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PSYCHOLOGICAL MECHANISMS OF IMPROVING TEACHING BASED ON INFORMATION-LOGICAL MODELING

Okbaeva Nilufar Urakovna
Associate Professor Department of Algebra and Geometry
Karshi State University
Email: nilufarokboyeva@gmail.com

Abstract
Teaching based on information-logical modeling serves as an important psychological mechanism in developing students' cognitive, logical, and algorithmic thinking skills in the modern educational process. This approach, grounded in the cognitive development theories of scholars such as Piaget and Vygotsky, activates students' mental operations such as comparison, classification, reasoning, and decision-making. Through the use of If–Then schemes, flowcharts, and conceptual maps, conditional, step-by-step, and abstract thinking are effectively formed. Moreover, modeling enhances attention and memory processes while fostering competencies in data analysis, information retrieval, and decision-making. By stimulating metacognitive thinking, soft skills, and independent reasoning, this methodology transforms education from a purely knowledge-transmitting process into a thinking-enhancing one. As a result, students acquire competencies in working with complex information, applying algorithmic approaches, and mastering new knowledge through analytical processes.

Keywords: Information-logical modeling, cognitive psychology, logical thinking, algorithmic approach, metacognitive thinking, educational process, soft skills, mental operations, flowchart, conceptual map.

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Introduction

In the modern education system, organizing the learning process effectively and developing students' intellectual potential are among the most pressing challenges. Digital technologies, information and communication tools, and innovative pedagogical approaches are increasingly becoming key factors in improving the quality of education. From this perspective, teaching technologies based on information-logical modeling are gaining a significant place in the educational process. This approach is recognized as an effective tool for activating students' cognitive activity, developing logical thinking, shaping algorithmic thinking skills, and enhancing their ability to conduct independent analysis.The essence of information-logical modeling lies in organizing the educational process on a systematic, logical, and algorithmic basis, closely linked to the psychological mechanisms of human thinking. Such an approach is grounded in the cognitive development theories of scholars such as Piaget and Vygotsky and stimulates mental operations — including comparison, classification, reasoning, and decision-making. Through modeling tools such as If–Then schemes, flowcharts, and conceptual maps, conditional, step-by-step, and abstract thinking are effectively formed.Today, one of the most important tasks facing the system of continuous education is to train students to think independently, solve problems through analysis, and work effectively with various sources of information. In this context, information-logical modeling serves not only as a knowledge-delivering method but also as a pedagogical tool that develops students' intellectual, metacognitive, and creative potential. Therefore, improving teaching methods based on this approach plays a crucial role in preparing highly competent specialists in the modern educational environment[1-5].

"The teaching model based on information-logical modeling is a powerful tool for developing students' intellectual, logical, and algorithmic thinking. The psychological basis of such teaching lies in its alignment with the characteristics of human thinking — systematicity, analyticity, and logic. Connection with cognitive development (based on Piaget and Vygotsky's theories):

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Psychological principle - its impact on teaching

According to Piaget, intelligence develops step by step — models of complexity should be selected according to the student's age.

Vygotsky – ZPD (Zone of Proximal Development) theory — the teacher supports modeling to facilitate the formation of complex thinking.

Psychological Aspects and Impact of Information-Logical Modeling
Activation of Cognitive Abilities:
From a psychological perspective, modeling activates students' ability to work with various mental operations such as comparison, classification, reasoning, and decision-making.

Formation of Logical Thinking:
Information-logical modeling represents a learning process based on constructing logical chains, performing algorithmic analysis, and finding solutions.

- **If–Then schemes** help develop conditional thinking.
- **Flowcharts and algorithms** enhance the ability to solve problems step by step.
- **Diagrams and conceptual maps** foster abstract and visual thinking skills.

Impact on Attention and Memory Processes:
Teaching based on modeling:

- Directs attention toward specific elements (focused thinking);
- Activates both short-term and long-term memory (graphic representation makes memorization easier);
- Encourages understanding-based knowledge formation rather than rote memorization through structure-oriented learning.

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Development of Competencies:

Information-logical modeling helps develop essential competencies such as information retrieval, analysis, and decision-making. It contributes to the development of soft skills — including problem-solving, communication, and visual expression — and activates metacognitive thinking, which involves monitoring and regulating one's own thought processes.

Improving teaching based on information-logical modeling enables students to develop:

- Intellectual and logical thinking;
- Independent analytical skills;
- Algorithmic approaches and psychological competencies necessary for working with complex information.

The psychological grounding of this methodology reinforces its function not only as a means of delivering knowledge but also as a powerful educational tool for fostering thinking skills.

Broader Educational Context

The ongoing reforms in all sectors of our country inevitably influence the processes of training, retraining, and improving the pedagogical and professional skills of teachers within the continuous education system. Changes occurring in socio-economic life and the education system directly affect the goals, tasks, content, and structure of the professional-pedagogical activities of teachers working at all levels of continuous education.

Therefore, educators in educational institutions must continuously improve their knowledge, skills, and qualifications in accordance with evolving societal changes.

For example, in many universities in developed countries such as the United States and the United Kingdom, students actively engage in continuous, independent learning both inside and outside the classroom. Their persistent efforts to collect and process information, work with computers and various information sources, and enhance their research skills are consistently supported by the state.

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Cognitive and Psychological Foundations of Teaching Through Information-Logical Modeling

In developed countries, the independent creative activities of teachers and educators increasingly require a balance of theoretical knowledge and practical skills. As a result, educational processes are more frequently implemented through **interactive teaching methods.** Self-awareness and purposeful activity, as integral components of these methods, reflect both the learner's internal world and their attitude toward the surrounding environment [9].

Improving teaching methods based on **information-logical modeling** is addressed by each teacher individually, depending on their capabilities and pedagogical experience. Taking into account the specific conditions and situations of the educational process, teachers enrich general methodology by expressing their own perspectives and approaches.

Formation of Concepts in Students:

The formation of conceptual understanding is one of the fundamental components of learning any subject. The primary task of the teacher is to ensure that students fully comprehend and internalize these concepts.

Solving this problem requires students to develop **basic skills** in formalizing the topic under study. It is also essential to cultivate the skills and competencies necessary for applying the acquired knowledge in **practical activities**. Such skills are manifested when students are able to manage and manipulate the studied objects on their own. However, even when a student understands the meaning of a concept, they may not yet grasp the role of operations performed with those concepts.

The Role of Operations in Learning:

Understanding the place, meaning, and degree of influence of operations requires engaging in activities that involve their practical application. Using **information models** in studying a topic creates conditions for indirectly comprehending the role and significance of these operations.

Some scholars attempt to understand the teaching process of higher education institutions and mathematics instruction from the perspective of the **interaction**

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between logical models and thinking models. At the same time, they link methodology with the science of optimal development of new knowledge and skills.

In the field of teaching information technologies, the methodological solution to the problem of developing a teaching model is considered through the construction of **logical-mathematical models**. A logical model is formal and abstracted from how mental activity actually occurs — yet it is realized precisely through that activity. Although the mechanism of human mental activity is the subject of psychological research, its outcomes are recognized across all sciences as the mechanism by which students perceive and process knowledge. This involves studying the individual's thinking process and the motivational factors behind cognitive activity[12-14].

Nature of Human Thinking:

Human thinking is the result of the activity of various brain structures. Many philosophers and psychologists have attempted — and continue to attempt — to define the characteristics of human intelligence. These can be summarized as follows:

1. **The ability to classify sensory images** – a trait inherent to humans that manifests itself in the interaction between thinking and language.
2. **The ability to adapt behavior** – or the capacity to learn. This is a key function of human intelligence and is expressed through purposeful adaptation to the external environment.
3. **Deductive reasoning ability** – the capacity to draw conclusions from existing concepts and probabilities. This ability is especially evident in precise sciences such as logic and mathematics, where formal mechanisms and rules for reasoning exist.
4. **Inductive reasoning ability** – the ability to generalize. This involves forming new concepts based on knowledge of individual ones and manifests itself in a person's capacity to abstract and develop new ideas and theories.
5. **The ability to construct and utilize conceptual models** within different fields of science. This enables individuals to develop a system of concepts

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about a subject area, correctly interpret phenomena, and navigate within that domain.

In **cognitive psychology, logic, and cybernetics**, the study of thinking is conducted by constructing **models of psychological processes** within the human brain. To identify the role of various aspects of psychological processes in organizing the learning process, several models of thinking developed in cognitive psychology are considered.

Thinking is determined by the interaction of **external and internal conditions**. Each stage of thought corresponds to a certain state of the object of knowledge and concludes by revealing the causes of changes in that state. Changing the state of the object generates a new direction of thought, and so on. The psychological mechanism of this process is **analysis through synthesis** — meaning that the object enters new connections and relationships, revealing previously unknown properties and producing a new state. Consequently, thinking involves the functions of analysis, synthesis, abstraction, and generalization.

In the first case, we consider knowledge as a product and then reflect on the results of analysis and generalization. In the second case, we contemplate the **process of activity** associated with analysis and synthesis.

Thus, the problem of the **unity of thinking and knowledge** — that is, the relationship between psychological processes and logical products — remains, to some extent, an open and ongoing subject of research.

Conclusion:

Organizing the educational process based on information-logical modeling is one of the important directions of modern pedagogy. It activates students' cognitive activity and develops their logical thinking and algorithmic reasoning skills. Research results show that teaching organized on the basis of modeling helps students form knowledge based on deep understanding, enhances attention and memory processes, and develops skills in analyzing complex information and making well-founded decisions.

Moreover, this methodology serves as an effective tool for developing students' metacognitive thinking, as well as soft skills such as independent analysis, communication, and creative approaches.

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At the same time, the psychological mechanisms of information-logical modeling correspond to the natural laws of human cognitive development and transform the educational process from a simple knowledge-giving activity into a system that develops thinking. This creates the necessary conditions for training highly qualified specialists in the modern education system — specialists who can think independently and approach problems in a complex and analytical way[15-19].

Recommendations:

1. It is necessary to widely implement educational technologies based on information-logical modeling into the educational process.
2. Teachers should undergo regular retraining and professional development in the methodology of logical modeling.
3. When designing curricula, psychological mechanisms based on cognitive development theories such as those of Piaget and Vygotsky should be considered.
4. Visual tools such as block diagrams, conceptual maps, and algorithms should be actively used in the learning process.
5. Greater attention should be given to tasks and interactive methods that develop students' skills in independent thinking, decision-making, and analysis.

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