METHODS OF TEACHING STUDENTS THE ABILITY TO APPLY KNOWLEDGE COMPREHENSIVELY TO SOLVING COMPLIANCE PROBLEMS

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Abstract. *This paper examines the problems arising for teachers in the formation of students' complex application of knowledge from various sections of physics courses and other academic disciplines. Also, a methodology for the formation of the ability to solve educational and cognitive complex problems is proposed.*

Key words: *Method, teaching, skills, complex application of knowledge, problem solving, physical concepts, physical phenomena, physical laws.*

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O'quvchilarga bog`lanishlarni aniqlash masalalarini yechishda bilimlarni kompleks qo'llash qobiliyatini o'rgatish metodikasi

Annotatsiya. *Ushbu maqolada fizika kurslarining turli bo'limlari va boshqa o'quv fanlari bo'yicha talabalarning bilimlarini kompleks qo'llashni rivojlantirishda o'qituvchilar duch keladigan muammolar muhokama qilinadi. Shuningdek, o'quv va kognitiv murakkab masalalarni hal qilish qobiliyatini shakllantirish metodologiyasi taklif etiladi.*

Kalit so`zlar: *Metod, o'qitish, ko'nikma, bilimlarni majmuali qo'llash, masala yechish, fizik tushunchalar, fizik hodisalar, fizik qonunlar.*

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Методика обучения учащихся умению комплексного применения знаний к решению задач на установление соответствия

Аннотация. *В данной статье рассматриваются проблемы возникающие у преподавателей при формировании у студентов комплексного применения знаний из различных разделов курсов физики и других учебных дисциплин. Также предложена методика формирования способности решать учебно-познавательные комплексные задачи.*

Ключевые слова: *Метод, обучение, навыки, комплексное применение знаний, решение проблем, физические концепции, физические явления, физические законы.*

INTRODUCTION

Education in a modern school is implemented as an integral educational process with a common structure and functions that reflect the interaction of teaching and learning. The function of teaching is a qualitative characteristic of the educational process, which expresses its purposefulness and effectiveness in the formation of the student's abilities. Solving complex problems contributes to the implementation of the following training functions: educational, developmental,

systematizing, upbringing, controlling and others. These functions are carried out in interconnection and complement each other. The unity of functions is the result of the purposeful construction of the teaching process as an educational system.

Simple tasks that test the assimilation of the most important physical concepts, phenomena and laws, as well as the ability to work with information of physical content on the basis of establishing the correspondence of positions presented in two sets. In the conditions of such tasks, they offer at least two sets containing elements that are not necessarily related to each other, as well as an indication of establishing a correspondence between elements from these sets. When establishing correspondence between the positions of sets, a close unity of "knowledge-descriptions" (concepts, laws, theories) and "knowledge-prescriptions" (methods of cognition) is ensured. Such an approach to the task of establishing compliance allows us to identify how developed students' abilities to produce knowledge are and how systematized they are[1].

DISCUSSION

Solving such tasks, students perform the following actions:

 understand the essence of the task;

 update the basic knowledge that contributes to the establishment of the correspondence presented in the two sets, transfer their knowledge of "knowledge-description" and "knowledge-prescriptions" to a new situation;

 conduct algorithmic or heuristic research;

 carry out generalization and synthesis of knowledge in conclusions, value judgments;

 consolidate the results of mental activity in filling out the scheme proposed to the student.

Analyzing the possibilities of matching tasks, we identify the following levels of complexity of information processing, depending on the number of connections involved in them:

1) subsystem, when solving tasks of this level, knowledge of descriptions and prescriptions from the same section of the physics course, the same topic are used;
2) in-system, when solving tasks of this level, knowledge of the description of the prescriptions of two or more sections of physics is used;
3) intersystem, the solution of tasks of this level is carried out on the basis of interdisciplinary connections, that is, knowledge of descriptions and prescriptions from two or more subjects are used;
4) mixed, solving tasks of this level requires the use of knowledge of descriptions and prescriptions from two or more sections of physics and other subjects of the natural-mathematical cycle.

The didactic possibilities of matching tasks are determined by such factors as: the content of the task, a special method for solving such tasks, their rational use (in place and time) in the educational process, the organization of independent work to solve them. Based on the didactic role of matching tasks, we will classify them (Table 7) [2].

Table 7

Classification of compliance tasks

<table>
<tr><td>Types of tasks</td><td colspan="2"></td></tr>
<tr><td colspan="3">The basis for classification.
The role of tasks in deepening knowledge of the essence of the studied laws, their manifestations in nature and application in technology</td></tr>
<tr><td rowspan="2">Tasks aimed at mastering scientific facts</td><td colspan="2">In the first column, statements describing the phenomenon of "liquid evaporation" are proposed. Establish a correspondence between statements and experienced confirmations.</td></tr>
<tr><td>STATEMENT
A. The intensity of liquid evaporation depends on the amount of free surface liquid
B. The intensity of evaporation of the liquid depends on the speed of removal of the vapors formed above it
C. The intensity of liquid evaporation depends on the type of liquid
D. The intensity of liquid evaporation depends on the temperature of the liquid</td><td>EXPERIENCE
1) If you cover the vessel tightly, leaving only a small free space above the liquid, then the mass of the liquid in the vessel practically does not change. In such a vessel, the number of molecules leaving the liquid becomes equal to the number of molecules returning back to the liquid at the same time (dynamic equilibrium)
2) To dry the laundry, it is hung on a rope
3) If the water in two identical glasses is maintained at different</td></tr>
</table>

<table>
<tr><td></td><td></td><td>temperatures, then with the loss of water, you can easily make sure that the hotter water evaporates faster, since the average velocities of the hot water molecule are greater than cold water
4) At the same temperature, ether will evaporate faster than water.</td></tr>
<tr><td rowspan="2">Tasks aimed at the formation of scientific concepts</td><td colspan="2">In the first column, statements about the concept of "mass" are proposed. Establish a correspondence between the statements and their defining characteristics.</td></tr>
<tr><td>STATEMENT
A. Since the masses of the molecules are very small, it is convenient to use in calculations
B. Relative molecular (or atomic) mass is called
C. The relative molecular weight is calculated as</td><td>CHARACTERISTIC
1) the ratio of the mass of a molecule (or atom) of a given substance to 1/12 of the mass of a carbon atom m_{0C}
2) not absolute mass values, but relative
3) the sum of the relative atomic masses of the atoms that make up the molecule</td></tr>
<tr><td rowspan="2">Tasks aimed at mastering the laws of nature</td><td colspan="2">Establish a correspondence between the name of the law and the formula corresponding to it</td></tr>
<tr><td>NAME OF THE LAW
A. Ohm's law for a section of the chain
B. Ohm's law for a complete chain
C. The law of serial connection of conductors
D. The law of parallel connection of conductors</td><td>FORMULA
1) $I = \frac{E}{R+r}$
2) $I = E(R + r)$
3) $I = \frac{U}{R}$
4) $I = UR$
5) $I = I_1 + I_2 + I_3$
6) $I_1 = I_2 = I_3$</td></tr>
<tr><td rowspan="2">Tasks aimed at explaining the principle of operation of technical devices</td><td colspan="2">Establish a correspondence between technical devices and the physical phenomena underlying the principle of their operation.</td></tr>
<tr><td>TECHNICAL DEVICES
A. Electrolysis bath
B. DC motor
C. Incandescent lamp</td><td>PHYSICAL PHENOMENA
1) Interaction of permanent magnets
2) The effect of a magnetic field on a conductor with a current
3) The phenomenon of electromagnetic induction
4) Thermal effect of current
5) Chemical action of current</td></tr>
<tr><td colspan="3">The basis for classification.
The role of tasks in identifying and establishing cause-and-effect relationships between phenomena of different nature</td></tr>
<tr><td rowspan="2">Tasks aimed at the development of generalized thinking</td><td colspan="2">Establish a correspondence between scientific discoveries in the field of mechanics and the names of scientists to whom these discoveries belong.</td></tr>
<tr><td>PHYSICAL DISCOVERIES
A. The Law on the Transfer of Pressure by Liquids and Gases</td><td>NAMES OF SCIENTISTS
1) B. Pascal
2) Torricelli
3) Archimedes</td></tr>
</table>

<table>
<tr><td></td><td>B. The law of universal gravitation
C. The law on the buoyant force acting on a body immersed in a liquid or gas</td><td>4) Euclid
5) I. Newton</td></tr>
<tr><td rowspan="2">Tasks aimed at using theories common to related sciences to explain phenomena and processes in living and inanimate nature</td><td colspan="2">Establish a correspondence between the bodies of the Solar System and their characteristics.</td></tr>
<tr><td>BODY
A. Venus
B. The moon
C. Jupiter</td><td>CHARACTERISTIC
1) The presence of a hydrosphere
2) The presence of a large number of satellites
3) The presence of volcanic-type mountains on the surface
4) Lack of atmosphere
5) Change of seasons</td></tr>
<tr><td colspan="3">The basis for classification.
The role of tasks in the expansion and systematization of methodological ideas about the history of the development of sciences studying nature</td></tr>
<tr><td rowspan="2">Tasks aimed at using historical facts</td><td colspan="2">In the first column, the statements made by the founders of the Molecular Kinetic Theory are proposed. Establish a correspondence between the statements in the first column and the scientist who expressed it.</td></tr>
<tr><td>STATEMENT
A. For the first time observed the thermal motion of particles suspended in a liquid
B. The molecular kinetic theory of thermal motion of particles suspended in a liquid has been created
C. For the first time, the idea that all matter consists of atoms was expressed</td><td>NAMES OF SCIENTISTS
1) Boltzmann
2) Democritus
3) Brown
4) Faraday
5) Einstein</td></tr>
<tr><td rowspan="2">Tasks aimed at mastering the unity of the description of ideas about modern pictures of the world</td><td colspan="2">Establish a correspondence between the physical nature of electrical conductivity and the type of charge carrier</td></tr>
<tr><td>THE NAME OF THE SUBSTANCE
A. metal
B. electrolyte
C. semiconductor</td><td>TYPE OF CONDUCTIVITY
1) ionic
2) electronic
3) electron-ion
4) atomic
5) electron-hole</td></tr>
</table>

We have also identified didactic tasks (theoretical and practical) that a teacher should solve when organizing cognitive activity of students to perform compliance tasks[3]. We will indicate the main ones:

1. Determine the sections (topics) of physics in which it is possible to use compliance tasks.

2. Determine the correspondence of the content of the material from the selected sections (topics) to the structure of the assignment to establish compliance.

3. Select tasks to establish compliance from different collections and manuals or independently compose.

4. To form students' ability to independently establish connections based on the correspondence of positions presented in two sets.

5. To form students' ability to perform tasks to establish compliance.

6. To form the students' ability to write down the selected numbers under the corresponding letters in the table intended for the task report.

Teaching students the ability to solve matching tasks has its own characteristics. These features are due to the system-forming function of compliance tasks, as well as the allocation of new operations in the structure of activities for their implementation:

determination of topics, sections of physics in the classroom, on which these positions were studied;

building inferences by establishing a connection based on the correspondence of positions presented in two sets, in order to obtain a relationship between the condition and the requirement of the task, to determine their sufficiency;

identification on the basis of establishing the correspondence of cause-and-effect relationships;

filling in the proposed response scheme.

CONCLUSION

The use of a system of educational and cognitive tasks of a complex nature in the process of teaching physics requires identifying the features of the methodology for their solution. The theory of the stage-by-stage formation of mental actions is the basis of the teaching methodology for solving complex problems. The approximate basis for actions of the third type is a generalized method for solving complex problems. The skills and abilities to solve complex

problems are formed in several stages on the basis of a prescription card and a work card, they are generalized, that is, they are applicable to solving other types of problems.

The formation of generalized skills for solving educational and cognitive tasks of a complex nature is one of the main conditions for managing the cognitive activity of students in the educational process and the formation of elements of creative activity.

Conducting a theoretical study of the structure of students' activity in solving educational and cognitive tasks of a complex nature, as well as the process of forming students' ability to solve such problems and elements of creative activity, allowed us to identify the levels of formation of students' ability to solve educational and cognitive tasks of a complex nature.

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