**REPUBLIC OF AZERBAIJAN**

*On the rights of manuscript*

# THE SYSTEM OF WORK ON THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN TEACHING MATHEMATICS IN COLLEGES

Specialty: 5801.01 – Theory and methodology of training and education (methodology of teaching mathematics)

Field of science: Pedagogy

Applicant: **Aliyeva Arzu Faig**

# ABSTRACT

of the dissertation submitted for the degree of Doctor of Philosophy

**NAKHCHIVAN– 2023**

The dissertation work was performed at the department of Educational Institute of the Azerbaijan Republic.

Scientific supervisor: (Scientific consultant): doctor of pedagogical sciences, professor **Mahmudov Mudafie Jamil**

Official opponents: doctor of pedagogical sciences, professor **Abulfat Palangov Gulam**

doctor of philosophy in pedagogy, docent **Khumar Novruzova Tofig**

doctor of philosophy in pedagogy **Fatma Hajiyeva Ramiz**

FD 2.40 Dissertation Council operating under the Nakhchivan Institute of Teachers of the Supreme Attestation Commission under the President of the Republic of Azerbaijan

Chairman of the dissertation council: doctor of pedagogical sciences **Aliyev Ismayil Israfil**

Scientific secretary of the dissertation council: **PhD in pedagogy, docent Shahbazova Giziltaj Tarverdi**

Chairman of the scientific seminar: doctor of mathematical sciences doc.**Yagub Mammadov Yagub**

## GENERAL CHARACTERISTICS OF THE STUDY

**Relevance and development of the theme.** Nowadays, information technologies are developing rapidly and their role is increasing day by day. The renewal and modernization of new training technologies and methods in science and technology plays an important role in solving applied issues and is significantly expanding.

One of the urgent problems faced in the globalized world is to build a new type of society in the current socio-economic conditions. This is manifested in three main directions: education, science and innovation. Thus, the issue of creating a new education system came to the fore. One of the requirements of new approaches in the education system is to minimize the delay in the flow of knowledge gained.

For this reason, it is an important task to carry out reforms in the field of mathematical education in our country using the possibilities of information and communication technologies (ICT). The decree of the president of the country signed in 2003 was a very important step in the application of ICT in the field of education in our country.

Decrees dated August 21, 2005 and June 10, 2008 provide for the application of ICT in all areas of the educational system in our country.

The reforms carried out in our country at the present time have led to the change, renewal and modernization of the content, volume and features of the mathematics course in the secondary special education system, as well as at all levels of education. Therefore, one of the main challenges is to teach students to think independently, to get a quality education by benefiting from ICT, to train modern specialists in accordance with modern requirements.

The introduction of ICT in education leads to the provision of a number of basic conditions in teaching mathematics in the system of secondary specialized education, namely:

–establishment of theoretical and practical teaching of mathematics in accordance with modern requirements;

– how to improve the quality of training through the use of ICT in teaching mathematics;

– implementation and modernization of the development process of experimental design and scientific research in colleges

– analysis and elimination of difficulties and contradictions that arise during the use of ICT.

In the process of teaching mathematics in secondary specialized educational institutions, it is necessary to have the following tools and resources in the process of using ICT:

– colleges with a modern material and technical basis;

– availability of personnel capable of using ICT effectively;

– internet connection of colleges.

At present, the process of rapid development and formation of ICT is under way. The use of new learning technologies and methods, ICT in mathematics training is a closely related issue. The role of computers in solving problems is invaluable. Therefore, it is necessary to take advantage of new learning technologies and methods during the use of ICT in the teaching of mathematics in colleges. Qualitative study of mathematical symbols of discrete mathematics in the teaching of mathematics based on the methodology of ICT should be solved for the creation of new methods and forms, new methods of using information technologies and calculations with computers without any difficulty. Improving the management of education by applying ICT, preparing the provision of pedagogical and administrative personnel in accordance with modern requirements, investigating the development trend of the application of ICT in education should be analyzed and the experience of progressive countries should be studied. Studies carried out in the indicated areas in our republic and foreign countries allow to study the aspects of the formation of the information society and certain patterns of socio-economic processes.

After the independence of the Republic of Azerbaijan, the rapid development of the economy, the integration of the education system into Europe and influential countries of the world made the introduction of new educational models into the educational process a demand. In 1999, on June 15, the Reform Program in the field of education was approved in our country. According to this program, it is planned to change, update and modernize the content and features of modern educational programs, education in accordance with modern requirements. The basis of new educational models in our country is the content of educational programs, increasing the scientific level, the implementation of world experience, continuous education, etc. form provisions. So, for the creation of a modern education system, it was necessary to integrate the traditional form of education in the education system of our country into modern educational models. In other words, the need for quality education was felt.

A number of studies have been conducted in our country regarding the application of ICT in the process of teaching physics, chemistry, mathematics etc. Starting from the beginning of the XXI century, some issues of general issues of ICT use and improvement of teaching in the process of teaching mathematics in Azerbaijan and foreign countries were considered. In this direction, V.P. Dyakonov, O.V. Zimina, G.I. Sarantsev, I.F. Shvygin, I.Y. Bayramov, Ya.M. Kolyagin, V.A. Onishuk can be noted. From the researchers of our republic, it is possible to note research of A.G. Palangov, I.B. Ahmadov, S.A. Feyziyev, R.Y. Shukurov, A.A. Guliyev, I.N. Ismayilov, M.J. Mahmudov, S.S. Hamidov, I.A. Jafarova, M.A.Alishov, T.A. Mammadov, Y.Y. Mammadov, M.S. Kazimov and others. The system of work on theoretical and practical problems of the use of ICT in the teaching process of mathematics in secondary specialized educational institutions in our republic and foreign countries has not been properly studied.

One of the main ways of improving the quality of training, improving the level of education is the wide and complete application of ICT in the educational sphere. This leads to the

expansion of new pedagogical methods and techniques in the use of ICT, as well as to structural changes in the education system.

The use of ICT in teaching mathematics in secondary specialized institutions presents a number of existing difficulties, which are accompanied by a large number of shortcomings, namely:

- lack of a wide-ranging system of training of ICT training technologies in ensuring the necessity of meeting the requirements of modern times of professional training in colleges;
- failure to achieve knowledge, skills and habits in the use of ICT, lack of programmatic-targeted approach;
- the absence of a system of measurements and indicators that allow to assess the level of education of specialists in the profession;
- the lack of literature in the field of specialist training related to the application of ICT in the solution of application issues;
- the inconsistency of the curriculum on the use of ICT in mathematics with the requirements of State Educational Standards during the training of specialists;
- consistent implementation of analytical examination of the results and shortcomings obtained in the training of specialists and the lack of formation of steps taken to eliminate the difficulties and contradictions that have arisen.

It is necessary to strengthen the inclusion of continuous education in overcoming difficulties and contradictions in the use of ICT in teaching mathematics in colleges and increase the role of approaches to implementing the principles of new learning technologies. That is, the professional trained by taking advantage of ICT in teaching mathematics in colleges must be a modern professional, should reflect its knowledge, skills and habits in any progressive countries of the world. Each person who completes their education must achieve the level of knowledge in their professional direction in accordance with modern requirements, and the role of

the use of ICT in this case is undeniable. However, at present, the inadequacy of the existing material and technical base is sharply felt in colleges.

The transition to the Bologna system is due to the modernization of the education system of our country, first of all, the successful introduction of advanced technologies and management methods, innovations based on scientific achievements in the socio-economic life of the country. The use of ICT in teaching mathematics in colleges as a means of improving the quality of education also makes its application in the professional direction necessary, that is, it plays an important role in improving training in the educational process.

Our research has shown that taking advantage of ICT in colleges increases the efficiency of teaching mathematics. The application of ICT distinguishes the teaching of mathematics from traditional lessons, the stages of explanation, motivation, research, implementation and evaluation are carried out appropriately.
The rapid development of the economy of our country, the integration of the country's education into all the progressive countries of the world allows the dynamic development of education and creates the demand for the implementation of the transition model from one-time education to the principle of continuous (lifelong) education. Z. Muradova wrote: " The importance of integration in education is great. Integration in the training process, integration in the teaching of subjects means the logical combination of separate parts in full interaction with each other.

In our country, the problem of using ICT during the teaching of mathematics in secondary vocational education institutions has not been widely investigated. This makes it difficult to overcome the problems encountered in the teaching of mathematics in theoretical and practical directions with the application of ICT. It is important to develop methods and methodical aids that will guide mathematics

[1] *Muradova, Z. The essence of interdisciplinary communication in the pedagogical process // - Baku: Scientific works of EIAR, - 2017. No. 5, - p. 54-57.*

teachers and create conditions for the application of ICT in separate classes.

At present, information technologies are rapidly developing, expanding, enriching and deepening. The inclusion of elements of modern mathematics in the mathematics course in colleges and the use of ICT in teaching mathematics is one of the main reasons for the enrichment of its content. It is extremely important to identify and benefit from new teaching methods and methods of using ICT in the teaching of mathematics. That is, when training specialists in any direction in colleges, students acquire the necessary knowledge and skills in taking advantage of ICT, new learning technologies in teaching mathematics.

The theoretical and practical system of using ICT in the teaching of mathematics in colleges involves the development of a new methodology, the improvement and renewal of teaching programs and textbooks.

Periodical innovations in mathematics programs should be in accordance with the state education standards, and should serve to update the content of education and raise its scientific level in the teaching process. During the teaching of many economic and technical subjects, solving problems is carried out with computers, in this case, the emergence of new mathematical methods is expected. Solving such problems requires the training of specialists who meet modern requirements.

From research and analysis it was concluded that the methodological system serving the formation of the concepts of geometry, algebra and mathematical analysis in students by using ICT in teaching mathematics in colleges has not been resolved. Therefore, taking into account the urgency of the problem, we involved the topic "The system of work on the use of information communication technologies in teaching mathematics in colleges" into the research.

**The object of the study** is the process of applying ICT in teaching mathematics in secondary specialized educational institutions.

**The subject of the study** is the system of work on the use of ICT in mathematics classes of secondary specialized educational institutions.

**The goal of the study** is to develop a new methodological system by determining the scientific and pedagogical features of the application of ICT in mathematics training in colleges, the possibilities and ways of using computers in the study of the subject.

**The research of hypothesis**: The purposeful use of ICT in teaching mathematics in theoretical and practical areas in colleges will increase the efficiency of training, lead to the development of logical thinking, and this will allow the formation of knowledge, skills and habits of future professionals. When the introduction of ICT is carried out sequentially, interest in the study of mathematics will increase and lead to the development of a new methodological system based on the professional orientation of students.

**The tasks of the study** are as follows:

- to clarify the general issues of the use of ICT in the process of teaching mathematics in colleges;
- to determine the role, importance and advantages of information and communication technologies in teaching mathematics;
- studying the problem in pedagogical and psychological literature;
- analyzing college mathematics textbooks in terms of problems;
- to study the problem of selection of teaching methods in mathematics and related teaching of related subjects with the use of information and communication technologies in colleges;
- to examine the current state of application of ICT in teaching mathematics and to determine its prospects;
- to reveal the directions of improvement of mathematics (theoretical and practical) teaching in colleges through the use of ICT;
- to clarify the pedagogical, psychological and methodological

requirements for the use of ICT and teacher training in the process of teaching mathematics in colleges;

- to consider the use of ICT as a means of improving the effectiveness of teaching mathematics;

- to bring to the attention the prospects of teaching mathematics with ICT in extracurricular activities;

- to clarify the theoretical, practical and methodological problems of the use of ICT in the training of mathematics in colleges;

- to provide information on the stages and results of the organization and conduct of the pedagogical experiment.

**Study methods.** Questionnaire survey, pedagogical observation, interview, method of Mathematical Statistics, pedagogical experiment, analysis and organization, as well as induction and deduction, etc. methods were used.

**Main provisions for defense:**

1. The quality of training improves when colleges use ICT in the process of teaching mathematics;
2. Psychological, pedagogical and methodological requirements for the use of ICT in mathematics training should be identified and taken into account;
3. The solution of problems that arise when using ICT in theoretical and practical directions in teaching mathematics has a positive effect on improving the quality of training;
4. Systematic use of ICT, interactive and active learning methods should be clearly expressed in order to develop students ' creative abilities.

**Scientific novelty of the study.** A system of work on the use of information and communication technologies in teaching mathematics in colleges has been created.

**The theoretical significance of the study** is that the theoretical issues of the work on the use of ICT were clarified in mathematics training. The study will enrich the science of pedagogy, the methodology of teaching mathematics with new scientific ideas. The

study can play an important role in the development of new educational programs, textbooks, methodological AIDS, teaching aids in mathematics.

**The practical significance of the study** is that mathematics teachers will be able to benefit from research in their practical activities, in the effective application of ICT.

**The methodological basis of the research** is a set of theoretical provisions, methods and other tools applied to study, understand and change pedagogical facts, events and processes.

**Approbation of the study:** The materials related to the main provisions of the dissertation work were presented at the Department of Theory and Methodology of Education of the Institute of Education of the Republic of Azerbaijan, the Department of Mathematics and its Teaching Technology of ASPU and the scientific seminar of the Department of General and Applied Mathematics of Azerbaijan Technical University, at republican and international scientific-practical conferences, was published in the form of an article in the press of our republic and foreign countries.

**The structure of the dissertation.** The dissertation consists of a title sheet, contents, an introduction, the content of the dissertation, conclusion, a list of references and appendices.

## MAIN CONTENT OF THE DISSERTATION

In the introduction part of the dissertation, the relevance of the problem is substantiated, the object, subject, goals and objectives of the study, hypothesis, methodological basis, research methods, scientific novelty of the study, theoretical and practical significance of the study, the provisions submitted for defense are interpreted, brief information is given on the study of the results.

**Chapter I** of dissection is called **"General issues of the use of ICT in the process of teaching mathematics in colleges"** and consists of 4 paragraphs.

The first paragraph of Chapter I deals with **"the role, importance and advantages of information and communication technologies in teaching mathematics in colleges".** In the use of ICT in secondary specialized educational institutions, the issues of what and how to teach to whom, depending on the qualifications, are commented on. It is noted that these factors must comply with the requirements of the modern era, and new methods and approaches should be important in changing the content and characteristics of those disciplines. It is also noted that one of the advantages of using ICT is that teachers and students can achieve integration implemented in the world education system using multimedia and internet opportunities. That is, teachers and students achieve an improvement in the quality of training using the methods obtained in the process of innovation and modernization.

The second paragraph of Chapter I **gives "The statement of the problem in the pedagogical and psychological literature and the analysis of textbooks from the point of view of the problem".** Textbooks on mathematics, research works close to the problem, works of prominent scientists of both our country and foreign countries were analyzed, useful aspects were characterized and the solution of the forthcoming issues was substantiated.

The third paragraph of Chapter I deals with the **"Rules for the selection of training methods in the related teaching of mathematics and related subjects with the use of information and communication technologies in colleges".** It is noted here that when there is a connection between mathematics and related subjects in colleges and the application of ICT is reflected, higher-quality knowledge, skills and skills will be obtained by the learners.

The fourth paragraph of Chapter I comments on **"the current state and prospects of the application of ICT in teaching mathematics in colleges".**

In order to improve the quality of teaching the mathematics course, it is recommended to use the internet to use the problems and examples of theorems. It is justified that the knowledge obtained through ICT makes students more flexible, encourages the

development of logical thinking and forms them as creative personalities. The creation of new methods and forms in teaching a mathematics course based on the methodology of ICT, the methodology for using new information technologies, the study of discrete mathematics in order to perform calculations without difficulty with computers should reflect itself.

**Chapter II** of the dissertation is entitled **"Directions for improving the teaching of mathematics (theoretical and practical) in colleges using ICT".** This chapter also consists of 5 paragraphs.

The first paragraph of Chapter II sets out **the *pedagogical, psychological and methodological requirements for the use of ICT and teacher training in the process of teaching mathematics in colleges.*** Also, the results of the analysis of the current situation in secondary schools according to modern requirements and the involvement of the teaching staff in scientific research are given here. In addition, it is justified that every year the theoretical and practical knowledge of mathematics is updated, and as a result of the emergence of new information, the competence of teachers decreases. Therefore, they see the solution to such a complex and difficult problem in the transition to lifelong education. At present, secondary specialized schools are putting forward their positive aspects in responding to the need to manage information flows in the educational process.

The second paragraph of Chapter II is entitled **"The use of ICT as a means of improving the effectiveness of teaching mathematics".** It is shown here that the application of ICT in the use of contrmissals, analogies, basic proven methods in improving the teaching of mathematics in theoretical and practical areas in colleges is of great importance in the development of logical thinking of future professionals. In addition, other factors that increase the efficiency of teaching mathematics were also analyzed and the ways of their use were interpreted.

And in the third paragraph of Chapter II, **the *perspectives for teaching mathematics with ICT in extracurricular activities*** are

indicated. Here, however, it is justified that in extracurricular and extracurricular educational work, students have a comprehensive development and the enrichment of their individual talents and abilities is formed. It is noted that with the use of ICT in colleges, extracurricular and extracurricular work on mathematics can be carried out individually, in groups and massively at the request of students. A number of basic requirements of extracurricular activities, issues of voluntary nature, usefulness and usefulness of the educational institution, planning on the basis of logical thinking, creating conditions for students' activities in this direction during its implementation are also commented. In addition, some principles of ICT in the process of teaching applied mathematics and its purposeful, systematic implementation in various types of extracurricular activities are noted.

The fourth paragraph of Chapter II of the dissertation is called ***"Theoretical, practical and methodological problems of the use of ICT in teaching mathematics in colleges".*** Here it is recommended to use three main cases in teaching the use of ICT in theoretical and practical areas: verification of knowledge, explanation of a new topic; deepening and strengthening of the studied topic. With these stages, a new methodology for conducting lessons was proposed, examples of lessons with their application were given. In this type of lessons, more than 21 questions, tasks and their solutions are shown in the traditional way and in the MathCad program on the computer. X. Hasanova noted: "Mathcad is a very useful mathematical program used in engineering, mathematics and many sciences. So, this program is considered as the first computer application that performs automatic calculation. At this time, the educational model obtained by using ICT in the teaching of mathematics was mentioned. In addition, the main stages envisaging the implementation of steps necessary for the implementation of the solution of mathematical problems by computer - problem formulation; mathematical

[2] *Hasanova, X. Teaching mathematics using ICT in higher schools // Scientific works of the Education Institute of the Republic of Azerbaijan, - Baku: - 2021. No. 2, - p. 104-109.*

modeling; selection of numerical solution methods; creation of algorithm of problem solving and data structure; programming; analysis of the result obtained on the basis of computer solution of the problem were interpreted with a new view.

***"Pedagogical experiment and its results"*** is given at the end of the second chapter, a detailed analysis was carried out.

Pedagogical experiments were carried out in three types, separated according to their tasks, namely, ascertaining (diagnostic), educational and verifying types.

Pedagogical experiment can be put on different problems in different directions in all areas of education. In other words, the changes, innovations and modernization of the taught subjects, the amount of total hours given to them, the amount of hours allocated for the semester, the amount of hours for lessons, laboratory work, and practical training are not satisfactory, by observing the objective and real situation, a pedagogical experiment was carried out in accordance with the subject calendar plan and the working curriculum.

1. Defining experiment. At this stage of the experiment, the following objectives were determined: The total number of hours allocated to the subject of mathematics for the first semester of the 2016-2017 academic year of the Azerbaijan Marine College is 90 hours, and the number of hours allocated for the semester is 60 hours. The type of lesson is mixed, that is, the teaching of the subject in theoretical and practical directions is carried out. Interviews with mathematics teachers of secondary specialized educational institutions, analyzing the content of mathematics and clarifying the ways of determining the knowledge and skills of students in these subjects, studying the level of teachers' activities, determining the methodology of teaching subjects, in the groups selected for the realization and formation of the hypothesis of the dissertation, ensuring the approximate correspondence of the levels of knowledge of students and teachers, revealing the level of groups in theoretical and practical directions from the point of view of the subject of the research work, the implementation of a questionnaire survey to

investigate the difficulties and contradictions that arise in the educational process.

The questions in the survey with college teachers were:

1. What are the possibilities of using ICT in textbooks and methodological literature in the programs of algebra and the beginning of mathematical analysis?
2. What textbooks and teaching aids are used in teaching the discipline algebra and the beginning of mathematical analysis?
3. What level of activity of students in the training of the limit, discontinuity and derivative of the function?
4. What difficulties and contradictions do you face in teaching algebra and the beginning courses of mathematical analysis?

From interviews and questionnaires with teachers of secondary specialized educational institutions, it became clear that most educators correctly understand the role, importance, goals and objectives, pedagogical-psychological and methodological nature of ICT in the process of teaching mathematics. Students' skills in solving examples with computers are at a low level, that is, they do not meet the training of specialists in accordance with modern requirements.

As a result of surveys conducted with college teachers, the use of ICT has realized the need to eliminate the difficulties and contradictions that have arisen in secondary school educational institutions, i.e:

- the study of the use and advantages of ICT in the teaching of the beginning course of algebra and mathematical analysis, deepening, strengthening, systematization of knowledge and skills and selection of topics and exercises in theoretical and practical directions;
- designing studies in terms of the development of logical thinking in students.

The determining type of the stage of planning the pedagogical experiment determines the relations of facts and dependencies between events as a special stage. That is, it has been observed that

the number of students of the group, the level of their knowledge, the profession, skills and competencies of the educators are the same. In order to clarify the levels of I-year students during their initial activities, the verification work included the following types of exercises:

1) Prove that the limit of the sequence $Q_n = \frac{5n-7}{7n+9}$ is $\frac{5}{7}$ and check in MATLAB.
2) give examples of the fact that the limit of the sequence is not the only one, and make it clear that this limit is so. Specify this process in MATLAB.
3) indicate at which point on the real axis the function y=|x| is not differentiable.
4) calculate the integral $\int_0^2 (2x + 3)dx$ and check it in MATLAB.
5) find the area covered by the graph of the function $y = ex$ in the fragment $[-1; 1]$.

The level of preparedness of students was determined by the following indicators: suppose a student performed at least 10 out of 8 studies, then the student's level of training is considered high. If he performed the correct solution of 4 to 8 exercises, then the student's level of training is considered average, if the number of exercises performed by the student is less than 4, the student's knowledge is assessed as low.

Taking into account the indicated, based on the result, students are conditionally evaluated in three options: weak (low) (6 students), medium (4 students), high (4 students).

It is possible to consider the comparison of students' knowledge levels in experimental and control groups as the same.

Completing test tasks, conducting theoretical and practical exercises, analyzing the solution of studies, interviews with mathematics teachers of secondary specialized educational institutions manifested themselves in the development and formation of the logical thinking activity of the students.

The results of a pedagogical experiment of a determining type (stage) manifested themselves in the following way:

- students with a high level of knowledge and skills in the development activity of logical thinking are a minority;

- the ability to use ICT in teaching mathematics in colleges is at a low level in students;

- it is necessary to improve mathematics teachers in accordance with modern requirements;

- the use of ICT and new learning methods in teaching mathematics is one of the important issues.

Thus, it is clear that the results of the determining experiment, as well as the analysis of the teaching of mathematics in theoretical and practical directions in the pedagogical-psychological literature, made it possible to satisfy the problem of the dissertation and to reflect the correctness of the hypothesis in the research.

The second, educational experiment phase of the pedagogical experiment aims to teach the experimental group students the new system, material, rule and type of activity. The objectives of the educational experiment are as follows:

- To reveal the possibilities of work in the development and formation of logical thinking during the training of the course of algebra and the beginning of analysis;

- Development of a methodology for the use of ICT in teaching the course of algebra and the beginning of analysis.

In the exercises presented to students during the educational experiment, various types of exercises should be used, the solution of which deviates from the known algorithm, which, along with practical exercises, should also present homework, verification and individual work to improve the quality of training. In this case, its influence on the qualities of the development of logical thinking of students has been resolved. In conducting the educational experiment, a methodical system using interactive (active) methods was developed, unlike traditional training methods, in the accepted groups.

Teachers of experimental groups got acquainted with the content, features and methodology of the developed methodological

system, were provided with the necessary teaching aids and literature materials. The purpose of the experiment was stated to them and effective ways were shown.

Educational experiment (2017-2018), which passed the second stage, in the academic year, the research work on interactive training of the developed methodological system on the use of ICT in teaching mathematics course has been resolved. A methodology has been developed aimed at eliminating the difficulties arising in the development of logical thinking of those studying the use of ICT in teaching mathematics and investigating contradictions. An educational experiment on the new system has been brought into the spotlight.

The activities of students in the use of ICT in teaching mathematics in selected groups in conducting the experiment were observed and dozens of different aspects were considered. At present, as at all levels of education, mathematics is taught as one of the main subjects in secondary specialized educational institutions, its content and infrastructure are changing depending on the rapid development of ICT. For this reason, changes and innovations must be taken into account in the teaching of mathematics. At present, the training of the following in accordance with modern requirements has been taken as the basis for teaching in colleges:

- basic concepts and definitions of mathematics;
- architecture, principle of operation, devices of a personal computer, basic knowledge of mathematical logic, data description;
- software, operation and cover systems of a personal computer, text, table and graphic editors;
- the database and its management systems;
- computer networks and internet services;
- information security.

In the experimental groups, ICT lessons were listened, students ' activities were observed, their knowledge and skills were tested. Analysis of this process shows that some learners make many mistakes in the process of using ICT in teaching mathematics. From

observations with teachers teaching mathematics in the groups where the experiment is planned to be conducted, it is seen that it is more useful to use new learning methods, that is, interactive and active learning methods.

The educational process has shown that some of the students face difficulties in using computers in mastering mathematics and cannot use ICT in solving examples given by the knowledge they have gained.

In the course of the experiment, the difficulties faced by students in using ICT in teaching mathematics were eliminated, the contradictions were investigated, and the preparation of suggestions for eliminating the indicated problems was resolved. That is, in the educational experiment, which passed the stage of the experiment, taking into account the analysis of the curriculum, the composition of the exercises with the use of appropriate topics and ICT was reflected. At the educational stage of the experiment, methods of teaching the use of ICT in theoretical and practical areas of Informatics were developed.

The educational experiment was conducted in 2017-2018 with students in ICT in the II-IV courses of the Azerbaijan Marine College in each specialty. One control and one experimental group were selected. Educational experiment passing through the stage of conducting a pedagogical experiment in the study in the process of training the course of mathematics, teaching the development of logical thinking of students, their qualities, methods of teaching Informatics in theoretical and practical directions were developed and this methodology was conducted in the indicated groups of experiments.

The verification phase of the pedagogical experiment covered 2018-2019 and 2019-2020. The purpose of the control experiment was to reveal the advantages of the methodology of using ICT in teaching ICT course in professional activity and its methodology as a means of improving the quality of training, and after studying the topics in the curriculum compiled on the subject program, the

experimental and control groups carried out work and verification work in accordance with

By comparing the results of the experimental and control groups during the verification experiment, it was concluded that if quality training was received in the experimental groups, then the mass application of the obtained results should find its own solution. During the verification experiment, the following conclusion was reached:

- implementation and approval of the obtained methodology;
- to clarify the availability of quality training;
- reflecting the acceptance or rejection of the hypothesis put forward in the research work.

In the verification experiment, the writing work carried out in the experimental and control groups was carried out according to different studies:

On the basis of the same material, inspection work was carried out in extreme and control groups. The purpose of applying the methodology of the compiled material, checking the quality of training, confirming and denying the hypothesis is reflected here. During the verification experiment, the verification writing tests were conducted in the experimental and control groups on the same tasks:

1) Indicate which of the functions given below is an even function.
   a) $y=\sin x^4+1x1$
   b) $y=\sin 5x$
   c) $y=x^3+x^5$
   d) $y=x^7$
   e) $y=x^5 \cdot cos2x$
2) Indicate which of the functions given below is an odd function.
   a) $y=\cos x$, b) $y=x^2\sin x^2$, c) $y=x \cdot sinx$,
   d) $y=x^2 \cdot sinx$, e) $y=x^2 \cdot cosx$
3) Find the set of values of the function $y=x^5|x|$.
   a) $(-\infty, 0]$, b) $[0, +\infty)$, c) $(-\infty, +\infty)$,
   d) $[-5, 5]$, e) $[5, +\infty)$

4) Find the domain of the function $y = \frac{1}{|x|-4}$.

a) $(4, +\infty)$

b) $(-\infty, 4)$

c) $(-4, 4)$

d) $D=(-\infty; -4)U(4;+\infty)$

e) $Q=(-\infty, -4) \cup (-4, 4) \cup (4, +\infty)$

5) Find the set of values of the function $y = \sqrt{36 - x^2}$.

a) (0,6)

b) (0, 6]

c) [0, 6]

d) (6, +∞)

e) [6, +∞)

6) Calculate the limits below.

$\lim\limits_{n\to\infty} \left(\sqrt{4+4} - \sqrt{n}\right)$

a) 2, b) 0, c) 1, d) -1, e)-2

7) $\lim\limits_{x\to 3} \frac{x^3-9x+20}{x^2-8x+15}$

a) 0, b) $\frac{1}{2}$, c) -2, d) 1, e) -1

8.Calculate the limit: $\lim\limits_{x\to 0} \frac{\sqrt{2+x}-\sqrt{2}}{x}$.

a) $\frac{\sqrt{2}}{2}$, b) $\frac{\sqrt{2}}{4}$, c) $\frac{\sqrt{2}}{3}$, d) $\sqrt{2}$, e) $\sqrt{2-1}$

9) Find the derivative of the function: $y = \frac{x}{x+3}$.

a) $\frac{3}{x+3}$

b) $-\frac{3}{x+3}$

c) $-\frac{1}{(x+3)^2}$

d) $\frac{3}{(x+3)^2}$

e) $-\frac{3}{(x+3)^2}$

10) Find the derivative of the function y= arctgx-arcctgx.

a) $\frac{x}{1+x^2}$

b) $\frac{2x}{1+x^2}$

c) $\frac{2}{1-x^2}$

d) $\frac{2}{1+x^2}$

e) $\frac{x-1}{1+x^2}$

11) Find the differential of the function $y = \frac{1}{5x^2}$.

a) dy=$\frac{1}{5x^2}dx$

b) dy=$-\frac{1}{5x^3}dx$

c) dy=$-\frac{2}{5x^3}dx$

d) dy=$\frac{2}{5x^3}dx$

e) dy=$-\frac{1}{10x^2}dx$

12) Find the differential of the function $y=(x^21)\cdot e^{-x}$.

a) $dy=(x^5-1)e^{-x}dx$

b) $dy=(2x-1)\cdot e^{-x}dx$

c) $dy=(x^2+2x+1)e^{-x}dx$

d) $dy=(2x-x^2-1)\cdot e^{-x}dx$

e) $dy=(1-x^2-2x)\cdot e^{-x}dx$

As a result of the pedagogical experiment, an experimental study was carried out according to the corrections and additions and improved methodology. Research was conducted on species that passed through the indicated stages of the pedagogical experiment, and the results of each stage were concluded by the method of mathematical statistics described in the methodical literature.

The level of knowledge and skills of students in algebra and the beginning of analysis on the studied material was calculated on the basis of the formula shown below:

$$M = \frac{\sum X}{N} \cdot 100\%,$$

here $\sum X$ – right answers, N is number of students. The results of verification work in the course of the first determining stage of the pedagogical experiment are presented in Table 1. From the obtained facts, analysis and research, it can be concluded that at the initial

stage, the level of knowledge of students in experimental and control groups is almost the same. 49 students took part in the examination conducted in both groups (25 students in experimental and 18 students in control groups).

In order to improve the quality of training in experimental groups, the principles and methods of training and education and the application of other directions were maximally used. In this case, it was tried to play a certain role in the development and formation of logical thinking of students ' knowledge and skills. It has been observed that the beginning of algebra and mathematical analysis in experimental groups corresponds to modern requirements for teaching in theoretical and practical directions. It should also be noted that the mathematical concept, definitions, propositions are fundamentally studied, the difficulties, contradictions, formalism etc. that have arisen are eliminated, the interest of those who study in the subject increases, the educational process becomes more active..

The results obtained at the third stage show that when comparing control groups and experimental groups, the number of high-level students increased by an average of 3 people, that is, the number of students with an average of 5 people who did not fully respond, and the number of incorrect answers, on the contrary, decreased by an average of 6 people.

From the above and observations, it can be seen that students who have the necessary knowledge and skills with the proposed methodology in the first academic year have higher success rates in mathematics than the control group students in the following academic years. So, analysis and research of the results of the experiment regularly increase interest in the study of courses of disciplines, contribute to the improvement of its quality, confirm the validity of our hypothesis in the aspect of the development and formation of logical thinking.

**Table 1**

Results of the determining experiment

| Groups | Number of students | High | | Medium | | Low | |
|---|---|---|---|---|---|---|---|
| | | number | % | number | % | number | % |
| EG-430 | 11 | 3 | 27,24 | 4 | 36,36 | 4 | 36,36 |
| CG-431 | 9 | 4 | 44,44 | 2 | 22,22 | 3 | 33,33 |
| EG-432 | 14 | 3 | 21,43 | 3 | 21,43 | 8 | 57,14 |
| CG-433 | 9 | 4 | 44,44 | 4 | 44,44 | 1 | 11,11 |
| ∑EG | 25 | 6 | 24 | 7 | 28 | 12 | 48 |
| ∑CG | 18 | 8 | 44,44 | 6 | 33,33 | 4 | 22,22 |

**Table 2**

The results of the verification experiment on the ("Undefinite integral section").

| Groups | Number of students | High | | Medium | | Low | |
|---|---|---|---|---|---|---|---|
| | | number | % | number | % | number | % |
| EG-430 | 11 | 4 | 36,36 | 4 | 36,36 | 3 | 27,27 |
| CG-431 | 9 | 4 | 44,44 | 3 | 33,33 | 2 | 22,22 |
| EG-432 | 14 | 4 | 28,57 | 5 | 35,71 | 5 | 35,71 |
| CG-433 | 9 | 3 | 33,33 | 5 | 55,56 | 1 | 11,11 |
| ∑EG | 25 | 8 | 32 | 9 | 36 | 8 | 32 |
| ∑CG | 18 | 7 | 38,88 | 8 | 44,44 | 3 | 16,67 |

**Table 3**

The results of the verification experiment on (Definite integral section).

| Groups | Number of students | High | | Medium | | Low | |
|---|---|---|---|---|---|---|---|
| | | number | % | number | % | number | % |
| EG-430 | 11 | 4 | 36,36 | 3 | 27,27 | 4 | 36,36 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CG-431 | 9 | 3 | 33,33 | 3 | 33,33 | 3 | 33,33 |
| EG-432 | 14 | 4 | 28,57 | 6 | 42,86 | 4 | 28,57 |
| CG-433 | 9 | 4 | 44,44 | 3 | 33,33 | 2 | 22,22 |
| ∑EG | 25 | 8 | 32 | 9 | 36 | 8 | 32 |
| ∑CG | 18 | 7 | 38,88 | 6 | 33,33 | 5 | 27,78 |

**Table 4**

(Section of straight line equations) test results

| Groups | Number of students | High | | Medium | | Low | |
|---|---|---|---|---|---|---|---|
| | | number | % | number | % | number | % |
| EG-438 | 15 | 11 | 73,33 | 2 | 13,33 | 2 | 13,33 |
| CG-439 | 14 | 11 | 78,57 | 1 | 7,14 | 2 | 14,29 |

**Table 5**

Results of a verification experiment on (ordinary differential equations section).

| Groups | Number of students | High | | Medium | | Low | |
|---|---|---|---|---|---|---|---|
| | | Number | % | number | % | number | % |
| EG-438 | 15 | 10 | 66,67 | 3 | 20 | 2 | 13,33 |
| CG-439 | 14 | 10 | 71,43 | 1 | 7,14 | 3 | 21,43 |

Observations have once again shown that although many students experience certain difficulties in using technological equipment, they are eager and eager to use other media to quickly interact, hold together a lot of information in different formats, work on a problem, and display a wide variety of audiovisual input.

## CONCLUSION

Referring to the theoretical research and pedagogical experiment conducted on the training of sections (with theories) of mathematical science in secondary specialized educational institutions, it is possible to draw the following conclusions:

1. Scientific, pedagogical and methodological works etc. on the use of ICT in teaching mathematics in colleges were analyzed.

2. The effective use of ICT in the process of mathematics training in secondary specialized educational institutions makes theoretical, practical and methodical problems a guide to demand. In the teaching of mathematics, the content, ways of implementation of intradisciplinary, interdisciplinary connections and succession have not yet been resolved.

3. Along with the use of ICT in teaching mathematics in colleges, it is necessary to implement programming, which is an integral part of it.

4. The realization of the concept reflecting the pro-professional orientation and interactivity of training in the use of ICT in teaching mathematics ensures the training of specialists in accordance with modern requirements.

5. According to the hypothesis of the conducted research, the use of ICT in teaching mathematics is of great importance in the development of creative abilities of future sub-bachelors and their formation as a person.

6. The main task of mathematics in secondary specialized educational institutions is to develop a working program in accordance with modern requirements for colleges and to prepare textbooks and teaching aids in accordance with it.

7. The use of ICT in teaching mathematics in colleges increases students' interest in mathematics and forms mathematical knowledge.

8. The study shows that the use of ICT facilitates the work of mathematics teachers in colleges.

It is possible to put forward the following suggestions regarding the study:

1. Training with the use of ICT in teaching mathematics course in secondary specialized educational institutions should be updated and modernized by the proposed methodology;
2. Planning the use of ICT in teaching mathematics, at what stages of classes should be drawn up a methodological document (technological map) of its use;
3. It is known that in the subject algebra and the beginning of analysis, proposals based on logical judgment in the use of ICT should be presented in proven proposals;
4. The absence of practical training in colleges and classes on laboratory work in the curriculum makes it possible to have a quality education through the use of ICT in teaching mathematics course;
5. The use of ICT in the teaching of mathematics courses in colleges should be modernized, and the role, importance, goals and objectives of the teaching process should be clarified accordingly.

**The main provisions and content of the dissertation are reflected in the following published works:**

1. Aliyeva, A.F. Information and communication technology as a methodological concept and its place and role in teaching mathematics in colleges // – Baku: Scientific works of AzTU, – 2018. №4, – p.149-152.
2. Aliyeva, A.F. Perspectives for the use of ICT in mathematics extracurricular activities in colleges // – Nakhchivan: Scientific works of Nakhchivan Institute of Teachers, – 2020. №3(61), – p. 69-74.
3. Aliyeva, A.F. Counterexamples in teaching differential calculus of multivariate functions in higher technical schools / A.F.Aliyeva, M.J.Mahmudov, N.T.Shikhaliyev // News Of Nakhchivan Institute of Teachers, v-13 –Baku: – 2017. №4, – p. 64-74.

4. Aliyeva, A.F. On the teaching of counterexamples in the section of ranks in higher technical schools / A.F.Aliyeva, M.J. Mahmudov, N.T.Shikhaliyev // Ganja State University, Fundamental, humanities and natural sciences series, – Baku: – 2018. №1, – p. 282-294.

5. Aliyeva, A.F. Possibilities and methods of using counterexamples in teaching the differential calculus section of a univariate function / A.F.Aliyeva, M.J.Mahmudov, N.T.Shikhaliyev // Scientific works of AzTU – Baku: – 2017. №2, – p. 75-82.

6. Aliyeva, A.F. The use of ICT in colleges as a means of improving the teaching of mathematics // – Baku: Scientific works of the IERA, – 2020. №3, – p.150-154.

7. Aliyeva, A.F. Place and role of using information and communication technologies in mathematics education in colleges // – Baku: Scientific works of the IERA, – 2019. №6, – p. 174-177.

8. Aliyeva, A.F. Theoretical, practical and methodological problems of the use of ICT in mathematics training in colleges // – Nakhchivan: Scientific works of Nakhchivan Institute of Teachers, – 2021. №3 (65), – p. 151-155.

9. Aliyeva, A.F. Advantages of using ICT in teaching mathematics in colleges // AzTU, Materials of "Universities of Azerbaijan and Turkey: education, science, technology" conferences, – Baku: – December, – 2019, – p. 68-70.

10. Aliyeva, A.F. Methods of teaching mathematics with the introduction of new information technology in colleges // – Baku: Scientific works of the IERA, – 2015. №4, – p. 57-60.

11. Aliyeva, A.F. Some actual problems of modern teacher training // Materials of ARTI conference "Strategic goals in Azerbaijan education and tasks facing pedagogical sciences", – 2015, – p.115-116.

12. Aliyeva, A.F. Application and main features of information and communication technologies in secondary specialized schools // – Baku: Scientific works of IERA, – 2017. №5, – p.146-149.

13. Aliyeva, A.F. Psychological and pedagogical foundations of the training of mathematics teachers in secondary specialized

schools // – Baku: Scientific works of the IERA, – 2017, №3, – p. 172-175.

14. Aliyeva, A.F. Mathematics and new information technologies in secondary schools // Sumgayit State University, Materials of the III Republican scientific conference "Applied problems of mathematics and new information technologies", – Sumgayit: – December 15-16, – 2016, – p. 323.

15. Aliyeva, A.F. Actual problems of teacher training curriculum // Northern Cyprus, Cyprus Science University, Materials of "7th International Conference on economic and Social Sciences", – Turkey, Cyprus: – May 7-8, – 2022, – p. 3-4.

16. Aliyeva, A.F. The current situation and prospects of the use of ICT in teaching mathematics in colleges // – Kazakh National Pedagogical University named after Abai, Pedagogy and psychology scientific-methodical journal, -2021, 3(48), - p. 187-196.

The defence of the dissertation will be held on 01 december 2023 at $11^{00}$ AM at the meeting of the FD 2.40 Dissertation Council operating under the Nakhchivan Institute of Teachers.

Address: Nakhchivan AR. Nakhchivan city, Heydar Aliyev avenue 1, AZ703, Nakhchivan Institute of Teachers.

It is possible to get acquainted with the dissertation at the library of the Nakhchivan Institute of Teachers.

Electronic versions of the dissertation and abstract are posted on the official website of the Nakhchivan Institute of Teachers.

Abstract was sent to the required addresses on 31 october 2023

Signed for print: 21.10.2023
Paper format: 60x84 1/16
Volume: 38386
Number of hard copies: 100