Abstract
of the dissertation of Totikova Guldana Arynovna for the degree of Doctor (PhD) in the specialty 6D010900 - "Mathematics" on the topic "Formation and criteria estimation of spatial representations of pupils when in traning mathematics in primary classes»

Relevance of the study.

Modern socio-cultural, economic and political changes in the Republic of Kazakhstan require improving the quality of work on the education of generations, identifying ways to effectively solve it. In the conditions of modern development of society, it is necessary to search for and update innovative directions of pedagogical activity, which is a priority task of education in the Republic of Kazakhstan.

In the program article of the Head of State N. A. Nazarbayev "Looking to the future: modernization of public consciousness", reflecting on the main functions and features of modernization, he emphasizes the importance of modernization: "The new modernization should not, as before, look arrogantly at historical experience and traditions. On the contrary, it should make the best traditions a prerequisite, an important condition for the success of modernization. Without relying on national and cultural roots, modernization will hang in the air. I want her to stay firmly on the ground. This means that history and national traditions must be taken into account."

Also in the program article, several directions of modernization of the consciousness of society as a whole and of every citizen of Kazakhstan are named. One of these areas is the "triumph of knowledge". In the direction of "the cult of knowledge", it is clearly stated that the most fundamental and main factor of success is education. This proves that education has always occupied a leading position, most importantly. And given that the foundation of knowledge remains in elementary school, the dissertation work can serve as a basis for being focused on an important issue.

In the National Report on the state and Development of the education system of the Republic of Kazakhstan at the end of 2018, in the analytical comparative information on the position of the education system of Kazakhstan in international rankings, it is noted that according to the PISA-2018 indicator, Kazakh schoolchildren took 71st place out of 79 countries in reading literacy, 55th place in mathematical literacy, 70th place in natural science literacy. PIRLS indicates that in 2016, 4th grade students rank 27th in reading literacy among 50 states.

Consequently, the quality of education of Kazakhstani schoolchildren in comparison with the world quality of education remains low. Therefore, significant changes are needed to improve the quality of education. From the point of view of our research, the formation of spatial understanding of students from primary school is important and relevant. After all, the formation of spatial understanding is necessary so that students can use the acquired knowledge in connection with life and correctly navigate the environment.

The state program for the development of education and science of the Republic of Kazakhstan for 2020 – 2025 identifies current issues that need to be addressed in the domestic system of education and science. One of them is the fact that the mathematical literacy of Kazakhstani schoolchildren is significantly lower than the average of the OECD member countries, and if this issue is not resolved in the near future, the national capital may deteriorate and the country's economic potential may decrease. In the development of mathematical literacy, it is important to form a spatial understanding of students. After all, this is necessary so that students, forming a spatial understanding, can relate the acquired knowledge to life and correctly navigate in the environment. In this context, the formation of spatial understanding, starting from the 1st grade, is one of the most urgent problems.

The priority goal of education in a modern school is the development of a person who is ready for effective interaction with the external environment, self-education and self-development. It is known that in the twenty-first century, the demand is for people who can create new ideas, initiate initiatives, and not for those who can do something. Consequently, the quality of knowledge provided from primary school is certainly of paramount importance. Meanwhile, the formation of spatial representations in primary school students associated with the assimilation of geometric material is one of the tasks of mathematical education. In the process of forming spatial representations, the mental activity of younger schoolchildren develops, the level of their judgment increases, i.e., the use of such methods of judgment in practice is activated, such as: analysis and generalization, comparison, classification, clarification, abstraction and generalization.

The formation of spatial representations associated with the assimilation of geometric material in primary school students is one of the tasks of mathematical education. In the process of forming spatial representations, the mental activity of younger schoolchildren develops, the level of their judgment increases, i.e., the use of such methods of judgment in practice is activated, such as: analysis and generalization, comparison, classification, clarification, abstraction and generalization.

The multiple increase in the information flow in the modern world gives an impetus to the development of interest in the problem of the formation of spatial representations in mathematics lessons in primary school children.

Therefore, the formation of spatial representations of students is one of the main tasks of teaching school mathematics. When purposefully implementing the process of forming spatial representations, the teacher should not only master the subject in depth, the teaching method, but also know the psychological and physiological features of the formation of spatial representations: "the emergence of feeling", "the development of perception and intuition", "the transition from feeling to thinking", etc.

This is not only one's own internal task in mastering the geometry course, but also one of the goals necessary to prepare students for the future life, i.e. for socially useful work. The problem of forming spatial representations in the correct

perception of the three-dimensional world and the objects located in it and their relative position is very relevant.

Therefore, in the era of advanced globalization of modern science and technology, the issue of forming and developing students ' spatial ideas about the future of a sovereign country – in front of educational institutions that educate today's youth-schools and kindergartens-becomes relevant.

The primary school has accumulated considerable experience in the formation and improvement of spatial representations of students. This question did not fall into the object of research of psychologists, teachers and methodologists. The problem of forming spatial representations in Russian scientists B. G. Ananyev, I. S. Yakimanskaya, N. I. Pustovalova, L. S. Vygodsky, P. Ya.Galperin, S. L. Rubinstein, T. I. Shamova and Kazakh scientists A. E. Abylkasymova, D. Rakhimbek, N. K. Madiyarov, B. Baymukhanov, M. E. Esmukan, K. T. Iskakhova, D. A. Zhunisbekova, etc. In these studies, the psychological and pedagogical foundations of the formation and development of spatial representations and representations of students are presented. Meanwhile, many specific methodological problems that considered some individual didactic aspects of our research problem, including the ways of forming and developing spatial representations of students in the process of teaching geometry, are presented in the works of G. D. Glazer, A.M. Pyshkalo, K. I. Neshkov, A.D. Semushin, B. M. Zazulyak, N. B. Istomin, I. G. Lipatnikov, E. V. Znamenskaya, S. V. Verchenko, B. F. Lomov, N. Ya.Semago, M. A. Goncharova, V. A. Kozhevnikov, L. T. Iskakova, S. A. Dzhanaberdieva, T. K. Ospanov, Sh.Kh.Kurmanalina, S. Sh.Sarsenbayeva, R. K. Omirtayeva, R. Ibragimov, A. A. Kdyrbayeva, K. G. Kozhabaev, N. K..Madiyarov et al.

In addition, the problem of the formation and development of spatial representations was dealt with by many other methodist mathematicians. In particular, M. A. Gabova, O. I. Galkina, A. M. Pyshkalo, A. E. Abylkasymova, D. Rakhimbek, N. K. Madiyarov, Ibragimov R., Galymova A. G. R. I. Kenzhebekova, M. U. Musabekov, S. O. Zhetpisbayeva and others.

A. M. Pyshkalo in his works on the study of the study of geometric material in primary classes notes that "spatial representations, being the basis for the development of spatial thinking, reflect the relationship and properties of real objects, i.e. the properties of three-dimensional visible or perceived space", warns that the problems of the formation of spatial representations in primary school are not studied.

A. E. Abylkasymova, D. Rakhimbek, R. Ibragimov investigated the problems associated with the formation of new concepts and the development of spatial imagination and the formation of spatial representations of high school students using visual aids in solving problems related to the study of stereometric material. In the study of scientists above, it is proved that the most important source of the formation of spatial representations of schoolchildren is the use of three-dimensional bodies when teaching planimetry. In the practice of schools, as a rule, flat figures are studied in most cases outside the bodies belonging to the

environment. As a result, the stock of spatial representations of students is poorly accumulated and it is difficult during the transition to teaching the course of stereometry, in performing various constructive operations related to stereometric forms. The use of spatial bodies and objects of the environment in teaching planimetry is extremely necessary, since it allows you to correlate abstract geometric concepts with specific objects, models and images of geometric shapes, and contributes to the development of spatial representations of students. In the above-mentioned research works of methodologists, a system of exercises for the formation and development of spatial representations is given, during which the basic planimetric concepts are fixed. The system of methodological techniques provides for the compilation and preparation of visual aids in mathematics and problem solving.

In the research work of N. K. Magyarov, methods for the development of spatial representations of students based on the solution of purposefully selected stereometric construction problems in geometry lessons are considered. In the course of stereometry, the cognitive, psychological and didactic foundations of the formation of spatial representations of students are defined. The method of forming spatial representations in the process of learning geometry based on the selected tasks for the purpose of constructing geometric shapes in space is developed. She revealed the role of stereometric tasks in the formation of spatial representations of students.

Despite the fact that the object of this research work is the problems of forming spatial representations in middle and senior school students, these works do not take into account the characteristics of younger students.

The main units of updating the content of education are the concepts of competence, which become integrative indicators of assessing the quality of education. In accordance with this, the choice of assessment technology based on a competence-based approach should be approached taking into account the individual characteristics of students and implementing the development of a variable educational environment. Hence, there is a need to create a universal assessment system that meets all the requirements of modern society and the needs of the student's personality.

Domestic and foreign scientists offer a test method for monitoring the level of formation of spatial representations. For the purpose of deeper verification of the level of development of spatial representations and its objective assessment, a system of diagnostic tasks was developed by I. S. Yakimanskaya, V. G. Zarkhin, H.-M. H. Kadayas, N. Ya. Semago, M. M. Semago . Also, as a result of studying the features of spatial representations in various academic disciplines of primary school, scientists proposed to introduce a system of special credit education.

Since the 2016-2017 academic year, mathematics of the 1st grade has been taught according to the updated curriculum. The updated curricula reflect the need to study geometric material and form spatial representations and representations of primary school children based on it.

It has shown the need to determine the formation and development of spatial representations of students using the technology of criteria-based assessment of educational achievements that meets all the requirements of modern society.

To achieve the child's ability to learn independently, the control and evaluation independence of the child is of particular importance, that is, the willingness and ability to control and evaluate his activities, identify and eliminate the causes of difficulties. The formation of these skills-control and evaluation activities in school, requires a review of its goals, content and technologies. Over the past twenty years, the issues related to the assessment of students ' academic achievements have been repeatedly revised.

In this regard, as one of the modern scientific directions, research work was not carried out on the issues of determining the pedagogical foundations for the formation and development of educational and cognitive competence of students using the technology of criteria-based assessment of educational achievements in accordance with the spatial representations of students.

The appearance of a number of contradictions between the updating of the content of primary school mathematics and the study of methodological problems necessary for the formation of spatial representations of students, one of the goals of teaching mathematics in primary classes, served as the basis for choosing the topic of the dissertation "Formation and criteria estimation of spatial representations of pupils when in traning mathematics in primary classes".

The purpose of the study: to identify the psychological and pedagogical basis for the formation of spatial representations of students when teaching primary school mathematics in the framework of the updated educational program, to develop a teaching methodology based on criteria-based assessment, and to prove its effectiveness in practice.

Object of research: the process of teaching mathematics in primary schools.

The subject of the study: the process of formation of spatial representations of students and criteria-based assessment of the levels of their formation in the study of primary school mathematics.

Expected results of the study: if the methodology of forming students 'spatial representations is developed in the study of primary school mathematics, and shortcomings are corrected in a timely manner on the basis of criteria-based assessment, then the main goals of teaching mathematics will be achieved and the quality of knowledge will increase, since the correct formation of students' spatial representations will have a direct positive impact on the quality of their mathematical knowledge.

Research problem: improving the methodology of forming spatial representations of students in the transition to the updated content of teaching mathematics in primary classes and developing methods for its criteria-based assessment.

Based on the object, subject, purpose, and scientific forecast of the study, the following **research objectives** were determined:

1. To identify the physiological, psychological, and pedagogical foundations of the formation of spatial representations in primary school children;

2. Determine the didactic conditions for the formation of spatial representations of students in the study of primary school mathematics;

3. Development of a technology for criteria-based assessment of the formation of spatial representations of students in the study of primary school mathematics according to the updated program;

4. To prove experimentally the effectiveness of the method of forming spatial representations based on criteria-based assessment in the process of teaching elementary school mathematics.

The main idea of the research is to identify and correct the gaps that have occurred by providing and evaluating an effective methodology for implementing the formation of spatial representations of students in teaching elementary school mathematics.

The methodological and theoretical foundations of the research work are the theory of knowledge, consistency, activity, principles of evaluation, differentiation and individualization of learning, humanization of education, theories of pedagogical, mathematical education and methods, physiology of schoolchildren, psychology and methodological prerequisites.

Sources of research: The Constitution of the Republic of Kazakhstan, the Law of the Republic of Kazakhstan "On Education", the State Program for the Development of Education and Science of the Republic of Kazakhstan for 2016-2019, and from 2019 the state program for the development of education and science of the Republic of Kazakhstan for 2020-2025, the works of philosophers, psychologists, teachers, methodologists related to the problem of research, official documents in the field of education, mandatory educational standards, curricula and programs.

Research methods: review and analysis of scientific-methodological and psychological-pedagogical literature on the problem of research, assessment methods used in the educational process of primary school; generalization and study of the experience of forming spatial representations of students; conversations with primary school teachers, questioning them; statistical processing and analysis of research results.

Research stages:

Stage I (2016-2017) - An analysis of the literature on the topic of the study was carried out, the initial data were summarized, the main idea of the study was determined, and the stages of the pedagogical experiment were identified. The analysis of the current state of the formation of spatial representations of students in the study of primary school mathematics is carried out and the state of criteria-based assessment in primary school in the conditions of transition to the updated content of education is determined. The psychological and pedagogical bases of formation of spatial representations in primary school are defined, the purpose and tasks, object and subject of research and the scientific forecast of research are specified, the ascertaining experiment is carried out.

Stage II (2017-2018)-The physiological and pedagogical foundations of the formation of spatial representations of students in the study of primary school mathematics were determined, a didactic model of the formation of spatial representations of students in the study of primary school mathematics was created. According to the results of the ascertaining experiment, a correction experiment was conducted. The method of forming spatial representations of students in the study of primary school mathematics according to the updated program has been developed and a system of exercises has been created. The formative experimental work is carried out, the analysis of intermediate results is carried out.

Stage III (2018-2019) - The method of forming students ' spatial representations and their criteria-based assessment in the process of teaching primary school mathematics is revealed. Indicators of the formation of spatial representations of students are formed. In the course of the study, a qualitative and quantitative analysis of the results of the experimental work carried out to prove the effectiveness of the developed methodology was carried out, and the results were summarized. According to the conducted research, conclusions were formulated, the dissertation work was designed in accordance with the requirements.

Research base: Turkestan region, Kelessky district, general secondary school No. 49 "Konyrtobe" and the city of Shymkent, school-gymnasium No. 47 named after T. Tazhibayev.

Scientific novelty of the study:

1. the pedagogical, psychological and physiological foundations of the formation of spatial representations of students in the study of primary school mathematics are determined;

2. didactic conditions for the formation of spatial representations of students in the training according to the updated program have been developed;

3. the method of forming spatial representations of students and their criteria-based assessment in the study of primary school mathematics according to the updated program is developed;

4. the effectiveness of the methodology for the formation of spatial representations in primary school children and its criteria-based assessment is proved on the basis of a pedagogical experiment.

The theoretical significance of the study: determination of the stages of formation and indicators of the development of spatial representations of students in the study of primary school mathematics, determination of the physiological and psychological foundations in accordance with the age characteristics of students and the creation of didactic conditions for the formation of spatial representations of younger students on its basis.

The practical significance of the study is to identify the prerequisites for the formation of students 'spatial representations in the study of primary school mathematics; to present ways to effectively use the methods, forms and means of forming students' spatial representations in the process of teaching geometric

material according to the updated program; to build a model of criteria-based assessment of students ' spatial representations; to develop methodological recommendations for building a recommended system of exercises to correct the identified shortcomings.

The developed materials can be used in the process of teaching primary school mathematics. The results of the research work and the developed methodology can be used by primary school teachers and students, methodologists.

Main provisions put forward for defense:

1. The quality of the formation of spatial representations of primary school students and its criteria-based assessment is influenced by the levels of development of their spatial imagination, images of figures, performing operations on drawings, models of figures, visual-graphic, speech transmission of the results of the analysis of educational material.

2. In connection with the formation of spatial representations in primary school students, the following principles are proposed: the choice of educational material, names, definitions, correct application of rules, types of work on writing, measurement, construction, calculation, modeling and conditions for their leveling, rules for determining the degrees of knowledge acquired by primary school students individually, and, accordingly, technologies for criteria-based assessment.

3. The method of forming spatial representations of primary school children and its criteria-based assessment is developed, and its effectiveness is proved on the basis of a pedagogical experiment.

The identification of the stages of formation and indicators of the development of spatial representations in primary school children, the creation of didactic conditions allow us to effectively organize this problem in mathematics lessons. There is a need to develop and implement systems of special tasks and exercises.

Within the framework of criteria-based assessment, it allows students to significantly stimulate the implementation of formative types of educational activities and spatial representations, expand the possibilities of analysis, and improve the quality of learning.

1. Evidence and validity of research results comprehensive analysis of physiological, psychological, pedagogical, educational and methodological literature and scientific works in accordance with the topic of the study and their justification in the course of the study; logical application of methods in accordance with the scientific apparatus of the study; criteria-based assessment of the formation of spatial representations of primary school students by methods corresponding to theoretical and experimental results is provided by the use of mathematical statistics in teaching primary school mathematics and processing the results of practice.

Approbation of the research results. In total, 22 scientific and methodological works have been published on the topic of the research work. Among them: in scientific publications recommended by the Committee for quality

assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan-3, in scientific journals included in the Scopus and Web of Science database-2, at international scientific and practical conferences of the Republic of Kazakhstan-8, at foreign international scientific and practical conferences-4, in foreign scientific journals - 2, copyright certificate -2 (No. 3178, dated 04.05.2019, No. 3351, dated 16.05.2019), a textbook approved by the UMK of the Ministry of Education and Science of the Republic of Kazakhstan - 1.

1. International scientific and practical Conference "Kazakhstan's Way: 25 years of peace and Creation together with the leader of the nation" (Shymkent, 2016);

2. International scientific and practical conference of undergraduates, PhD students and young applicants of the SKSU named after M. Auezov. (Shymkent, 2016);

3. XI International Scientific and Practical Conference "Europa Science". (Moscow, 2017);

4. The 19th Scientific Student Conference of M. Auezov SKSU "In the new global reality-the contribution of youth to the development of Kazakhstan" (Shymkent, 2016);

5. International Scientific and Practical Conference "Scientific Research: Key problems of the Third Millennium" (Moscow, 2016);

6. Republican student scientific and practical conference "Actual problems of youth in the new world conditions and ways to solve them" (Shymkent, 2020);

7. VIII International Scientific and Practical Conference " Mathematics, Education, Culture "(200 years since the birth of Karl Friedrich Gauss) at the International Scientific and Practical Conference (Tolyatti, 2017);

8. VIII International Scientific and Practical Conference " Mathematics, Education, Culture "(200 years since the birth of Karl Friedrich Gauss) at the International Scientific and Practical Conference (Tolyatti, 2017);

9. Science and life of Kazakhstan. International popular science magazine. (Astana, 2017);

10. International scientific and practical Conference "Auezov Readings-15: The Third modernization of Kazakhstan-New concepts and modern solutions", dedicated to the 120th anniversary of M. Auezov (Shymkent, 2017);

11. Bulletin, L. N. Gumilyov Eurasian National University, (Astana, 2017);

12. Scientific almanac. RSCI. (Tambov, 2018);

13. International scientific and Practical Conference "Auezov Readings-16:" The Fourth Industrial Revolution: New opportunities for modernization in the field of science, education and culture of Kazakhstan", dedicated to the 25th anniversary of Independence of the Republic of Kazakhstan (Shymkent, 2018);

14. 39th International Scientific Conference of the Eurasian Scientific Association Strategies for the Sustainable Development of World Science (Moscow 2018);

15. Science and life of Kazakhstan. International scientific journal. (Astana, 2019);

16. II International Forum of Modern Teachers " Modern Education: Challenges, Trends and Strategies "(Shymkent, 2019);

17. "Auezov Readings-18: International Scientific and Practical Conference "Spiritual heritage of the Great Abai", dedicated to the 175th anniversary of Abai Kunanbayev (Shymkent, 2020);

18. Criteria-based Assessment of Spatial Representations in Primary School Students Elementary Education Online, (Turkey, 2019); doi: 10.17051/ilkonline.2019.561888;

19. Effectiveness Of Development Of Spatial Thinking In Schoolchildren Of Junior Classes By Application Of Plane And Spatial Modeling Of Geometric Figures In Didactic Games. European Journal of Contemporary Education, (Slovak Republic, 2020): DOI: 10.13187/ejced.2020.4.902

20. Certificate of entering information into the State Register of Rights to Objects Protected by Copyright, No. 3178 (Astana, 2019);

21. Certificate of entering information into the State Register of Rights to Objects Protected by Copyright, No. 3351 (Astana, 2019);

2. Formation of spatial representations and criteria-based assessment of students in the study of primary school mathematics. training manual, RMS MES RK, (Shymkent, 2019);

Structure and content of the dissertation: The dissertation consists of normative references, definitions, introduction, conclusions and conclusions for two chapters and chapters, a list of references, appendices.

The dissertation work is presented on 143 pages of computer text and includes 7 diagrams, 42 figures, 16 tables. The list of references consists of 183 titles.

The introduction reveals the contradiction in the research problem, substantiates the relevance, establishes the object, subject, purpose and objectives of the research, scientific forecast; describes the research methods, scientific novelty and theoretical, practical significance; outlines the main provisions submitted for defense, provides data on the verification and implementation of the results achieved.

In the first section -1) The analysis of the conducted research on the problem of the formation of spatial representations of students in the study of primary school mathematics is carried out. Here, in the context of the transition to the updated content of education, the problem of criteria-based assessment of the formation of spatial representations of students in teaching primary school mathematics has not yet been sufficiently solved.

2) Currently in the primary school curriculum-in accordance with the main goals of mathematical literacy, the subject defines several tasks. One of them is the development of students ' skills in the use of spatial concepts (imagination) and mathematical terms. Meanwhile, spatial representations are the basis of the totality of higher mental processes, such as reading, writing, computing, thinking, etc. Here it became clear that mental images of objects are created that reflect the

spatial relationships of phenomena, movements, volumes, shapes, locations, and movements of objects.

3) The formation of spatial representations in younger schoolchildren is a psychological, pedagogical and methodological problem, since the mechanism of spatial perception of students changes and improves in the process of their educational, educational and cognitive activities and the development of personally significant qualities.

4) Didactic conditions for the formation of spatial representations of students in the study of elementary school mathematics have been created.

In the second part - 1), a model of the criterion system for evaluating students ' activities, which forms their spatial representations, along with educational achievements, is developed, and a methodology for its implementation is proposed, and priorities are determined.

2) An analysis of the system of exercises in school textbooks is carried out, a system of additional exercises for the formation of spatial representations is created, and a teaching method is proposed.

3) The effectiveness of the criteria-based assessment system is determined: it allows the teacher to objectively evaluate the student's academic achievements; allows them to understand the difficulties that arise in students, as well as to evaluate them; parents are provided with reliable evidence of the child's educational achievements. The indicators of the formation of spatial representations of students and the effectiveness of the methodology of their criterion assessment were experimentally tested.

In conclusion, the results of the theoretical analysis of psychological, physiological, and pedagogical literature, generalization of data on the technologies of forming spatial representations and criteria-based assessment of students in the study of primary school mathematics, and conclusions from them on the possibilities of determining effective activity.

Recommendations are given for the formation of spatial representations of students and the criterion assessment of their level of formation, as a system of exercises using mental operations performed in a certain order, with a level distribution of the main topics.

A structural and content model of the process of forming spatial representations of primary school children and its criteria-based assessment is developed.

The types of tasks that ensure the effectiveness of the process of forming spatial representations and criteria-based assessment of students are determined, conclusions are given on level topics aimed at developing methods of criteria-based assessment in accordance with the types of tasks.

The conclusion is made on the methodology of forming spatial representations of students and the development of criteria-based assessment.

The effectiveness of the proposed methodology for the formation of spatial representations of students and the development of criteria-based assessment is proved as a result of a pedagogical experiment.