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Organization of educational and developmental training of school students at mathematics lessons

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Abstract

The purpose of this paper is to highlight the importance of teaching and teaching mathematics in the country and will seek to address the educational weaknesses in this field. The objectives of math education, which include: Educational, cultural and emotional goals, will be discussed in general. This necessity is stipulated by the innovative processes occurring in the educational system of the Republic of Kazakhstan. The results of the research show that students getting the profession of mathematics teachers lack in their training process orientation at the development of schoolchildren's personal traits.

Keywords: educational and developmental training, education (upbringing), personality, personality formation, development.

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Organización de la formación educativa y de desarrollo de los estudiantes de la escuela en las lecciones de matemáticas

Resumen

El propósito de este documento es resaltar la importancia de la enseñanza y la enseñanza de las matemáticas en el país, y buscará abordar las debilidades educativas en este campo. Los objetivos de la educación matemática incluyen: metas educativas, culturales y emocionales, serán discutidos en general. Esta necesidad está estipulada por los procesos innovadores que se producen en el sistema educativo de la República de Kazajstán. Los resultados de la investigación muestran que los estudiantes que obtienen la profesión de profesores de matemáticas carecen de orientación en su proceso de capacitación en el desarrollo de los rasgos personales de los escolares.

Palabras clave: capacitación educativa y de desarrollo, educación (educación del hogar), personalidad, formación de personalidad, desarrollo.

1. INTRODUCTION

In the contemporary world, governments are aiming to raise their intelligence and intelligence capabilities, increase their ability and capacities, and advance their determined goals. In the past, about a hundred years ago, students enrolled as a group without knowledge and "ability" at the school, and the teacher attended the classroom with all kinds of intelligence. For example, a seven-year-old student with an IQ of

150 followed a seven-year-old student with an IQ of 80, and he repeatedly repeated what the teacher said or wrote on the blackboard. The main task of improving mathematical education at the present stage of the society development is to repurpose the methodological system and focus it on the developmental function of instruction whose aim is to forms kills of efficient employment of the educational content. Such system of education demands shifting of attitudes: school students, who used to be the objects of the educational activity, should be regarded now as its subjects.

Activity is the driving force of personality development and education: a child can develop and study only in the conditions of activity. The outstanding psychologist L. Vygotsky considered bringing-up processes to be the inherent basis of the child's development responsible for the formation of new patterns in his/her behavior. He believed that bringing-up processes must be based on the student's individual activity, thus reducing the art of an educator only to the direction and regulation of this activity (VYGOTSKY, 1991). Consequently, without organizing comprehensive activity for students, the school cannot expect any significant progress in his/her development (self-development) and training. Establishing a hierarchy of relations between education (upbringing), development and training is "the most urgent issue" of the educational and developmental system. Having determined these relations, the teacher will be able to let students into the "zone of proximal development" (Vygotsky, 1991). In the present paper the author draws on the fundamental principles of the theory of educational and developmental training offered by L.Vygotsky, A.Leontyev, L.Zankov, P.Galperin, D.Elkonin, V.Davydov (Zimnyaya, 1997). The reference to the works of these authors, as well as to a number of dissertational studies on the

educational and developmental training, speaks of the scale of this problem, a large variety of approaches to its solution and the ever-growing interest to educational and developmental training (Vygotsky, 1987). The analysis of publications on the problem of teachers' training, as well as the study of its solutions and practical implementations in universities and secondary schools, show that there has not yet been elaborated a methodology for preparing future mathematics teachers to give effect to the educational and developmental functions of the school mathematics course. Hence, it is very important to work out a methodology that, alongside with professional knowledge, would provide future specialists with the theory and methodology of students' development and upbringing through mathematics teaching, and would help to work out an adequate system of didactic aids for its implementation in the conditions of the university training practices. What can educational and developmental mathematics training give to students? To answer this question, it is necessary to reconsider the very notion of training, to get an insight into the problem by giving due consideration to the content of the school course of mathematics and carry out a thorough critical analysis (Vygotsky, 1987). For the time being there has not been carried out yet a special study that would take into account modern regalia and development trends in higher and secondary schools and offer a systematic approach to the creation of theoretical foundations of educative and developmental mathematics training as well as a technology for exercising the educational and developmental functions of the school course of mathematics. Finding solutions to the above problems is the basic objective in this study.

1.1. The expedience of the research results from

- New social demands for personality upbringing and development and for the development of the ability to actively and creatively acquire knowledge;

- The existence of factors (educational, ideological, psychological, pedagogical, methodological) encouraging the formation of scientific and theoretical foundations of educational and developmental mathematics training;

- Psychological readiness of teachers to accept the idea of educational and developmental training.

1.2. The relevance of the research

Mathematical science is also a requirement of human life, and those who know numbers and figures and law are well-known simple and logical calculations and calculations, their minds are ready to accept a complex series of difficulties and difficulties in life, and in the context of the problems and inadequacies of society and personal and social affairs Preparedness and ability to complete as much as their mental capacity. Is stipulated by a number of contradictions, which include:

- contradictions between the existing opportunities of educational and developmental aspects of the content of the school course of mathematics, the insufficient professional level of teachers required for their application, and the lack of theoretical bases and practical technologies of training essential to ensure intensification of upbringing and development outcomes of students in the process of exercising activities connected with mathematical content;

- The necessity to organize mathematical education of schoolchildren on the basis of developmental technologies and the existing knowledge-orientated training of teachers;

- The requirements of the school curricula to the level of mathematical development of students and the real results of their mathematical development observed so far.

1.3. The aim of the research

It is to identify potential opportunities of the school course of mathematics for the implementation of educational and developmental functions, to elaborate the structure of teachers' training activity to ensure the organization of the corresponding educational process.

1.4. Hypothesis of the research

If we determine and implement educational and developmental opportunities of the school course of mathematics in the light of the new educational paradigm, this will considerably contribute to the students' conscious learning of the program material, enhance schoolchildren's creative activity, promote their intellectual development, increase motivation to study the subject and turn the student into a full-fledged subject of the learning activity. Proceeding from the aforesaid, there were set the following **research objectives**:

1) To determine the role and place of the educational and developmental training in the modern educational paradigm and define its methodological bases in the process of teaching mathematics;

2) To identify and demonstrate the basic trends of implementing educational and developmental functions in the process of teaching mathematics at school;

3) To work out a theoretical model of the system of educational and developmental training for teaching mathematics at school;

4) To develop a system of requirements to the knowledge, skills and competences of the future mathematics teacher to promote the development of methodological culture and proficiency;

5) To make an experimental evaluation of the elaborated methodology of educational and developmental teaching.

2. METHODOLOGY

The present study is part of a broader research whose aim is to examine the components that influence the learning of teachers in mathematics. The theoretical basis for this study was the "theory based on data". For a deeper description of the experiences and beliefs of mathematical teachers about professional learning, the "phenomenology" method was chosen because it allows them to understand the experiences and how to conceptualize the participants in the research. This research method usually requires interviewing people to understand why and how they are confronted with the problem that the researcher poses, and for accessing rich data, "interviewing" is the strongest tool. Over a period of years we have been developing, specifying and testing in schools the conception of educational and developmental teaching mathematics. Its main idea consisted in recognizing the child as a full-fledged subject of the educational activity; in developing the need for knowledge; fostering

responsible attitude toward learning and discipline; ensuring the unity of education and upbringing. In the course of the research there were conducted several surveys and polls; the respondents included 100 students from Sh. Ualikhanov Kokshetau State University, 120 students from Kostanay and North Kazakhstan Universities, as well as about 200 teachers and 560 secondary school students of the region.100% of the teachers participating in the survey have a university degree, i.e. they attended some courses related to methods of teaching mathematics when they used to be university students. Mathematics teachers' accumulated period of work can be seen in the following diagram (Figure 1).

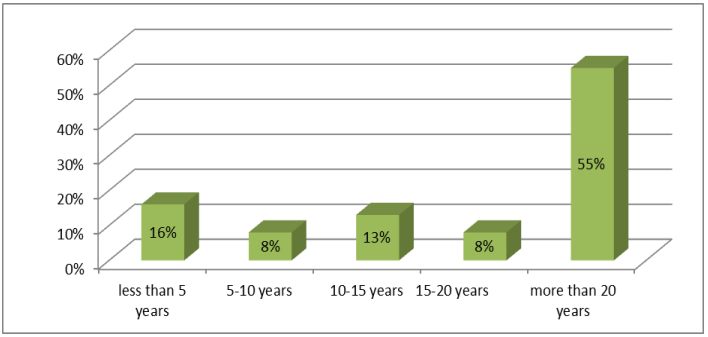


Figure 1.Mathematics teachers' accumulated period of employment

In the process of the experiment we tested our research hypothesis, determined the key factors affecting the content of the school course of mathematics, studied teachers' and students' expectations from educational and developmental training, analyzed the influence of the school mathematical education on the formation of the student's personality and specified the peculiarities of forming reasoning capacity at

mathematics lessons. We proceeded from the proposition that cognitive interest should be the groundwork of the educational and developmental training: the upbringing and educational processes will never be complete and thoroughgoing if the student is indifferent to the subject and has no motivation to get new knowledge. The main objectives of the conducted survey were as follows:

- To determine the state of the educational and developmental training in the school practice of teaching mathematics;
- To itemize the educational and developmental content of the learning material;
- To find methodological instruments and techniques for implementing the model of educational and developmental training; to give logically-psychological and pedagogical definitions of the teacher's activity connected with the implementation of educational and developmental learning content;
- To identify the influence of the educational and developmental content on the development of students' cognitive interest in the course of studying mathematics, and to find out the opinion of teachers on the development of students' cognitive interest.

The conducted survey with the participation of teachers, students and students showed the following:

31.7% of all the interviewed teachers understand the importance of personality formation in the process of teaching mathematics and the need to solve the problem, and 60% of them give their preference to the classical forms of lessons. In their opinion, the main way to promote students' development is to solve as many tasks as possible.42% of young

teachers find it very difficult to actualize the educative (upbringing) function of mathematics, 23% experience difficulties in organizing extracurricular activities on the subject. The level of mathematical training does not satisfy 31% of teachers and 58% are not satisfied with their level of methodological competence. In the questionnaire section ‘notes’ the respondents noted that they had never, or very rarely, applied educational and developmental materials in their classroom, therefore they could not evaluate their influence on the development of their students' cognitive interest. The question: "Do your students realize the connection between real life and the tasks they solve?" was answered by the school teachers in the following ways:

31% of teachers chose the answer "Yes, since they solve contextual (practice-oriented) tasks with interest ":14% out of them are teachers with more than 20 years of work experience, 5% of teachers have been in the profession for 10-15 years, 5% of teachers have 15-20 years of work experience, 3% are teachers whose length of service is 5-10 years and 4% are recent university graduates:

45% of teachers chose the following answer: "Only those students who have already come across practice-oriented tasks in their practice realize the connection";

16.3% believe that schoolchildren mostly do not see the connection because they have rarely dealt with the tasks having some life context;

7.7% of teachers noted that students do not see the connection because of the small number of such tasks.

According to the results of the questionnaire survey, only 61.2% of the third-year students gave the affirmative answer to the question "Will

you be able to use the content of mathematics for educational and developmental purposes?" In the questionnaires, school students also expressed their personal attitude to studying mathematics at school. To the question "What, in your opinion, is the role of mathematics in the educational process? The following answers were given: 60% of the 5^{th}-11^{th} graders think that mathematics is one of the most important and interesting subjects; 39.1% of the surveyed pupils note its role in the formation of their life stance and moral position; 0.9% find it difficult to answer the question. The answers to the question "What motivates you to solve tasks" showed the following motives of students: the most frequent motive (42%) is the "interest in the decision process"; 25.4% are "interested in obtaining the result"; 19.2% indicated as their motive the "desire to overcome difficulties"; 10.3% solve tasks on account of the "habit of meeting the requirements of teachers and parents;3.1% of the respondents answered that they have some other motives not specified in the questionnaire. The question "What tasks are the most interesting for you?" was answered in the following ways: 39% of the respondents consider "tasks with practical content reflecting real life situations, i.e. contextual tasks" to be the most interesting ones; 29.3% chose "puzzle tasks that require an original solution, i.e. creative tasks";6.3% consider "difficult tasks" to be interesting;25.4% of the respondents think no tasks are interesting. In their comments to the survey, the students noted that classes are interesting and exciting, if in the process of explaining new material and when solving tasks, there is used some material related to real life and life situations. Both university and secondary school students think that the most interesting tasks are the following:

- Tasks with explicit contradictions (tasks - problems, tasks - paradoxes);

- Optimization tasks (whose objective is to select an optimal solution);

- Tasks for reviewing (whose objective is to find errors or check the result);

- Concretization tasks (whose objective is to make more precise the aim of the task, its conditions and requirements);

- Logical tasks (whose objectives are to specify cause-effect relations, to find proofs, to define concepts, etc.).

The questionnaire survey and interviews helped to learn the attitude of teachers to the organization of teaching mathematics and to the students' active cognitive activity. They also helped to know the teachers' opinion on the school curricula and textbooks and their compliance with the concept of educational and developmental training.

3. RESULTS

In the present article the author speaks of the necessity to train a teacher of a new format: a modern teacher must be competent enough to work in the market conditions using all the progressive experience of the developed countries. This necessity is stipulated by the innovative processes occurring in the educational system of the Republic of Kazakhstan. Modern teachers must know how to promote students' creativity and develop their skills of independent acquisition of knowledge. From this perspective, the school must be viewed as an institution aimed at facilitating personality formation and creating conditions for self-education and self-development, timely recognizing the individual characteristics of its students and taking them into account in

the course of education. The idea of teaching mathematics through educational and developmental training is the directing vector of the above-mentioned changes. Having analyzed the existing school practices, we may conclude that mathematics teachers still tend to focus primarily on transferring to students the knowledge of their subject. The results of the research show that students getting the profession of mathematics teachers lack in their training process orientation at the development of schoolchildren's personal traits. The research study of the problem of mathematics teachers' training exposed a need to review and re-evaluate the methodological component of training. The present research is aimed at clarifying the essence of the concepts "education", "development" and "training", as well as at determining their correlations and influence on the formation of the student's personality. The given research dwells on structural characteristics of the concepts "personality", "personality formation" and "education", defines correlations and connections between them and determines conditions and driving forces that contribute to student's personality formation in the process of studying mathematics. It also formulates a definition of educational and developmental training by resorting to a minimal system of components and eliciting their significance in stimulating the formation and development of a child's personality in the process of studying. The analysis of philosophical, psychological, pedagogical and methodological studies, as well as conversations with teachers and methodologists, allowed us to accept the following definition of **the educational and developmental training**: *It is training organized with due regard for the individuality and singularity of the child's personality, ensuring comprehensive mastery of knowledge, forming active learning activity and directly affecting personal development and growth of the child.*

The teacher must remember that knowledge affects only the intellect and human thinking, but not consciousness at large. Knowledge appeals to the human brain, but not to the whole person. Even the mindset of a person is not always adequate to his/her knowledge. Therefore, in our opinion, education wherein training prevails, responds primarily to the question "What to do?", whereas the student studying at school should receive the answer to the question "How to live?". The question "How to live?" belongs to the domain of educational upbringing. Thus, the mission of education is to teach students to live and, what is more important, to teach students not just to live, but to live with dignity, in conformity with the highest social criteria. When studying at school, students should not only gain knowledge, but also find the meaning of life, fill it with a specific value system.It was found out that educational and developmental training is driven by the following system of principles facilitating the formation of the child's personality:

- The process of upbringing plays the leading part in the formation of the child's personality;

- The source of education and development lies in the student, his/her subjective experience, personal needs;

- The content of training should be adequate to the phases of the child's development and be conducted at such a level, by such methods and means that correspond to these phases and stimulate mental development;

- formation of the personality is carried out through practical activity, guided by a system of personally-meaningful motives, interests, beliefs and ideals that are important to the individual;

- Identification of "zones of proximal development" and special sensitive periods should be a method of development diagnostics and a way of expanding the scope of activity.

The analysis of academic literature and the results of the experimental work have made it possible to determine the model of the learning process essential for the implementation of the educational and developmental functions of the school course of mathematics. The model consists of the following structural components: *didactic conditions*, actualizing the educational and developmental functions of teaching mathematics; *objectives of training*, whose priority is educational and developmental functions of the educational process; *content of learning* adequate to the leading types of mathematical activity, describing the essence of the subject of mathematics, its leading ideas and methods of cognition of reality, revealing the structure of mathematical objects; *methods and forms of training* that provide incentives for the motivational and cognitive spheres of students' activity, which form the basic mental processes and reflexive activity of students; *educational tools*, that complement the structure of the educational process and promote exploration and creative activity of students. A particular attention in the study is given to the methodological literacy of the teacher which includes presentation of the material and *explanation*. It has great developmental and educational opportunities that help to ensure vigorous mental activity of students. The *ability* of the teacher to describe an object and reasonably explain the material is an important indicator of his research style and pedagogical activity. The implementation of the above is shown in two examples below:

a) Solve the equation $|x-2|+|x+3|=5$.

The standard solution presupposes splitting of the number axis into intervals with the points $x = 2,\ x = -3$ with the respective zeroing of the submodular expressions, and further expanding of the modules at each of the obtained intervals. The teacher draws attention to the fact that the module is the distance, hence the problem of the task is to find such x, whose distances to the points $x = -3,\ x = 2$, when summed up, amount to 5 (such x make up the interval $-3 \le x \le 2$).

b) Find the values of the parameter **a**, for which the system of equations has more than two solutions.

$$\begin{cases} 7ax + 4y = -8, \\ x + 7ay = 49a^2 \end{cases}$$

The standard approach to solving the equation presupposes the expression of one of the equation unknowns and substituting it into another equation. The teacher offers to students to form a geometric image for each equation (each equation is a straight line, and straight lines on the plane can be either parallel, or coincident, or intersecting); since it is required to find the values of the parameter **a**, for which the system has more than two solutions, coincident straight lines are the most appropriate variant. Thence we have:

$$\begin{cases} y = -\dfrac{7a}{4}x - 2, \\ y = -\dfrac{1}{7a}x + 7a, \end{cases} \Rightarrow \begin{cases} -\dfrac{7a}{4} = -\dfrac{1}{7a}, \\ 7a = -2,\ a = -\dfrac{2}{7}. \end{cases}$$

In the process of description there occurs not only statement of facts, but also growth of knowledge, its development and enrichment. To describe an object the researcher resorts to such logical methods as: collation, comparison, analysis, synthesis, generalization, etc. In the process of solving tasks, the teacher, having asked a question, gave the students an opportunity to think first and only then demanded the right answer. It is very important for the formation of thinking that the student should be able to explain how he came to this or that solution, what actions he made, why he gave up some of the ideas, etc. If training goes in this way, the teacher gets an overview of the student's thinking and his/her level of development. It is proved that teaching mathematics at school demands achieving a balance between the empirical and theoretical levels of cognition; it is undesirable to overuse excessive specifics and visual images. However, a hasty transition to a theoretical level without reliance on the empirical level leads to a restraint in the development of children. The results of our experimental work also proved that school researches in the field of mathematics are very effective for the realization of the educational and developmental functions of teaching mathematics. Below is given one of the variants of the control work for the eleventh form, the completion of which attests of the students' possession of heuristic techniques:

1. Solve the inequality: $8^{\frac{3x-1}{3}} < 4^{\frac{x+3}{2}}$

2. Solve the equation: $\log_3(x+1) + \log_3(x+3) = 1$

3. Solve the equation: $\sin x + \sin 2x + \sin 3x = 1$

4. Solve the equation: $\sqrt{x^2 - 3x + 5} + x^2 = 3x + 7$

5. For what values of the parameter **a** does the equation $(a-1)x^2+2(2a+1)x+(4a+3)=0$ have only solution satisfying the condition -2<x<3?

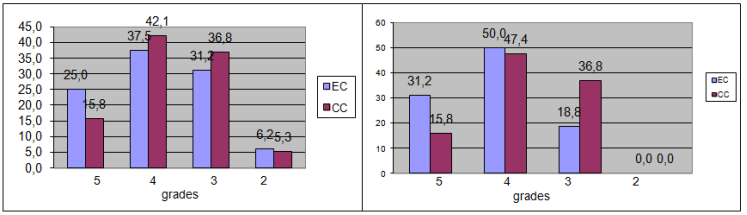
The level of complexity of the first three tasks corresponds to most tasks of the textbook. The fourth and the fifth tasks are heuristic: they test the level of development of students and require creative application of knowledge, analysis of non-standard situations, independence. The results of the test work are shown in Table 1.As we can see in the table, although the results of the first three tasks in both classes are almost identical, the ratio of excellent and good grades in the experimental class is about 18% higher. Consequently, significant changes in the mental development of schoolchildren of the experimental class are experimentally confirmed through the use of the developmental method of teaching.

Table 1. Results of the test

Number of the solved tasks	Completed the test successfully			
	Experimental class EC(27 pupils)		Control class CC(26 pupils)	
	Number of pupils	%	Number of pupils	%
5	2	7,4	-	-
4	5	18,5	2	7,6
3	11	40,7	11	42,3
2	7	25,9	10	38,4
1	2	7,4	3	11,5
0	-	-	-	-

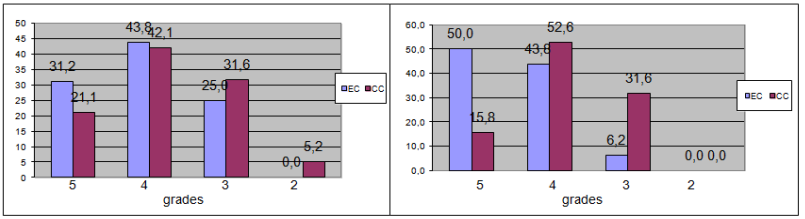
The results that we achieved due to the use of our methodology are shown in the following histograms (histograms on the left show the results obtained before the experiment, and histograms on the right show the results after the experiment).

Histogram of the assessment of school students' skills to solve problems



Histogram 1 Histogram 2

Histogram of students' methodological maturity



Histogram 3 Histogram 4

Having completed the experiment, we came to the conclusion that teachers have accumulated a solid experience of using productive methods of teaching mathematics; schoolchildren and university students are interested in acquiring learning skills that contribute to revealing the educational and developmental potential of the content of mathematics. However, both teachers and students need to understand the essence of the educational and developmental teaching mathematics and broaden their knowledge of innovative technologies. In cooperation with students and teachers, we identified a range of new problems that may serve as the basis for further research:

- The formation of professional qualities of the future mathematics teacher, ensuring the effective implementation of the educational and

developmental functions of the school course of mathematics in the context of the core, baseline and special competencies;

- The study of various aspects of educational and development mathematics training at school in the context of globalization and integration into the world educational space.

A teacher, putting forth a question, should give students an opportunity to think it over first and only then ask for the right answer, since for the formation of thinking it is very important to get students to explain how they came to the solution of this task, what steps they made, why they had to give up this or that idea, etc. By organizing training in such a way, the teacher will get an idea of the student's thinking and the level of his/her mental maturity. To check the level of students' logical thinking maturity, it is useful to give students problems and exercises on the operations: comparison; classification; generalizations; analogical inference; analysis and synthesis.

4. DISCUSSIONS

The problem of educational and developmental content, as well as education and upbringing, has long concerned scientists around the world. There have been conducted numerous studies in this sphere by Kazakhstani and foreign scientists. There exist different points of view on this issue. Thus, according to one of them, training is development (James, 1985, Morgan and Sørensen, 1999, Schmidt, et al., 2007): in its supporters 'opinion, training merges fully with development, and every step in learning corresponds to a step in the development. Another point of view, proposed by the French psychologist J. Piaget and his school, denies

the connection between training and development. J. Piaget believes that training is just an external condition of maturation (Horn, 2005). Most researchers adhere to the point of view offered by L. Vygotsky. According to him, training leads to development and must go ahead of it, playing a leading role in the child's mental development (Vygotsky, 1987). Thus, according to the fundamental thesis of L. Vygotsky, training and development represent a unity, wherein training comes ahead of development and stimulates it, basing itself, at the same time, on the actual development. The idea of the developmental training offered by Vygotsky was later supported and developed in the works and educational practices of (Sechenov, 1947, Vaillant, 1971, Leontiev, 1983), etc. The theory of developmental training does not have a common conceptual foundation today and is presented in various distinctive directions. In modern Russian pedagogy the concept of person-centered developmental training was studied by I. Yakimanskaya from the stand point of psychology. According to I. Yakimanskaya, the aim of training consists in the development of the student's individuality (Yakimanskaya, ET AL., 2017). In the academic and pedagogical literature of Russia and Kazakhstan, references to the researches on the problems of education, upbringing and development can be found in the works of I. Depman (1946, On the Educational Significance of Mathematics), G. Ganeeva (1997, Theoretical Foundations of Developmental Teaching Mathematics in Secondary Schools), S. Slepkan (1987, Methodological system for the realization of the developing function of teaching mathematics), K. Kozhabaev (1988, Teaching mathematics at school and its role in the bringing-up process), etc. The problems of development and training were also considered by the outstanding mathematicians (Smith, 2000, Chen, 2012, Tagunova, et al., 2016) and others.

In our study a particular importance was attached to the works of (Smith, 2000), which offer certain solutions to the theoretical and methodological problems of implementing developmental function of teaching mathematics in secondary schools as well as their ways of encouraging unconventional and critical thinking. Reference to the works of the mentioned authors, as well as to a number of dissertational theses on educational and developmental training, indicates the inexhaustibility of this problem, diversity of approaches to its solution and the ever-growing interest in educational and developmental training. Having analyzed academic literature and the results of the experimental work, we can conclude that any work is carried out in two directions: external, or visible, and internal, not visible for an outsider and whose fulfillment the doers themselves are not conscious of. Observation over the course of the student's "inner thought" will allow the teacher to learn the strong and weak sides of the student's thinking so that the teacher might, when necessary, direct the student's thinking on the right track. Therefore, in order to teach students to solve mathematical problems, it is very important to understand the students' reasoning when they are solving the task. How did the students understand the statement of the problem? What are they going to do? What is the sequence of their thoughts in search of the solution to the problem? The teacher can receive this information asking such questions as "Why?", "On what grounds?",etc. Mathematics training material can mostly conform to the objectives of the educational and developmental training when it gets in line with the following principles:

-school course of mathematics must be worked out on the basis of the contemporary science, pedagogically adapted to the age of the child and the objectives of the instruction;

- Theoretical material must, whenever possible, accord with its state and interpretation in science, and be presented to students within a certain didactic system;

- Theoretical material must be presented as an object for finding a solution to the problem, actualizing the new knowledge;

- Presentation of the learning material should focus not on memorization, but on understanding; presentation of the learning material should base on the cross-cutting (key) issues of mathematics;

- Introduction of the theoretical material and its studying must be motivated and justified;

- Humanization and humanitarization must be prioritized in the content of training; the applied and practical orientation of the school course of mathematics should be enhanced;

- Interdisciplinary and interdisciplinary connections must be realized; worldview (educational) orientation of the knowledge obtained in school should be increased;

- The content of the learning material must be adequate to the development of the students' logic thinking; the level of complexity of the learning material should be taken into account in order to require minimal assistance from the teachers;

- The interest of pupils to mathematics should be encouraged and developed;

- The content of the learning material should be enriched by using additional material that contributes to the upbringing and development of students;

- The presented material must be given in the form of a harmonious didactic system with delimited levels of complexity;

- Training tasks should be widely used.

The process of activating students' learning and cognitive activity can be presented as two stages: 1) the awakening and development of interest as a means of motivating to activity; 2) directing this awakened activity of students.

5. CONCLUSION

Since the early eighties, in response to many protests that ignore teacher as a job and not a profession, new approaches to teachers were introduced as "professional interns." One of the most significant and influential events of this decade was the use of the "teacher-researcher" approach, rooted in critical theories, and in particular, the "action research" or "action research" view. The great goal of mathematical education is to strengthen the power of thought. Students need to learn knowledge and skills in mathematics, science and reading, in order to deal with the challenges of life so that they can solve complex life problems by processing information from the world around them. Taking into account special characteristics of mathematics as a science and a discipline, proceeding from the psychological and pedagogical approaches to the creation of pedagogical systems and methodology of the system approach, basing on the outcomes achieved in the course of the research, we obtained the following results:

A theory of educational and developmental teaching mathematics was worked out, and there was also created a model of using the content

of the school course of mathematics to promote upbringing and development of the student's personality. The theoretical and experimental research proved that when the conditions formulated in the hypothesis are fulfilled, the quality of future teachers' preparedness for implementing educational and developmental training at mathematics lessons are considerably improved. Only specially organized training for students will help them to acquire efficient learning skills essential for the organization of educational and developmental training by means of the school course of mathematics.

It has been proved that teaching mathematics will be educational and developmental only if there is interrelatedness of three constituent principles of the educational process:

a) Change of the student's status: transition from being the object of the learning activity to the position of the subject;

b) Training is conducted in the zone of proximal development;

c) Training promotes upbringing and development of mathematical abilities.

Findings of the research showed that teaching by providing visualization-based activities was significantly influenced by students' perceptions of the concept of marginalizing and the difference between the two groups in this regard. But presentation of visualization activities in the teaching of the limit does not affect the students' spatial ability. In this regard, the difference between the two groups is not meaningful.

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