

Software-Methodological Model for Developing Logical Thinking in A Digital Educational Environment

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Abstract: This article analyzes the development of a software-methodological model for developing logical thinking among academic lyceum students in a digital educational environment and its pedagogical possibilities. The study highlights the mechanisms for developing students' analytical, critical and logical thinking skills through the use of digital educational tools, interactive electronic resources, multimedia technologies and online learning platforms. In addition, a software-methodological model that includes the target, content-related, technological and result-oriented components of forming logical thinking is proposed. The research results show that the educational process organized on the basis of a digital educational environment serves to increase students' cognitive activity, develop their independent thinking and improve educational effectiveness.

Keywords: Digital educational environment, logical thinking, software-methodological model, electronic educational resources, interactive learning, information and communication technologies, analytical thinking, critical thinking, academic lyceum, educational effectiveness, digital pedagogy, competency-based approach, innovative educational technologies, independent learning, multimedia tools.

Introduction: The digital transformation of modern society is also having a significant impact on the education system. As a result of the rapid development of information and communication technologies, the digital educational environment is widely used in the educational process, and students' opportunities for acquiring knowledge are expanding further. The digital educational environment not only provides quick access to educational resources, but also creates favorable conditions for developing students' higher-level cognitive skills, such as independent thinking, analysis, problem solving and decision making.

Today, one of the main tasks of education is the formation and development of logical thinking in the individual. Logical thinking expresses a person's ability to analyze information, compare, generalize, identify cause-and-effect relationships and draw reasoned conclusions. Especially in the digital age, when the flow of information is sharply increasing, the development of students' critical and logical thinking competencies

appears as one of the urgent pedagogical problems.

The age and psychological characteristics of academic lyceum students create broad opportunities for forming abstract and logical thinking in them. Therefore, the development of a scientifically grounded software-methodological model for developing students' logical thinking through the effective use of the didactic possibilities of the digital educational environment is of great importance. Such a model serves to develop students' logical thinking skills step by step by integrating educational content, methods, tools and technologies into a single system.

The purpose of this study is to develop a software-methodological model aimed at developing academic lyceum students' logical thinking in a digital educational environment and to substantiate its pedagogical effectiveness. The research results serve to improve the educational process, increase students' intellectual potential on the basis of digital technologies and form their modern competencies.

LITERATURE REVIEW

The issue of developing logical thinking in a digital educational environment is one of the current scientific directions emerging at the intersection of pedagogy, psychology and information technology. Research conducted in this direction is aimed at developing students' cognitive activity, integrating digital technologies into the educational process and forming logical and critical thinking competencies.

The theoretical foundations of logical thinking have been widely studied by psychologists. In particular, Jean Piaget, in his theory of cognitive development, substantiated that students' ability to think logically is formed depending on age stages [1]. According to him, at the stage of formal operations, students become capable of abstract and logical thinking. Lev Vygotsky, in turn, emphasized the role of the social environment and education in the development of thinking and advanced the concept of the zone of proximal development. This theory also serves as an important methodological basis in the use of modern digital educational tools [2].

In studies on the development of critical and logical thinking in the educational process, the taxonomy developed by Benjamin Bloom is of particular importance. In Bloom's taxonomy, the process of acquiring knowledge is explained through the stages of knowing, understanding, applying, analyzing, synthesizing and evaluating. In particular, the stages of analysis and evaluation are considered important factors in developing students' logical thinking [3].

Among scholars who have studied the pedagogical possibilities of the digital educational environment, the works of Marc Prensky, Tony Bates and Michael Moore occupy a special place. They emphasize that an educational environment organized on the basis of digital technologies develops students' independent learning, information processing and problem-solving abilities [4].

In recent years, many studies have been conducted on the impact of electronic educational resources, distance learning platforms and interactive digital tools on the development of logical thinking. Research results show that the use of virtual laboratories, simulations, intellectual games, electronic tests and problem-based tasks develops students' skills of analytical thinking, identifying cause-and-effect relationships and making

reasoned decisions [5].

Uzbek scholars have also studied issues related to the development of digital education and the enhancement of students' intellectual potential on the basis of a competency-based approach. In particular, in scientific research conducted in the republic on the digitalization of education, the creation of electronic educational resources and the introduction of innovative pedagogical technologies, the development of students' independent and logical thinking competencies is recognized as an important task.

The analyzed scientific sources show that although the psychological-pedagogical foundations of developing logical thinking have been sufficiently studied, the issue of developing an integrated software-methodological model aimed at developing the logical thinking of academic lyceum students in a digital educational environment still remains relevant. Therefore, in this study, the development of a software-methodological model that serves to develop students' logical thinking, taking into account the possibilities of the digital educational environment, and the substantiation of its effectiveness are set as the goal [8].

RESEARCH METHODOLOGY AND EMPIRICAL ANALYSIS

The rapid development of digital technologies requires the introduction of new pedagogical approaches and innovative methods into the education system. In particular, the digital educational environment creates broad opportunities for developing students' skills of independent thinking, information analysis, problem solving and drawing logical conclusions. Therefore, the development of a software-methodological model aimed at developing the logical thinking of academic lyceum students and determining its effectiveness is one of the main tasks of this research.

In the research process, the methods of pedagogical observation, questionnaire, testing, comparison, diagnostics and statistical analysis were used. The theoretical basis of the research consisted of the scientific works of local and foreign scholars on logical thinking, critical thinking, the competency-based approach and digital pedagogy. The empirical research was carried out with the participation of academic lyceum students.

At the initial stage of the research, diagnostic tests and questionnaires were conducted in order to determine

the level of students' logical thinking. The results showed that although most students have sufficient skills in receiving and memorizing information, they face difficulties in performing higher-level logical operations such as analysis, comparison, generalization and drawing reasoned conclusions. In particular, low activity among students was observed in solving complex problem situations and identifying cause-and-effect relationships.

After that, within the framework of the research, a software-methodological model based on the digital educational environment was developed. The model included interactive tasks, electronic tests, virtual problem situations, logical games, multimedia resources and reflective assessment tools. These tools were aimed at developing students' skills of analytical thinking, information processing and drawing logical conclusions.

During the experimental work, experimental and control groups were organized. In the experimental group, the educational process was conducted on the basis of the developed software-methodological model, while in the control group traditional teaching methods were used. The results of the final diagnostics conducted at the end of the experiment showed that the indicators of logical thinking among students in the experimental group had increased significantly.

According to the results of the empirical analysis, the use of the digital educational environment brought about the following positive changes:

- development of information analysis skills;

- increase in the effectiveness of solving problem situations;
- formation of critical and independent thinking;
- increase in the speed and accuracy of decision making;
- strengthening of students' learning motivation and activity.

The research results showed that interactive and problem-based learning activities organized in a digital educational environment are an important pedagogical factor in developing the logical thinking of academic lyceum students. At the same time, the purposeful and methodologically grounded use of digital tools serves to develop students' cognitive competencies and improve the quality of education.

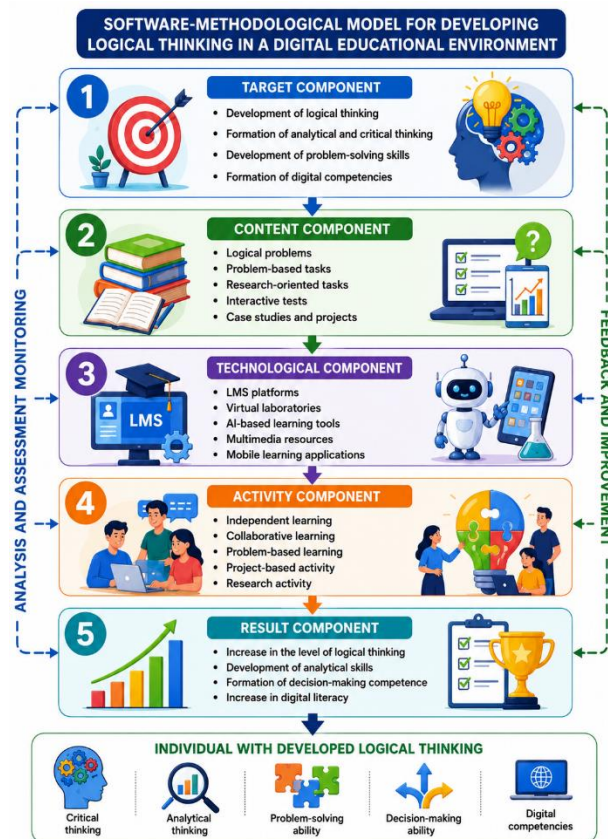
In our opinion, the digital educational environment is an effective pedagogical platform for developing logical thinking.

Interactive electronic resources and problem-based tasks activate students' analytical thinking activity.

The introduction of the software-methodological model into educational practice ensures stable growth in logical thinking indicators.

The educational process organized on the basis of digital technologies serves to develop students' independent and critical thinking competencies.

The systematic use of digital educational resources for developing logical thinking in academic lyceums is one of the important factors in increasing educational effectiveness.



The model proposed above consists of the following structural components:

1. Target component

- Development of logical thinking;
- Formation of analytical and critical thinking;
- Development of skills for solving problem situations;
- Formation of digital competencies.

2. Content component

- Logical problems;
- Problem-based tasks;
- Research-oriented tasks;
- Interactive tests;
- Case studies and project work.

3. Technological component

- LMS platforms;
- Virtual laboratories;
- Artificial intelligence-based educational tools;
- Multimedia resources;
- Mobile learning applications.

4. Activity component

- Independent learning;

- Collaborative learning;

- Problem-based teaching;

- Project activity;

- Research activity.

5. Result component

- Increase in the level of logical thinking;
- Development of analytical skills;
- Formation of decision-making competence;
- Increase in digital literacy.

RESULTS

The analyses show that interactive lessons organized in a digital educational environment are more effective in developing students' logical thinking than traditional teaching methods.

In the educational process organized on the basis of the proposed model: information analysis skills develop; the ability to solve problem situations is formed; independent learning activity is activated; the skill of effectively using digital tools increases; critical and creative thinking develops.

The effectiveness of the model is ensured through interactive tasks, practical lessons organized in a virtual environment, and electronic assessment systems.

CONCLUSION

In this study, the pedagogical possibilities of the digital educational environment in developing the logical thinking of academic lyceum students were studied, and a software-methodological model aimed at effectively organizing this process was developed. During the research, the theoretical foundations of logical thinking, the factors influencing its development, and the didactic possibilities of digital educational technologies were analyzed.

The results of the conducted theoretical and empirical studies showed that the digital educational environment creates favorable conditions for developing students' skills of receiving information, analyzing, comparing, generalizing and drawing reasoned conclusions. The use of interactive electronic resources, multimedia tools, virtual tasks, logical games and digital assessment systems increases students' learning activity and serves to form their independent and critical thinking abilities.

As a result of the research, the developed software-methodological model was described as an integrated pedagogical system consisting of target, content-related, technological and result-oriented components. The implementation of the model in practice made it possible to increase students' level of logical thinking, develop their skills for solving problem situations, and strengthen their digital competencies.

The results of the empirical analysis confirmed that the indicators of logical thinking in the experimental groups increased at a higher level compared to the control groups. This made it possible to scientifically substantiate the effectiveness of the software-methodological model based on the digital educational environment.

Thus, it was determined that the software-methodological model for developing logical thinking in a digital educational environment is an effective means of increasing the intellectual potential of academic lyceum students, forming their analytical and critical thinking competencies, and improving the quality of education. The research results have important scientific and practical significance in developing and implementing methodological recommendations aimed at developing logical thinking on the basis of digital technologies in the system of general secondary and

secondary specialized education.

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