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TÍTULO: Aspectos psicológicos y pedagógicos de la enseñanza de las ciencias naturales.

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RESUMEN: La educación se está modernizando y renovando. Los objetivos, las prioridades, el contenido y los valores de la educación general primaria están cambiando en la formación de conocimientos, y el desarrollo de la personalidad y habilidades de los niños. Estos cambios afectan la educación en ciencias naturales en la escuela primaria. Al enseñar ciencias naturales en la escuela primaria, la tarea de desarrollar la personalidad de los niños, la formación de los fundamentos de su pensamiento científico en el campo de la naturaleza y la sociedad, y aprender a comprender el mundo que lo rodea, aparece en primer plano. Es posible formar estas cualidades teniendo en

cuenta los aspectos psicológicos y pedagógicos de la enseñanza de las ciencias naturales a los niños de primaria.

PALABRAS CLAVES: ciencias naturales, educación primaria, condiciones psicológicas, enfoques pedagógicos, contenidos educativos actualizados.

TITLE: Psychological and pedagogical aspects of teaching natural sciences.

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ABSTRACT: Modern education is being modernized and renewed. The goals, priorities, content, and values of primary general education are changing. There is a shift from the formation of knowledge, skills, and abilities to the development of children's personality and abilities. These changes affected the natural science education in elementary school. When teaching natural science in elementary school, the task of developing the personality of elementary schoolchildren, the formation of the foundations of their scientific thinking in the field of nature and society, and learning how to understand the world around, comes to the fore. It is possible to form these qualities

when taking into account the psychological and pedagogical aspects of teaching natural science to primary schoolchildren.

KEY WORDS: natural sciences, primary education, psychological conditions, pedagogical approaches, updated educational content.

INTRODUCTION.

Modern educational processes have led to dramatic changes in the strategy of primary education reflected in the correction of priorities and the content of the primary natural science education.

The analysis of philosophical, psychological, pedagogical and methodical literature enables revealing the contradictions between the following:

- Toughening requirements of society and the state to the level and quality of primary natural science education and the inability to implement these requirements in the traditional system when the necessary psychological and pedagogical environment for the formation of learning activities among primary schoolchildren is not created;
- The theoretical substantiation of the content of natural science education in modern primary school and insufficiently developed psychological and pedagogical conditions for teaching natural science to primary schoolchildren;
- The rich potential of the content of the course of elementary natural science education and the insufficient consideration of the psychological and pedagogical aspects of the natural science teaching to primary schoolchildren.

The research problem has been formulated on the basis of the identified contradictions. This problem consists in finding a model of an academic natural science lesson taking into account the psychological and pedagogical conditions of teaching in elementary school.

At various times philosophers, psychologists, and teachers studied the psychological and pedagogical conditions of natural science teaching (B.G. Ananyev, L.I. Bozhovich, A.N. Leontyev, V.N. Myasishchev, A.V. Petrovsky, and others). S.A. Amonashvili, Y.K. Babansky, P.Y. Galperin, V.V. Davydov, I.Y. Lerner, V.Y. Liaudis, M.N. Skatkin, N.F. Talyzina, L.V. Trubaychuk, and others considered the theoretical principles of the personality development of primary schoolchildren as educational participants. A.I. Bochkarev, V.I. Kuznetsova, and L.V. Moiseyev created modern natural science concepts. A.A. Vakhrushev, N.F. Vinogradova, Z.A. Klepinina, O.N. Lazareva, M.N. Skatkin, and others proposed ideas substantiating the process of the natural science education of primary schoolchildren. Y.V. Bondarevskaya, N.F. Talyzina and others expressed ideas about the peculiarities of personality development in the early school years.

The research takes into account significant works devoted to the development of natural science education in elementary school (A.A Vakhrushev, L.V. Vesnina, N.F. Vinogradova, Z.A. Klepinina, T.B. Kropacheva, N.G. Lavrentyeva, O.N. Lazareva, etc.), the development of the theory and practice of implementing pedagogical technologies (Y.V. Korotayeva, V.S. Kukushin, G.K. Selevko, etc.), problems of organizing educational activities (A.S. Granitskaya, V.K. Dyachenko, Y.V. Korotayeva, V.Y. Liaudis, etc.).

DEVELOPMENT.

In the modern environment, considerable attention is paid to the issue of personality developing of 6-10-years-old children, the formation of various types of their activities since it is in an elementary school that the foundations of initial scientific knowledge and the development of thinking are laid down (Teaching Natural Science, 1858; Williams, 1893; McComas, 2004). One of the theoretical foundations of the purposeful and intensive formation of scientific knowledge can be the process of forming the initial scientific concepts among primary schoolchildren, i.e. the use of specific methods that enhance students' interest in the process of obtaining knowledge of scientific concepts

in educational activities. The formation of the conceptual apparatus of primary schoolchildren regarding natural science knowledge requires an integrated approach for the interaction of the philosophical, psychological and pedagogical sciences that enables a deeper awareness and enrichment of empirical school practice.

In the psychological-pedagogical theory, various definitions of the initial concepts are given and are beginning to be studied in elementary school. S.P. Baranov and I.D. Lushnikov consider initial scientific concepts as abstractions based on sensual experience.

The proponents of the theory of the phased formation of mental actions (P.Y. Galperin, D.B. Davydov, and N.F. Talyzina) define the initial scientific concepts as a system of mental actions.

M.A. Danilov, V.V. Krayevsky, I.Y. Lerner, N.A. Menchinskaya, M.N. Skatkin, M.N. Shardakov, G.I. Shchukina, and A.V. Usov studied the structure, degree, and assimilation levels of concepts. The problem of the theory and practice of moral and environmental education is disclosed in the studies of Kazakh scientists such as G.K. Barlybayev, Y.Z. Battalkhanov, B. Gabdulina, A.A. Guseynov, Z. Zhatkanbayev, A.Y. Mankesh, R.M. Mustafina, M.N. Sarybekov, and N.S. Sarybekov.

The Kazakh Education Act states that the content of education should form students' worldview adequate to the modern knowledge and education levels (Nazarbayev, 2018). The formation of natural science concepts seems to be especially relevant since they lay the foundation of knowledge among schoolchildren. Children encounter natural phenomena very early and seek to know them (M. S. E., 1863; Natural Science 1873). However, direct experience cannot serve as material for independent generalization for the analysis of phenomena, and the identification of relationships between them (Leontiev, n.d.; Lemke, n.d.; Lemke, 1990).

The school curriculum has a section that implies the formation of elementary natural science concepts among primary schoolchildren. The implementation of this section builds a foundation of children's knowledge, contributes to the formation of their natural science knowledge. In addition, natural science concepts are the content that is most conducive to the development of children's thinking. The assimilation of elementary natural science concepts contributes to the development of children's curiosity (Meder, 1945; Laurillard, 2012; Skripko, 2016).

An important stage in the development of a child's social cognition is the transition of ideas about the world around them to a meaningful basis characterized by conceptual and semantic richness. V.V. Davydov studied the role and development of generalizations in primary school age in detail. In his research, he developed the main principles of L.S. Vygotsky.

J.A. Comenius, in his "Orbis Pictus", embodied, in modern terms, his concept of familiarizing a child with the world around him/her. His work is a kind of encyclopedia for children, in which the world is presented to the child in all its diversity and at the level of the development of the science of that time. The pictures and short texts accompanying them help children learn about the first human activities on the earth such as gardening, farming, and animal husbandry; about books, the art of speech, ethics, wisdom, humanitas, and other moral qualities; about physics, chemistry, and astronomy.

The analysis of psychological and pedagogical literature shows that in primary school age there are significant changes in a child's psyche. In this regard, the mastering of knowledge and ideas about the world rebuilds the "everyday concepts" that were formed earlier in children, and school thinking contributes to the development of theoretical thinking in the forms accessible to students of this age.

Objectively, there is a contradiction between the needs of the practice of forming natural science concepts and the degree of knowledge and scientific generality of the experience gained when forming ideas and concepts for primary schoolchildren.

A concept reflects the general principles and properties of objects. Judgment is the connection of concepts, through which the dependencies between things are reflected. Judgment, in fact, is nothing but the ability of thinking.

The main element of judgment are concepts that are connected in a certain way and give rise to a new thought structure. Judgments themselves help clarify the essence of a concept.

The elementary school course called "Natural Science" forms basic concepts that, for the first time, introduce children to the understanding of the laws of the world, rely on the sensory experience of primary schoolchildren and provide a transition from the concept of a phenomenon to its essence. Primary observations of various states of water, for example, do not yet enable establishing the awareness of the cause of a change in water. Schoolchildren cannot explain the characteristic signs of water, snow, fog, and ice since they have only generalized ideas. In the course of further practical work and observations, they learn that some objects consist of one substance and have a different state in the function of the different temperature of the medium. After that, on the basis of ideas, the initial scientific concepts about the properties of water are formed.

The main feature of the initial concepts lies in the fact that regardless of the age of the students, the initial awareness of the patterns and essence of an object or phenomenon occurs sensually. It means that the assimilation of the initial scientific concepts determines the transition of primary schoolchildren to the scientific knowledge about real objects and phenomena.

Every concept has its own characteristics depending on the different number of objects and phenomena reflected in them, as well as on interrelations with other concepts. These characteristics include content, scope, and dynamism.

Since the content of the "Natural Science" course is based on many sciences, this led to the borrowing of terms from the relevant scientific fields with the aim of a complete and clear formation of concepts. The most important task of the high-quality content of the course is the availability of new textbooks, in accordance with the new or updated content of education.

Working groups were created under the nationwide Scientific and Practical Center "Textbook." These working groups included secondary school teachers, teachers of Nazarbayev "Intellectual schools", teachers of universities, pedagogical institutes and colleges, who examined textbooks in accordance with the following characteristics:

1 - Compliance with the conceptual provisions of the state obligatory standard, model syllabus, and model curriculum.

2 - Observance of the basic scientific content of the course.

3 - Value orientation.

4 - Kazakh component.

5 - Practice orientation.

6 - Focus on the development of critical thinking and analytical skills.

7 - Focus on the development of research and independent creative work skills.

8 - Focus on the development of language competence and communication.

9 - Consistency, logical sequence and continuity of content.

10 - Conformity of content to age psychological features.

11 - Increased motivation for learning activities.

12 - Student-friendliness of teaching materials.

13 - Clearness of teaching materials.

14 - Observance of the principle of gender equality, non-admission of social infringement, consideration of the particularities of urban and rural areas.

15 - Compliance with the rules of writing.

16 - Quality of sources (references) of educational information.

17 - Compliance with the format, design of the cover and title page of the textbook and workbooks.

18 - Book design.

19 - Availability and quality of electronic applications (GR codes).

20 - Interactivity and multimedia.

21- Elimination of shortcomings according to the examination, the first meeting of the course commission, approbation and public evaluation.

Such an examination of textbooks covers all the features of the development and creation of educational books for elementary and middle school students since a unified approach demonstrates the presence of a systematic and integral cognitive activity of students. Thus, the public assessment of textbooks is carried out in the public domain for all who wish to familiarize themselves with the content of the textbooks provided for examination (Ministry of Education, 2018).

The analysis of natural science textbooks for primary schoolchildren showed that, in general, each edition (there were three ones) presented full-weight textbooks, whose content and scope generally correspond to the stated requirements.

The authors of the article offer several comments on the natural science textbook. Firstly, in all editions, there is a congestion of codes (stickers) intended for performing tasks or, for example, memorizing a rule. Secondly, the presence of such codes is fragmented into small parts that are not focused on the holistic perception of the textbook content and makes it difficult to give a general conceptualization of the discipline-related knowledge. Thirdly, in spite of the fact that natural-science knowledge is of a general theoretical and fundamental nature, the focus on the cultural, national and ethnic knowledge is not sufficiently represented. Fourthly, when revealing the meaning of the “Natural History” course that is, at the initial level, a “fusion” of knowledge of such

fundamental sciences as chemistry, biology, astronomy, physics, and geography, developers experienced problems with the holistic perception of the course and, as a rule, the content was an intermittent transfer of knowledge, i.e. each part exists independently, the interdisciplinary interaction of individual disciplines is poorly represented; for example, the experimental textbook "Natural Science" (1998, Omsk) demonstrates the theoretical material presented in a form accessible to primary schoolchildren. 7-8-years-old children are offered topics on human anatomy ("The skeleton is a reliable support of a human", "Muscles and their work"), there are topics about healthy lifestyles, such as "Our body", "Why does a schoolchild need a regimen", "TV in the house", “The secret of longevity", "Why we need hardening", etc.).

In addition, the textbook includes material regarding the development of mental processes such as memory, sensation, perception, temperament, and abilities. The questionnaire survey conducted with the children of the pro-gymnasium class of the “Balaus” kindergarten (Arkalyk, 1998), obtained the following results:

- 73% of children were very interested in topics on personal development psychology.
- 68% liked the topic materials “Why does a person eat”.
- The following topics were more difficult to understand for primary schoolchildren (87%): "Blood. The heart and his work", "The brain and the senses".
- The material dedicated to the additional reading, for example, “Hippocratic Oath”, “Appendicitis”, “In the laboratory”, “What an x-ray can and cannot do”, “Where children come from” turned out to be somewhat unexpected for children.

At the same time, children studied many topics with interest, asked a large number of additional questions that required the teacher to provide versatile training in all areas of the natural science (Shayakhmetova, Nurmukhanbetova, & Fakhrudenova, 2016). The "Natural Science" textbook

offers a lot of practical material on what should be a good posture of a person, various exercises to determine one's strength, dexterity, endurance, etc.

The pedagogy of modern times requires a quick response to everything that happens not only in education, but also in the world community, and this makes the task of education broader and more significant (Makarchuk, 2009; Zinatulina, 2018; Bogdanets, 2007). The authors believe that the transition to the updated content of secondary education in Kazakhstan is correct in terms of the effectiveness and quality of knowledge, their skillful use in everyday life.

The Natural Science curriculum contains all the fundamental requirements and rules for teaching the discipline, such as a description of the classroom, the use of information and communication technologies, and the content organization of the subject according to which the subject is studied during the whole period of study at the primary level (1 hour a week in 1st and 2nd grades; 2 hours a week in 3rd and 4th classes).

Unlike the content of the 1998 textbook, the new program presents a study of the fundamentals of the natural sciences, summarizes, synthesizes many topics, and divides them into sections and subsections. Thus, the section "I am a researcher" has the following subsections: 1.1 "The role of science and researchers", 1.2 "Methods of nature cognition". The teaching system is distributed as follows: the first number indicates the grade (year), the second and third numbers indicate a subsection of the curriculum, the fourth number is the number of an educational objective (please see Table 1) (Ministry of Education, 2016).

Table 1. System of educational objectives.

Subsection	**1 grade**	**2 grade**	**3 grade**	**4 grade**
1.1 The role of science and researchers	1.1.1.1 To explain the need to study phenomena, processes, and objects of the world around us.	2.1.1.1 To determine the conditions and personal qualities necessary for studying phenomena, processes, and objects of the world around us.	3.1.1.1 To talk about the most significant scientific discoveries and their impact on everyday life	4.1.1.1 To identify current trends based on one's own thoughts

A primary school teacher, as follows from this curriculum, must have in-depth knowledge of biology, chemistry, physics, astronomy, and zoology. As one can see, all this encourages universities that conduct training of primary education teachers to expand the trajectory of the educational curriculum. The analysis of model curricula shows that primary education is humanized, i.e. more attention is paid to such disciplines as linguistics, literary arts, and mathematics, i.e. disciplines of traditional education.

Primary schoolchildren's single holistic view of the "Natural Science" course should be built, taking into account the age and individual characteristics of the development of mental processes of a personality.

Within the framework of the updated content of education, the educational activities of students in terms of psychological and pedagogical conditions have changed towards the formation of individual personality qualities. The forms of organizing education in a traditional school consist in the fact that it is customary not to provide indulgence regarding age, i.e. "since you come to school, you must learn." According to K.N. Polivanova, such an attitude can lead to the following performance in a class where "...the majority of children have average performance, there are several slow learners and some fast ones (excellent students)" (Polivanova, 2000).

Subsequently, teaching to children in primary school shows the following: slow learners' performance gets even lower, average learners' performance does not change, and fast learners' indicator of intelligence is an amount of knowledge. When diagnosing the mental processes of primary schoolchildren of the so-called "ordinary school", the school that switched to updating the content of education, and the Nazarbayev Intellectual Schools in Kokshetau, the authors obtained the following results (please see Figure 1).

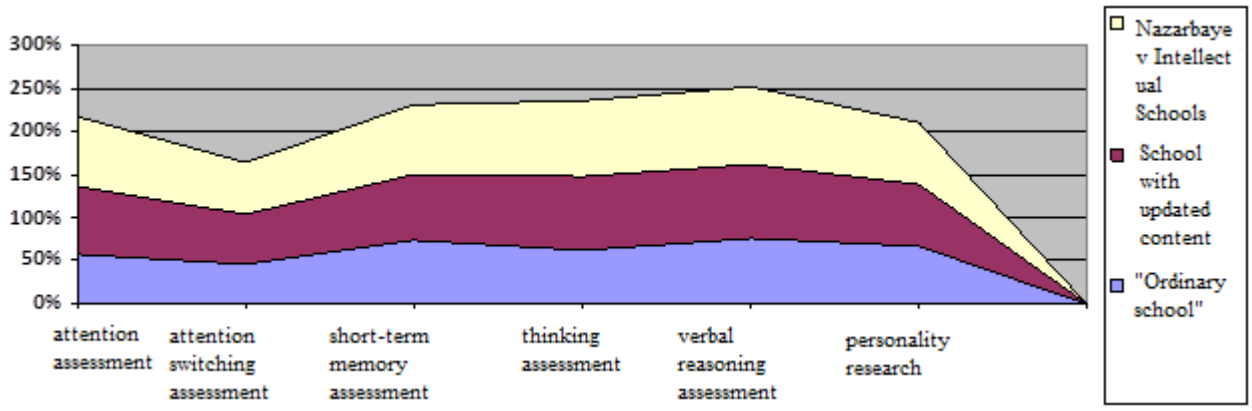

Figure 1. Diagnosis of mental processes of primary schoolchildren.

The results of a diagnostic study of the development of mental processes showed that children, who study in an “ordinary school” with the use of the traditional teaching scheme (teacher - academic subject - student (class)) where the main link (the content of education) is often omitted, have relatively low rates for all processes necessary for the development of a successful education.

The children enrolled in the Nazarbayev Intellectual Schools under a special curriculum comparable to the content of the international curriculum GCE AS/A-level (United Kingdom) showed higher learning outcomes because it is aimed at the interests of the individual and is characterized by the development of readiness for conscious choice, decision-making and responsible participation in society (Nazarbayev Intellectual Schools, 2017).

The updated educational content is based on the principle of spirality, focus on educational objectives, availability of cross-cutting topics, formulation of short-term, medium-term and long-term plans, as well as on the presence of learning principles by which every teacher should be guided (freedom, cooperation, trust, tolerance). This content demonstrates the results of the development of mental processes that are higher than those of children in the “ordinary school” but lower than those of the children in Nazarbayev Intellectual Schools (NIS).

The research on the motivation for successful educational activities of children according to M.R. Ginzburg, on the basis of which various motives were diagnosed (cognitive motive, broad social motives, "positional" motive, motives "external" in relation to learning, game motive, and high grade motive) is a demonstration of the significance of the development of primary schoolchildren's mental processes (see Figure 2).

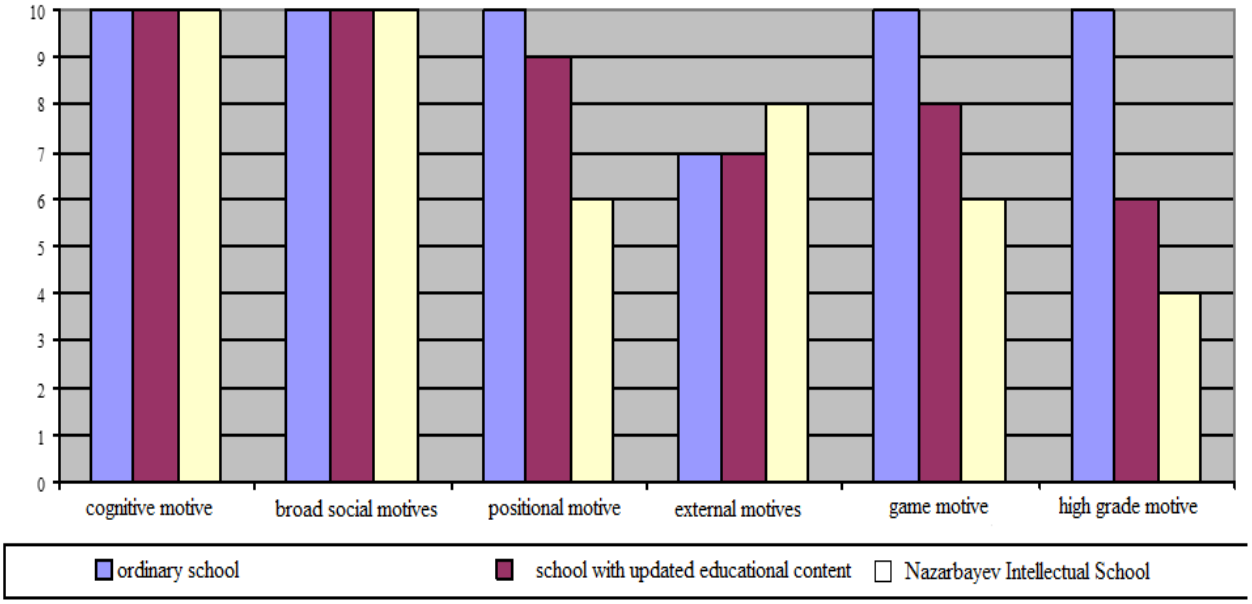

Figure 2. Research on the motivation for successful educational activities of children according to M.R. Ginzburg.

As it is seen from Figure 2, the main motives, in general, occur in all primary schoolchildren. The differences are observed in the parameters of "external" motives implying "submission to the requirements of adults," "game" motive showing the degree of the child's readiness for educational activities when "inadequately the game is transferred to the new educational sphere."

With regards to the motive of getting a high grade, under formative and summative assessment of children studying at the Nazarbayev Intellectual School and the school with updated educational content, the research revealed that the concept of "high grade" does not take precedence in these schoolchildren's successful activities.

CONCLUSIONS.

The educational activities of primary schoolchildren depend on the degree of their motivation and the aspiration to self-realization and self-actualization with the help of their own intellectual, emotional, cognitive, and mental resources.

The implementation of such a subject as “Natural Science” in elementary school as part of updating the content of education in the Republic of Kazakhstan forms in children the ability for analytical and synthetic activities, teaches the skills of generalization, abstraction, and concretization. All these concepts are mental operations since thinking as a mental process performs an indirect reflection of reality (Rubinshteyn, 2005).

In the educational process, the formation of primary schoolchildren’s thinking skills with the help of the “Natural Science” subject will be more qualitative and natural than the simple contemplation of the phenomena of the reality in which the child is constantly present and where a simple systematic explanation of adult phenomena of nature and society is not enough.

A simple contemplation, for example, of a meteorite, does not carry any data about the object, and only chemical analysis allows us to answer what a meteorite consists of and, as a result, an understanding of such phenomena as “meteorite rain” will help to create a vivid understanding of the meaning and role of the meteorite in human life. Illustrative action thinking, which develops through practical actions or manipulation with objects, develops the ability of a holistic perception of an object, even if it is in a disassembled state (Osborne, Bell, & Gilbert, 1983; Lave, 1988; Nalimova, 2014). Such examples of perception include “a man in a boat in the middle of the lake” that is visually perceived as a little person, but our brain knows that distance affects the true size of a subject or object.

The scope of a concept describes the number of objects reflected in the mind with the help of a given concept or covered by this concept. Since the number of objects in the concept can be different, it becomes necessary to classify concepts not only by content but also by scope. Among the authors who have studied this problem, there is no consensus in the names of these groups: some call them singular and common ones, others call them simple and complex ones but essentially these terms are identical groups of concepts. S.A. Pavlovich, in addition, identifies an intermediate group such as collective concepts. They are in constant change and development, i.e. in dynamics.

Simple (single) concepts include a small (most often one) number of knowledge elements, complex (common) ones include several, sometimes very many, knowledge elements and are formed from single concepts. Collective concepts occupy an intermediate position according to the number of elements of knowledge.

Simple (single), collective and complex (general) concepts are dynamic. They are in constant change and development. This change can be carried out in two directions: “horizontally” and “vertically.” The change in the concept of "horizontally" is that the same concept can be in relation to another either single, or collective, or general, which is defined by the phrase "in relation." Such a change of concepts is often used in learning and communication and does not require the use of a special technique, it is enough to be limited to simple questions, often requiring a brief reproduction of information.

With the development of the concepts “vertically,” there is a qualitative improvement of the concepts associated with their transition to a new level (“quality”) requiring a special technique, which is infinitely carried out in practice, i.e. every concept is in constant development.

The learning process in primary school ends with the formation of mostly elementary concepts. Despite the term "elementary", these are really concepts, since:

- They reflect a certain level of study of educational material about the world, summarize the signs, often even significant ones, of the objects or phenomena under study.

- With the help of these concepts, primary schoolchildren penetrate into the essence of the studied subjects and phenomena.

- These concepts are expressed by terms, have definitions, and their content is disclosed by certain methods of explanation and description.

Therefore, scientific knowledge is formed under the influence of such a factor as thinking. Thinking is a very complex and multifaceted human mental activity, which, along with perception, memory, imagination, and attention, is comprehensively studied, especially in recent times, when humanity is experiencing many scientific discoveries.

The development of thinking can be achieved in the learning process under the following conditions:

- Tasks are complex and are aimed at developing perception, attention, and forming an image of reality;

- Tasks in exercises stimulate students' analytical and synthetic activity, and develop all mental operations;

- Tasks stimulate students' mental activity and their inclusion in a variety of learning and cognitive activities.

When teaching, the material should be given in such a way that solving problematic creative tasks be the main way of understanding the world, so that children have a holistic, bright natural science picture of the world of natural conditions in the lives of people in different countries and corners of the globe, and pay particular attention to their country.

The basis of natural science knowledge is theoretical concepts and theoretical thinking acquired by students in the process of learning activities. Natural science knowledge is a combination of facts, theories explaining facts, and a scientific method that make it possible to get facts and build explanatory models.

Natural science, as an academic subject, reveals to children the wealth and diversity of the world around them, the patterns of natural processes that can be understood at their age, the relationship between humans and nature.

The science of nature now defines the priority directions of scientific and technological progress, plays a huge role in scientific understanding of the world, and reveals the patterns of the development of nature. In an effort to comprehend the world, science explores the surrounding objects and phenomena, systematizes, generalizes them, and draws appropriate conclusions.

Natural science is inextricably linked with other sciences. The course of primary natural science is an integral part of the educational component. The leading goal of this course is to develop the personal qualities of primary schoolchildren. It, on the one hand, has been recognized by leading methodologists since the implementation of natural science in schools, on the other hand, it is an urgent need of our time when elementary school is reoriented to updated content of education.

Therefore, the above leads to the conclusion:

1. General and individual ideas are, like perceptions, illustrative. They are images of certain specific features of objects, people, phenomena, processes, etc. However, knowledge of reality is not limited to them.

2. In the process of thinking, a person forms concepts in which it is not the concrete visual features of objects that are reflected, even the most general, but the essence of objective phenomena and their basic patterns.

3. Concepts are formed as a result of the abstractive activity of thinking, by abstracting from the specific features inherent in objects, and by concentrating thought on the connections and patterns essential for a given phenomenon.

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