SPECIFIC CHARACTERISTICS OF STUDENTS' PERCEPTION OF CHEMISTRY

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Abstract. *This article describes the characteristics of students' perception of chemistry, the types of memory and the formation of logical-figurative thinking. Also, the role of chemistry in the mental development of schoolchildren according to their age and their effective study are presented.*

Keywords: *perception, thinking, logical-figurative, age characteristics, mental development, memory, teaching chemistry, chemical sign.*

It is known that chemistry expresses knowledge in chemical language, i.e. schemes, formulas, material and mathematical models, etc. And this is the arsenal of chemistry, with the help of which scientific knowledge is codified. However, the mental process relationships between chemical symbols, concepts, and laws have not been developed in most schoolchildren, and existing chemistry programs include the elementary level of chemistry learning.

Due to the lack of development of mental operations, the theoretical and logical thinking of schoolchildren is developing very weakly. When mastering the subject, students cannot connect general theoretical rules (knowledge given in an abstract form) and specific descriptions. For example, the content of the material that students need to learn remains abstract because they cannot imagine why it is needed and its practical significance. In the period from childhood to adolescence, learners "grab" only individual facts or a set of factors, that is, an image, and not the hypothesis, the evidence presented in it, when learning the meaning of the main information. This leads to students not understanding evidence, theoretical thinking, and the origin of various laws. As a result, any information that conveys the scientific knowledge system is not absorbed by the students at a sufficiently high level. The primary learning activity by students is not understanding, they are often trying to remember information [58].

According to P. Y. Galperin, the first task of teaching any new movement is to find the first materialized or embodied form of the movement and to correctly determine its true content [59].

According to this theory, it is necessary to go through the following stages in the formation of skills for working with chemical symbols:

- laboratory experiments with substances or modeling of chemical concepts and phenomena;
- creating a figurative image of the studied object;
- pronounce the meaning of chemical concepts or events aloud;
- marking the particles of the substance with chemical signs and recording them through chemical reactions;

The effectiveness of semantic (content) memory in schoolchildren is much higher than that of mechanical memory. According to the characteristics of the available data, memory is divided into four types:

- logical;
- instrumental;
- emotional;
- verbal-logical (semantic);

It is necessary to take into account the individual characteristics of students' memory, which requires a more complete and accurate separation of its logical and figurative aspects when presenting information.

The efficiency of a high school student's voluntary memory is that he remembers only 10% of what he reads, 25% of what he hears, 30% of what he sees, 50% of what he sees and hears, 70% of what he discusses, 90% of what he says and 90% of what he does together [60].

With the transition to adolescence, not only the abstract-generalizing, but also the figurative content of mental activity is significantly changed and enriched (in particular, the ability to clarify, describe, reveal the content of concrete images and imaginations develops).

All academic subjects studied by a teenager, first of all, stimulate the development of his imaginative and logical thinking. Naturally, a characteristic feature of a teenager's mental activity is the growth of this type of thinking ability from year to year. As a result, adolescents with underdeveloped verbal skills are at a disadvantage. Given the large number of such children among schoolchildren, the problem of creating more favorable conditions for their education arises [61].

An important feature of the mental activity of a teenager is the importance of the role of concrete-image components of thinking. The role of visual material in the learning process is very important, and the fastest and most accurate learning of concepts occurs based on methodically selected visual images. Adolescents learn these symbols of conceptual concepts more easily. If concepts, by their very nature, are not sufficiently based on visual images, adolescents will have significant difficulties in their acquisition. The influence of direct emotional impressions on the thinking of a teenager is so great that in some cases it is stronger than the influence of words (teacher's explanation, textbook text). This characteristic of adolescent thinking sets specific requirements for organizing the process of acquiring knowledge. When presenting the educational material, the teacher should use both concrete and figurative features, as well as logical, abstract, conceptual connections and relationships [62].

This table presents the characteristics of the mental development of high school students and the proposed teaching approaches that implement these characteristics.

Table 1.

Features of mental development of high school students

Features of mental development of high school students	**Recommended teaching methods**
Students have not developed mental processes with most symbols and abstract concepts. Also, theoretical conceptual thinking is extremely underdeveloped. When acquiring semantic information, students better "understand" the image of the object being studied.	It is necessary to engage the logical thinking of students in the formation of abstract concepts and chemical language.
Most students lack the ability to move in the mind, but it increases significantly	When forming chemical concepts, one must go through the following stages: laboratory

throughout the year. The same effect cannot be achieved at different levels of performance of the new task: when working with objects, when performing the movement out loud (without directly relying on the objects), and when moving silently.	experience, modeling chemical objects, creating their visual image, speaking aloud the meaning of chemical phenomena, forming a symbolic representation of concepts or phenomena.
A student with a relatively low level of memory development is effective when he memorizes, discusses something, works together, and engages in his clear-image thinking.	In the process of teaching, it is necessary to use not only verbal-logical, but also all types of memory: logical, motor, and emotional. In the early years of the foundation stage, the form of chemistry teaching should be well-directed laboratory experiments and modelling.
Unnecessary data is destroyed by a deletion mechanism that makes it no longer in memory.	The information should be structured in such a way that it is necessary to repeatedly return to what was previously learned and expand and deepen the students' ideas based on it.
Non-verbal thinking (of the right hemisphere) is characteristically more serious than verbal.	Teaching methods are based not only on the application and development of logical-verbal abilities, but also on non-verbal (figurative) methods.

It is desirable that all subjects taught to students should be presented in two components: thematic-metaphorical and figurative-logical. Among the sciences of the cycle of natural sciences, chemistry is the most obvious. Emotional and figurative presentation of chemical facts allows students to understand that chemical changes are an integral part of the world around them.

High school students are highly demanding from the point of view of developmental psychology, they evaluate everything very strictly, they see the world around them only in black and white, causing many difficulties. Even the simplest chemical changes are caused by various interactions, which must be considered not in isolation, but in almost all of their interactions in order to achieve homogeneous results. During several years of study, the concepts of "atom", "element", "molecule", "chemical bond" and other concepts should change several times in the minds of students. In this case, the implementation of spiral education has a good effect and is appropriate for the purpose.

Chemical experiment as a type of research activity of students exists practically only in chemistry classes in high school, and therefore takes on the methodological task of not only forming chemical knowledge, but also acquiring and organizing scientific knowledge.

The psychological mechanism of students' loss of interest in chemistry or chemophobia is explained by the following two reasons: students with developed logical thinking reject chemistry as a poorly structured science, the absence of a figurative component in teaching makes students with developed figurative thinking indifferent to chemistry.

We can say that it is necessary to change the method of teaching chemistry to the purposeful development and the use of figurative thinking, analyzing the features of the mental development of students and the specific features of the perception of chemistry. The methodology of teaching

chemistry, taking into account the imagery of this subject, allows students to develop their interest in it.

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