REPUBLIC OF AZERBAIJAN

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THEORY AND PRACTICE OF TEACHING ALGEBRA IN HIGHER PEDAGOGICAL SCHOOLS

Proficiency: 5801.01 – Theory and methodology of education and teaching (mathematics instruction methodology)

Field of science: Pedagogy

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ABSTRACT

of the dissertation

for the Degree of Doctor of Science

Nakhchivan – 2024

The work was performed at Nakhchivan State University.

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BED 2.40/1 One-time dissertation council formed on the basis of the Dissertation Council - FD 2.40 operating at Nakhchivan Teachers Institute of the Supreme Attestation Commission under the President of the Republic of Azerbaijan

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GENERAL CHARACTERISTICS OF THE STUDY

Relevance of the topic and degree of elaboration. After regaining its independence, our country began to implement educational reforms, which include fundamental changes in the education system, including the higher education system. Transition to a multi-level education system, successive structural changes in the higher education system, distinction between bachelor's and master's degrees and others brought about serious innovations in the curricula and programs belonging to traditional education. All this has led to the emergence of a number of scientific-methodical problems, which are waiting to be solved, related to the teaching of mathematical subjects, including the algebra course, in higher pedagogical schools. These can be broadly grouped as follows:

1. Methodological problems arising from the New Education Reform itself and the demands caused by the innovation it brings. After the Azerbaijan Education System joined the Bologna process, the training activities implemented on the basis of the New Education Program acquired a new content. Now, in almost all classes of general education schools, subjects are taught on the basis of subject curricula (educational programs). Development of new subject curricula and implementation of training based on them in higher schools, including higher pedagogical schools, is considered an important task. Accordingly, in the training of specialized subjects, content lines should be prepared first, and appropriate standards and sub-standards of training should be developed based on these content lines.

2. Problems caused by the structural changes in the curricula in connection with the transition to the New Education System. In the curricula of mathematics majors in accordance with the New Education System of higher pedagogic schools, unlike the curricula of the previous educational system, subjects such as "Higher Algebra", "Linear Algebra", "Number Theory", "Numerical Systems" are not taught separately. The course called "Algebra and number theory" and now "Algebra" is taught, which includes their necessary elements. In the teaching of a modern algebra course, the elements of the abstract algebra course form the foundation of the basic course. Along with all

this, the number of teaching hours allocated to the training of the algebra course was significantly reduced compared to the total number of training hours allocated to the teaching of the subjects that make up its content[1]. As a result, there were many issues awaiting resolution related to the development of the scientific methodical system in the training of the new algebra course.

3. The problems arising from the necessity and demand of bringing the important fundamental scientific results obtained in the scientific researches that condition the development of the science of algebra to the teaching methodical literature in this field. Starting from the middle of the 20th century, the published results of the researches of mathematicians united under the pseudonym "Burbaki" in France formed a new view of mathematics. It should be noted that mathematics is a unified science and its basis is the theory of sets and various structures included with these sets. In various mathematical theories, elements that remain invariant to a certain group of transformations, various mathematical structures are studied. Algebra is a mathematical science that studies algebraic structures. Since the 60s of the last century, the important cases of algebraic structures have been taught in European secondary schools.[2] In the former Soviet Union, since that period, the scientific-methodical issues of studying the elements of the group, which is an important type of algebraic structure, have been studied in secondary schools.[3] Thus, teaching abstract algebra elements in the algebra course of higher pedagogical schools has become a necessity. It is already expected that concepts of algebra such as generalized categories, functors and scientific ideas related to them, broader mathematical information related to algebraic

[1] Baxşəliyev Y.R. Universitetlərin riyaziyyat fakültələrində riyaziyyatın nəzəri məsələlərinin cəbri strukturlar əsasında təlimi. Ped.elm. dok....dis. avtoref. – Bakı, – 2009, – 40 s.

[2] Одинцов П.К. Вопросы алгебры в программах и учебниках по математике гимназии –Нешатель (Швейцария) // Математика в школе, –1969, № 4, – с. 91-93

[3] Рафикова Ф.М. Изучение элементов теории групы в средней школе. – М.: Изд-во МГПУ, –1972, –132 с.

structure, will be included in the program of the algebra course. As a result of all this, many methodical, psychological and pedagogical issues related to the teaching of the algebra course in higher pedagogical schools appear and it is necessary to solve them.

4. Problems related to the lack of practical workbooks and their compatibility with the literature reflecting the theoretical materials in the background of renewal and deepening of the theoretical teaching material in algebra. The changes made in the content and structure of the algebra course program prompt the development of new textbooks and teaching aids in accordance with them. Any textbooks and teaching aids are fundamentally different from those that have existed before. It should be noted that even if the content of the program has not changed, but only the structure has changed, the selection of appropriate sums from the existing teaching materials for practical exercises, as well as in updating the lecture material, causes certain difficulties. As a result, there is a need to compile new programs and textbooks for practical exercises in algebra. As a result of this request, in the 80s and 90s of the last century, sums books were published in Russian edited by A.I. Kostrikin[4], co-authored by L.B. Shneperman[5], L.Y. Kulikov,[6] A.I. Mockalenko and A.A. Fomin. In the current era, using these sums books, selecting and systematizing the sums to be taught to students in practical exercises in the algebra course, determining the functions of the studies to be solved and determining the main lines and methods for solving them are issues that create serious methodological difficulties.

5. Methodological and pedagogical-psychological problems arising from the differences between the content and requirements of the mathematics test tasks used in the student admission process in higher pedagogical schools and the requirements for the training of the

[4] Сборник задач по алгебре / Под редак. А.И.Кострикина. – М.: Факториал, – 1995, – 454 с.

[5] Шнеперман Л.Б.Сборник задач по алгебре и теории чисел / Учеб. пособие для физ. мат. факультетов пед ин–тов. Минск: Выш. школа, – 1982, – 225 с.

[6] Куликов Л.Я., Москаленко А.И., Фомин А.А. Сборник задач по алгебре и теории чисел. –М.: Просвещение, – 1993, – 288 с.

algebra course. Starting from 1992, the selection of students for higher and secondary specialized schools in our Republic is carried out by means of test exams. In recent times, the semester exams in a number of universities continue to be conducted using the test method.

At the moment, there is no alternative to the test procedure for student selection to higher schools. However, at the same time, conducting student admissions, especially semester exams, by the test method leads to the emergence of a number of defects. So, most of the students are trained with a "tutor-teacher" for an additional 2-3 years outside of school. The success of the training in the preparation based on the "test bank" is mainly based on the memory factor of the listeners. As a result, the majority of students admitted to higher schools have certain problems in the development of mathematical thinking, logical expression of their thoughts, systematic understanding of the algebra course, and development of creative abilities. Also, conducting semester exams using the test method hardly creates an incentive for in-depth assimilation of theoretical material. The fact that mathematical problems requiring the fulfillment of complex procedural rules are left out of the test shows a more negative effect on the effective teaching of the algebra course.

The scientific and methodical problems we have listed show that, as in the teaching of mathematics in general education schools, certain scientific and methodical problems arise in the teaching of mathematics courses in higher schools, and their timely solution and elimination is a very important issue.

Searching for solutions to the above-mentioned scientific and methodical problems in the teaching of the algebra course, the lack of studies related to the teaching of the algebra course, and the need to establish a methodical system for the training of the algebra course show the **relevance** and importance of our research and the dissertation work that is intended to be studied.

Pedagogical-psychological and general didactic issues of training in higher schools are relatively widely covered in methodical literature. The prominent pedagogues and psychologists of Azerbaijan, A.A.Alizadeh, A.S.Bayramov, B.A.Ahmadov, H.M.Ahmadov, N.M.Kazimov, B.Y.Bashirov, F.A.Rustamov,

T.Y.Dadashova, M.A.Ismikhanov, R.A.Bakhtiyarova and others have valuable scientific works written related to pedagogical-psychological issues of higher education.

In the works of S.I.Arkhangelskiy, V.V.Davydov, P.Y.Galperin, N.F.Talizina, A.I.Sherbakov, V.A.Slasten, one of the Russian psychologists and pedagogues in that field, the problems related to teacher training and the formation of pedagogical mastery during the period of its preparation in pedagogical schools are reflected.

The issues of teaching mathematics in higher schools have been less studied compared to the psychological and pedagogical issues of teaching and learning mathematics in secondary schools. In this direction, Academician L.D.Kudryavtsev's "Modern mathematics and its teaching"[7], Prof. M.V.Pototsky's "Teaching of higher mathematics in pedagogical institutes"[8], Academician B.V.Gnedenko's "Mathematical education in higher schools"[9], M.R.Kuvayev's "Methodology of teaching mathematics in higher schools"[10], etc. his works are very precious and valuable from a scientific-methodical point of view.

Scientific methodical researches related to teaching of mathematics in higher schools were mainly conducted in two directions:

1) Issues of improving the training of high-level personnel in professional, scientific and practical directions. In this direction, the scientific research works of Russian scientists S.I.Arkhangelskiy, V.V.Afanasyev, S.S.Zorin, V.V.Gusev, Y.M.Kolyagin, G.L.Lukankin, A.G.Mordkovich, Y.I.Grudenov, Georgian scientist V.N.Kelbakiani, Belarusian scientist I.A.Novik, as well as Azerbaijani

[7] Кудрявцев Л. Д. Современная математика и ее преподования. –М.: Наука, i9–1980, –143 с.

[8] Потоцкий М.В. Преподавание высшей математики в педагогическом институте. –М.: Просвещение, –1975, –208 с.

[9] Гнеденко Б.В. Математическое образование в вузах. М.: Высшая школа, 1981, 174 с.

[10] Куваев М.Р. Методика преподавания математики в вузе.Томск, Изд–во Томского университета, –1990, –390 с.

pedagogic scientists S.S.Hamidov, A.S.Adigozalov, M.C.Mahmudov, G.R.Baylarov and others can be mentioned.

2) Scientific-methodical issues directly related to the teaching of taught mathematics subjects. As an example of the work done in this direction, professor, doctor of pedagogical sciences R.M.Aslanov's doctoral dissertation on the study of the methodical system for teaching differential equations[11] and docent, PhD in mathematics, H.A.Mammadov's monograph "Mathematical analysis teaching methodology"[12] for pedagogically oriented higher schools, etc. we can show. Research on the teaching of algebra is scarce.

N.N.Ryjova's candidate dissertation[13] is dedicated to the contents, forms and methods of their implementation of the professional and methodical training of future mathematics teachers in the selected specialty courses and specialty seminars in the study of algebra and number theory. In docent, Phd in mathematics, Sh.S.Abdullayev's dissertation[14], the issues of formation of algebraic knowledge of mathematics faculty students of pedagogical institutes were studied. Associate Professor of ASPU, Doctor of Pedagogical Sciences Y.R.Bakhshaliyev's doctoral dissertation[15] is related to the study of the problems related to the teaching of theoretical issues of mathematics based on algebraic structures, etc.

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[11] Асланов Р.М. Методическая система обучения дифференциальным уравнением в педвузе: Автореф.дис....докт.пед. наука. – Москва, – 1997, – 36 с.

[12] Məmmədov H.Ə. Riyazi analizin tədrisi metodikası. – Bakı: ADPU nəşriyyatı, –2002.–392 s.

[13] Рыжова Н.Н. Взаимосвязь специальной и методической подготовки при изучении алгебры и теории чисел в педагогическом институте. Дис. ... канд.пед.наук. – Самара, – 1994, – 170 с.

[14] Abdullayev Ş.S.Pedaqoji İnstitut tələbələrinin cəbri biliklərinin formalaşdırılması. (Çoxhədlilər cəbri üzrə) ped.elm.nam....dis. avtoreferatı. – Bakı: ADPU, – 1994, – 20 s.

[15] Baxşəliyev Y.R. Universitetlərin riyaziyyat fakültələrində riyaziyyatın nəzəri məsələlərinin cəbri strukturlar əsasında təlimi. Ped. elm. dok.dis. avtoref. –Bakı; –2009,– 40 s.

The object of the research is the teaching process of the algebra course in mathematics majors (undergraduate) of higher pedagogical schools.

The subject of the research is the theoretical and methodical problems of teaching the algebra course in mathematics majors of higher pedagogical schools.

The purpose and tasks of the research. It is to define a scientific-theoretical, pedagogical-psychological, methodologically fully justified methodical system that serves to raise the level of algebra course teaching in mathematics majors of higher pedagogical schools.

The hypothesis of the study is that the teaching of the algebra course in the mathematics majors of the higher pedagogical schools with a defined methodical system can lead to effective mathematical results in the teaching of the algebra course.

The hypothesis of the research is based on such a planning that the determination of the methodological features of teaching the algebra course in multi-level higher pedagogical education, the realization and the design of the realization model on this basis, is like the process of formation of professional competences in mathematics. This will create an opportunity to fully implement the professional training of graduates in accordance with modern standards due to the full use of all opportunities in the multi-level higher vocational education system in higher pedagogical schools. The training process requires mobility, flexibility, use of time resources, students' initiative, addressability, etc. distinguished by its positive features, innovative methodical approaches and convenient methods of solving professional problems will be used in the training of the algebra course.

In accordance with the purpose of the dissertation and the proposed hypothesis, the research faces the following **tasks:**

1) To determine the main mathematical development trends in modern education and problems in teaching mathematical subjects, including algebra, in higher pedagogical schools;

2) To determine the place of the algebra course in the multi-level higher pedagogical education system;

3) To determine the methodical basis of teaching the algebra course in the multi-level higher pedagogical education system and to prepare the project of the model to realize it in the modern higher pedagogical education;

4) To prepare a complex of professional tasks for the algebra course in the relevant directions, to ensure the development of mathematical professional competence for bachelors and masters;

5) To test the effectiveness of the formation of the methodical bases of teaching the algebra course in the multi-level higher pedagogical education system, as well as the designed model of its methodical bases using an experimental method;

6) To learn ways to solve educational problems determined from philosophical, pedagogical-psychological, methodical literatures and higher pedagogical school experience;

7) Develop a new excellent educational program for the Algebra course;

8) To develop the practical and theoretical basis of determining intra-subject relations in the new algebra course;

9) Theoretically prepare interdisciplinary issues in algebra course;

10) Elaborate the method of regularly teaching students the determined intra-disciplinary and inter-disciplinary relations;

11) To connect the type of problems selected for practical exercises on the algebra course, the requirements given to them and the methods of solving them with the content of a short, suitable lecture exercise;

12) To fully investigate the theoretical issues of teaching the elements of the algebra course - abstract algebra, linear algebra and algebra of polynomials;

13) To study the general methodological features of the elective subject called "Basics of Fuzzy Algebra" and issues related to the algebra course;

14) To develop the methodology of using the capabilities of the MATLAB program in the teaching of the algebra course of the higher pedagogical school.

The scientific-methodological basis of the research is the set of theoretical provisions, methods and tools applied for the purpose of understanding and changing pedagogical facts, events and processes.

Research methods:

- General theoretical (analysis of scientific literature, concept-terminological system, normative-program documents; modeling);
- Empirical (pedagogical observation, survey, testing, experimental work);
- Quantitative and qualitative analysis of interpretation and mathematical results;
- Carrying out a complete analysis of algebra course topics in normative documents - state standards, educational plans and programs;
- Analysis of teaching experiences of algebra course in higher pedagogical schools, including personal experience;
- Analysis of philosophical, psychological-pedagogical, mathematical, methodical literature and textbooks to study the primary sources of the research topic.

The **provisions** presented for defense in the research work carried out are as follows:

1) A new teaching program, educational program (curriculum) has been developed for the algebra course;

2) Selection of algebraic problems to be studied in practical exercises on the algebra course from textbooks, recommended algebraic problems and the general direction of their solution are defined;

3) Pedagogical-psychological foundations of algebra course training were studied, the construction of the course based on the concept of abstract elements of algebra was fully studied;

4) Ways of studying intra-disciplinary relations in the algebra course were developed, interdisciplinary relations were determined in the training of elements of linear algebra;

5) The program of the optional subject called "Basics of Fuzzy Algebra" was developed, and its effect on the formation and generalization of the basic concepts in the algebra course was studied;

6) The mathematical creativity of students was checked, the role of practical (seminar) exercises in algebra was studied in the formation and development of creative abilities;

7) The teaching technologies used in the teaching of the algebra course have been fully investigated;

8) The methodology of performing operations on vectors and matrices in the Matlab program was studied;

9) The proposed realization model of the methodical features of the training of the algebra course (maintaining the professional training potential corresponding to the specialty as an adaptive mechanism and forming professional competence from mathematics to a new level - master's level) shows the positive dynamics of mathematical professional competence.

Scientific novelty of the research. The ways and means of intra-disciplinary relations are practically studied in the teaching of the algebra course in the mathematics majors of the higher pedagogical schools. The development of new teaching and learning programs for the algebra course, as well as the program, structure and structure of the elective "Basics of Fuzzy Algebra" and its role in the effectiveness of teaching the algebra course are given. The importance of practical exercises of algebra and the role of ICT in the formation of students' mathematical creative abilities are determined.

The theoretical significance of the research is that, as a result of the analysis of pedagogical-psychological literature, textbooks, teaching and methodical materials, various experiences and personal experience, the theoretical issues of teaching in increasing the knowledge, skills and habits of the students studying in the mathematics majors of the higher pedagogical schools related to the algebra course, increasing the efficiency of the training is fully studied.

Practical significance of research. Task cases were used as a learning tool (as one of the pedagogical conditions) during the algebra course during the professional training of students. Through this, the nature and scope of students' mathematical abilities, which are important in various directions of professional activity, are determined.

Algorithm for the compilation of algebra course cases in the database of professional tasks adapted to the multi-level higher pedagogical education system (bachelor's, master's) is proposed. It was determined that the existing task cases greatly help the rapid development of individual abilities, students' independence, creative thinking, critical thinking, and the formation of mathematical competence, taking into account the specific professional direction of training.

Approval and application. In connection with a number of topics related to the dissertation work, the "General mathematics" department of Nakhchivan State University (NSU) and the "Methodology of teaching subjects and technology teaching" department, and in addition, "Mathematics and teaching methodology" of Nakhchivan Teachers Institute (NTI), Reports and discussions were held at joint seminars of "Higher mathematics and informatics" departments.

The main essence and provisions of the dissertation work were presented in four significant scientific-practical conferences, three international scientific conferences, two international congresses and two international symposiums, thirty-four articles were published in the magazines recommended by the Higher Attestation Commission and reflected comprehensively.

Increasing the efficiency of training in lectures and practical (seminar) classes related to the algebra course of higher pedagogical schools, in teaching-methodical research, in the preparation of textbooks and teaching aids related to algebra, methodological instructions and recommendations for teachers related to the methodology of teaching mathematics, in the work experience of teachers, teaching algebra in higher pedagogical schools it is expected to be theoretically and practically important in improving its content.

The name of the organization where the dissertation work was performed: Nakhchivan State University (NSU). The subject of the dissertation was discussed at the meeting of the Scientific Council of NSU on November 4, 2009 and at the meeting of the Scientific Council for Pedagogy and Psychology of the Republican Scientific

Research Coordination Council on May 16, 2018 and approved with partial changes.

The total volume of the dissertation with a mark. Dissertation work consists of table of contents, introduction, four chapters, pedagogical experiment, conclusion and list of used literature. The total volume of the dissertation is 402685 marks. So, the title page and table of contents - 5908, introduction - 26965, first chapter - 150988, second chapter - 102421, third chapter - 65199, fourth chapter - 46128 and conclusion - 5076 characters.

The bibliographic material is 200 titles.

THE MAIN CONTENT OF THE DISSERTATION

In the introduction of the work, the relevance of solving the scientific-methodical problems arising in the teaching of the algebra course taught in the mathematics majors of higher pedagogical schools in connection with the implementation of educational reforms in our Republic is justified, the purpose, object, premise, hypothesis, tasks and methods of the research are expressed, its scientific innovation, theoretical and practical importance is shown.

Chapter I is called "The modern state of algebra course teaching in higher pedagogic schools and its implementation in the New Education Program". In the first paragraph entitled "Theoretical and methodological foundations of algebra course teaching in higher pedagogic schools", the structure of the algebra course and the characteristic aspect of the teaching methodologies of the directions it contains were investigated.

Starting from the 70s of the 20th century, the courses "Theory of Numbers" and "Systems of Numbers" were removed from the curriculum, and their necessary elements, together with the elements of linear algebra and algebra of polynomials, were first taught in the course called "Algebra and Number Theory" and then in the course called "Algebra". .

Algebra course plays an important and significant role in the process of mathematization observed in various fields of science in connection with the modern state of scientific and technical progress.

Thus, such "algebraization" begins to take place in mathematical theories themselves. Teaching the elements of abstract algebra is of great importance in connection with generalization and abstraction.

"Abstract algebra" means the branch of mathematical science that studies algebraic structures (semigroup, group, algebra, ring, square, vector space). Currently, it is planned to teach the elements of abstract algebra in the algebra course.

In our opinion, it is more appropriate to give abstract algebra elements at the beginning of the modern algebra course, unlike previous algebra courses. In the algebra course built according to this rule, the abstract algebraic elements form the trunk of the "algebra tree". After the concepts of relation, algebraic action, algebraic structure and algebraic system are given and the necessary mathematical information related to them is studied, their special cases, group, ring, square, vector space divisions are studied.

The issues studied in the ring section are the main elements of the natural number system, the ring of integers, and the numerical systems. In the "branch" of the ring of integers, the main issues related to the division relation of number theory, comparisons and the solution of univariate comparisons are located.

Rational numbers, real numbers and squares of complex numbers are studied in connection with the fundamental concept of algebraic structure called "square". Although the indicated sections are the main sections of the discipline of numerical systems, they are connected to the "body" of abstract algebra and are studied on the basis of it.

One of the branches (divisions of the algebraic structure) from the "trunk" of abstract algebra is the vector space over a given square. This is the basic concept of the linear algebra section of the algebra course, which has very wide applications. And the algebra of polynomials belongs to the ring branch, which is a simple or repeated transcendental extension of a commutative ring.

Giving the structure of the algebra course in the manner described above clearly reveals a number of its positive aspects:

1) After studying the elements of abstract algebra in the general case, when studying the special cases, these elements are once again deeply studied and fully mastered.

2) The presentation of abstract algebraic elements at the beginning of the algebra course and its research from the general to the specific principle has a great impact on the unified interpretation of the studied topics and the systematic presentation of algebraic material.

3) Strictly mathematical justification of the algebra course based on the elements of abstract algebra gives a strong impetus to the discovery and compilation of intra-subject relationships.

4) As it is known from the history of the creation and development of mathematics, each set of natural, complete, rational, real and complex numbers contains any of the previous sets. In other words, each set is expanded according to a certain rule to create the next set. Based on the elements of abstract algebra, it is determined that one of the numerical systems is obtained as a result of the expansion of the other by a certain rule. For example, the square of real numbers is a linearly ordered complete square; the field of complex numbers is the complex extension of the field of real numbers; A ring of integers is a minimal extension of the semi ring of natural numbers that contains it such that addition and multiplication operations in this extension are continuations of addition and multiplication operations in the semi ring of natural numbers.

5) The system of properties defining the algebraic structure, the type of the algebra, the basic set defining the algebra, and the basic operations together determine the type of the algebra.

The following main specific aspects should be noted in the teaching of abstract algebra elements:

1) After giving the algebraic structure, algebraic structures of the same type, morphisms of algebraic structures (homomorphism, epimorphism, monomorphism, isomorphism, endomorphism, automorphism) are given. An algebraic structure differs from a set in that it is a set provided by actions. Morphisms, on the other hand, differ from reflection in that they retain operations in an algebraic structure. Thus, when proving various properties here, the proof process is performed everywhere by a general rule.

2) Subset and factor-set concepts are generalized for algebraic structures, and sub-algebra, factor-algebra concepts and properties related to them are widely studied.

3) The concepts of group, ring, square, space, subgroup, subring, subfield, subspace, factor-group, factor-ring, factor-square, factor-space, which are special cases of algebraic structures, are introduced following the given principle. It should be noted that the factor-area and factor-space sections are not taught in the algebra course in mathematics majors of higher pedagogical schools.

4) Procedural rules applied in the study of algebraic structures include group, ring, etc. in special cases like

5) The decision of the abstract elements of algebra in the basis of the algebra course has a serious effect on the dominance of the principle of scientific character in the teaching of the course.

In this paragraph, which is given a brief explanation, the existence of some conditional agreements in mathematics is brought to attention and its essence is explained. The axiomatic method is one of the important methods and the basis for building a mathematical theory seriously and systematically. The content of this method, which is based on the principle of systematic character and consistency of training, is that certain mathematical concepts that are considered as the first (beginning) are given and they are called basic concepts. Also, the main relationships related to those concepts, which are not defined, are also shown here. Certain mathematical propositions expressing the properties of basic concepts and basic relations are accepted as unprovable and are called axiomatic system. Based on the main concepts and axioms, further concepts of the theory are created, the propositions put forward are taken through logical reasoning and rigorously proven.

In spite of what has been said, some conventional agreements are also found in order to maintain generality and simplify the interpretation in the concepts and justifications given in the teaching of mathematics. When accepting these conditional agreements, care is taken that they do not lead to propositions that contradict the results obtained in the established theory and fully agree with the provisions of the general theory [22].

Note that a number of conditional agreements are of particular importance in the course of linear algebra. Paying special attention to them is, in our opinion, one of the most important issues in teaching

algebra. Thus, the clarification and special emphasis of conditional agreements by the teacher during the training process is one of the very important factors that affect the in-depth study of mathematical material by students and the development of their mathematical thinking.

The second paragraph of the first chapter of the dissertation is called "Setting the content, goals and tasks of algebra course teaching in higher pedagogical schools in the New Education Program". In this paragraph, the programs related to the algebra course were first analyzed. For this purpose, the program of the "Algebra and Number Theory" subject published in 1971 of API[16], and the "Algebra" subject syllabus[17] for the bachelor's training of ASPU compiled in 2014 were comparatively analyzed.

The analysis of the programs showed that there are three trends in their updating:

1) Removal of a number of topics;

2) Making changes in the sequence of teaching some concepts, mathematical proposals and elements, taking into account methodological nuances;

3) Broader inclusion of abstract algebraic elements and explanation of traditional topics of algebra on the basis of abstract algebraic elements.

Along with these, topics that were present in the previous programs of the algebra course, but not intended to be taught in the latest programs, were shown.

It should be noted that the differences in the curricula of the "Mathematics Teaching" and "Mathematics and Informatics Teaching" specialties in the higher schools in the Republic of Azerbaijan have contributed to the diversity of the courses' educational programs. Although this situation is not considered positive (in our

[16] Pedaqoji institutlar üçün proqram /Cəbr və ədədlər nəzəriyyəsi. (2104 №-li "Riyaziyyat" ixtisasları üçün), Moskva nəşrindən tərcümə edilmişdir. /(Tərcümə edəni: Y.R.Baxşəliyev. – Bakı: APİ, – 1971, –11 s.

[17] Pedaqoji universitetlərdə bakalavr hazırlığı üçün proqram. "Cəbr" fənninin proqrqamı / Tərtib edənlər: L.Ş.Əbdülkərimli, H.A.Əkbərova, Ş.S.Abdullayev. – Bakı: ADPU, – 2014, – 26 s.

opinion), it is also reflected in the educational programs of three higher schools operating in Nakhchivan. Taking this into account, the author working at Nakhchivan State University has prepared an author's program from the algebra course.

Serious changes in the content and structure of the algebra program require the preparation of new textbooks and teaching aids. These textbooks and study materials must be fundamentally different from previously available teaching materials. As a result, there is a need to compile problem and example books from algebra in accordance with the programs and textbooks on practical exercises. It should be noted that even if the content of the program has not changed, but only the structure has changed, the selection of problems and examples from the existing teaching materials related to algebra for practical exercises, as in the lecture, creates certain difficulties for teachers.

In the 80s and 90s of the 20th century, in accordance with the new curriculum of algebra, the collections of problems and examples compiled by L.B.Shneperman and also L.Y.Kulikov, A.I.Mockalenko, A.A.Fomin (see p.5) are intended for mathematics majors of pedagogical institutes. The collection of problems and examples published under the editorship of A.I. Kostrikin was also developed for mathematics majors of universities and pedagogical institutes (see p.5). Due to the structure of the textbooks prepared by L.B.Shneperman and edited by A.I.Kostrikin, they are not completely compatible with the textbooks written on the basis of the current mathematics program of pedagogical profile higher schools. The book of problems and examples compiled by L.Y.Kulikov, A.I.Moskalenko, and A.A.Fomin corresponds to the "Algebra course" textbook[18] written for students of mathematics majors of pedagogical universities. However, it also has some methodological flaws. The problem and example book focuses on exploring concepts and ideas and reinforcing and testing their mastery. Computational problems and examples that require a lot of time and labor to solve, especially by

[18] Baxşəliyev Y.R., Əbdülkərimli L.Ş. Cəbr kursu (dərslik). – Bakı: Elm və Təhsil, – 2011, – 448 s.

performing many mathematical transformations, are given relatively little space here. Also, there are few mathematical tasks that serve the systematic formation of knowledge, skills and habits of a training nature.

Taking these into account, practical exercises on the algebra course are recommended in the paragraph, indicating the learning objectives, suitable literature and study numbers for each exercise topic. One or more workbooks are shown for each practical exercise. The purpose of offering additional questions besides the necessary basic questions is to form students' mathematical creative abilities and encourage them to pursue scientific research.

At the end of the second paragraph of the first chapter, the training program (curriculum) of the algebra course developed by the dissertation author for the "Mathematics teaching" and "Mathematics and informatics teaching" specialties of higher pedagogical schools is explained and justified [37].

In this work, the learning results of the full course of algebra on general and content lines, and then the learning results and content standards for semesters (I - IV) are interpreted.

The third paragraph of the first chapter is called "Psychological-pedagogical aspects of algebra course teaching in higher pedagogical schools". Issues of psychological-pedagogical tasks in the teaching of mathematics in general education schools have been widely studied, and important scientific research works related to the psychological-pedagogical foundations of mathematics education have been carried out. In this direction, V.A.Gusev, L.I.Slepkan, L.M.Fridman, V.V.Davydov, O.C.Medvedeva, M.B.Pototsky, H.F.Talizina and others. has very useful scientific works.

It should be noted that the psychological-pedagogical issues of teaching mathematics, including the algebra course, have not been fundamentally and fully studied in higher pedagogical schools. In this paragraph, attention is paid to some psychological-pedagogical aspects of algebra course training in higher pedagogical schools [39].

Until independence in the Republic of Azerbaijan, the programs, methodical materials, textbooks and textbooks related to the teaching of mathematics were mainly translated from relevant literature in the

Russian language. As a result of not paying serious attention to the differences in the grammars of the Russian and Azerbaijani languages, in some cases vague expressions appeared in writing, speaking and explanations. This, in turn, lowered the quality and efficiency of mathematics education. It prevented pupils and students from mastering the material and reduced their interest in the subject. This aspect was particularly evident when defining concepts and proving mathematical propositions. Observations show that focusing on the schematic explanation of the definitions of concepts and the proof of mathematical propositions has a positive effect on the perception and understanding of concepts and propositions [5].

The role and importance of using previous mathematical concepts in the mastering of abstract mathematical concepts and relationships, the causes of some mathematical misunderstandings and the ways to eliminate them were investigated [24,28]. As a result of abstraction, new approaches and views of mathematical concepts and relationships emerge. At the same time, the visual intuitive ideas related to those concepts and relationships, as well as the corresponding elements of the informally given theory before abstraction, retain their essence. They are used covertly or overtly in the abstraction process. In this process, it is necessary to pay attention to two aspects:

1) Visual-intuitive concepts and elements of informal theory can be used as interpretations of abstract concepts and relationships. In this case, it becomes easier to grasp and understand the elements of the abstract theory, and the students' activity in the learning process increases.

2) In serious formal mathematical deductions, referring to visual-intuitive ideas, results of informal theory, the seriousness of the proof is violated, and in a number of cases, doubts arise about the correctness of the results.

Students have knowledge of natural, complete, rational, real, complex numbers and polynomials based on visual-intuitive ideas and appropriate informal theories from school mathematics. Those concepts and knowledge are expanded and deepened in the algebra course. At this time, it is necessary to pay attention to understanding the organic connection between the serious (formal) theory and the

elementary (informal) theory in order to grasp and remember the attitudes, actions and ideas in the mathematical theory that is strictly established. Such a methodological approach includes the system of natural numbers and the ring of integers, the field of ratios and the field of rational numbers of the domain of completeness, the linear polynomial of t over the given area and the field of complex numbers, the simple transcendental extension of the domain of completeness and the ring of univariate polynomials, etc. It is prominently revealed in judgments related to tandems.

As a result of observations, it was determined that the indicated methodical approach leads to the following important results in the training process.

1) It has a positive effect on the process of strengthening intra-disciplinary and inter-disciplinary relations;

2) Connected and logical mastering, as a result of which fluent mastering occurs, the activity and independence of students increases;

3) In the training process, students' learning-cognitive activities increase, scientific creativity abilities develop.

It is preferred to build modern mathematical theories on the basis of the set-theoretic concept. A number of problems arise in connection with the strict construction of mathematical theory in educational literature, which is different from scientific literature. Scientific research conducted to solve them leads to the interpretation of mathematical theories in various modifications. Failure to pay attention to explaining these causes a number of shortcomings in the teaching of mathematical courses. A number of misunderstandings and shortcomings can be pointed out in connection with the introduction of concepts in the training of the algebra course in pedagogical profile higher schools.

1. Misunderstandings and errors arise as a result of refusing to give it strictly for the sake of easy understanding of the algebraic concept.

2. Instead of a strict definition of the concept, the expression (formula) used for calculation is accepted as a definition for the concept.

3. Misunderstandings arise as a result of taking the sign of the concept as a definition instead of the definition of the concept in the teaching of the algebra course.

4. Definition of the same concept in different literature creates misunderstandings for students.

5. In a number of cases, when the mathematical concept is introduced more seriously, students' ideas about that concept cause them to make mistakes in the assimilation of new information.

Efforts aimed at eliminating the indicated misunderstandings and shortcomings lead to an increase in the cognitive activity of students in the training of algebraic concepts and, therefore, the algebra course.

In the dissertation, chapter II entitled "Theoretical-methodical and scientific bases of building an algebra course based on the concept of abstract algebra" consisted of 5 paragraphs, the issues of building a modern algebra course, defining the fundamental concepts of linear algebra based on it and defining the elective subject "Fuzzy Algebra Basics" dedicated to the ways.

In the late 19th and early 20th centuries, the language of set theory became the universal language of mathematics. After the famous treatises of H. Burbaki, mathematics began to be considered as a science that studies various operations (together with the set) set on sets. Considering this point, the logical structure of teaching the elements of abstract algebra, which forms the basis of the algebra course, is explained in the first paragraph on the topic "Problems of building an algebra course based on the idea of multiplicity and set theory and the methodology of introducing the basic concepts of algebra".

Implementation of algebra course training in higher schools based on abstract algebra elements poses many problems in front of algebra teaching methodology: organization of course training in new content; getting rid of old, redundant material; bringing the algebra course closer to the modern level of mathematics; determining the relationship of the algebra course with other subjects; development of students' thinking; increasing visibility in teaching algebra, etc. The second paragraph of Chapter II is devoted to the study of the place and importance of the isomorphism relation in the algebra course.

It should be noted that the improvement of teaching algebra is directly related to the improvement of mathematical written language. This improvement is made possible by the introduction of elements of set theory, mathematical logic and abstract algebra in the algebra course. Refinement and perfection of the mathematical language serves to fully comply with the scientific principle of teaching in the algebra course. The problem of specifying the system of mathematical symbols and markings arises in the teaching of the algebra course. Also, it is important to study the methodical place of their giving.

At the same time, the algebra course should not only adapt more to the modern state of science and practice, but also fulfill its educational role - laconic and precise language should be formed, logical thinking should be raised, and those necessary for personality development should be developed. These issues are discussed in the third paragraph entitled "Possibilities of using some mathematical symbols and schemes used in the teaching of the Algebra course". Here, the mathematical symbols used in the algebra course are classified and interpreted according to the fields they belong to.

1) Theoretical-multiple symbols;
2) Mathematical logic symbols;
3) Symbols related to abstract algebraic elements;
4) Symbols of classical algebra and number theory.

While systematic character, logic, fluency and other principles are expected in the interpretation and explanation of algebraic concepts and related mathematical propositions and theorems, which play an important role in the formation of students' mathematical worldview, there is a need for teaching technologies that help the understanding of those concepts, facilitate their deep assimilation, and enhance their interrelationships. One of them and the most important one is the realization of the use of scheme, table and block-schemes, which show the connections between the topics studied in lectures and practical sessions and the components of a specific topic, and the organic connection [5].

The realization of the use of schemes is profitable and suitable for achieving a number of methodical, pedagogical and psychological goals.

To show the organic relations of learned mathematical concepts;

To grasp and remember the studied material in a complete and systematic way;

To serve to implement the repetition of topics by creating connections between past and new topics;

Conveniently present the learned calculation algorithm;

To stimulate the visibility of the studied topic.

Experience and observations show that if formalism is not allowed when using schemes, the studied mathematical topics are not only welcomed by students with interest, but also deeply and perfectly mastered.

In the fourth paragraph, the fundamental concepts of linear algebra (vector space, subspace, isomorphism of vector spaces, vector space with scalar multiplication, Euclidean space, linear algebra, linear algebra of complex numbers, algebra of complete matrices over the square, algebra of operators of vector space, etc.) and their algebraic properties attention has been paid to its presentation with the help of the concept of structure. It was determined that presenting the basic concepts of linear algebra as an algebraic structure promotes the emergence of a number of positive aspects in the teaching of algebra:

Increases intra-disciplinary relations;

Repetition of similar procedures on different mathematical objects strongly influences mastery while visualizing abstraction.

It should be noted that the approach we have shown, i.e., the tendency to abstract and generalize concepts given in a visual-intuitively content form, manifests itself in many sections of mathematics. At the end of the paragraph, it is explained that the main concepts of the theory of combinations are strictly based on the concept of set theory. This approach has been shown to encourage their comparative interpretation while allowing them to consider a point of view.

In the fifth paragraph of the second chapter called "The structure, content and methodological features of the elective subject called "Fuzzy Algebra Basics", the purpose, program, teaching issues of the said elective subject, and the interpretation of the mathematical symbols and markings used in this subject are given.

In all spheres of education, including in the higher pedagogical education system, the search for new ways and methods of training specialists with deep enough knowledge and raising the level of education of students continues. In this regard, higher mathematics teachers face a number of issues waiting to be resolved.

M.V. Pototsky (see p.6) believes that the higher mathematics courses of the pedagogical institute should fulfill a number of tasks, of which the following two should be specially mentioned:

1) "... first of all, to clarify the issues explained by the teacher at the school at the modern scientific level;

2) "... to provide students with a broad mathematical outlook, as much as possible familiarity with modern mathematics and its issues."

In our opinion, these issues can be successfully solved in the process of studying elective subjects. Based on this, the graduates of the higher pedagogical school can take appropriate optional courses in their future pedagogical activities.

Elective subjects, as well as specialized courses and specialized seminars, give higher school teachers the opportunity to teach their students not only known knowledge established in science, but also to motivate and prepare them for creative work. They are intended for students to quickly acquire modern knowledge in narrow areas of science, as a result of which students are given some modern problems of science. Considering this point of view, it is important and appropriate to provide an elective subject called "Basics of Fuzzy Algebra" for senior students of mathematics majors of higher pedagogic schools.

It should be noted that within the framework of one course (30 hours of lectures and 30 hours of practical training) it is impossible to reflect all the issues of fuzzy algebra that exist in various monographs and articles related to different directions. Also, taking into account the special aspects of mathematics teacher training, it is not considered appropriate to teach a number of issues, especially many issues of applied nature.

The course "Basics of Fuzzy Algebra" that we offer is based on the fuzzy set[19] given by L. Zadeh. A fuzzy (after this - q/s) set is a generalization of a regular set.

Using this generalization, some problems studied in the algebra course can be explained and interpreted in a new way based on the theory of fuzzy sets.

A curriculum reflecting the content and structure of the proposed elective subject has been prepared. What is learned in this course can be grouped into four sections [23]:

Fuzzy sets. Fuzzy various operations on sets and their properties;

C/s relationships. Various g/s relationships. Q/S properties of Q/S relations and Q/S relations created by them;

Q/s numbers and extended arithmetic operations on them, operations on L-R type, triangular and trapezoidal q/s numbers. Q/s linguistic variables.

Q/s linear algebra and quadratic equations. Simple q/s relational equations. Polynomial equations.

It is possible to show the advantage and some methodological features of the teaching of the optional course "Basics of Fuzzy Algebra" in mathematics majors in higher pedagogical schools.

Studying the materials of the elective course called "Basics of Fuzzy Algebra" is possible for III-year students of mathematics majors of higher pedagogical schools. The methods of Q/s algebra find more and more wide applications. There is a growing body of literature on these methods and their specific applications. Q/s sets give a serious impetus to the extensive development of a number of mathematical theories, and to the increase in the popularity of the problem among mathematicians.

Therefore, the presented course opens wide perspectives for the development of students' mathematical worldview, gives students the opportunity to quickly engage in creative work in a very wide area of science, including algebra. It allows students to get acquainted with some problems and issues of modern mathematics, to inform them

[19] Заде Л.А. Понятие лингвистической переменной и его применение к принятию приближенных решений. – М.: Мир, –1976, –168 с.

through independent research work. The course is mainly devoted to mathematical aspects of q/s set theory. It has an educational function as it affects the scientific-thinking of future high school teachers, it forms the basis for the development of the students' personality and mathematical worldview, and the development of their mathematical culture. The teaching of the course "Basics of Fuzzy Algebra" provides an opportunity to formulate and solve a number of problems arising in the humanities in the form of mathematical problems. It makes it possible to find methods of solving ordinary mathematical problems in cases where the data cannot be expressed in the form of quantities.

Elements of set theory already occupy an important place in mathematics curricula in secondary schools. Therefore, it is possible to teach the elective course "Basics of Fuzzy Algebra" in the form of a facultative course with the appropriate name in general education schools. Along with all this, it should be noted that the presented course helps to create interdisciplinary connections in mathematics, expands, deepens and strengthens students' algebraic knowledge.

The theory of q/s sets created by L.A. Zadeh has given rise to new directions in many fields of science, especially mathematics. Extensive research has been started on the processing of problems studied in various classical theories of mathematics on the basis of q/s set. At the same time, a wide range of research related to the practical issues of science, technology, and humanities has gained a lot of momentum by using q/s sets.

Various terms and notations have emerged during these studies. In the process of substantiating and studying the theoretical and practical results obtained in the conducted research works, it is important to show the various symbols and markings included in the process in an appropriate, unified and general manner, in the study, development and application of the theories related to g/s sets.

A more general concept of a suitable course, widely applicable in mathematics and other fields of science, is created by including materials containing the necessary concepts and considerations about g/s sets and g/s relations included in the program of the elective subject "Fuzzy Algebra Basics" in the algebra course.

Chapter III of the dissertation entitled "Methods of teaching elements of linear algebra and issues of using modern teaching technologies during training" consists of five paragraphs.

The main goal of teaching mathematics, including algebra, in higher pedagogical schools is to provide students with deep and systematic scientific knowledge. In order to achieve this goal, the separate topics of the taught course should be logically and organically connected with each other, and should be delivered to students in a consistent and systematic way, fully connected. To realize this work, the creation and strengthening of intra-disciplinary relations is of great importance. Methodical methods (principles) of creating intra-subject relationships in the algebra course are of interest due to their role and importance in training. There is a need to interpret the algebra course not as a combination of separate sections, but in a unified, whole, connected way. This makes the creation of intra-subject connections even more urgent in the current algebra course.

A number of ways of creating intra-subject connections can be shown in the algebra course [7, 20, 21]:

1) Using set theory language and symbols [17];

2) Creation of internal connections through structural schemes [5];

3) Naming and numbering of mathematical propositions in lectures;

4) Allowing a concept to be expressed in different terms and eliminating misunderstandings caused by the use of the same term in different meanings;

5) Strengthening the connections between topics studied in lectures and practical sessions [14];

6) Using different types of replication procedures;

7) Showing the place and importance of separate mathematical concepts and theories in the whole course [12,16];

8) Conducting and compiling the text of the final, summary lectures, etc.

When studying the elements of linear algebra, which is the most important division of algebra according to its application, it is preferred to create intra-subject relationships by naming and

numbering mathematical propositions. This is due to the following factors:

1) The same property can be attributed to several concepts, objects, prompting the student to compare;

2) When naming a mathematical proposal, an important aspect that clearly reflects the main essence of the mathematical proposal is briefly indicated. This directs the student's attention to the main aspects, has a positive effect on learning and memorization;

3) There are many elements that make it possible to apply concentricity in the teaching of linear algebra;

4) It allows to express the mathematical proposition given in symbolic writing and other forms in natural language and as a result to assimilate it with content.

Taking this as a basis, in the first paragraph, the issues of naming the propositions in the sections "Vector spaces"[20] and "Linear views and linear operators"[21] have been explained. In the second paragraph, using the method of naming mathematical propositions, an example of the text of a review lecture on the section "Vector spaces" is given, reflecting the formation of intra-discipline relations.

In the third paragraph of Chapter III, the role and importance of teaching elements of linear algebra in creating interdisciplinary connections and teaching in various mathematical courses is emphasized. Let's note that in the pedagogical dictionary, the concept of interdisciplinary communication is defined as the mutual agreement of educational programs[22].

The study of interdisciplinary issues in the teaching of mathematical courses in pedagogical schools is calculated to serve the improvement of the quality and efficiency of teaching, continuous and solid assimilation of knowledge.

Linear algebra is closely related to mathematical analysis, geometry, elementary mathematics, theory of differential equations,

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[20] Куликов Л.Я. Алгебра и теория чисел. – М.: Высшая школа, – 1979, – 554 с.

[21] Baxşəliyev Y.R., Əbdülkərimli L.Ş. Cəbr və ədədlər nəzəriyyəsi kursu. –Bakı: Nurlan, – 2008, – 560 s.

[22] Преемственность в обучении математике. Пособие для учителей, сборник статей. Сост.А.М. Пышкло.– М., Просвещение, –1978, –150 с.

functional analysis, linear programming, and other mathematical courses. It is for this reason that there are textbooks and teaching aids that describe the integration of linear algebra with a number of mathematical courses. In this paragraph, the role of elements of linear algebra in the interpretation of a number of concepts and relationships given in the section "Differential geometry of space lines" studied in the course of differential geometry is shown.

Application of concepts, ideas and rules related to elements of linear algebra in geometry;

Expression of a number of formulas and concepts related to linear algebra with terms related to geometry;

Ensuring uniformity and coordination in terminology and symbolic writings used in various mathematical disciplines;

Generalization of concepts and relationships known from geometry through elements of linear algebra.

In the fifth paragraph of Chapter III entitled "Modern learning technologies used in the teaching of linear algebra problems", it is noted that traditional learning technology and problem-based learning technology are mainly preferred in teaching linear algebra elements in the algebra course of higher pedagogic schools, and those learning technologies are investigated.

In traditional learning technology, the main goal is imparted knowledge by the teacher and memorization and comprehension by the students. The main place in the assimilation of knowledge is memory (memory) restorative thinking.

The main structural elements of the traditional teaching technology applied in the lecture can be shown as follows:

Brief survey of facts to be used in the lecture from the previous topics → lecture plan → teacher's explanation → conclusion.

In the practical exercise, the main structural elements are the following:

Checking homework → request new topic material → assessment → solving studies → assigning new topic tasks.

Structural elements of problematic learning technology can be shown in the following scheme:

Problem situation → problem → solution model → problem solution → result.

In problematic training, the teacher creates a problem situation (situation) and attracts students to search; they solve the set problem either by the partial search method or by the method of researchers. Problem-based learning technology pushes students to scientific research and gives them a serious impetus to acquire scientific cognitive methods. At the same time, it is possible to solve a number of psychological-pedagogical issues in the exercises controlled by the problematic learning technology.

Both the advantages and disadvantages of both training technologies are shown in the research work. Ways to eliminate the missing aspects have been sought.

On the basis of observation and experience, it was determined that the inclusion of the "lecture text compilation" component in the structure of the traditional teaching technology brings new nuances to that technology and enables the elimination of its defects. As a result of the observations, it was determined that the inclusion of the "lecture text compilation" component in the traditional teaching technology leads to the emergence of a number of positive trends.

Students are more interested in research, which leads to the acquisition of activity, attention and creativity in the lecture.

Students acquire searching skills and habits by acting independently.

During the semester, there is an opportunity to monitor the student's activity in the lecture session.

Lack of time in studying lecture material is eliminated. The knowledge acquired independently at home (in the process of preparing the lecture text) together with the materials given in the classroom session contain the essence of a whole topic.

The "Lecture text compilation" component is used to increase students' subject interest, cognitive activity, etc. has a serious effect on the formation of pedagogical and psychological qualities.

The basis of problem-based learning technology was laid by the American psychologist, philosopher, educator John Dewey (1859-1952) while investigating the process of development of thinking in

the educational process. C. Dewey believed that learners should follow the path of scientists in the learning process. They must hypothesize, search for answers, and search again when they make a mistake. He believed that the 20th century was characterized by the culmination of teaching and scientific thinking. In an exercise guided by problem-based learning technology, it is assumed that students gain knowledge not by listening and understanding, but by searching and finding it themselves.

In secondary and higher schools, exercises guided by problem-based learning technologies are one of the effective means of strengthening educational functions. First, it allows the formation of creative thinking in students, the emergence and development of the ability to solve problems independently. It becomes a powerful tool for students to believe in their knowledge. Problem-based learning in the application of mathematics acts as a tool that creates a confident idea in students about the real origin of mathematical concepts and shapes the importance of mathematical methods in solving the problems of practical exercises. Secondly, the developmental direction of problem-based learning in mathematics is mostly related to the fact that it is selected with a special approach to the organization of students' cognitive activity, the activity of their thinking, the development of mathematical abilities, independence and other positive qualities of the student's personality.

Problem-based learning has special methodological aspects, which result in the creation of a deep interest in the studied subject in students, and the development of their ability to creatively approach the material being studied.

It should be noted that in the practical exercises in the algebra course, the management of the exercise with problem-based learning technology leads to more efficient results.

The advantages of applying problem-based learning technology are as follows:

1) Very wide independence of learners; 2) Formation of thinking interest or personal motivation in students; 3) Emergence of dialectical thinking.

Let's show the missing aspects: 1) It is rarely used for the formation of practical skills and habits; 2) A lot of time is spent on acquired knowledge.

The main elements of the problem-based learning technology and the structural scheme with which they are connected are shown at the beginning of this paragraph. In the researched technology-driven exercises, the main task is to create a problem situation and pose a problem.

The problem situation is a cognitive issue, characterized by a conflict between the acquired knowledge, skills and attitudes and the new demands presented. A problem situation is a conflict between knowledge describing past experience and the inability to explain a new phenomenon. This obstacle is also a condition for the need for understanding.

A problem is a creative problem that requires students to take initiative in their judgments to find solutions that have not been tried before.

At the end of the paragraph, some concrete examples related to creating a problem situation and setting a problem in teaching the elements of linear algebra were considered.

It should be noted that in the exercises controlled by problematic learning technology, fertile conditions are created for students to work freely. At this time, one cannot be satisfied only with the period covered by the audience training. In such training technology, it is assumed that the student works independently outside the lecture hall.

In the era we live in, which is called the age of technologies, modern technologies are widely integrated into the system of general education and higher education, as well as into the mathematical education system. In order to reveal the integration of technology in education within the framework of teaching mathematics, the data obtained from the thematic analysis method were examined [45]. The process of technology integration in the study was designed with Gagne's Model of Learning Situations [45]. Integrating technology with this model aims to validate and enhance understanding.

There are two approaches to using technology in educational institutions: "learning from technology" and "learning with

technology". It is important for the mathematics teacher to consider at which stage in the technology integration process they will use technology. The use of MATLAB in the teaching of an algebra course enables the integration of modern technology into the teaching of an algebra course, and is an example of and important for learning with technology.

The last chapter of the dissertation is dedicated to the study of "learning with technology" in the MATLAB program environment and is called "Methodology of using the possibilities of the MATLAB program in the teaching of the higher pedagogical school algebra course". That chapter consists of three paragraphs. In the first paragraph, the rules for performing simple operations on matrices in the MATLAB software package are described. By using this program, various mathematical operations can be realized with the help of a computer. Analytically solving such problems takes hours, or sometimes it is impossible to determine the solution. At the same time, in connection with the inclusion of computer technologies in the educational process, the teaching of mathematical subjects, including algebra, in higher schools requires a new approach. In the conducted research, only the environment of the program and the examples of the rules for solving some problems of the algebra course, which can be easily implemented, were mentioned here. Before that, by giving simple concepts and the rules of its use, the foundation is created for the use of more complex operations.

The MATLAB program is a universal system that implements the solution algorithms of modern numerical and analytical methods. Through this, issues are resolved with high accuracy and promptness. One of the advantages of the package is the visualization of the result of the calculation through graphics and animation.

In the first paragraph, commands in direct calculation mode, interpretation of data in the program, input of vectors and matrices, etc. after simple operations are shown, the standard functions used to perform operations on matrices in an algebra course are given. In the second paragraph of Chapter IV, the methodology of performing operations on vectors and matrices in the MATLAB program was studied. It is known that operations with vectors and matrices in the

MATLAB program are performed in two forms: transformations by elements and transformations by matrix (vector) operations.

The operations envisaged in the work are divided into five groups and explained:

- Operation symbols indicating actions performed on matrices;
- Signs of special functions applied to matrices;
- Signs of the rules for conducting operations with elements of the matrix;
- Functions that perform various operations on elements in rows and columns of vectors;
- Functions that perform calculations related to the rows or columns of the matrix.

It should be noted that the MATLAB software package has the ability to solve more complex problems (solving algebraic and transcendental equations, solving a system of linear algebraic equations, solving nonlinear equations) in the algebra course. At the same time, the MATLAB software package has important applications in the teaching of a number of topics studied in other courses of higher schools (mathematical analysis, differential equations, etc.), as well as very wide application areas in mathematical research. Therefore, it is important to learn how to solve simple problems using the MATLAB program in the algebra course of higher pedagogical schools, as well as in a number of other courses [42, 43]. Thus, by applying the MATLAB program, performing simple operations and procedures related to vectors and matrices lays the groundwork for solving complex problems later. It also has a positive effect on students' acquisition of computer technologies and their future use in their activities. In general, MATLAB, MATCAD Mathematics, etc. are used in the teaching of practical exercises in the algebra course. It is appropriate to use application programs as tools.

The third paragraph of Chapter IV is devoted to the organization of the pedagogical experiment carried out in the research work and the analysis of the obtained results.

Our research work consisted of three stages (determining, educational and checking) and covered the 2015-2020 academic years. In order to study the level of knowledge, skills and habits of students

majoring in mathematics on the algebra course and to determine the characteristic difficulties, a survey was conducted among the students of the higher school.

75% of the students who took part in the survey considered algebra to be the most complex among the subjects studied at the university, 14% - complex, 5% - the easiest subject, and 6% - the most difficult subject due to subjective difficulties.

It should be noted that the vast majority of the students who participated in the survey reported the abstractness of the algebra subject and considered it to be a more difficult subject compared to other mathematical subjects. During the survey, most of the requests associated the emergence of difficulties in learning algebra with various types of activities. Thus, students face certain mathematical difficulties in mastering theoretical issues, applying theoretical knowledge in practice, and mastering new pedagogical methods and principles of activity. In particular, it can be said that the majority of students periodically encounter difficulties in mastering the elements of abstract algebra, which form the foundation of algebra.

A part of the students (33%) mention the voluminous expression of definitions and theorems as one of the main difficulties. This once again fully shows that, first of all, even partially, the students do not have the habit of logically analyzing the teaching material, correctly defining what is given and what is sought, and determining the logical structure of the material taught in algebra.

It should be noted that less than half of the students (49%) have certain difficulties in the practical application of theoretical knowledge. If we take into account that the vast majority of students have difficulties in mastering the theoretical foundations of this science from mathematics for one or another known reason, then we can say that mastering the theoretical foundations of algebra is a more difficult component of training compared to the application of acquired practical knowledge. In addition, some of the students who have difficulties in mastering the theoretical material (15%) also note that there is no difficulty in their practical application. Therefore, it is possible to talk about the presence of a component in the teaching of algebra that distinguishes its theoretical content from its practical

application. Knowing the definitions, formulas and the rules of their use, the rules of expression and application of algebraic facts, as well as the basic methods and principles of the subject are extremely important and necessary conditions for students to be successful in practical exercises. In addition, more than 30% of students face certain difficulties in the process of proving algebraic facts. Compared to proving theorems, algebraic exercises related to proof cause more difficulties for students (75%). There are certain differences between these two forms of proof. Thus, the proof of theorems from algebra is given to students in the form of a synthetic interpretation, and sometimes ready-made. New data and requirements become known. At this time, students do not have much difficulty in determining the knowledge and skills necessary for proof. However, in algebraic exercises related to proof only, students have to independently choose which theoretical facts to base on.

On the other hand, compared to algebraic works that are offered for independent proof, theorems that require algebraic proof are more general and more complex mathematical propositions.

About a third of students (35%) have difficulties in mastering the use of algebraic methods and theorems, which sometimes exceeds 50%. It should be noted that a large part of the mathematical difficulties that arise during the solution of algebraic studies are related to the selection of the correct non-standard method of solving the problem.

Students see the elimination of the mathematical difficulties encountered, the more accurate algorithmization of the methods of solving algebra tasks, and the increase of the use of visualization when interpreting the problem.

Thus, the results of an extensive survey of students allow us to group the main mathematical difficulties they face in mastering algebra material as follows:

- Difficulties with mastering the theoretical foundations;
- Difficulties related to the practical application of theoretical knowledge;
- Difficulties in mastering the mathematical method (technology) and principles;

- Insufficient justification of mathematical motivation, etc.

During the survey, the causes of the difficulties encountered by the students were investigated.

Students mostly (70%) say that they lack the ability to use logical symbols and logical operations in teaching algebra as the main reason for difficulties. Obviously, this is one of the objective reasons. Thus, the algebra course is more formal and abstract than other mathematical courses studied in high school. This is determined by the high level of abstraction of algebra. Algebraic propositions sometimes have two or three different quantifiers instead of one. Since each quantifier has some mathematical meaning behind it, the matter gets complicated. It is not enough to master the meaning of each quantifier in isolation. At the same time, it is very important for students to correctly understand how the meaning of this or that mathematical proposition will change depending on the sequence of quantifiers. It should be noted that, in addition, work with logical operations requires certain mathematical habits, for example, to quickly reveal the reasons that cause certain mathematical difficulties in students.

Some of the students (35%) point to a higher degree of generality of mathematical-logical judgments in the higher school mathematics course compared to the school mathematics course as the reason for the mathematical difficulties they face. Students tend to think that some of the mathematical propositions are illustrated by examples from algebra, and some of the proofs are replaced by true and logical judgments like in a high school math course. This is especially noted by students of the first academic year of higher education majoring in mathematics.

More than half of the students (55%) cite lack of time as a subjective reason for the extensive and complete mastering of the algebra course. It should be noted that this case is more characteristic of the requirements of the 1st academic year.

It should be noted that according to the opinion of the vast majority of students (76%), insufficient formation of basic mathematical habits also causes them certain difficulties. Correctly solving basic mathematical studies and checking problem solving can include the ability to compare new mathematical methods

(technologies) with known traditional mathematical methods, analyze their differences, and explore the practical possibilities of the applied method and computing technique (technology). It should be noted that in the list of habits that cause major difficulties for students, firstly, it is very important to correctly know the ability to investigate the possible application of a mathematical method, secondly, to implement the definition of a mathematical solution algorithm, and thirdly, to reconcile the previously learned mathematical solution methods with new mathematical methods (technologies). This case shows that, for students, first of all, not enough time is allocated to the formation of these mathematical habits in the training process, and on the other hand, the formation of these habits makes it much more difficult for the students to fully and comprehensively master the subject of algebra.

Pedagogical experiment was conducted at the Faculty of Physics and Mathematics of Nakhchivan State University in 2015-2020 and was successfully implemented. During the indicated period (in five consecutive academic years), a pedagogical experiment was conducted in the algebra course taught in groups consisting of first-year students studying in "Mathematics teaching" and "Mathematics-informatics teaching" specialties. The experiment consisted of three separate stages (determining, training and checking).

Each group was divided into two subgroups, control and experimental. In the selection of control and experimental groups, the number of students in that group, their knowledge levels, mathematical skills and experiences were fully taken into account.

The initial (determinative) stage of empirical and theoretical research was carried out in all groups at the beginning of each semester in 2015-2020. At this stage, the purpose of the research was to determine the level of knowledge, skills and habits of students studying mathematics majors of higher pedagogical schools. Thus, at the beginning of each semester, all activities related to the defining stage are carried out in the control and experimental groups.

The educational stage was organized for experimental groups. That is, in the control groups, algebra training was carried out in a traditional way, while in the experimental groups, the following

recommendations determined by the author in the theoretical studies conducted are taken into account:

- Detection of intra-subject relationships and their use in teaching algebra course [20];
- referring to propositions (theorem, result, property, rule, formula) by naming them in lectures and practical exercises [32];
- using the elements of MATLAB fourth generation programming language in the teaching of algebra course, along with creating an opportunity for the effectiveness of teaching the course, showing the possibility of using computer technology in the algebra course [42,43,45];
- increasing the efficiency of algebra course teaching by interpreting the stages of proofs of concepts and theorems with block schemes and increasing the visibility of course teaching and raising the algorithmic culture of students [5].

During the educational experiment stage of the research covering the years 2015-2020, extensive teaching-research work was carried out by us related to teaching and mastering the solution of the system of studies developed from algebra on the activation of students' mathematical activities, development of mathematical-logical thinking. In the educational experiment phase of the research, the goal is to teach different ways of solving problems from the algebra course, which enables the activation of students' cognitive activity and the continuous development of their thinking, to develop a mathematical methodology aimed at eliminating certain deficiencies related to the algebraic problem solving skills of students, to familiarize students with the content and methodology of the algebra course. It consisted of conducting an educational experiment on the new algebraic methodical system we prepared and determining the methodology of the experiment. In the process of the pedagogical experiment, the opinions, ideas and specific solutions regarding the content and teaching methodology of the methodical system proposed by the author were delivered to the students of the experimental groups on time, and they were fully provided with the necessary algebra materials.

Finally, the verification experiment, the third stage of the pedagogical experiment, was conducted for both control and experimental groups.

It should be noted that at the end of the pedagogical experiment, taking into account all corrections and additions, the experimental research work was successfully carried out based on the improved methodical system. The new mathematical results obtained at each stage of the pedagogical experiment were extensively and fully analyzed by mathematical-statistical methods. For this purpose, at a certain stage of algebra education, both the control and experimental groups were tested based on the same algebra material. As a result, the level of mathematical knowledge, skills and habits of the students in the final algebra subject was used as a new research method. has been done. This research work has given great results and has been successfully completed. We evaluate the scientific-methodical result obtained as a result of the experiment as an innovation in the teaching of algebra. We recommend its wide and comprehensive application in algebra teaching in the future.

The analysis of the obtained results shows that at the initial stage (at the beginning of the experiment) the level of knowledge and skills (percentage of absorption) of both the control and experimental group students in algebra was very close to each other.

It should be noted that the number of students in the control groups was 154 and the number of students in the experimental groups was 161 in both the determining and checking stages of the experiment.

In the control group, success was 88.96%, and quality was 42.8%. At that stage, the success in the experimental groups was 91.93%, and the quality was 66.25%.

In the checking stage, the success in the control groups was 88.96%, and the efficiency was 53.25%. At this stage, the success in the experimental groups was 97.75%, and the quality was 66.25%.

During the observations, it became clear that the system of algebraic problems solved in algebra lessons activates students' knowledge, skills and cognitive activities, and develops logical thinking. As a result, their general development levels and assimilative

abilities also increase. Algebra training increases students' interest in mathematics, and as a result, the quality and effectiveness of training increases. This once again confirms the correctness of the working hypothesis of our research work.

The result

The following results were determined based on the study of the existing textbooks, teaching aids, and the New Education Program related to the teaching of the algebra course in higher pedagogical schools:

1. After the restoration of state independence in the Republic of Azerbaijan, the reforms carried out in the education system, including the higher education system, necessitated the following:

a) Integration into the European education system by carrying out serious reforms in higher schools;

b) Comprehensive renewal of the goals, content and methods of higher education in connection with the transition to a graduated education system, fundamental changes in basic educational programs (State Education Standards), curricula and subject programs [37].

2. Since courses such as higher algebra, linear algebra, number theory, numerical systems, and some problems of algebra, which were previously taught separately in mathematics teacher majors of higher pedagogical schools, have been removed from the curriculum, there is a need to work on the methodology of teaching their important elements in algebra.

3. Although the teaching of the necessary elements of the discontinued mathematical courses is provided in the algebra course in the new curriculum, the number of hours allocated to it has been reduced. This reduces the possibility of deep assimilation of the material.

4. Creating intra-subject relationships in the algebra course, which is intended to be taught in a very short time using new tools, implementing a single integrative course, increasing students' interest in the subject, meeting the requirements of the modern education system, solving problems caused by changes, ensuring free cognitive activity of students and it is very important to build a methodical system that prepares for creative works [19,20, 21].

5. In higher pedagogical schools, algebra is combined with other mathematical subjects, for example, geometry, mathematical analysis, etc. there is a need to develop the methodology of teaching related issues [35, 40].

6. The modern algebra course has been comprehensively updated since the 50s of the 20th century. The algebra course based on set theory is a mathematical science of algebraic structures, and the content of the course is explained linearly. In this course, which is intended to be taught in a strictly mathematical manner, conditional agreements are allowed, these conditional agreements are related to trivial cases and do not harm the seriousness of the course [22, 44].

7. An author's program for teaching the algebra course has been prepared, this program differs little in content from the existing corresponding program of ADPU, and has some different aspects in terms of structure. There is a need to include information on new computer technologies [42, 43, 45].

8. There is a need for changes in the content and structure of the program, a textbook written in accordance with it, teaching aids, including problem books compiled for practical exercises.

9. Deficiencies exist in fully meeting current program requirements. In order to overcome this gap in the dissertation, by referring to the given problem books, in the practical exercises, the topic taught for each exercise and the recommended issues were determined. At this time, general information should be given about the nature and purpose of the issues in the exercise, acting according to the methodology and principles given in the problem book compiled by X.D. Ikramov [14, 15].

10. For the algebra course taught in the mathematics majors of higher pedagogical schools, teaching should be conducted on the following four content lines [37]:

1) Numbers and actions; 2) Algebraic systems;

3) Relationships; 4) Equations.

11. It is appropriate to use block-schemes and didactic blocks to increase students' cognitive activity [5, 25].

12. The linear construction of an algebra course based on the elements of abstract algebra presents algebra in a single course by

including elements of abstract algebra, linear algebra, polynomial algebra, and number theory. It has a strong influence on the formation of organic relations between departments, including inter-disciplinary relations [25,26, 28].

13. Since Q/s set theory and MATLAB SYSTEM are widely used in mathematics and a number of scientific fields, the concept of including their necessary elements in the modern algebra course program is appropriate and possible [23,43,45].

Offers:

1. A deep mastery of the elements of abstract algebra ensures successful mastery of the algebra course. On the other hand, it gives a strong impetus to the development of students' mathematical thinking. This later creates a foundation for success in teaching other mathematical subjects (for example, functional analysis, theory of functions with real and complex variables). In order to overcome the difficulties that arise during the teaching of abstract algebra elements, attention to practical exercises should be increased and necessary practical exercise material should be developed, which was not in the previous textbooks.

2. It should be noted that, taking into account that there is no more detailed information about squares and images in the program, as well as providing information that creates ideas about the group of categories and functors that are generalizations of algebraic structures, it is appropriate to include these elements in the program and to develop them methodically at the level of the educational course.

3. Inclusion of the elective subject "Basics of fuzzy algebra" in the curriculum is based on the similarity and generalization between the algebra studied on the basis of the fuzzy (ordinary) set and the algebra based on the fuzzy set, and by showing the parallels and differences between them, the development of students' mathematical thinking and creative abilities. It is useful to work towards increasing cognitive activities.

4. The conducted observation and analysis show that deepening and expanding the program of the algebra course and increasing the number of hours allocated to the teaching of the course are in line with the goal.

5. MatCad, MatLab, Mathematics, etc., are used in conducting practical exercises. Attention should be paid to the use of such applications and they should be used as tools in teaching.

The main provisions of the dissertation are reflected in the following publications.

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The defense will be held on 17 September 2024 at 10:00 the meeting of the Dissertation council FD 2.40 of Supreme Attestation Comission under the President of the Republic of Azerbaijan operating at Nakhchivan Teachers' Institute

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Electronic version of abstract are available on the official website of the Nakhchivan Teachers Institute (www.nmi.edu.az).

Abstract was sent to the required addresses on 28 June 2024.

Signed for print: 12.06.2024

Paper format: 60×84.16/1

Volume: 78.854

Number of hardcopies: 20