DEVELOPMENT OF UNIVERSAL EDUCATIONAL SKILLS OF PUPILS IN THE FORMING OF PHYSICAL CONCEPTS

Krutova I.A., Zhukova N.V.

Astrakhan State University, Astrakhan, e-mail: irinkrutova@yandex.ru, unndinn@hotmail.com

In article the problem solving method of universal educational skills formation of pupils at a physics lesson are described. Special attention is given to the acquisition process of the elements of physical knowledges, the activity on recognition and simulation of certain situations are to be carried out on the basis of them. Recognition of the situations corresponding to some concept or scientific fact is carried out in strict compliance with the system of the necessary features, included into the concept. Method proposed of organizing pupils' activity for new knowledge acquisition with reference to the theory of step by step mental actions forming which promote development of their universal educational actions.

Keywords: universal educational actions, physical knowledge, problems-exercises, concept identification, theory of step by step mental actions forming

The current stage of the society development is characterized by considerable changes in the ideas of the goals of education and ways of their accomplishing. Considering the result of education not as a sum of domain knowledge, but as a system of skills, allowing acting in any situation, sets new reference points for contemporary school-level education that must create the conditions for the development of universal educational actions. Universal educational actions are understood herein as a complex of the ways of pupils' actions, providing independent acquisition of new knowledge, forming the skills, including the organization of the process. The universal character of the educational actions lies in their being meta-subject, so they must be formed while studying different school subjects.

Among universal educational actions it is necessary to form particularly the cognitive universal actions, namely, general educational (independent distinguishing and forming of a cognitive goal; structuring of the knowledge; choosing the most efficient ways to solve a problem depending on the particular conditions, etc.) and logical (analysis aiming to distinguish features, choosing the bases and criteria for comparison and classification of objects, identification of the concept, making chain of logic reasoning, etc.).

The process of knowledge acquisition always means that pupils perform certain educational actions. That is why while planning the acquisition of any knowledge it is necessary to define within which activity (in which skills) the pupils must use it, what the purpose of acquiring it is. Besides, a teacher must be sure that pupils have mastered the whole system of actions comprising the skill of studying required in this case [7].

The present methods of teaching certain school subjects do not involve teaching pupils how they should draw up their activity programme on the basis of the knowledge that must be acquired.

Every pupil masters this activity, and consequently acquires the knowledge, spontaneously. At the same time a teacher can and must control the acquisition of the knowledge by controlling the forming of those types of activity which are to be carried out on the basis of this knowledge.

Each element of the physical knowledge is connected with two types of activity: on recognition and on simulation of certain situations. The programme of these types of activity is based on the content of the corresponding knowledge [1].

The following elements can be distinguished among the physical knowledge: concepts, laws, scientific facts, theories. Concepts are divided into concepts of physical objects, physical phenomena and physical magnitudes.

Pupils must acquire the elements of physical knowledge by carrying out certain activities, connected with recognition and reproduction of them in certain situations. This implies that to organize such an activity, problems-exercises are required, the tasks of them must specify the goals which make the pupil carry out the activity on recognition or simulation of certain situations. The problems-exercises are solved with reference to some physical knowledge that enables the pupils to understand the essence and digest the content of the new knowledge as contrasted with the complex problems, where the whole attention is paid to the physical content and so the aim is not achieved. However, the problem books recommended to the pupils contain a few problems-exercises, so teachers have to write them themselves.

To acquire some physical knowledge a pupil must carry out the same activity in different situations, the following requirements to be satisfied:

1) the situations must be interesting to the pupils, physical knowledge must be applied in solving important problems;

2) the number of the situations must be about 8–10. This is in full compliance with the data of

psychological researches saying that to master an activity one must perform it at least 8 times;

3) the situations must be of three types:

a) have the features of the concept they are brought to;

b) not have some of the features, c) have some indefinite features;

4) the situations can be described verbally, presented in the form of drawings, graphs or tables;

5) the situations must be arranged in such a way that the situations which differ from each other were in the beginning, followed by more similar ones;

6) situations in which pupils can carry out the activity with the real objects are quite valuable.

For example, when a teacher gives pupils the task «to reproduce the diffusion phenomenon, choosing the necessary objects», the following sets of objects are offered:

a) a glass of water; strawberry syrup;

b) a bottle of perfume;

c) an aluminum spoon, a glass of hot water;

d) a glass of water, potassium permanganate, a glass stick etc.

The peculiarity of all the mentioned exercises is that the programme of the activity on achieving the goal, that was stated in the requirements of the problem, is elaborated on the basis of the knowledge, which is stated in the goal.

Activity on recognition in logics is called concept identification. This activity has a very strict logic scheme explained by the content of the notion «concept identification»: concept identification means defining if the situation (object, phenomenon) involves all the features stated in the definition of the concept.

For this reason, it is required:

1) to name the concept to be identified in the given situation;

2) to give the definition of the concept;

3) to define the features of the concept;

4) to name the first feature;

5) to define if the situation possesses the feature;

6) to name the second feature;

7) to define if the given situation possesses the feature;

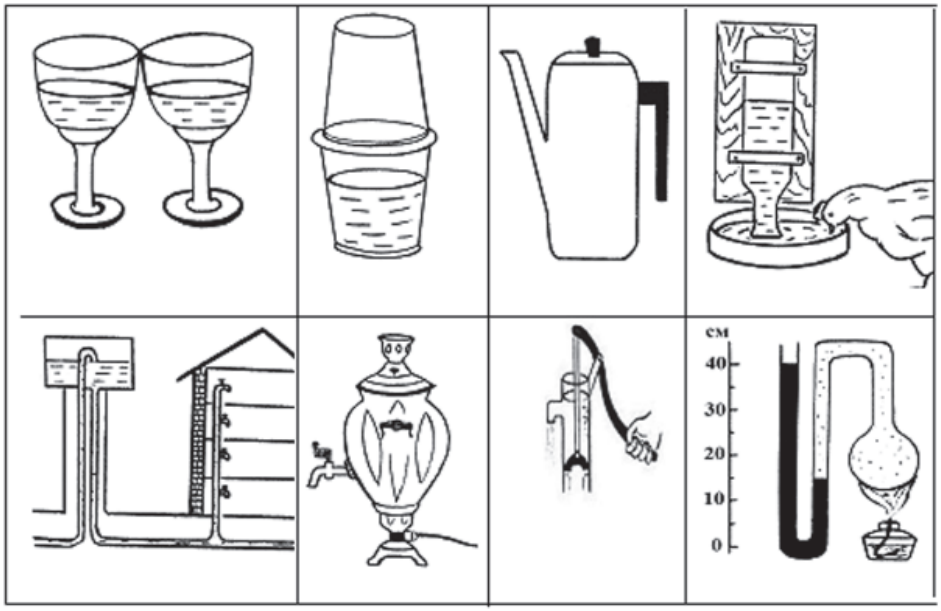
…

n) to formulate the conclusion.

There is a logical rule of drawing conclusions: the situation only suits the given concept in case it possesses the whole system of the necessary and sufficient features, included into the concept [7]. If it lacks at least one of them, it cannot belong to this concept. If it is impossible to define if the situation has or lacks some feature, the answer remains uncertain even in case all other features are present: it cannot be stated if the situation belongs to the concept or not.

Recognition of the situations corresponding to some concept (or scientific fact) or another is carried out in strict compliance with this logic scheme. In addition, the method of analyzing the situations while identifying if they possess the features of the concept is determined by the content of the certain concept.

Example. The task is «to identify if there is a phenomenon of electrostatic charging of bodies in certain situations».



To fulfill this task it is required:

1) to name the concept to be identified in the given situation: electrostatic charging of bodies;

2) to give the definition of the concept: electrostatic charging of bodies is a phenomenon, implying that if two bodies are in contact

or rubbing each other, they both acquire the ability of attracting other bodies;

3) to define the features of electrostatic charging of bodies: I – involvement of two bodies, II – the two bodies are in contact or rubbing together; III – the two bodies acquire the ability of attracting other bodies;

4) to name the first feature: two bodies must be involved;

5) to define if there are two bodies in the situation;

6) to name the second feature: the two bodies are in contact or rubbing together;

7) to define if the two bodies are in contact or rubbing together;

8) to name the third feature: acquisition by the two bodies the ability of attracting other bodies;

9) to define if the two bodies acquired the ability of attracting other bodies;

10) to formulate the conclusion.

This example illustrates that an action on recognition has two elements: logical one (general logical scheme of the activity) and conceptual one (way of analyzing certain situations to define if they have the features stated in the concept).

To know the structure, functions and basic features of the action allows to model the most rational types of cognitive activity and to select requirements to them in the end of the study course. The theory of step by step mental actions forming distinguishes five stages in the process of acquiring crucially new actions [2].

It is rational to start teaching any new activity with setting a problem that requires this activity. Thus, a motivation stage is first organized; at this stage it becomes necessary for the pupils to recognize or simulate a certain situation.

The next stage is drawing up a scheme of the approximate basis of actions. For this purpose it is required to set the system of necessary and satisfying features, which characterize certain phenomena, and show how one should define the presence or lack of the chosen system of characteristics and make the appropriate conclusion. Then pupils should elaborate the way of solving a particular task in a generalized form. This stage provides preliminary insight into the activity, understanding of its logic, but to master this activity one must carry it out independently for several times leaning upon the acquired knowledge.

Then the stage of performing the activity in the material form follows. Beside the way of performing the exercise pupils must be provided with the system of tasks where this activity must be carried out. It is advisable that in the situations 1 and 2 there should be an opportunity to carry out the activity manually, applying certain objects and equipment. In that case the pupils will remember not only the features of the concept and the logical rule of the concept identification, but will be able to apply them both, i.e. they will master one of the logical methods of work with the concept. At this stage it is important to control not only the final result of the activity, but to observe the correct implementation of each action. At this stage the simultaneous work of all the pupils is organized. Each of them performs the actions and shows the result to the teacher.

The next stage is the stage of verbal actions. The new character of their work is explained to the pupils – in pairs, where one of them is a pupil and the other is a teacher. The exercise is done in the context of 3–4 situations with the action being performed in a form of speaking aloud without any materialization tools.

When pupils master the activity in this form they should be allowed to work individually without leaning upon the way of the exercise performing and without reasoning aloud, i.e. they are taken to the stage of argument to themselves. This stage is characterized by the pupils' commenting the whole process, like in the previous stage, but to themselves, silently. The pupils should perform the exercise in the context of the situations 5 and 6, saying to themselves not only the name of the action, but the way of its being carried out. The control is effected on the basis of the final result. This is a transitive stage to the last one – the stage of the mental actions. In this final stage the activity is being generalized, shortened and automatized. Exercise in the context of situations 7 and 8 can be treated as a control one. The pupils can be asked to do it very quickly.

To manage the pupils' cognitive activity on acquisition of physical knowledge we have elaborated a new didactical tool, which presents tasks on application of knowledge, at least 8 certain situations are selected for each task and ways of fulfilling the tasks are defined in a generalized sense. It is called «Physics workbook» and is designed for acquisition of principal physical notions, laws and scientific facts by pupils [6]. The title of the handbook underlines that pupils use it at the lessons, but it does not substitute a Physics copybook, where the pupil takes notes while acquiring new physical knowledge, implementing practical work [3, 4, 5]. The pupil carries out some different activities in it: draws up a programme for the tasks fulfilling in a generalized way, trains many times in its

implementing while recognizing or simulating certain situations, solving problems-exercises, explaining phenomena.

Situations of the tasks are interesting to the pupils, for they allow them to apply the knowledge of Physics in tackling practical problems. Computer lends invaluable support in elaboration of such didactical tools, for it helps to form a bank of problems-exercises in all the topics of the school-time Physics course. This facilitates the preparatory work of a Physics teacher, as there is a possibility of immediate access to didactical tools, enabling to organize the process of acquisition of physical knowledge.

The method described of organizing pupils' activity in the stage of application of the knowledge allows pupils not only to acquire some new knowledge at a lesson without any particular overlearning, but to develop their universal educational actions.

References

1. Anofrikova S.V. Alphabet teaching activities, illustrated examples of physics teachers. Part 1. Develop lessons. – M.: Moscow State Pedagogical University, 2001. – 236 p.

2. Galperin P.Ya. Introduction in Psychology. – M.: Book house «University», 1999. – 332 p.

3. Krutova I.A. Base tendencies of using computer in the process of «creation» and acquisition of concepts on physical phenomena among pupils // Fundamental research. – 2007. – № 7. – P. 63–65.

4. Krutova I.A. Formation of cognitive competence among secondary school children to the study of physical phenomena // Geology, Geography and Global Energy. – 2006. – № 8. – P. 184–187.

5. Stefanova G.P., Krutova I.A. Use of computing technology in the forming of cognitive activity of pupils in physics teaching // Bulletin of Vyatka State Humanities University. – 2011. – № 4–1. – P. 160–164.

6. Stefanova G.P., Krutova I.A. Physics: workbook for grade 7: Manual. – Astrakhan: Publishing house «Astrakhan University», 2011. – 130 p.

7. Talyzina N.F. Managing the process of knowledge acquisition. – M.: Moscow State University, 1984. – 344 p.