THEORETICAL-METHODOLOGICAL BASES OF FORMATION OF LOGIC OF UNIVERSAL EDUCATIONAL ACTIVITIES IN PHYSICS LESSONS

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Abstract. Purpose. Designing a modern physics lesson on the basis of a system of didactic, methodical and logical-psychological connections, allowing to form universal educational actions. **Methodology**. The research is based on system-activity and technological approaches. **Results**. The theoretical and methodological basis for the formation of logical universal educational actions in physics lessons in the framework of the second generation of the Federal State Education Standards of the Basic General Education (FSES) is presented. Macro -, meso - and micro - levels of formation of logical operations in the process of studying physical concepts are considered. The analysis of the dynamics of the functional development of logical operations is a didactic condition for the formation of logical universal educational actions.

Keywords: analysis, synthesis, comparison, abstraction, classification, universal educational actions.

1. Introduction. The Federal State Educational Standard defines the results of mastering the main educational program: personal, meta-subject and subject.

Meta-subject results include the sum of meta-subject knowledge and universal learning activities (ULA), which are divided into cognitive, regulatory, and communicative. Cognitive universal actions include: general, educational, logical, problem statement and problem solution [11].

FSES identifies the following logical universal learning actions: analysis and synthesis of objects; selection of grounds (почему не basis?) and criteria for comparing and classifying objects; definition, deduction of consequences; establishing causal relationships, building a logical chain of reasoning, proof; making hypotheses and their justification.

Logical universal educational actions are nothing but the means of obtaining knowledge: the disjunction of an object or the isolation of the properties (relations, links) of a subject - analysis; making parts into a new general - synthesis; the identifying of differences and similarities of objects - comparison, the identifying of a hierarchy with respect to classification criteria - systematization; identification of features or components that are essential for a given distribution — abstraction; the definition of essentially common to a number of objects or phenomena signs – generalization the division into classes according to a similar or substantially general characteristic is classification.

2.REVIEW OF LITERATURE. The main ideas of the formation of universal educational actions are in line with the studies of the psychology of thinking under the guidance of leading scientists A. N. Leontyev and S. L. Rubinshtein. The study of mental activity was carried out in three directions: 1) thinking processes of the student (analysis - synthesis and operations derived from them); 2) properties of mental activity (speed, flexibility, criticality, creativity); 3) products of mental activity, i.e. knowledge (scientific concepts).

In the course of the research, conclusions were made about the interrelation of the learning process and the development of thinking, about changing the quality of analytical-synthetic activity and its composition, as well as about the need for purposeful formation of universal educational activities such as analysis, synthesis, comparison, abstraction, synthesis and classification (C L. Rubinstein [10], A. N. Leontiev [6], V. V. Davydov [4], A. A. Lyublinskaya [7], D. N. Bogoyavlensky [2], N. A. Menchinskaya [8], P. Ya. Halperin [3], E. P. Kabanova-Meller [5], N. N. Pospelov, I. N. Pospelov [9] and others).

3.RESEARCH METHODS. The study is based on system-activity and technological approaches.

4.RESULTS AND DISCUSSION.

The object of our study: the theoretical and methodological foundations of the formation of logical universal educational actions.

Subject of research: the development of general recommendations for the formation of logical operations.

Purpose: the design of modern physics lesson based on a system of didactic, methodical, and logical-psychological links, allowing to form universal learning activities.

The analysis of the considered logical operations allows us to make the following conclusion: a logical operation is capable of transforming, with a change in which its qualitative leap occurs to a more complex level. This is well illustrated in Figure 1 [12, p.30].

Each logical operation has its own function, and the development of mental operations is based on the continuity and continuity of these functions, and in dynamics, which clearly demonstrates the basic and sequential stages of the formation of logical operations and determines the didactic conditions of the process under study.

We have developed a system of didactic, methodological, and logical-psychological links that allows you to manage the process of the formation of logical operations based on the selected dynamics.

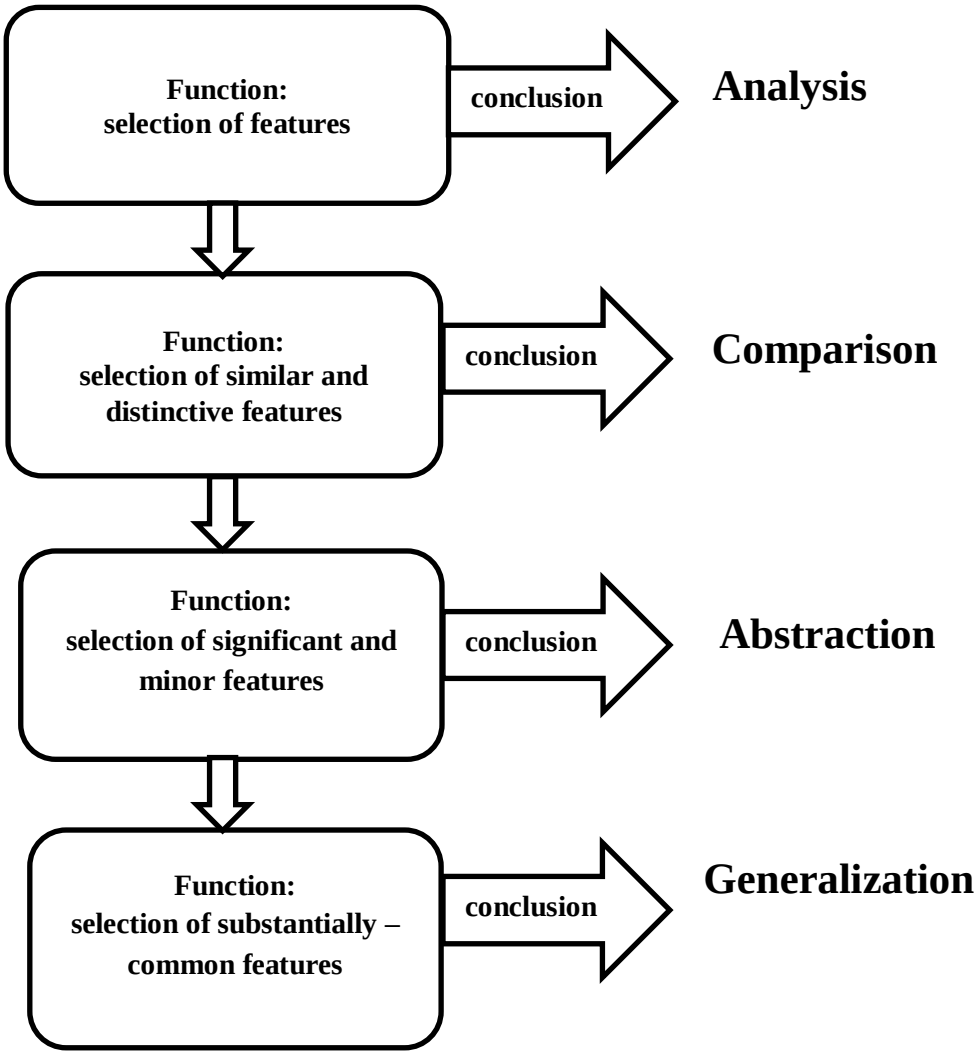


Figure 1. Dynamics of the functional development of logical operations

The cognitive process forms a system of three levels: the macro-level - determines the activity characteristic of the educational process and is subordinated to the didactic goals of the lesson; the meso-level is responsible for the methodological structure of the lesson and is a set of actions subordinated to educational goals; the micro-level (operation) - corresponds to the dynamics of the functional development of logical operations (see Figure 2) [1].

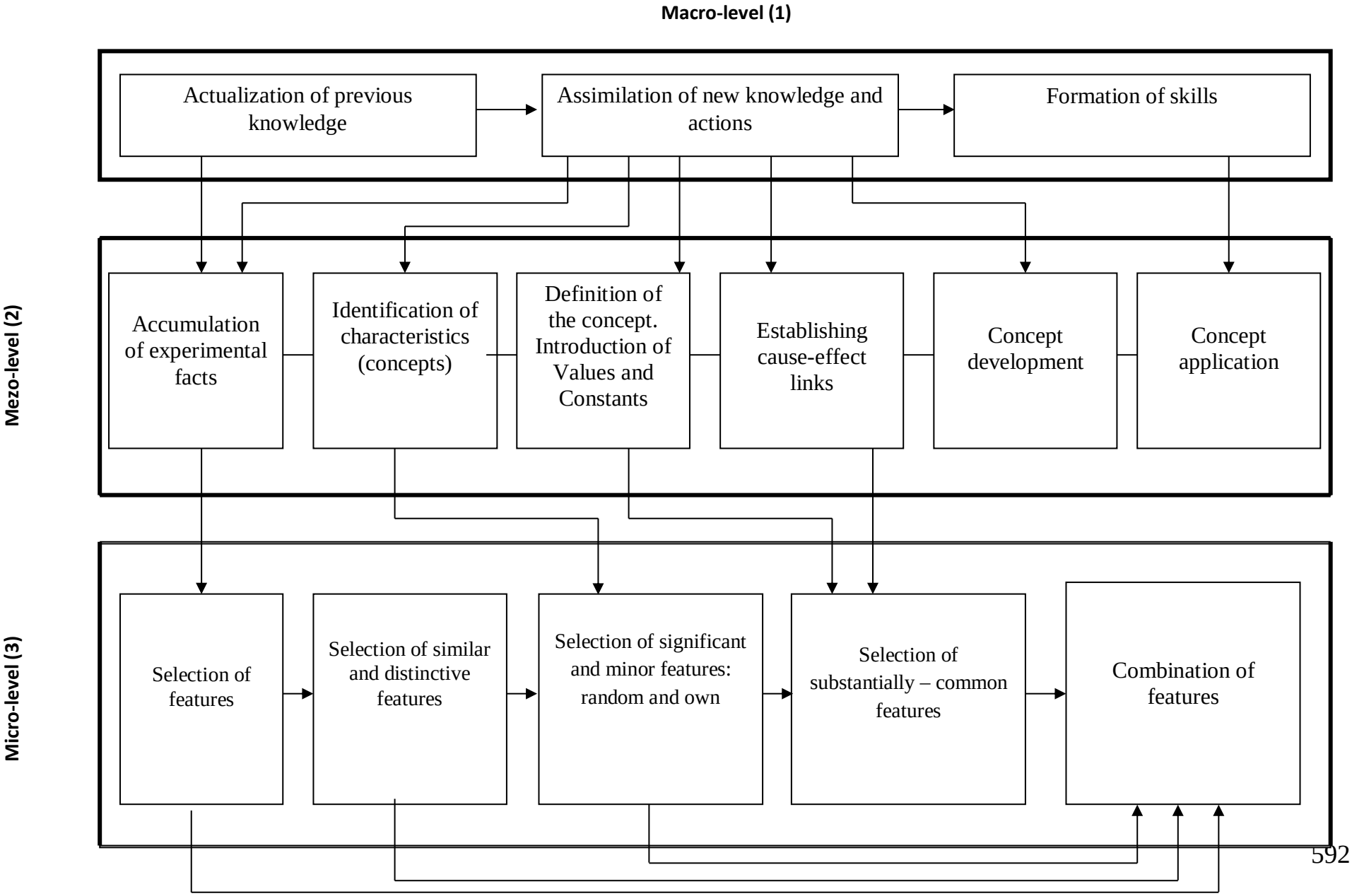
Imagine the relationship between the methodological structure of the lesson (meso-level) and the dynamics of the functional development of logical operations (micro-level) on the example of the formation of a physical concept.

The first stage - the accumulation of experimental facts begins with an analysis of facts and phenomena known to students from everyday experience, or a demonstration of a physical phenomenon by a teacher.

At the same time, various changes occurring in the observed system are recorded in order to establish a system of signs characterizing the primary idea of an object or phenomenon. As soon as the base of signs is enriched with the necessary and sufficient amount, they proceed to the selection of signs of similarity and difference.

The second stage is the identification of the characteristic features of the phenomenon (concept).

Figure 2. The system of didactic, methodical and logical-psychological links



This stage involves the selection of the system of distinctive features, an essential and basic feature. In the future, this knowledge will allow associating an essential feature with the species difference of the object being studied, belonging to a particular class. The third stage is the identifying of cause-effect relationships. Here, the student needs to discover the connection of the essential feature of the emerging concept (cause) with the well-known concept (consequence). The fourth stage is the definition of the concept. Highlighting the essentially general characteristics of the concept, they proceed to the definition, i.e. the definition of the concept, which consists in combining the selected features according to the scheme of subordination of generic similarities and species differences. The fifth stage - the development of the concept - ensures its further concretization, which requires a higher level of generalization, since it reflects not one essential aspect, but reveals its diverse connections. Under the development of the concept should be understood and the classification of concepts (drawing up classification schemes and tables), and their systematization. The sixth stage - the application of the concept allows to improve the universal learning activities.

5. Summary . Thus, the general recommendations for the formation of logical operations are as follows:

1. At the stage of accumulation of experimental facts, it is more expedient to form in students the ability to single out the attributes of an object, phenomenon, concept, i.e. form the ability to analyze objects, physical phenomena or concepts.

2. Formation of the ability to conduct a comparison in order to identify signs of similarities and differences can be entered at any stage of the lesson, moreover, any type of lesson.

3. Abstraction is formed at the stage of identifying the characteristic features of a concept when identifying significant, basic and random features of an object, phenomenon, or concept.

4. Familiarity with the structural components of the generalization operation is advisable at the stage of establishing causal relationships.

5. Synthesis, as an operation uniting all the selected essential features, is more effective to enter at the definition stage [4].

6. Conclusion. Based on the analysis of psychological and pedagogical, methodological and logical literature on the formation of logical operations, the theoretical and methodological provisions for solving this problem are disclosed.

Selected logical universal actions that form a kind of hierarchical ladder. Of these, necessary and sufficient are:

- analysis of objects or phenomena;
- synthesis of selected elements through analysis;
- comparison of the studied subjects for various reasons;
- abstraction of essential and non-essential features of objects, phenomena or concepts;
- generalization of objects according to general and essential features.

The selected dynamics of the functional development of logical operations is a didactic condition for the formation of logical universal learning actions.

The built system of didactic, methodical, and logical-psychological connections is a didactic tool that allows you to manage the process of the formation of logical universal learning actions in physics lessons.

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