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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

METHODOLOGY OF ORGANIZATION AND IMPLEMENTATION OF PRACTICAL WORK IN COMPUTER SCIENCE IN MATHEMATICAL FACULTIES OF HIGHER EDUCATIONAL INSTITUTIONS

Speciality:	5801.01 – Theory and methods of teaching and education (Methods of teaching computer science)
Field of science:	Pedagogy
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GENERAL CHARACTERISTICS OF THE STUDY

The Azerbaijani government closely monitors the rapidly changing world of information technology and spares no effort to ensure that the education system of Azerbaijan does not lag behind these processes. All of this has also been reflected in the official documents of the Republic of Azerbaijan.

The use of information technology in education has not escaped the attention of the Law of the Republic of Azerbaijan "On Education" dated June 19, 2009 No. 833-IIIQ. Therefore, the basic concepts include the word innovation (innovation is a progressive nature (novelty), formed on the basis of various initiatives, scientific research)[1].

Due to the use of information and communication technologies in education, which is especially emphasized in the Concept of General Education in the Republic of Azerbaijan, the national curriculum has become completely independent, given that in the modern era public, cultural and social life are globalized and universalized, the role of ICT is increasing, competition is intensifying, talents and abilities of each person are of exceptional importance, it is aimed at the required level of education, the acquisition of knowledge and skills, the formation of personality, the main driving force for the development of society and problem solving for decision making.

The National Curriculum for subjects reflects the content of computer science: In the subject "Informatics" it is noted that the formation of the ability and habit of using a computer is ensured by the presence of an algorithmic culture among pupils.

One of the documents that plays a vital role in the life of our education is the State Strategy for the Development of Education in the Republic of Azerbaijan.

The strategy statess that the experience of developed countries demonstrates that better results are achieved by active-interactive teaching methods based on modern technologies, which bring logical

[1] The Law on Education of the Republic of Azerbaijan // Law No. 833-IIIQ dated June 19, 2009. Baku: Legislative Collection of the Republic of Azerbaijan, 2009. p. 31.

thinking to a high level and consider individual parameters of the student. For this purpose, the constant creation of modern teaching methods, as well as improving the abilities of teachers, play an important role in the development of education.[2]

Relevance of the research. The study of information technology is an important step in understanding the nature of information. Information technology is associated with the emergence of the son of man, but until the twentieth century it was not a special subject of study. The emergence of computers, their use to collect, process and store data, the speed of information collection has repeatedly surpassed the dynamics of development of knowledge and practical economics.

In modern times, it has become clear that there is an important difference between the scale of information and the assimilation of it by individuals. That is why the problem has become more serious.

These facts set a number of requirements for maintaining a high level of professional skills of a mathematics teacher. To cope with this task, it is necessary to continuously improve the entire learning process in higher pedagogical schools. The continuous improvement of the computer science is important in this regard. The new quality of professional training of mathematics teachers in the field of informatics requires new methods and variety of content in the teaching of informatics. This, in turn, helps to increase the professionalism of future mathematics teachers in pedagogical and information culture. The content of the computer science course is completed by using modern information technologies directly in the learning process.

Many psychologists, educators, and methodologists have addressed the issues of teacher professional training. The psychological and pedagogical principles of training in pedagogical higher education institutions have been studied by researchers such as F.A. Rustamov, F.B.Sadıgov, A.N.Abbasov, F.S.Avdeeva, S.I.Arkhangelski, V.A.Gusev, V.I.Zagvyazinski, Y.M.Kolyaqin, N.V.Kuzmina, Q.L.Lukyankin, N.V.Metelski, A.Q.Mordkoviç, N.D.Nikifirov, E.D.Novojilov, P.I.Pid-

[2] State Strategy for the Development of Education // Approved by the decree of the President of the Republic of Azerbaijan dated October 24, 2013. Baku: Legislative Collection of the Republic of Azerbaijan, 2013. p. 15.

kasistıy, V.A.Slastenin, Q.İ.Saransev, N.F.Talızina, R.S.Cherkasov, A.I.Shcherbakov and other scholars.

Many scientists, such as I.N.Antipov, B.S.Qershunski, A.P.Ershov, V.A.Izvozchikov, V.M.Monakhov, A.A.Kuznetsov, I.V.Maruseva, I.V.Robert, I.A.Rumyansev, N.F.Talyzina have chosen the problems of education in an informed society as an object of the study.

The continuous development of computer science in solving problems related to the training of specialists in the field of information is obvious.

The use of information technology in education, quality improvement of professional training of teachers working in various fields of ICT and other aspects of information technology have been studied by A.G.Palangov, I.N.Ismayilov, A.M.Mammadov, I.B.Ahmadov, G.I.Bashirova, A.M.Qasimova, N.Abishov, V.V.Aleynikov, A.L.Denisova, S.R.Domanova, N.V.Klemeshova, E.V.Klimenko, Q.A.Kruchinina, T.A.Lavina, D.P.Muravlev, Q.N.Nekrasova, K.R.Ovchinnikova, S.V.Panyukova, S.N.Pozdnyakov, T.A.Polyakova, D.E.Prokudin, L.V.Rojina, V.L.Rudik, N.A.Sizintseva, A.V.Selpuxin, N.K.Solopova, O.A.Sosedko, O.K.Filatov, I.A.Tsvelay, Q.B.Chepurenko, T.V.Shanqina, T.Sh.Shakhnabieva and others.

The continuous development of computer science in solving problems related to the training of specialists in the field of information is obvious. This manifests itself in various forms: the emergence of new versions of operating systems, office suites, development tools, graphics packages; changing the model of using new tools in professional activities. For example, the transition from the algorithmic programming model to the object-oriented programming paradigm, the widespread use of the concept of object in many software tools, the development of Internet technology, the continuous improvement of software tools which are functionally developed etc. All this helps students to learn information technology in detail. This plays an invaluable role in the formation of their future professional activity.

The MS Office package developed by the Microsoft campaign is used in many areas of human life. Microsoft Office Standard 2019 program is currently the most popular and in-demand.This office program has a complete set and consists of high-performance appli-

cations.

The Internet (JavaScript, VBScript, PHP, Perl, etc.), as well as traditional algorithmic programming, will require new approaches in teaching students the basics of programming in the near future. Then the main task will be to apply information technology to professional activities as the number one task. Mathematical training of students does not meet the requirements of the time in using the teaching materials for the course of computer science.

All this makes our research work (methodology of organizing and conducting practical work on Informatics in mathematics faculties of universities) relevant.

The development of training in the fundamentals of information technology and the improvement of the professional activities of mathematics teachers in this field constitute the problem of the research

Object of research: The process of professional training of future mathematics teachers in pedagogical universities.

Subject of research: Method and content of teaching computer science to math students.

The purpose of the study:

- to create didactic and methodological conditions for the use of information technology to improve the learning process of mathematical students of pedagogical universities;

- to direct the use of MS Office package to object-oriented programming and use of information technologies in the learning process.

The duties of the study are:

1. To generalize the experience of using information technology in the system of training future teachers.

2. To identify the psychological, pedagogical and methodological features of the use of information technology.

3. To create a course “Informatics” that provides vocational training of students in mathematics.

4. To develop a methodology of teaching computer science for math students.

5. To develop a set of laboratory work on the MS Office package for math students.

6. To develop methodical bases of use of object-oriented prog-

ramming model and a set of laboratory work on its use.

7. Experimental verification of the learning effect of the use of the developed teaching material.

Research methods: The research methods used in the dissertation are observation, questionnaire, comparison, generalization, study of school documents and advanced school experience, analysis of psychological, pedagogical and methodological literature and pedagogical experiments.

The main provisions of the defense:

1. Content concept for math students to study computer science.
2. Informatics course for the mathematics department of pedagogical universities.
3. Teaching methods of teaching computer science to math students.
4. MS Office package and set of laboratory works on object-oriented programming.

Scientific novelty and theoretical significance of the research:

- The concept of the computer science course has been created. Through this concept, it is possible to carry out a comprehensive professional training of a mathematics teacher in this field, to form a general pedagogical and information culture;
- Methodological approaches have been developed to improve the professional training of future mathematics teachers in the study of computer science;
- A training methodology has been developed taking into account the professional orientation of mathematical students in the study of computer science.

The practical significance of the research. The following issues have been developed:

- Content of Informatics course for math students;
- A set of laboratory works on the professional MS Office package;
- Methodological bases of the model on the set of laboratory works for object-oriented programming and its use.

Hypothesis of the research: Improving the professional training of mathematics students when studying the “Informatics” course occurs

in the following cases:

- If the course is intended in the joint context of the general pedagogical, mathematical and information culture of the mathematics teacher with his professional training;

- If the course covers the methodological training of future mathematics teachers and the ability to implement the use of information technology in the learning process;

- If the students' cognitive interests become active in the process of studying this course.

Approbation of the research.13 scientific papers on the topic of the dissertation have been published. Out of these, 9 articles (including 2 foreign ones) were published in scientific journals, 4 theses were presented at international conferences.

The general provisions of the dissertation were regularly reported at the Department of Informatics of Ganja State University.

The total volume of the dissertation with a sign indicating the volume of the structural sections of the dissertation separately. The dissertation consists of 2 chapters, covering 10 paragraphs, conclusions and proposals, a list of references and applications. Introduction – 24982 points, 14 pages, chapter I – 97426 points, 51 pages, chapter II – 78558 points, 59 pages, conclusion and proposals – 3385 points, 2 pages, list of used literature – 15 pages, appendices 8 pages, total volume of the dissertation 204351 points, 151 pages.

THE MAIN CONTENT OF THE STUDY

The introduction substantiates the relevance of the research, indicates the goals and objectives of the research, object and subject, hypothesis and provisions for defense, explains the scientific novelty of the work, reflects the level of study, theoretical and practical significance, structure and approbation of the dissertation.

Chapter I is called **"Theoretical bases of activity of future mathematics teachers in the field of informatics".** This chapter contains 5 paraghraps.

The first paragraph of the chapter describes the **psychological, pedagogical and methodological aspects of the use of computers in**

the professional activities of mathematics teachers. In this section, based on the views of various psychologists and educators, opinions have been formed about the versatility of the use of computers in the professional activities of mathematics teachers. The main reason is that the problems of didactics are solved with the help of the media. The training also explains the pedagogical and psychological aspects of the computer.

In the educational process, a computer can serve both as a subject of learning and as a teaching tool. The initial acquisition of competencies leads to an understanding of the capabilities of the computer. At the same time, it makes the use of computers in solving various problems a necessity, in other words, it requires computer literacy.

In the second case, the computer is a very powerful tool that enhances and improves the quality of training. The directions we have mentioned are referred to as the social process of computerization of education.

The main advantage of software training through a computer system is that the process of adaptation to to the characteristics of the activity becomes easy. It ensures the students' progress in managed learning, a process of individualization of learning is formed as they acquire practical skills. The transfer of knowledge with the existing learning technology complicates the creative, reflexive-theoretical thinking of pupils and students, because within this scheme, learning takes a unique programmed form.

Instrumental or educational programs, programming languages, create a unique interface on a computer. This interface has a certain didactic load. Our aim is also to ensure that with the help of that didactic burden, future mathematics teachers can pursue their professional skills at a high level.

Paragraph 2 is about the **software used in the formation of computer science knowledge of students majoring in mathematics teaching.** It discusses the professional use of computers by future mathematics teachers in their professional activities. In addition to the use of special curricula and teaching computer environment in the mathematics classes of pedagogical universities, it is possible to use the knowledge and skills acquired in the course of computer science, as in

schools.

It is a fact that the foundation of information activity lies in the

- Formulation of the creative task;
- Construction of the information model;
- Investigation of the model;
- Analysis of the obtained results.

The capabilities of the computer related to the creation and processing of information are extensively utilized at every stage. The results obtained in the educational process must be presented in such a way that they can be easily analyzed later.

Pupils and students use a variety of software tools to learn mathematics.

Algorithms are an important tool in mathematics. In general, the algorithm has two main objectives: first, to develop students' logical thinking, and second, to develop programming skills in students. It has been noted that the installation and description of algorithms in Informatics and the ability to program can be used to teach mathematics. Research by various scientists (A.Q.Tigerov, X.T.Novruzova, E.Jacobsen) In many school mathematical algorithms are implemented with the help of spreadsheets, because spreadsheets are primarily designed to process the data in the spreadsheet. In mathematics, spreadsheets are used to find curves and to predict and compile formulas in number theory in geometry.

In our modern era, many mathematical programs have been developed to perform mathematical calculations correctly, which differ structurally from text editors and graphic editors (such as Matlab, Maple, Mathcad, Mathematica). When needed, mathematical software packages implement these methods:

- The graph of the function is constructed with pre-defined steps of the argument.

- All mathematical software packages have various operations for files created using text and graphic editors, including placement and removal of parts, configuration, as well as informational references.

- All mathematical software packages have various operations for files created using text and graphic editors, including placement and removal of parts, configuration, as well as informational references.

- Mathematical software packages with different uppercase and lowercase letters contain the constants π, e, and i. The identifier Infinity is used to denote limits.

- Operations with arbitrary base numbers are performed in various number systems (from 2 to 36) on real and complex numbers.

- By ensuring the required base, the calculation of integer numbers is carried out with high precision.

- A set of tools for performing various operations with matrices is available in mathematical software packages.

- New generation integrated mathematical systems also utilize symbolic algebra.

Understanding the didactic possibilities in computer teaching can help in selecting the necessary materials to achieve the desired pedagogical effect. There is no single method used in computers. Different programs are based on different theoretical judgments, adapt to different situations, and may have different results. Extensive generalizations in the field of education and recommendation of a single model are ineffective. The best way is to behave according to the situation while using computer in teaching process.

Paragraph 3 epmphasizes the "**Importance of information technology, computer literacy and computer culture in the formation of professional competence of future mathematics teachers".** Computer literacy includes the skills such as having the ability to work on computers and other information devices; minimum knowledge of basic office programs; managing folders and files independently; skills to know the meaning of the main terms of computer science. The acquisition of computer literacy includes: 1) the acquisition of practical computer skills; 2) knowing the basics of programming; 3) having an idea of the operation and principles of the computer device; 4) understanding the role of the computer in human life and applying it in this field.

The methodology of the formation of the teacher's information culture should be based on cognitive theory, modern psychological and pedagogical concept and provide high knowledge through effective dynamics of information. Automated information systems used in teacher training, or rather, automated teaching systems, should be,

above all, a means of improving the quality, expanding and deepening knowledge in the field in which the teacher operates.

Paragraph 4 explains the "**Analysis of the state standard for higher vocational education and the standards for the course of computer science for students of higher pedagogical schools".**

In accordance with the state educational standard, the content of each module is specified by the scientific council of the university. Standards should be set by the Ministry of Education.

An example of the implementation of the program on computer science course based on the state educational standard is given, as well as the program proposed by V.L. Matrosov and S.A.Zhdanov that was reviewed [101].

The main sections are as follows:

1. Introduction. Informatization, its essence and main directions.
2. Informatics as a complex scientific discipline.
3. Basic devices, their purpose and functional principles.
4. Understanding the operating system (OS) and operatingcover.
5. Computer networks. Local and global networks.
6. Internet, principles of construction of internet network.
7. Creation of internet information resources.
8. Basic ideas about modern information technologies.
9. Text editor.
10. Meansof preparation and presentation of graphic information on a personal computer.
11. Database (DB).
12. Integrated information environment.
13. Information and communication technologies in education and training.
14. Modeling.
15. Basics of programming.

A personal computer serves both as a professional tool and a learning resource for aspiring teachers. Consequently, mathematics teachers in the Computer Science course must obtain the following knowledge:

- using software tools when teaching mathematics;
- preparing software for teaching how to solve problems in

mathematics;

- creation of various documents (cards related to tests, tests on paper, graphic lines with mathematical content, spreadsheets, databases);

- creation of mathematical tasks on a computer (equations, systems of equations, etc.);

- creation of presentation educational materials.

Paragraph 5 analyzes "**The literatureof the teaching methodoldogy dealing withh the problem.** This section provides an analysis of the works which are important for our research in our country. Among such researchers A.M.Mammadov, R.Y.Shukurov, I.M.Ibrahimov, S.S.Hamidov, H.Tagiyev, S.A.Zamanova, Sh.A.Hamidova, Z.F.Kazimov, H.T.Novruzova, N.Aliyev, M.Alishov, S.C.Taghiyeva, G.I.Bashirova, A.M.Gasimova, M.A.Hasanova, E.M.Orujova et al. can be shown. The use of these research works from a practical point of view and as a model has not lost its relevance today.

R.Y.Shukurov in his research, explored the impact of computers on students' cognitive activity in the learning process.

S.A.Zamanova conducted research on the theme called "Computers as a means of individualization in teaching mathematics in high school".

Sh.A.Hamidova conducted research work on "Mathematical modeling as the formation of students' knowledge".

S.C.Tagiyeva conducted research on improving the quality of mathematics education by algorithmic methods (grades VII-IX), studied the possibilities of algorithms in problem solving

Z.F.Kazimov in his study "Problems of increasing the effectiveness of cognitive activity of students of higher pedagogical schools in the context of information technology (based on the mathematics course of the Pedagogical Faculty) notes that by using the didactic capabilities of the computer in a pedagogically justified way, it is possible to activate the cognitive activity of students in teaching mathematics at the Faculty of Pedagogy and Methodology of Primary Education of higher pedagogical schools and increase its effectiveness.

S.S.Hamidov in his dissertation on the subject of teaching computers to students of the Higher Pedagogical School (Faculty of

Mathematics) studied various variants of the computer operating system in connection with the inculcation of computer literacy in the Higher Pedagogical School.

A.G.Palangov develops new teaching methods along with traditional methods to increase students' geometric knowledge by developing educational programs that implement computer-student dialogue in the Gbasik language on the geometry course.

The first paragraph of this chapter is devoted to the structure and content of the program on the course of Informatics at the Faculty of Mathematics of the University

Chapter II is called **"Methodical provision of preparation of future mathematics teachers for computer science course".**

The first paragraph of this chapter is devoted to "**The structure and content of the program on the course of Informatics at the Faculty of Mathematics of the University".** The classification of the topics covered along with the program of the course is shown in this chapter as well.

The program of the course consists of the following sections:

- The concept of information concept;
- Hardware and development history of personal computers (PC hardware);
- PC software and their interface (PC software);
- Algorithms, programming, programming languages, models;
- Basics of object-oriented programming;
- Local and global networks. Internet;
- Basics of information security;
- ICT in education

Lectures and practical work should be held on the basis of this program. After learning, future mathematics teachers should have the following knowledge of the Computer Science course:

1. Basic concepts of computer science;
2. Composition of commonly used PCs and devices;
3. Basic principles of algorithms;
4. Instrumental programs. Python programming language;
5. A number of standard programs belonging to MS Windows operating system;

6. Classification and scope of software;
7. MS Word, MS Excel, MS PowerPoint, MS Access programs;
8. Local and global networks. Internet and its possibilities;
9. Trends in the development of computer hardware and software.

In addition to having this knowledge, the future mathematics teacher should also be able to:

1. Connecting various devices to the computer and using it;
2. Drawing algorithm diagrams using a computer, making drawings of geometric and other technical objects;
3. Using standard programs in the MS Windows operating system;
4. Creating educational programs in Python and implementing it;
5. Using MS Word for creation of educational documents (cards, multiple choice answers for independent work and tests, methodical materials, etc.), as well as general documents (service documents, letters, resumes, etc.);
6. Using computing power for graphing functions, graphical solutions of equations and system equations, as well as other learning tasks in the MS Excel application program;
7. Creating and displaying slides as teaching materials in MS PowerPoint;
8. Using the MS Access program to create an educational database;
9. Finding and using educational materials on the Internet;
10. Using electronic equipment designed for education;
11. Create and manage your own course on the Internet.

Paragraph 2 shows "**The practical work on the subject of operating systems and methods of their implementation".** In the Mathematics and Computer Science teaching specialization, the course 'Computer Hardware and Software' is taught for 60 hours (30 lectures, 30 practical sessions). The inclusion of practical work in the course is essential. This section provides practical work on this subject and methods of their implementation.

Practical work №1: Topic: The concept of operating system, the description of the list of files and directories on the screen, the creation

of directories, access to and access to the directory, the classification of the execution of transition commands in the directory.

Practical work №1: Topic: Classification of commands for copying, moving, deleting, and renaming files and folders in the Windows operating system.

Paragraph 3 explains **"THE methodology of preparing and conducting practical work in Excel".** Students majoring in mathematics learn the following MS Office programs and use them in their future careers:

MS Excel is also an important factor in providing Mathematics specialists with practical work in order to form knowledge, skills and habits in order to perform many mathematical calculations, compile tables and diagrams and perform tasks. Section 3 gives some practical work to work in MS Excel.

Practical work №1 Topic: Creating simple formulas and formatting cells in an Excel spreadsheet.

The main purpose of the practical work, explanation and assignments for students were indicated.

Paragraph 4 is called "**Practical Work in Python Programming Language and the ways to it".** Python, an instrumental programming language, is taught in both secondary schools and teacher training universities. One of the main characteristics of this language is that it is a teaching-oriented programming language. This section provides methods for preparing and conducting practical work in Python.

- Practical work №1: Topic: Basic elements of Python language and writing expressions
- Practical work №2: Topic: Linear structured programs.
- Practical work №3: Topic: Branching structured programs
- Practical work №4: Topic: Periodically structured programs.

The main purpose of the practical work, explanation and assignments for students were indicated. The number of practical assignments should be as many as the number of students in the class. Taking into account that the nature of the work is the same and the volume of the dissertation will exceed the required level, we have given the assignments which are 5 in number the dissertation. Similarly, other tasks are given in a section called appendices.

“Organization of pedagogical experiment and analysis of the obtained results”.

Our research was tested through a pedagogical experiment consisting of 3 stages:

- The initial stage of empirical and theoretical research (defining)
- The educational stage of the pedagogical experiment
- Testing stage of pedagogical experiment

The purpose of the first stage of the research which covers the years 2017-2018 and called “The initial stage (empirical) of empirical and theoretical research” isto dertermine the reason for the organization and conduct of practical work on Informatics in the faculties of Mathematics of universities, the essence of the problem and the theoretical and methodological basis for solving this problem.

Favorable conditions for the application of the experiment, the universities to be experimented were identified, experimental and control groups were selected, the levels of students and teachers were provided to be approximately equal in these groups, the level of the groups was studied in written form and orally.

A new methodological system based on effective software tools and their application has been developed for the experiment conducted in the research work on the organization and conduct of practical work on Informatics in the Mathematics faculties of universities.

The universities where the pedagogical experiment was conducted were Ganja State University, Azerbaijan State Pedagogical University, Mathematics faculties of Sumgayit State Universities. Experimental and control groups with generally equal levels by grade were identified by initial inspection.

In the second stage of the pedagogical experiment, which covers the years 2018-2019, the research work was carried out in math faculties on the place, programs, syllabi, textbooks, teaching aids of computer science, information and communication technologies used in training, the study and master of developed methodology on the use of ICT Teaching.

In order to conduct the training in the experimental groups with the proposed methodology, practical work on the topics were prepared in separate groups and a sample scenario of their use was prepared.

Lesson scenario.

The purpose of the lesson:

- To explain to students the importance and function of the concept of variables in the program to implement the solution of mathematical problems on the computer and to develop their knowledge in this field according to the requirements of State Education Standards.

- To form students' knowledge of computer science with the help of mathematical tasks and to motivate students to strengthen theoretical knowledge with the help of practical tasks.

- To cultivate perseverance, struggle and self-confidence in students in order to achieve the final result.

- To develop students' skills to work more freely with modern ICT.

The structure of the lesson.

- Organization of the initial stage of the lesson.

- To form students' knowledge of fixed, variable, standard functions and spelling in Python, spelling of arithmetic expressions, mastery, development of input-output operator.

- To accustom students to the use of variables in both mathematical form and programming.

- Give rules for setting up simple programs involving variables and constants.

First, information about the Python language, language identifiers, operators, then information about the general structure of the program in Python is given.

An example of a question format is as follows:

1. To calculate the volume of a prism base with sides a=5 and b=4, and height is h=11, a program in the Python programming language should be designed and implemented on a computer.

$V=S_{ot}*h$

```
a=float(input("insert one base side of the prism:"))
b= float(input("insert the other base side of the prism:"))
h= float(input("insert the height of the prism:"))
# Calculate the volume of the prism
V=a*b*h
# Print the result
```

Print (“Volume of the prism:”,V)

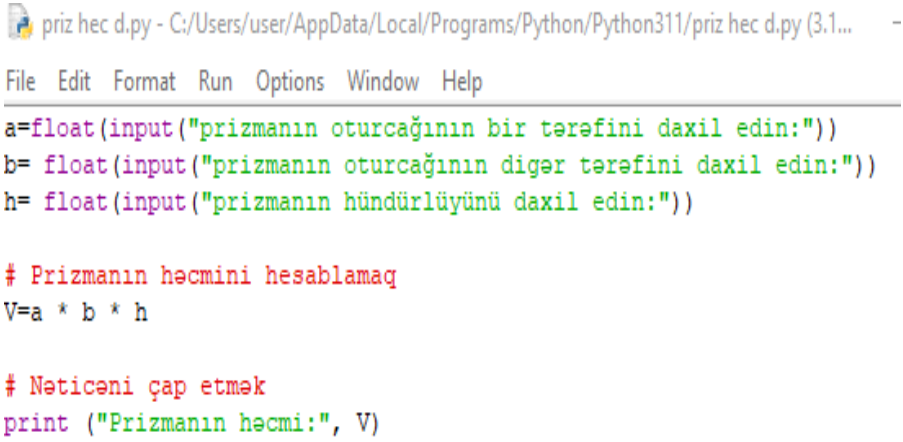

Figure 2.5.1

Enter the height and bases of the prism after issuing the Run command.

>>>insert one base side of the prism: 5

>>>insert the other base side of the prism: 4

>>>insert the height of the prism: 11

Volume of the prism 220.0

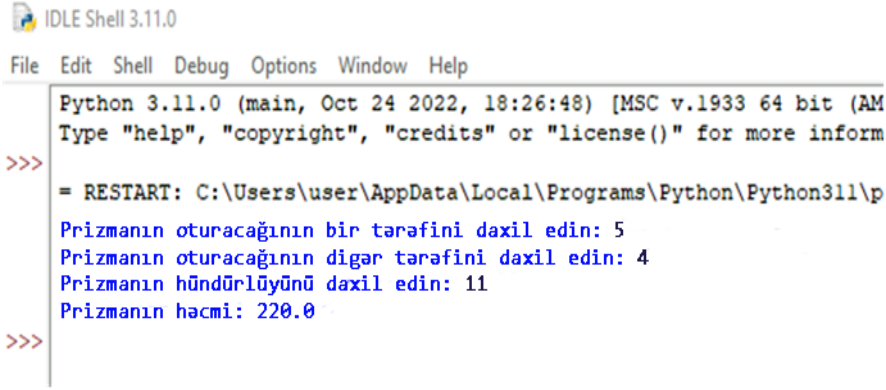

Figure 2.5.2

In the end, students are demanded to prepare a program for

calculating a simple mathematical task and the surfaces and volumes of polynomials which aim at strengthening knowledge.The text of the program is specified with the students. Then the teacher, with the help of the students, sets up the computers and implements the solution.

In the next stage of the lesson, the teacher summarizes the results, analyzes and corrects common mistakes. Student assessment is based on this type of study. Then the teacher concludes the lesson.

After studying the program material involved in the experiment in the third stage of the pedagogical experiment covering 2019-2020, the test material is identified, and test tasks based on the program material are given in both experimental and control groups. The test tasks have been designed according to the content of each practical work. Tests on both MS Windows operating system, Application programs, and Instrumental programming languages have been developed on three topics.

The results of the research are presented in Table 1.

Table 1

Experimental learning	2017-2018	2018-2019	2019-2020	2020-2021
Applications	77%	078%	83%	88%
Instrumental applications	80%	79%	82%	83%
Windows Operating. System	90%	90%	92%	92%

The results in the table are the percentages of the test tasks for all three types of programming. The table shows that the efficiency of teaching has increased every year. The mostnoticeable change is observed in the study of application programs.

Now let's mark it as follows: let's mark the degree of learning of application programs with X_1, the degree of learning of instrumental programs with X_2, the level of learning of operating system with X_3.

Let Y_1 have points in computer science course of 2017-2018 academic year, Y_2 with 2018-2019, Y_3 with 2019-2020 and Y_4 with 2020-2021 academic years.

Correlation coefficients of exam points are calculated using Excel spreadsheet program and Stadio program (by A.P.Kulaichev).

The correlation coefficient for exam points shows the effectiveness of practical work and teaching material in the table below.

Table 2

The efficiency of learning of computer science over the years	Methodical indicator of teaching		
	X_1	X_2	X_3
Y_1	O,208	0,389**	0,454**
Y_2	0,192	0,298*	0,378**
Y_3	0,344**	0,411**	0,422**
Y_4	0,403**	0,452**	0,478**

* P<0,05; **P<0,01

It is clear from the table that all correlation coefficients are positive, most of which are significant enough.

Based on the results of the correlation analysis, it can be said that the organization of trainings using the training materials prepared by us has a high impact on the quality of the lesson. These also appear to be confirmed in Table 3, based on the results of a comparison of all students' learning achievements.

The comparative analysis of the exam scores of the students majoring in computer science teaching for the academic years according to the student criteria were as follows:

Table 3

	Y_1	Y_2	Y_3
Y_2	0,808	-	0,051
Y_3	1, 007	0,009	-

As can be seen from the table, the students worked efficiently throughout the experiment.

Table 4

Levels of mastery of application programs on t-student criteria by years

	$X_{1(2017\text{-}18}$	$X_{1(2018\text{-}19)}$	$X_{1(2019\text{-}20)}$	$X_{1(2020\text{-}21)}$
$X_{1(2017\text{-}18)}$	-	1,26	2,26*	2,98**
$X_{1(2018\text{-}19)}$	-1,26	-	3,01**	3,22**
$X_{1(2019\text{-}20)}$	2,26*	3,01**	-	1,72
$X_{1(2020\text{-}21)}$	2,98**	3,22**	1,72	-

* P<0,05; **P<0,01

It can be seen from Table 4 that with the application of practical work, the level of mastery of office and applied programs has significantly increased in 2017-2021.

The regression method was also used to prove the effectiveness of our methodological approach used in the teaching process. The general form of the regression equation is as follows:

$$Y= a_0 + a_1 * X_1 + a_2 * X_1 + a_3 * X_3$$

Here y is for variable, a for variables and Xi is the answer expressed by predicates. In this case, the indicators of predicates (independent variables) in the Y1-Y4 academic years, which we use for X1-X3, are understood.

As a result of statistical processing of experimental materials, the following four regression equations were obtained using the Stadia statistical package:

$$Y_1= 2,74 + 0,76 * X_1 + 0,33 * X_2 + 0,28 * X_3 \quad (1)$$
$$Y_2= 1,22 + 0,63 * X_1 + 0,62 * X_2 + 0,43 * X_3 \quad (2)$$
$$Y_3 = 3,32 + 0,78 * X_1 + 0,75 * X_2 + 0,47 * X_3 \quad (3)$$
$$Y_4 = 2,04 + 0,86 * X_1 + 0,52 * X_2 + 0,48 * X_3 \quad (4)$$

It appears that all coefficients of the regression equations are positive. This shows a stable, direct relative relationship between response and predictors. Analysis of all equations (1) - (4) shows that this study is successful and important. For calculated coefficients the level is more than 0.05. At the end of the pedagogical experiment, an experimental study was conducted on the basis of an improved methodological system, taking into account all the corrections and additions.

In the course of the experiment, it was also determined that:

a. The organization and implementation of practical work increases the responsibility of students, they become more responsible about the study ;

b. students' interest in the subject increases, they try to engage in more practical tasks;

c. students always come to class prepared, knowing that, as always, their knowledge will be daily tested;

d. we receive information about each student in each lesson, monitor the overall learning dynamics of the group, provide the ne-

cessary assistance;

e. students are more easily aware of new topics than in the previous period, because the previous topics have not been broken, the gaps in their knowledge have been gradually eliminated, so they are better prepared to understand the next topics;

f. time is used efficiently in the learning process, more students are given knowledge in less time, students' idle time is reduced, they are always active.

Thus, the analysis of the results of the experiment shows that the creative work of students of the Faculty of Mathematics serves to increase the mathematical thinking of students, which shows that the proposed methodological system has been quite effective. This proves that the hypothesis put forward in the study is true.

In accordance with the goals and objectives of the study, the following results were obtained:

1) The main essence of the ideas reflected in Chapter I is that the current global changes require the establishment of the education system in our country at the level of today's requirements. All these paths go through scientific and technical progress. If we pay attention to the development of any field of science, the application of new technologies is inevitable. This makes computer science the leading course of the time, because as researchers say, it stimulates the development of other sciences not just itself.

2) Information and communication technologies are needed to actively participate in the labor market, which today requires serious competition. In this situation, the vast majority of work is carried with the help of information and communication technologies. That is why the process of training for the labor market begins in the lower grades of secondary schools, because learning this course in a short time and getting to its subtleties is impossible.

3) The final stage of the labor market preparation process is completed in universities. In this regard, our dissertation meets the requirements of the modern labor market. Higher education institutions train future mathematics teachers, and in order to carry out their professional activities at a high level, they must not only know their profession well, but also have appropriate computer skills. In

order to carry out professional activities with dignity, it is necessary to be constantly acquainted with the updated aspects of information and communication technologies.

4) Computer skills of mathematics teachers should be different from other professions. Thus, they must be able to use programming languages skillfully in the teaching process. Only then the future mathematics teachers will be able to cope with their work.

5) Experimental studies and statistical analysis of the results proved the hypothesis. Practical work accelerates the process of optimizing the content of both computer science and mathematics education, increases students' interest in subjects.

According to our research work, the following proposals have been put forward.

1. The practical work prepared with the help of modern computing tools and peripherals provides the optimization of training and increases the effectiveness of the lesson.

2. Teaching subjects in universities with modern teaching methods is an active process, it should be aimed at democracy, humanism and independence.

3. Preparation and teaching the practical work of informatics in the faculties of mathematics of higher education through creative tasks emphasizes the development of the tasks and objectives of training, the necessary knowledge and skills, students' creative and heuristic creative thinking.

4. It is necessary to develop and apply creative practical work to develop students' logical thinking. This knowledge plays an important role in visualizing-modeling the content of the issue.

Dealing with the content of the dissertation, the following articles were published in the periodicals recommended by the EAC, and reports were made at international and national scientific-methodological conference:

1. Babayeva S.R. The need for new information technologies in higher education. Azerbaijan State Pedagogical University. Journal of ICT in Education № 4, 2017. p. 161-166. (ISBN-2522-4298)

2. Babayeva S.R. General idea about computer mathematical systems and ways of its application. Transactions of Pedagogical

University № 1 2018, p. 18-23 (ISSN 2520-2049)

3. Babayeva S.R. Problems of application of new information technologies in universities. Transactions of Pedagogical University № 2 2018, p 9-15 (ISSN 2520-2049)

4. Babayeva S.R. On the importance of new information technologies in the development of modern education. Institute of Education. Scientific News № 3 2018, p 212-215 (ISSN 2409-8817)

5. Babayeva S.R. Promethean boards and its use in laboratory classes Ganja State University. III International Scientific Conference of Young Scientists. Conference materials. October 17-18, 2018. p. 182-185.

6. Babayeva S.R. Methods of preparing and conducting practical work in MS Excel. Materials of the XXIII Republican scientific conference of doctoral students and young researchers. 2019, 03-04 December

7. Babayeva S.R. Distance education platform-moodle system for distance organization of computer science lessons in universities, technology of creating courses and lessons in this system. Institute of Education. Scientific works №4. 2019, p.100-105. (ISSN 2409-8817)

8. Babayeva S.R. Psychological, pedagogical and methodological aspects of the use of computers in the professional activities of mathematics teachers Ganja State University. Scientific news- № 1. 2020, p. 132-135.

9. Babayeva S.R. The importance of information culture in the professional training of future teachers of mathematics. Collection of articles on the materials of the XXVII International Scientific-Practical Conference) № 9 (27) 2019, p. 18-22 (ISSN 2541-9862)

10. Babayeva S.R. Software used in the development and improvement of the educational process. Spirit time journal № 4 (16), Berlin 2019, p. 30-34 (ISSN 2522-9923)

11. Babayeva S.R. Formation of knowledge on computer science in students studying in pedagogical universities. Collection of reports of the I International scientific-practical conference, Vladikavkaz 2020, p. 30-33 (ISBN 978-5-9500071-9-4)

12. Babaeva.S.R. On the formation of skills to work with electronic boards in students of universities, trained in the specialty of a

teacher of mathematics. International scientific-research journal №6 (75) / part 3Moscow 2020.

13. Бабаева С.Р. Программные средства, используемые при изучении информатики студентами вузов. MODERN HUMANITIES SUCCESS/УСПЕХИ ГУМАНИТАРНЫХ НАУК, журнал № 5. Москва 2024, стр. 150-155 (ISSN 2618-7175)

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