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Methods For Developing Logical And Critical Thinking In School Lessons

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ABSTRACT
This article discusses the development of logical and critical thinking skills in students within the context of school education, utilizing modern digital technologies. It analyzes the potential of digital technologies in fostering these skills and demonstrates the impact of various digital tools such as GeoGebra, Desmos, programming resources, simulations, and problem-based learning on the educational process. The research focuses on cultivating not only students' knowledge but also their capacity for independent thinking, analysis, and decision-making.

KEYWORDS: Critical thinking, logical thinking, digital technologies, interactive applications, competency-based approach, coding, simulations, problem-based learning.

INTRODUCTION
In today's digital age, the education system is evolving in close connection with modern technologies. In particular, integrating traditional teaching methods with digital tools plays a significant role in enhancing the quality and effectiveness of education. The use of digital technologies in school lessons not only facilitates a deeper understanding of the learning material but also helps develop students' logical and critical thinking skills.
The modern education system is aimed at developing human capital within increasingly complex socio-economic conditions; in this process, fostering the younger generation to become individuals capable of logical and critical thinking is of great importance. As one of the most vital competencies of the 21st century, critical and logical thinking skills not only enhance the effectiveness of the learning process but also lay the foundation for students to achieve success in their future professional and personal lives.

Literature Analysis
Logical thinking is the ability to analyze reality consistently, understand cause-and-effect relationships, and draw conclusions based on concrete evidence. Critical thinking, on the other hand, is a form of thought based on analyzing and evaluating existing information, comparing diverse perspectives, and making independent decisions. The necessity of these cognitive processes and methods for their development are discussed below.
As a result of the rapid advancement of information technology, students now have access to vast amounts of data from various sources. This situation necessitates critical thinking skills such as the ability to analyze information, compare alternative viewpoints, and reach well-founded conclusions. A critical thinker evaluates matters based not merely on isolated facts, but on an understanding of cause-and-effect relationships, and is capable of substantiating their own perspective [1].

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Today's educational system is structured around a competency-based approach. This approach aims to develop in students not only the acquisition of knowledge but also the ability to apply that knowledge in real-life situations. Critical thinking serves as the foundation for processes such as self-regulation, reflection, problem identification, and the pursuit of solutions [2]. In the process of globalization, society is transitioning toward a stage of innovative development. Consequently, the traditional educational approach based on rote memorization is losing its relevance. It is being replaced by pedagogical methods centered on analytical, logical, and creative thinking. A critical thinker is capable of approaching socio-economic challenges from a fresh perspective and generating innovative ideas [3].

Critical thinking is not merely an intellectual activity; it is also a social one. In a democratic society, critical thinking plays a vital role in cultivating conscious, free-thinking citizens who possess a sense of social responsibility. Such individuals are equipped to analyze and evaluate information, as well as to make informed social decisions [4].

Research indicates that fostering critical and logical thinking skills from childhood positively influences subsequent intellectual and social development [5]. For this reason, modern education places significant emphasis on developing these skills from an early age.

Materials and methods. In general education schools, the development of logical and critical thinking in students is intrinsically linked to their age-related characteristics.

The development of logical and critical thinking within the pedagogical process encompasses several stages. According to Jerome Bruner's theory of cognitive development, children's thinking processes progress through three primary stages: enactive (action-based), iconic (image-based), and symbolic (abstract-logical). In school-aged students, logical thinking skills are formed gradually and become increasingly complex as the students mature.

Developing students' logical and critical thinking abilities must be carried out with due consideration for their age-related characteristics. According to Jean Piaget's theory, cognitive development proceeds through distinct stages, with each stage characterized by specific modes of thought [7].

Primary school students (ages 6–10): During this developmental period, concrete-operational thinking emerges. Children gain the ability to engage with concrete objects and situations, though working with abstract concepts remains challenging. Fundamental logical operations such as analysis, synthesis, and comparison undergo active development. Middle school students (ages 11–14): During the transition to the stage of formal operational thinking, students develop the ability to work with abstract concepts, formulate hypotheses, and test them. Key elements of critical thinking reflection, skepticism, and independent thought begin to develop intensively.

High school students (ages 15–17): At this age, logical and critical thinking reach an advanced level. Students become fully capable of solving complex abstract problems, analyzing and critically evaluating information from various sources, and drawing logically sound conclusions.

According to the research of L.S. Vygotsky [6] and J. Piaget [9], students in their early teens specifically those aged 14–15 transition into the stage of formal operational thinking. This stage is characterized by the following features:

- The development of the ability to operate with abstract concepts.
- The formation of skills for formulating hypotheses and testing them empirically.

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- The activation of metacognitive strategies.
- An increased inclination to independently analyze problematic situations.

Furthermore, from the perspective of A.N. Leontiev's activity theory, a shift in the motivational sphere is observed in students of this age: their interest moves from the content of an academic subject toward its personal significance. [11].

The exact sciences are a primary instrument for logical reasoning. Mathematics, in particular, is inherently based on logical thought: solving a problem, constructing a proof, or analyzing an equation relies on deductive or inductive logical reasoning. Consequently, mathematics lessons serve as one of the most effective means for developing students' ability to think in an orderly, consistent, and well-founded manner. The study of algebra encompasses topics such as quadratic equations and inequalities, the theory of functions, and progressions a field that engages various forms of logical reasoning. In the 9th-grade algebra curriculum, topics like functions, equations and inequalities, progressions, and quadratic functions (along with their graphs) strengthen students' analytical thinking. Specifically, determining the patterns of change in a function, analyzing graphs, and evaluating sets of solutions foster the development of critical thinking skills. For instance, when solving a quadratic equation, a student may employ several different methods (such as using the discriminant, applying formulas, or factoring). This process teaches the student to compare various solution strategies and select the most appropriate one.

In geometry, topics such as circles, vectors, the coordinate method, and the fundamental elements of trigonometry are introduced. This block highlights, to the greatest extent, the synthesis between visual-spatial and logical-deductive reasoning. In geometry, the processes of proving, applying theorems, and identifying logical connections serve as essential exercises for logical thinking. Within the 9th-grade geometry curriculum, subjects such as parallelograms, trapezoids, circles, and the similarity of triangles foster the development of competencies in argumentation and drawing logical conclusions.

In the social sciences and humanities, 9th-grade students develop skills in comprehending events and phenomena, comparing diverse perspectives, and formulating conclusions based on evidence. Specifically, in the study of history, students cultivate the ability to analyze historical events, examine their underlying causes and consequences, and grasp the interconnected nature of historical processes. In a modern educational environment, it is no longer acceptable for students to merely memorize historical dates, the names of figures, or specific events. Instead of simply committing information to memory, students must acquire the skills to understand a problem, break it down into potential solutions, conduct a step-by-step analysis, and provide a rationale for their chosen solution. Such an approach is impossible without the capacity for logical and critical thinking.

In the ninth-grade history curriculum, the study of historical events, the development of states, and political and socio-economic progress fosters analytical thinking skills in students. By identifying the causes and consequences of historical processes, comparing events across different eras, and evaluating the actions of historical figures, students gain a deeper understanding of these phenomena. For instance, when examining the factors that influenced the development of a state, students identify political, economic, and social causes, determine the interconnections between them, and grounded in historical evidence explain which factors were of decisive importance. Through this process, students develop skills in identifying cause-

and-effect relationships, synthesizing information, evaluating evidence, and drawing independent conclusions.

In literature classes, studying the themes, ideas, character systems, plot development, and artistic devices of literary works provides a significant opportunity to develop students' logical and critical thinking. Evaluating characters' decisions, connecting their actions to specific circumstances, and comparing the perspectives of different characters strengthens students' analytical reasoning. For instance, when analyzing a decision made by a character in a literary work, students identify the factors that motivated the character's actions, compare them with the reactions of other characters, and assess the consequences of that decision. Furthermore, substantiating one's own point of view with examples from the text fosters skills in argumentation, evaluation, and drawing independent conclusions.

The subject of geography encourages students to study natural and socio-economic phenomena, identify differences between regions, and analyze the impact of geographical factors on human life and the development of society. In modern education, it is no longer sufficient for students merely to memorize geographical names, figures, and locations. Skills such as analyzing maps, diagrams, tables, and statistical data, determining the causes of regional disparities, and substantiating conclusions with evidence are essential for students in today's educational environment. In geography lessons, 9th-grade students explore topics such as population distribution, natural resources, economic processes, the development of nations, and environmental issues all of which foster the development of logical and critical thinking. Comparing geographical data, identifying patterns on maps, and interpreting statistical indicators enhance students' competence in working with information. For instance, when examining the reasons for variations in population density across different regions, students analyze natural conditions, water resources, transport infrastructure, and economic processes as interconnected factors. This process develops skills in understanding underlying principles, identifying cause-and-effect relationships, and critically evaluating the reliability of information.

Through the study of law, students learn legal concepts, develop the ability to apply laws and regulations to specific situations, distinguish between the rights and obligations of citizens, and find solutions to problems. Rather than merely memorizing legal terms and norms, students are encouraged to engage in logical and critical thinking by grasping the essence of a situation, identifying relevant legal rules, comparing different perspectives, and substantiating their own conclusions with legal arguments. In the context of legal studies, ninth-grade students analyze the relationships between the individual, society, and the state, as well as issues concerning citizens' rights and obligations, the rule of law, and social responsibility a process that fosters their logical and critical thinking skills. By discussing legal scenarios, applying norms to specific cases, and evaluating the consequences of decisions, students learn to engage in independent reasoning.

The use of digital technologies in these processes enables the integration of historical sources, electronic maps, interactive texts, video materials, and situational tasks into the educational process. The primary goal here is not the memorization of information, but rather teaching students to analyze it independently, evaluate its reliability, and draw evidence-based conclusions.

Conclusion

In conclusion, fostering logical and critical thinking among 9th-grade students through digital technologies is a priority in modern education. When the content, methodology, and tools of school education are refined to align with a digital environment, students develop not only specific knowledge but also high-level cognitive competencies. Key scientific-pedagogical requirements for enhancing didactic support include integrating competency-based, problem-oriented, and constructivist approaches; utilizing digital platforms purposefully; creating a bank of interactive tasks; and establishing an assessment system rooted in diagnostics. Consequently, lessons structured around digital technologies teach students to think independently, conduct logical analysis, evaluate critically, and draw well-founded conclusions. This, in turn, helps students develop into competitive individuals, prepared for their future academic and professional pursuits.

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