classification of information and communication technologies in education, determination of the conditions for ICT tools choice;

3. Determine the level of training college teachers for using information and communication technologies;

4. Identify the didactic conditions for the use of information and communication technologies in teaching mathematics in college, practical justification of their implementation and experimental testing of their effectiveness.

The following **research methods** were used to achieve the aim and objectives:

- *general scientific methods of theoretical investigation*: analysis of psycho-pedagogical, scientific-methodological and special literature on the topic of research;

- *methods of social investigation*: questionnaires and interviews with students and teachers, control tests, analysis of the results;

- *methods of empirical investigation*: conducting pedagogical experiment for the purpose to prove the hypothesis of the research, use methods of statistical study, processing and analysis of the results.

**Methodological basis of the research.** Works of advanced scholars in didactics Babansky Y.K., Bespalko V.P., Talyzina N.F., Danilova M.A., Skatkina M.N., etc.; on psychological requirements for designing information and communication technology tools in the works of Rubtsov V.V., Kaptelin V.N., Lvovsky V.A.; works on computerization of learning activities by Kritsky A.G,

Panyukova S.V., Shchukina G.I., Krutetsky V.A., Kuzmina N.V. etc; studies of efficiency and necessity of ICT use by Mashbits E.I., Bidaibekov Y.Y., Grinskun V.V., Burlakova T.V., Ogurtsova E.Y., Abykanova B.T., etc.; the necessity of ICT use in mathematics education process was mentioned by Glaser G.D., Kapustina T. V., Kravtsov S.S., Robert I.V., Jakobson L.L., Branovsky Y.S., Doliner L.I., Akhmetova O.S., Kuznetsov E.I., Baimakhanova L.A., Abylkassymova A.Y., Babayev D.B., Smagulov E.J., Seitova S.M, Mubarakov A.M., Sydykov B.D., Shuakbayeva R.S., Baidildinov T.J., Bekmoldayeva R.B., Baidybekova A.O., Mussatayeva I.S., Yessengabylov I.J., Aldabergenova A.O., Zhiembayev J.T., Bekbolganova A.K., etc.

**Theoretical basis of the research.** Psychological and pedagogical theories of learning; effective methods of organizing educational and cognitive activity of a student under conditions of using ICT; research on informatization of education; achievements in creation and application of CPS; established capabilities of ICT in teaching mathematical specialties; goals and objectives of ICT application; didactic principles and conditions.

**Sources of the research:** Law of the Republic of Kazakhstan “On Education”; normative documents of the Ministry of Education and Science of the Republic of Kazakhstan on education; state compulsory standard of technical and vocational education; National Project “Quality Education “Educated Nation”; works of psychologists, educators and other scientists on research issues; personal experience of the author, working curriculum, educational and methodological manuals.

**Scientific novelty of the research:**

- Psychological and pedagogical foundations of the use of information and communication technologies in the process of mathematics learning have been defined;
- Classification of information and communication technologies has been developed, pedagogical and ergonomic, and also technical requirements for the choice of ICT tools have been determined;
- The level of training of mathematics teachers for the use of information and communication technologies in college has been determined;
- Didactic conditions of using information and communication technologies in teaching mathematics in college have been determined, their implementation has been practically substantiated and their effectiveness has been experimentally verified.

**Theoretical significance of the research results** lies in addition and generalization of classification of information and communication technologies used in teaching mathematics; in a set of pedagogical and ergonomic requirements for the choice of ICT tools; in development the content of training mathematics teachers to use information and communication technologies tools in college; in practical justification of implementation didactic conditions for the use of information and communication technologies in teaching mathematics in college.

**Practical significance of the research:** the didactic conditions and educational site proposed in the research can be used by teachers of mathematics

and college students in teaching mathematics in order to strengthen the cognitive activity of students, improve the quality of learning process.

**Evidence and validity of the research results:** provided by scientific and educational and methodological literature on the researched problem; application the set of scientific research methods, rational combination of theoretical and experimental types of research; use of statistical methods, mathematical processing confirming the results of conducted experimental research.

**Main provisions for defense:**

1. The psychological and pedagogical substantiation of use of information and communication technologies in the process of teaching mathematics is the theoretical basis of the study;

2. The developed classification of information and communication technologies in education will become an addition to the classification of information and communication technologies in learning mathematics; The identified pedagogical and ergonomic requirements for the choice of ICT tools may become a methodological ground of the study;

3. The revealed level of training mathematics teachers on use of information and communication technologies in college is the background for the content of their training;

4. The established didactic conditions for use of information and communication technologies in teaching mathematics in college and the practical justification for their implementation, as well as their effective use, have a positive influence on improving the quality of education.

**Research base:** College “Zhansugurov College”, Taldykorgan Higher Polytechnic College, Zharkent Higher Humanities and Technical College, Taldykorgan Agro-Technical College.

**The main stages of the study:** Experimental work was carried out in the conditions of the educational process in accordance with the goals and objectives of the study in the period from 2018 to 2021.

**At the first stage** - (2018-2019), analysis of psychological, pedagogical, scientific and methodological literature, curricula for mathematics in college was carried out in accordance with the set research problem. The scientific apparatus of the research work was determined. The experience of using information and communication technologies in education was studied and theoretically substantiated. Psychological and pedagogical foundations for use of information and communication technologies in the process of teaching mathematics were determined. A stating experiment was carried out to find out the readiness of mathematics teachers to use ICT tools in their professional activities.

**At the second stage** - (2019-2020) a course was organized for college mathematics teachers called “*Improving the competencies of mathematics teachers in ICT*”. Final test was held to determine the level of readiness of mathematics teachers to use ICT tools. The didactic conditions for ICT use in teaching mathematics in college were identified, the model of the educational site was developed for practical implementation of the identified conditions, and the

website <https://bilimorda.kz> / (search experiment) was created based on the developed model.

**At the third stage** - (2020-2021) formative experiment was carried out, didactic conditions for use of information and communication technologies in teaching mathematics were implemented and tested. The results obtained were summarized and compared with the research hypothesis. The effectiveness of didactic conditions was proven and implemented in the educational process.

**Approval and implementation of work in practice** . The main results of the study were heard and discussed at the scientific and methodological seminar of the Department “Mathematics and Informatics” of Zhetysu University named after I. Zhansugurov, and were also displayed in the textbooks “Methods of using information and communication technologies in teaching mathematics to college students”, “Use of computer technologies in organization of extracurricular activities”.

From June 01 to June 26, 2020, on the basis of the Taldykorgan Higher Polytechnic College, advanced training courses for mathematics teachers in colleges were held.

The results of the study were introduced into the educational process of Zhansugurov College, Taldykorgan Higher Polytechnic College, Taldykorgan Agro-Technical College, Zharkent Higher Humanitarian and Technical College.

**Publications.** The main content of the dissertation, along with domestic and foreign scientific consultants, has been covered in the journals of the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan and at international scientific and practical conferences. 10 scientific papers published on the main content of the dissertation:

1. Scientific papers published in the editions of the Scopus database - 1 (percentile - 74);
2. Scientific works published in publications recommended by the Committee for Control in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan - 4;
3. Scientific papers published at international scientific conferences-3;
4. Scientific papers published in foreign peer-reviewed journals-1;
5. Textbook recommended by the Republican Academic and Methodic Council of the Ministry of Education and Science of the Republic of Kazakhstan-1;
6. Textbook recommended by the Republican Academic and Methodic Association on the program “Vocational education” of the Taldykorgan Higher Polytechnic College -1;

**Dissertation structure:** the dissertation consists of normative references, definitions, abbreviations, introduction, two parts, conclusion, list of references and appendix.

**The content of the dissertation.** The **introduction** substantiates the relevance and significance of the research topic, defines the purpose, object and subject, hypothesis and tasks of the research work, outlines the methodological and theoretical foundations, research methods, its stages, scientific novelty, theoretical

and practical significance, provisions for defense, substantiation of the research results.

The first section “**Theoretical foundations of the use of information and communication technologies in learning mathematics**” considers the psychological and pedagogical foundations for the use of information and communication technologies in the process of teaching mathematics, the possibilities of information and communication technologies and their application in learning mathematics. The goals, objectives and principles of using information and communication technologies in learning mathematics are also indicated.

The second section “**Implementation of didactic conditions for the use of information and communication technologies in learning mathematics in college**” presents the didactic conditions for learning mathematics using information and communication technologies in college and shows how to implement them, the results of the pedagogical experiment to determine the level of knowledge of mathematics teachers in the field application of information and communication technologies in professional activities, as well as didactic conditions for the use of information and communication technologies in teaching mathematics in college, pedagogical conditions for their practical implementation are recommended, experiment and analysis of the research results are conducted and presented.

**In conclusion**, the main results of the research work carried out are formulated and summarized, a list of papers in which the results of the study are published is given.

**The appendix** contains materials, questionnaires and acts of implementation of the results of research work used in the course of the study.