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SCIENTIFIC AND THEORETICAL ESSENCE OF THE HEURISTIC APPROACH

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Abstract. The heuristic approach is a scientific-theoretical concept that involves using creative thinking, intuitive decision-making, and experience-based methods to solve problems. Unlike traditional algorithmic methods, this approach does not rely on rigid rules or sequential procedures; instead, it facilitates the generation of new ideas, the examination of problems from multiple perspectives, and the identification of optimal solutions. Heuristic methods are particularly effective in complex, ambiguous, and multi-option situations. Their scientific essence is linked to unlocking the creative potential of human thought, enabling independent knowledge acquisition, and making flexible decisions in problem-solving contexts.

Keywords: heuristics, heuristic approach, creative thinking, problem-solving, intuitive decision, algorithmic method, cognition, innovation, knowledge acquisition, methodology.

The heuristic approach (heuristic learning) is an educational model that directs learners to achieve knowledge through independent research, discovery, and problem-solving rather than passive reception of ready-made knowledge [1]. Its main characteristics include: Creating a Problematic Situation. The concept of a problematic situation in pedagogy and psychology is based on several theories. First, according to Jean Piaget's cognitive development theory, human thinking develops through the processes of assimilation and accommodation [2].

- Assimilation is the process of integrating new information into existing knowledge and schemas. Example: If a child has previously recognized a dog, they might initially call a cat a "dog" because they are fitting the new animal into an existing schema. Characteristic: New experiences are adapted to existing knowledge. Cognitive change is minimal. Stability is maintained.

- Accommodation is the process of modifying existing schemas to incorporate new information. Example: The child distinguishes between a cat and a dog and creates a new "cat" schema. Characteristic: Existing knowledge changes or expands, and new concepts emerge. This is a primary source of cognitive development.

Equilibration. In Piaget's theory, the balance between these two processes is crucial: If assimilation dominates → development slows. If accommodation dominates → cognitive instability occurs. Hence, humans constantly strive for equilibrium.

Stages of Cognitive Development:

1. Sensorimotor stage (0–2 years): Learning through action and perception.
2. Preoperational stage (2–7 years): Strong imagination, but logical thinking is not fully developed.
3. Concrete operational stage (7–11 years): Development of logical thinking based on concrete objects.
4. Formal operational stage (11+ years): Formation of abstract and theoretical thinking.

Scientific Significance: Forms the basis of educational methodology. Determines age-appropriate teaching methods. Explains the natural mechanism of cognitive development. A problematic situation activates these processes and compels the learner to acquire new knowledge independently. Additionally, according to Lev Vygotsky's "zone of proximal development" theory, a problematic situation serves as a tool to bridge the gap between the learner's current knowledge and potential capabilities [3–7].

Jerome Bruner interpreted education as a "process of discovery," considering the problematic situation as the main mechanism of discovery learning [8].

A problematic situation triggers the following internal processes: Cognitive dissonance – the feeling that existing knowledge is insufficient, increased motivation – desire to solve the problem, activation of thinking – analysis, synthesis, comparison, hypothesis generation – development of tentative solutions. As a result, the learner transforms from a passive listener into an active researcher.

Conditions for the Effectiveness of a Problematic Situation: Appropriateness of the problem: It should correspond to the learner's level, neither too easy nor too difficult [9].

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The Existence of Conflict: The difference between "I know" and "I don't know," or a contradictory fact or phenomenon.

Motivational Significance: Relevance to real-life situations, interesting and meaningful content.

Activity Orientation: The learner is engaged in independent exploration.

Technologies for Creating a Problematic Situation:

- Problem posing through questions: The teacher asks not a simple but an open, challenging question. Example: "Why…?", "How…?"
- Creating a contradictory situation: Two opposing ideas or outcomes are presented, and the learner investigates the reason.
- Problem based on experience: The result of a practical experiment differs from expectations.
- Using real-life situations: Knowledge needs are formed through real problems.
- Analyzing incorrect solutions: An incorrect answer is provided, and the reasons for the error are examined.

Practical Example: Topic: Present Perfect vs. Past Simple

Creating a Problematic Situation: The teacher writes two sentences on the board:

1. I have lost my key.
2. I lost my key yesterday.

The teacher asks: "What is the difference between these two sentences? When is each used?"

Learners' response: They understand both sentences but cannot clearly explain the grammatical difference. This creates a cognitive conflict (problem): "Why are two similar sentences used differently?"

Lesson Process (Based on the Heuristic Approach):

1. Understanding the problem: Students translate the sentences and try to identify the difference.
2. Hypothesis formulation: Students guess that one relates to the present, the other to the past.
3. Investigation (research): The teacher provides additional examples:

- She has gone to London.
- She went to London last year.

Students independently formulate the rule.

Conclusion: Present Perfect → result is connected to the present. Past Simple → refers to a specific past time.

Methodological Techniques: Problem posing through questions, comparison method, independent rule formulation, pair work.

Result: Through this problematic situation, learners: Understand grammar rather than memorize it, Think independently, Learn to apply it correctly in real communication. Another Short Example (Speaking Lesson): Situation: The teacher asks: "If you travel abroad but do not know the language, how will you communicate?"

Problem: The learner wants to express ideas but lacks vocabulary.

Solution: Learners search for new words, use gestures and simple sentences, and develop communicative strategies.

Significance in Foreign Language Teaching: Creating problematic situations is crucial for developing learners' communicative competence. It enables independent application of grammatical and lexical knowledge in natural speech. This approach makes language learning closer to real communicative activity rather than artificial practice.

Analysis Process: The learner cannot explain the phenomenon using existing knowledge, so hypotheses are proposed and tested through experiments or models. As a result, the principle of Archimedes is understood [10].

Pedagogical Effectiveness: Research shows that teaching based on problematic situations: Ensures deep and long-term knowledge retention, develops critical and creative thinking, cultivates learners' independent decision-making skills, makes the educational process interactive and engaging [11].

Conclusion: Creating a problematic situation, as the core mechanism of heuristic education, activates learners' cognitive activity, directs them toward independent inquiry, and allows them to acquire knowledge not in ready-made form but through discovery. Therefore, systematic use of problematic situations in modern educational systems is an important factor enhancing pedagogical effectiveness. It is characterized by the development of independent thinking, cultivation of a creative approach, prioritization of learner activity, and the teacher acting as a facilitator.

Scientific literature emphasizes that heuristic education: Develops learners' creative thinking and research skills, facilitates knowledge acquisition through solving problematic situations.

Theoretical Foundations of Heuristic Education: Constructivism: Knowledge is constructed by the learner, with experience and activity as key factors. Cognitive Psychology: Focuses on thinking processes (analysis, synthesis, induction) and problem-solving strategies. Activity-Oriented Approach: Learning is considered an active process.

Main Methods: Problem-Based Learning (PBL): Learners are presented with a problem and independently find solutions. Discovery Learning: Knowledge is "discovered," not given; widely used in the USA and Finland. Socratic Method: Thinking is guided through probing questions. Project Method: Focused on achieving practical results. Research Method: Small-scale scientific investigations are conducted.

Structure of a Heuristic Lesson:

1. Motivation (posing the problem)
2. Understanding the problem
3. Formulating a hypothesis
4. Experimentation / investigation
5. Analyzing results
6. Drawing conclusions

Heuristic Educational Technologies: Modern technologies that enable effective application of the heuristic approach include: Interactive technologies: Brainstorming, debates, clusters. Brainstorming: A method of group discussion for solving a problem or generating new ideas. Participants propose as many ideas as possible.

Basic Principles: No criticism (ideas are not rejected). Free thinking (even unusual ideas are accepted). Quantity of ideas → higher chance of success. Development and combination of ideas

Advantages: Develops creative thinking . Helps view problems from multiple perspectives. Improves teamwork skills.

Applications: At the beginning of a lesson to introduce a topic. Identifying a problem. Generating new ideas.

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Debate Method: Definition: Debate is an interactive method in which participants justify and defend opposing viewpoints on a specific topic using evidence.

Structure:

1. A topic is selected.
2. Participants are divided into groups (e.g., “pro” and “con”).
3. Each group defends its position with supporting arguments.
4. A conclusion is drawn at the end.

Advantages: Develops critical thinking. Enhances language and speech culture. Cultivates skills in reasoning and analysis.

Application: Effective for discussing social, political, economic, or scientific topics.

Cluster Method: Definition: The cluster method is a way of visually representing ideas and concepts related to a central concept.

Procedure: Write the main topic at the center. Surround it with related ideas, connecting them to the central concept and to each other.

Advantages: Helps understand the topic systematically. Develops logical thinking. Simplifies complex information.

Application: Useful for introducing, reviewing, or summarizing new topics.

Brainstorming, Debate, and Cluster Methods play an important role in modern education. They develop learners’ creative, critical, and logical thinking and facilitate deep understanding of knowledge. Therefore, their extensive use in lessons is recommended.

Digital Technologies: Virtual laboratories. Simulations. Multimedia tools.

STEAM and Integrated Learning: Focus on interdisciplinary connections and real-life problems. STEAM combines Science, Technology, Engineering, Art, and Mathematics. Goal: Connect theoretical knowledge with practical applications, fostering creative and critical thinking.

Principles: Interdisciplinary connections: Solve a problem or complete a project by integrating multiple subjects; Real-life problems: Apply knowledge to everyday or societal challenges; Practical activity: Conduct experiments, projects, or prototype development.

Advantages: Develops complex problem-solving skills. Encourages creative and innovative thinking. Connects theoretical knowledge to real-life applications.

Example: Use mathematics and physics to analyze and solve environmental problems, or create technological prototypes through art and design.

Gamification (Learning Through Game Elements): Definition: Gamification is the integration of game elements into the learning process to increase motivation and engagement.

Core Elements: Points and rewards. Levels and tasks. Competitions and leaderboards. Storylines and adventures.

Advantages: Increases learner motivation. Encourages active participation. Makes complex topics engaging and understandable

Example (Environmental Issues): Learners work in small groups to select an environmental problem (e.g., global warming, plastic pollution). Science, Technology group analyzes the problem scientifically. Mathematics group presents statistics and charts. Art group creates posters or infographics. English group presents findings in English.

Outcome: Learners integrate multiple subjects, understand the problem, and express their findings in English.

Example (English Lesson – Vocabulary & Grammar): Students work in a "level-up" system: +10 points for correct answers. Mini-quizzes like "Word treasure hunt". Badges awarded: "Grammar Master," "Vocabulary Hero". Learners track progress in leaderboards and compete in groups. Result: Interactive and engaging lessons with practical application of knowledge

Integration of STEAM and Gamification: Combining STEAM with gamification creates lessons that are interdisciplinary, practical, interactive, motivating, and engaging. This approach fosters deep knowledge acquisition, creative and critical thinking, and real-world problem-solving skills.

Ethnopedagogical Technologies: Develop thinking through folk oral creativity. Advantages of the Heuristic Approach: Develops independent thinking. Enhances creativity. Trains learners in decision-making in problematic situations. Promotes deep and durable knowledge acquisition. Increases learner motivation. Enables the development of subject-specific heuristic methodologies. Integrates digital technologies with heuristic methods. Builds heuristic models incorporating national (ethnopedagogical) components. Combines with competency-based approaches. Allows experimental research and pilot studies

Characteristics of a Problematic Situation: Cannot be solved with prior knowledge. Stimulates interest and inquiry. Compels acquisition of new knowledge. Activates cognitive processes.

Example: The teacher asks: "Why does ice float in water, but iron sinks?". This question forces the learner to think, reveals the insufficiency of previous knowledge, and leads to the discovery of a new concept (density). Significance in Education: Problem-based situations in education foster independent thinking, enhance problem-solving skills, make lessons more engaging, and support deeper knowledge acquisition.

Process Stages:

1. Perceiving the problem
2. Formulating a question
3. Making a hypothesis
4. Testing or investigation
5. Drawing conclusions

Conclusion. A problematic situation is one of the main factors that activate human cognitive activity, creating a conflict (cognitive dissonance) between existing knowledge and a new task, thereby stimulating the development of thinking. According to Jean Piaget's theory, in such situations, individuals employ the mechanisms of assimilation and accommodation during the process of acquiring new information, ultimately achieving equilibrium. At the same time, in Lev Vygotsky's educational approach, problematic situations are most effective within the zone of proximal development, as they foster higher-level knowledge and skills through social collaboration and guided support. As a result, problematic situations serve not only as a means for acquiring new knowledge but also as a scientifically grounded tool for developing higher-order cognitive competencies, including independent thinking, analytical skills, problem-solving abilities, and creative approaches.

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