THE DEVELOPMENT OF MATHEMATICAL ABILITIES IN YOUNGER STUDENTS

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Abstract. *Consider how a person's abilities are detected. One of the most important and complex topics in psychology is human abilities, their appearance, formation and development. Since these are the qualities thanks to which an individual easily acquires knowledge and is successful in any activity, we can talk about their innate nature, about a genetic predisposition. At the same time, the process of developing these skills does not remain without attention. It is not entirely true to talk about a person's abilities to paint, if they did not try to make him addicted to drawing, because only in the process of systematic training in this type of activity you can find out the truth about their presence or absence.*
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The world of mathematics - the world of quantitative, functional, spatial and other relations expressed through numerical and other symbolic symbols - is very specific and original. A mathematician deals with conditional symbolic designations of mathematical relations, thinks with them, operates, combines. In this very peculiar world, according to M. Dzhumaev [7], in the process of a very specific mathematical activity, the general ability is so changed, so transformed that, remaining general in nature, it already acts as a specific ability.

At present, the problem of developing the mathematical abilities of schoolchildren is already becoming urgent in elementary school. This follows from the fact that abilities anticipate new activities, go beyond the already established ones. There is an interdependence between abilities and activities.

The problem of developing the mathematical abilities of children in modern life is of great importance. This is explained, first of all, by the rapid development of information and communication technologies and their penetration into various fields of knowledge. Mathematics has great opportunities for the development of children's thinking, in the process of their learning from a very early age. The formation of initial mathematical knowledge and skills in children of primary school age should be carried out in such a way that training gives not only an immediate practical result, but also a broad developmental effect.

Abilities are personal characteristics of an individual, based on which a person achieves significant success in a certain type of activity. Abilities are not directly related to skills, knowledge and competencies, but manifest themselves in the speed, depth and thoroughness of comprehending the methods and techniques of activity. They are given to a person, according to I. S. Yakimanskaya [18], from birth, therefore, already in childhood, the child's inclinations to one or another occupation are manifested.

The innate ability of a person. Usually no one notices or pays attention to them. Why over time, the ability to rejoice, to be in the present tense, to communicate, to play, to enjoy life, to express emotions openly, to feel love, to be active and happy is lost.

Hidden possibilities of man. By the way, they are also congenital, but they often manifest themselves as a result of sudden shocks, critical situations, in the vast majority of a negative nature. Then the person suddenly "sees the light", becoming a clairvoyant, he is subject to telepathy, x-ray vision and similar phenomena.

Talents. It is them that we most often mean by the phrase "human abilities." When an individual is realized in any activity, reaching significant heights, talent is evident. Musical, artistic, literary, sports, etc. If a child likes to do something, it makes sense to pay close attention to this activity and help the young talent to set foot on the path of developing his talent. From the point of view of E. G. Yudin [17], human abilities can be developed in two ways.

1. As mentioned above, this is the experience of a critical situation, though not necessarily sudden. The development of abilities is helped by a feeling of hopelessness, a forced state of affairs, when life itself dictates conditions. For example, a civilian does not have the ability to survive in extreme conditions. And if there was a war, he willy-nilly will develop new skills. If a person is hungry and unclothed from childhood, he will either develop a criminal talent, or become a businessman, or both. While peers who grew up in warmth and comfort, most likely, will become just competent specialists in any business.

2. First, answer the question of whether there is a need to develop the ability to play billiards if you have never taken a cue in your hands? Then how do you know if you have these abilities? Conclusion: you can find your talents by experience. The main thing is that you like the business that you will be doing, and everything else will follow.

One of the important and complex topics in psychology is human abilities, their emergence, formation and development. It should be noted that there is no clear definition of this category. For example, B. M. Teplov [12] says that abilities in psychology can be considered as individual characteristics that distinguish one person from another.

If we are talking about the abilities of an individual, then, first of all, we mean his capabilities in a certain type of activity. For example, a person can be a good carpenter or joiner, easily master foreign languages, understand mathematical laws and solve problems without difficulty. He performs all these actions, taking into account the fact that other people who study with him have worse knowledge of these skills, do not show their abilities in the same way. In psychology, this term can be defined as a certain potential that an individual has, which he can develop to achieve better results.

When parents talk about the possibilities of their children, phrases are often heard that their child shows certain abilities. As a rule, when it comes to preschoolers, it means that the child draws well or is more physically developed in relation to his peers, which allows him to achieve high results in sports. Many brag about the successes of their children, are proud of them.

Ability in psychology is often associated with terms such as "talent" and "giftedness". This comparison is justified, because if you help a child develop his skills, improve them, then after a certain period of time it will be quite possible to say about him that he is gifted. For example, V.P. Efroimson [16] argues that if a preschooler shows interest in painting or music, he likes to do this, then you should consider putting him in a circle in order to develop his abilities.

In psychology, the achievements of a talented person are the result of the coordinated work of his neuropsychic properties and the activity itself. That is why such people are somewhat absent-minded, uncollected, constantly distracted. But, when circumstances so require, they easily mobilize all their efforts to achieve high results in the sphere of their own talent.

Let us consider how human abilities are revealed. Since these are the qualities due to which an individual acquires knowledge quite easily and is successful in any activity, we can talk about their innate character, about a genetic predisposition. At the same time, the process of developing these skills does not remain without attention. It is not quite right to talk about a person’s abilities for painting if they were not addicted to drawing, because only in the process of systematic training in this type of activity can one find out the truth about their presence or absence.

Psychology explains the development of abilities quite simply: for this, only small inclinations are needed. But most people, according to I.P. Shkuratova [15], have such people at birth, but some turn out to be more capable than others, because only by improving what is laid down by nature, you can achieve high results.

Ability structure.

The activity (labor, educational, etc.) that a person masters makes high demands on his psychological qualities (intelligence features, emotional-volitional sphere, sensorimotor skills). These requirements cannot be satisfied by any quality alone, even if it has reached a very high level of development. The opinion that a single mental property can provide high productivity of activity, act as an equivalent of all abilities, is devoid of scientific reliability. Abilities are a set of mental qualities with a complex structure.

The structure of the totality of mental qualities, which acts as an ability, is ultimately determined by the requirements of a particular activity and is different for different types of activity.

A person's abilities for a certain type of activity have a complex structure, which is a set of features of the psyche. So, for example, the structure of musical abilities includes: ear for music, ability for auditory representations, musical rhythmic feeling. Literary abilities consist of the following components: a high level of aesthetic sense, the need for self-expression, an original, perfect language, a tendency to fantasize, a high level of development of figurative memory.

The success of an activity depends on a combination of abilities. In the absence of the inclinations to develop any abilities, their deficiency can be made up for by developing other abilities, either through the acquisition of skills, or through the formation of an individual style of activity. This kind of substitution, according to V. D. Shadrikov [14], is a compensatory possibility of the psyche.

Any inclinations, before turning into abilities, must go a long way of development. So, in the period from birth to 6-7 years, the work of all analyzers improves, the development and functional differentiation of individual sections of the cerebral cortex, the connections between them and the organs of movement, especially the hands, which is a condition for the development of general abilities. Junior and middle school age is the time of accelerated development of special abilities. The necessary conditions for their formation during this period are play, creative, motivated and diverse activities, which should be in the “zone of potential development” (L. S. Vygotsky), i.e. at the limits of the child. In addition, the formation of abilities is carried out in conjunction with the development of a person's volitional sphere, and is also determined by the quality of training and education.

Cases of pathological decline in abilities are defined as oligophrenia. It has a different degree of severity: light debility; medium-imbitility; deep idiocy, which determines the development of special programs, the selection of methods and corrections in auxiliary educational institutions.

Types of abilities.

According to the breadth and focus, the following types of abilities are distinguished:

- general abilities - favorable opportunities for the development of the characteristics of the human psyche, equally important for many types of activity. These, for example, include mental abilities, subtlety and accuracy of manual movements, developed memory and perfect speech, etc.

- special abilities - determine the success of a person in specific activities, which require the makings of a special kind. These are, for example, mathematical, musical, technical, linguistic, etc.

In the first days of school, the child does not perceive all the incoming information. This is due to the child's adaptation to new conditions. Each student has their own time to adapt. A week is enough for one person, while the other cannot get used to a new environment for a whole month. The development of the abilities of younger pupils begins with a simple game. Through the game, you can introduce a little child to a lot of things. A special place is given to the development of creative abilities. Child psychologists say that through the creative abilities of younger pupils, you can tell a lot about a particular child, namely, about the level of his development, about his psychological readiness for school and the development of other important psychological processes. It is through creativity that many children learn complex tasks. Now every school pays special attention to classroom environments. Computer tables and desks are placed not as before one after another, but against each other. Thus, the child does not have to stand up to see something on the board. Even such a seemingly small thing contributes to the proper development of the child. In our time, notes N. I. Chuprikova [60], thanks to the psychological approach, schools take into account many nuances that were not previously paid attention to. In order to fully develop the creative abilities of younger pupils, in addition to lessons in the classroom, various excursions to museums and exhibitions are held. Thus, children do not just develop, they are instilled with life values and meaning from childhood.

V. A. Krutetsky [9] singled out the following six components in the structure of schoolchildren’s mathematical abilities:

1) formalized perception of mathematical material;

2) generalization of mathematical material;

3) curtailment of mathematical thinking - a tendency to think in the process of mathematical activity by abbreviated structures;

4) flexibility of the thought process;

5) the desire for a kind of economy of mental effort - for the "elegance" of decisions;

6) mathematical memory.

Let's break down the content of each component.

1. Formalized perception of mathematical material: in the "embryonic" form, this component begins to appear already in grades 2-3 (by the age of 8). In pupils more capable of mathematics, under the influence of training, a desire is formed to understand the condition of the problem, to compare its data. In the task they begin to be interested in not just individual quantities, but precisely the ratios of quantities. If less capable pupils perceive individual, specific elements of the task as not related to each other, and immediately after reading the task, they begin to perform various operations with all given numbers (add, subtract, further, multiply and divide), without thinking about the meaning of the problem and without trying to isolate the main relationships, then more capable pupils have a peculiar need, when perceiving the conditions of

the task, to reveal these relationships, to connect individual indicators and quantities. So far, this process is still more or less “stretched” in time: quickly determining the desired ratio is observed only in very simple tasks for the most capable pupils. Gradually, capable pupils begin to see relationships between certain quantities in the task, so they often do not attach much importance to what specific objects are discussed in the task, to the point that they confuse the names of the objects / phenomena they are talking about. So solving the task about apple trees: “There were 9 apple trees in the garden, one of them died, and the gardener planted 6 more apple trees. How many apple trees are there in the garden? - such pupils can write down "There are 14 trees" in the answer.

Less capable pupils adhere to the exact name of the objects; they see in tasks not some kind of mathematical relationship, but only specific objects with which something needs to be done. Thus solving the task about apple trees, the pupil cannot reformulate the question: “How many apple trees are there in the garden?” to “How many trees are there in the garden?”, since this question for the pupil is related to another task. If, after solving the problem about apple trees, pupils are offered a similar task about pears: “9 pears grew in the garden, one of them died, and the gardener planted 6 more pears. How many pears are in the garden? - they will start solving it as a completely new problem.

The same is observed in the construction of tasks by pupils. The less capable begin with the subject content (“I will make a problem about apples”), then with some difficulty introduce relationships (“I will make a problem for “more - less”), and only then “objectifies” them (“There are 20 apples on my apple tree”, and on Masha’s - 18 apples. Whose apple tree has more apples?").

By isolating relationships, according to A. V. Beloshistaya [8], more capable and many average pupils begin to differentiate the data in grades 2-3 already:

- select those that are necessary for the solution;
- be aware of what values are missing;
- filter out superfluous, unnecessary information (including numerical data). Gradually, the process of primary orientation under the conditions of the task begins to curtail. The “folded” nature of perception is clearly visible when solving elementary tasks, where there is less data and therefore the perception of the entire system of relations as a whole is facilitated. The tendency to "coagulation" of perception intensifies from grade 2 to grade 4.

More capable pupils have a clearly expressed tendency to a kind of analytical-synthetic perception of the conditions of the task: they perceive not only single elements, but also peculiar “semantic mathematical structures”, complexes of interconnected mathematical quantities and categories. Of course, this feature is manifested on relatively simple arithmetic material and, consequently, on a more or less elementary level. Further development of the analytic-synthetic perception of the task condition goes along the path of curtailing (reducing) this process.

In middle school age, the process of primary data analysis and synthesis of the conditions of a not very difficult task for very capable pupils is maximally "curtailed", extremely limited in time, so that it practically merges with the moment of perception: it is not divided into stages of data analysis and synthesis, elements of reasoning are not noticeable .

The trend towards formalization of perception, the allocation of a formal structure in middle age acquires a wide character among more capable pupils.

In the middle school age, another ability for the perception of mathematical material by schoolchildren is outlined, and in the senior school age reaches significant development: a kind of versatility, the diversity of perception, when the same task, the same mathematical expression is perceived, evaluated from different points of view.

2. Generalization of mathematical material: the ability to generalize mathematical material as the ability to capture the general in various tasks and examples and, accordingly, to see the different in general, begins to take shape before all other components.

Already in grade 1, one can observe manifestations of generalization in elementary forms. At this stage of development of pupils, it is still too early to speak of this ability as a specific ability to generalize precisely mathematical material. Rather, here we can talk about the general ability to generalize, as one of the manifestations of the properties of learning.

At the initial stages of schooling, mathematical generalizations are usually formed gradually and are extended to a relatively limited range of phenomena. With age, the generalization becomes more and more broad, extending to a larger circle of homogeneous mathematical phenomena. At primary school age, a relatively simpler type of generalization is observed - the movement from the particular to the well-known general - the ability to see the already known general in the particular, in other words, to bring the particular case under the general rule. This type of generalization reaches a great development in middle school age. The more capable the pupil, the more successfully he copes with the tasks for the corresponding generalization. As a rule, only at the beginning of middle school age is there a generalization of an inductive nature - from the particular to the unknown general.

The development of the ability to generalize goes along the line of a gradual number of special exercises of the same type, which are a prerequisite for such a generalization. For the most capable pupils of middle school age, such a generalization occurs immediately, by analyzing one individual phenomenon in a series of similar phenomena, as the ability to see the still unknown general in the individual. The path of generalization "from (many) particulars to the unknown general" is gradually transformed into a qualitatively very special path "from (one) particular to the unknown general."

This ability is closely related to the ability to formalize the perception of mathematical material, and by analogy with "formalized perception" we can speak of a "formalized solution".

Capable adolescents are generally characterized by generalized problem solving (a tendency to solve each specific problem in a general way). In an elementary form, this tendency can also be noted among younger schoolchildren who freely solve tasks of the following type: “The store received 8 bags of flour, 2 kg each. During the day, 3 bags of flour were sold. How many kilograms of flour are left?

For senior schoolchildren capable of mathematics, it is typical not only to generalize specific material, but also to translate already generalized information into a more general plan. Senior school students capable of mathematics rise to the level of generalization of methods, principles of approach to analysis and solving problems of various types; these methods differ in varying degrees of generalization.

Let us describe the motivation for the activity of generalization. At primary school age, generalization is caused by some external stimulus: the teacher's instructions, the logic of the task, or its requirement - there is most often no need for generalization here. With the development of the student in the learning process, there is an increasing independence of generalization from external stimuli, and already in middle school age, the need for generalization is clearly revealed even when there is no external need for this. It is especially developed at senior school age in students capable of mathematics. Thus, the motivation for the activity of generalization moves from an external need to an internal need.

3. Curtailment of thinking: curtailment, abbreviation of reasoning and the system of corresponding actions in the process of mathematical activity is, according to V. A. Krutetsky [10], specific for pupils capable of mathematics, mainly of senior school age, although it is clearly seen in middle (adolescent) age.

This component of mathematical abilities at primary school age is manifested only in the most elementary form, when capable pupils solve only the simplest tasks; as soon as the task becomes more complicated, the pupil thinks it over and solves it step by step, the reasoning is detailed and detailed. The process of curtailment is more clearly expressed in capable pupils after they solve a number of tasks and examples of the same type. In this case, individual links of reasoning are more often omitted, while actions are usually preserved and reproduced sequentially on paper. For example, when solving the task: “For the school exhibition, the guys made 32 drawings, 5 pupils of the third grade made 4 drawings each, the rest of the drawings were made by 6 pupils of the second grade equally. How many drawings did the second grade pupils make for the exhibition?” - such a pupil, immediately after the first reading of the problem, is able to sum up: 12: 6 = 2. The drawing was made by each pupil of the second grade. Thus, the two previous stages in solving the task were carried out mentally and very quickly: $4 \times 5 = 20$, $32 - 20 = 12$ or $32 - 4 \times 5 = 12$.

It is possible to outline two directions for the development of the considered component of mathematical abilities from middle to older age. On the one hand, the repeated repetition of the same type of reasoning and a system of corresponding actions, which is a necessary condition for the beginning of the curtailment process at early age stages, gradually ceases to be such a necessary condition. Reasoning and the system of corresponding actions begin to collapse immediately when a new type of task is solved.

The second direction of development concerns schoolchildren's awareness of the omitted links of reasoning.

At first, the omitted links are recognized: the pupils do not voice or visualize them, but they are clearly “present” when thinking aloud and reproducing the corresponding actions in writing, as a result of which one can observe pauses that fall precisely on those links that are skipped[5].

In the future, the reduced links are no longer recognized at the moment of reproduction of the corresponding actions: there are no pauses in the corresponding places; however, the reasoning can be easily deployed, that is, all the dropped links can be restored, and this can be done by the pupil at any time - in the event of difficulties or at the request of the teacher. Finally, at later stages of development, when the pupil thinks in folded structures, he experiences difficulties if he is faced with the need to unfold the process of reasoning as completely as possible. In some cases, pupils clearly find it difficult to justify their train of thought, stating that it is obvious to them, but they have never thought about how to explain the obvious. For example, if a senior school student capable of mathematics solves the task: “Find the relationship between GCD and LCM of two numbers,” he immediately concludes: the product of GCD by LCM of two numbers is equal to the product of these numbers. At the request of the teacher, he explains (expands the reasoning): the

GCM of two numbers is their common factors, the GCM is the product of the numbers themselves, in which the common part is included only once. This reasoning is unlikely to be understood by most of his classmates[4].

4. Flexibility of the thought process: in its infancy, this component was found only among younger schoolchildren capable of mathematics, the majority did not show a clear tendency to look for several different ways to solve the same task, switching from one train of thought to another (such a transition turns out to be difficult for them). Moreover, for younger pupils, the requirement to find another way to solve the problem is perplexing: for many of them, the very idea that a problem can have several correct solutions is unacceptable. But pupils who are capable of mathematics, by the end of elementary school, already demonstrate a certain flexibility of thought processes in the search for other solutions. However, it should be noted that this never happens on their own initiative, but always after leading questions from the teacher. Pupils who are less capable of mathematics, even in older grades, have difficulty switching from one mental operation to another (qualitatively different), they are usually very constrained by the initially found method of solving, prone to stereotyped and hack trains of thought. Interestingly, in such cases, the point is not that it is difficult to switch from a simple to a more complex solution; it is often difficult to switch from a more laborious to an easier way if the first is familiar and the second is new and unfamiliar. One way is inhibited by another. For example, when solving the quadratic equation $(5 - x) \times (x + 7) = 0$, some pupils, instead of immediately finding the roots, using the product equality property to zero: x \u003d 5, x \u003d - 7, - began to give the left side equations to the standard form in order to then use the formulas of the discriminant and the roots of the quadratic equation.

The development of the flexibility of thinking follows the path of ever more complete liberation from the shackling influence of the previous course of thought. In adolescents and senior school students who are more capable of mathematics, according to M. Dzhumaev [4-6], breaking and restructuring the existing ways of thinking are completed quickly and without unnecessary problems; they on their own initiative find different ways to solve problems.

5. The desire to save mental effort, rationality: the tendency to evaluate a number of possible solutions and choose from them the most clear, simple and economical, the most rational solution in primary school age is not yet clearly expressed. Only the most able rated various solutions as "simpler" and "more complex", "better" and "worst", based only on the number of operations performed. This trend begins to noticeably manifest itself only in middle school (adolescent) age.

If for pupils with average abilities the goal is to solve the task, then for those capable of mathematics it is to solve it in the best, most economical way. Although adolescents do not always manage to find the most rational solution to a task, in most cases they choose the path that leads to the goal faster and easier. The considered component of mathematical abilities, according to M. Dzhumaev [7-8], reaches its special development at the senior school age. This tendency is characteristic of all high school students capable of mathematics and manifests itself in a very bright and expressive form: after solving the task, creative searches usually begin, aimed at researching and improving the found method in order to find the most economical and rational one.

6. Math memory: manifestations of proper mathematical memory in its developed forms (when only generalizations and mental schemes would be remembered) are not observed at

primary school age: all pupils (both capable of mathematics and others) usually memorize both specific data and relations and generalized mathematical structures (formulas, rules, etc.). Their memory stores the general and the particular, the essential and the inessential, the necessary and the unnecessary. Since the ratio of the given tasks is gradually becoming the main one for younger pupils, if they forget something, then it is most likely not mathematical relationships, but numbers, specific data.

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