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EFFECTIVE METHODS OF MANAGING STUDENTS' COGNITIVE LOAD IN THE PROCESS OF TEACHING INFORMATION TECHNOLOGIES

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Abstract

This study is aimed at identifying and improving effective methods for managing students' cognitive load in the process of teaching information technologies. During the research, the main principles of Cognitive Load Theory were analyzed, and methods focused on optimal presentation of educational materials, information segmentation, rational use of multimedia tools, and reduction of excessive cognitive load were developed. The practical experiment was conducted at Andijan State Medical Institute with the participation of 60 students. The obtained results demonstrated that an approach based on cognitive load management increases students' level of knowledge acquisition and ensures the effectiveness of the educational process. The findings of the research are of significant importance for improving the methodology of teaching information technologies in medical higher education institutions.

Keywords: Information technologies, cognitive load, cognitive load theory, teaching methodology, multimedia tools, segmentation, educational process, knowledge acquisition, educational efficiency, medical education, innovative

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approach, didactic design, interactive learning, digital educational technologies, student activity.

Introduction

Currently, the rapid development of digital technologies has significantly influenced the medical education system. The effective use of information technologies in the training of modern medical specialists plays an important role not only in mastering theoretical knowledge but also in developing practical skills. Electronic learning platforms, virtual laboratories, simulation programs, and multimedia tools contribute to improving the quality of the educational process. At the same time, the increasing volume and complexity of educational materials may lead to an increase in students' cognitive load.

According to Cognitive Load Theory, human working memory is limited and capable of processing only a restricted amount of information at one time. If educational materials are excessively complex, disorganized, or overloaded with unnecessary information, students' attention decreases, negatively affecting the effectiveness of knowledge acquisition. In particular, the necessity of mastering a large amount of theoretical and practical information within a short period in medical education makes the issue of cognitive load management even more relevant.

Incorrectly organized presentation methods, complicated interfaces, or excessive visual elements in teaching information technologies create additional load on students' working memory. As a result, the efficiency of acquiring knowledge aimed at the main educational objectives decreases. Therefore, simplifying educational materials, presenting information step by step, and rationally using visual and interactive methods are considered important pedagogical tasks.

Today, pedagogical approaches aimed at optimizing cognitive load are gaining special importance in medical education. In particular, the moderate use of multimedia technologies, implementation of adaptive learning systems,

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application of modular teaching methods, and use of interactive simulations help students acquire knowledge more effectively. Furthermore, presenting information through visual schemes, graphics, and algorithms enhances the comprehensibility of educational materials and reduces excessive cognitive load. The relevance of this research lies in the fact that developing scientifically grounded methods for managing cognitive load in the process of teaching information technologies and determining their effectiveness are among the important pedagogical issues of today. The methodological recommendations developed on the basis of the research findings will contribute to optimizing students' learning activities, improving deep knowledge acquisition, and developing professional competencies in medical education.

Methodology

The research was conducted at Andijan State Medical Institute with the participation of 60 students. The participants were randomly divided into two groups: the control group (30 students) received education based on the traditional teaching method, while the experimental group (30 students) was taught using a methodology focused on cognitive load management. During the research process, methods such as step-by-step explanation using multimedia tools, information segmentation (dividing educational material into smaller parts), maintaining a balance between visual and textual information, and reducing excessive information (preventing the redundancy effect) were applied. The students' level of knowledge was assessed through specially designed tests, while the level of cognitive load was determined through questionnaires and measured using a 10-point scale.

Main Part

The issue of managing students' cognitive load in the process of teaching information technologies is considered one of the important directions of modern

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pedagogy and didactics. According to Cognitive Load Theory, the capacity of human working memory is limited, and when educational materials are improperly organized, excessive cognitive load occurs, negatively affecting effective knowledge acquisition. Therefore, it is important to structurally organize educational materials on a scientific basis and present them in accordance with students' cognitive capabilities during the teaching process.

In this research, several methodological approaches were developed and implemented in practice as effective methods of managing cognitive load. In particular, through the segmentation of educational materials, complex information was divided into smaller and more easily understandable parts. This method enabled students to master information step by step and reduced the load placed on working memory. In addition, through the rational use of multimedia tools, visual and auditory channels were activated simultaneously, making it possible to strengthen knowledge acquisition based on the dual coding mechanism.

Furthermore, maintaining a balance between visual and textual information was considered an important factor. Since excessive text or unnecessary visual elements may increase cognitive load, educational materials were simplified and the main ideas were clearly highlighted. By reducing the redundancy effect (excessive repetitive information), students' attention was focused on essential information. At the same time, the use of interactive methods ensured active student participation and contributed to the development of independent thinking and analytical skills. The research results showed that the group taught using the methodology based on cognitive load management demonstrated a significantly higher level of academic achievement. This once again confirms the necessity of scientifically organizing the teaching process, especially through the application of modern pedagogical approaches in teaching information technologies.

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Effectiveness of the Methodology

During the research, the effectiveness of the methodology based on cognitive load management was confirmed through practical results. The approaches applied in the experimental group, including segmentation, rational use of multimedia tools, and reduction of excessive information, enabled students to acquire educational materials more deeply and quickly. As a result, the level of knowledge acquisition in this group was significantly higher compared to the control group taught using traditional methods.

In particular, the experimental group demonstrated a higher average level of academic achievement, and improvements were observed in students' understanding and practical application of complex topics. The reduction in cognitive load decreased students' level of fatigue during the educational process and allowed them to focus more on the core content. Consequently, this increased their level of independent learning activity. Moreover, the methodology had a positive impact on students' motivation. Interactive and visually enriched lessons aroused students' interest and encouraged active participation in the learning process. Statistical analysis revealed that the difference between the experimental and control groups was statistically significant ($p < 0.05$), which indicates that the methodology is scientifically grounded and effective.

Practical Recommendations

In order to improve the effectiveness of managing students' cognitive load in teaching information technologies, it is advisable to implement the following practical recommendations:

1. **Segmentation of educational materials** – It is recommended to divide complex topics into smaller, logically structured parts and explain them step by step. This helps students perceive information more easily.

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2. **Purposeful use of multimedia tools** – Text, graphics, audio, and video materials should be used in a balanced and integrated way to ensure multi-channel information perception.
3. **Reduction of excessive information** – During the teaching process, unnecessary and repetitive information should be minimized, while greater attention should be focused on key concepts.
4. **Maintaining a balance between visual and textual information** – It is necessary to avoid excessive text or unnecessary images in slides and educational materials and present them in an optimal proportion.
5. **Application of interactive methods** – It is recommended to ensure students' active participation through question-and-answer activities, group work, and practical assignments.
6. **Considering students' individual characteristics** – It is important to apply a differentiated approach according to students' knowledge level, preparedness, and learning pace.
7. **Monitoring cognitive load** – Students' cognitive load levels should be regularly assessed using special questionnaires and analytical tools.
8. **Use of digital educational platforms** – In distance and blended learning environments, it is advisable to present educational materials systematically and conveniently through modern digital platforms.

Conclusion

The results of this research confirmed that managing students' cognitive load is an important pedagogical factor in the process of teaching information technologies. Methodological approaches aimed at optimizing cognitive load — including segmentation of educational materials, rational use of multimedia tools, reduction of excessive information, and maintaining a balance between visual and textual data — had a positive impact on students' effective knowledge acquisition. The results obtained during the study demonstrated higher academic

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achievement and lower cognitive load levels in the experimental group, proving the effectiveness of the proposed methodology. This indicates the necessity of scientifically organizing the teaching process and implementing modern pedagogical technologies. At the same time, the developed methodology has significant practical importance in improving the quality of teaching information technologies in medical higher education institutions, developing students' independent thinking skills, and ensuring educational effectiveness.

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