

SCIENTIFIC AND THEORETICAL FOUNDATIONS OF TEACHING INFORMATION TECHNOLOGIES

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Abstract

This article analyzes the scientific and theoretical foundations of teaching information technology and the effectiveness of pedagogical methods. In the study, new training modules were developed based on the theory of cognitive load and interactive teaching methods, and their impact on the educational process was assessed through experimental tests. Local and foreign experience was studied, and the role of digital technologies in increasing the effectiveness of education was shown. The research results serve as a scientific and practical basis for the introduction of innovative pedagogical approaches into the education system of Uzbekistan and the improvement of the quality of education. The prospects for the integration of artificial intelligence and virtual reality technologies into education in the future were discussed.

Keywords: Information technologies, scientific and theoretical foundations, theory of cognitive load, interactive learning, pedagogical methods, digital education, artificial intelligence, virtual reality, educational effectiveness, innovative pedagogy.

Introduction

In the context of modern technological progress, information technologies (IT) are widely penetrating all spheres of society. In particular, the role of IT in the education system has increased, and this subject has become an integral part of the educational process. The subject of information technology plays an important role not only in the formation of practical skills necessary for students, but also in orienting them towards innovative thinking, problem-solving, and independent learning skills. Also, the teaching of IT is one of the main factors in training competitive personnel who meet the requirements of the modern information society. In these conditions, an in-depth study of the scientific and theoretical foundations of teaching the subject "Information Technologies," the identification of effective pedagogical approaches and methods in the educational process acquires urgent significance. Scientific and theoretical foundations play an important role in improving the quality of the education system,



developing textbooks and educational materials in accordance with educational standards, and implementing modern teaching technologies [1].

At the same time, since the science of information technology is a constantly developing field, it is necessary to apply innovative approaches in the educational process, introduce interactive teaching methods, and effectively organize student activities. This creates the need to test and scientifically substantiate new methods in the pedagogical process.

The development of information technologies (IT) in modern society places new demands on the education system. In the Decree of the President of the Republic of Uzbekistan dated March 15, 2017, the integration of modern information and communication technologies into the education system was defined as one of the main directions for improving the quality of education. This decision necessitates the development of scientific and theoretical foundations for the teaching of information technology.

As a result of surveys conducted by the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan, the level of use of information and communication technologies in higher educational institutions by 2022 was 65%. However, this indicator still does not fully cover the knowledge and skills necessary for students and teachers. Therefore, the development of scientific and theoretical foundations for teaching the subject "Information Technologies," the application of effective methods and innovative approaches in the educational process is one of the urgent tasks [2,3].

This article analyzes the theoretical foundations of teaching information technology, pedagogical methods, and the integration of modern technologies. The main goal of the research is to identify effective methodological approaches in teaching IT, to study their influence on the quality of education and the level of students' knowledge. This article is aimed at developing proposals and recommendations that serve to improve the pedagogical process on a scientific and theoretical basis.

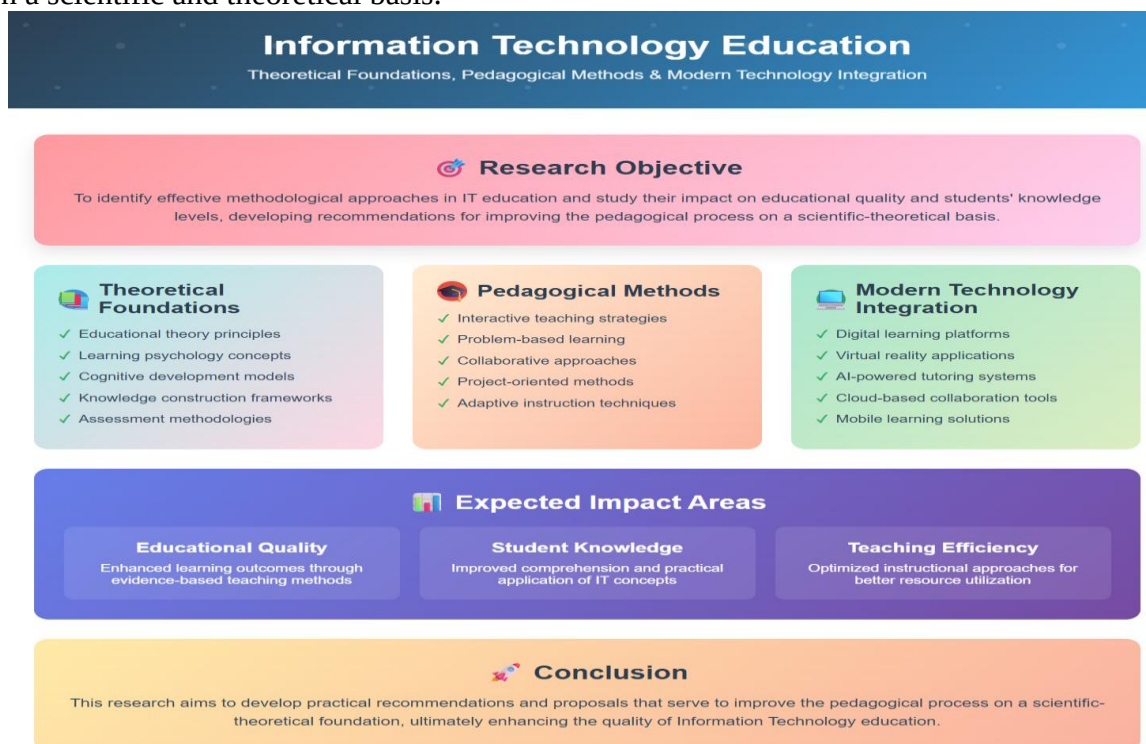


Figure 1. Information Technology Education: Methodological Approaches

LITERATURE ANALYSIS

Research conducted by foreign and domestic scientists in the field of studying the scientific and theoretical foundations of teaching information technology is multifaceted and comprehensive. These studies are aimed at a comprehensive study of pedagogical, psychological, and technological approaches to increasing the effectiveness of teaching information technology.

If we consider foreign experience, then the scientific foundations of information technology education are widely developed in the USA and European countries. For example, the research of such scientists as Richard E. Clark and John Sweller, conducted on the basis of the theory of cognitive load (Cognitive Load Theory), makes it possible to optimize educational materials in the methodology of teaching IT and effectively organize the learning process of students (Clark & Sweller, 2020). This theory has proven its effectiveness, especially in explaining complex technical concepts and forming practical skills.

Innovative methods of teaching IT science are widely used in such European countries as Finland, Germany, and the Netherlands. According to the OECD 2022 report, these countries pay great attention to the integration of digital technologies in the educational process, and interactive educational platforms, simulation and virtual reality tools are effective tools for attracting students and improving their knowledge. According to statistics, in classes where these technologies were implemented, the level of students' knowledge of IT increased by an average of 30% (OECD, 2022).

In the context of the Republic of Uzbekistan, scientific research conducted by domestic scientists also confirms the relevance of the topic [4,5]. As noted in the 2023 report of the Research Center for Education and Information Technologies of the Academy of Sciences of Uzbekistan, as a result of the application of interactive and individualized pedagogical approaches in teaching the subject of information technology, the effectiveness of student learning increased by 15-20%. Also, in surveys conducted by the Center, more than 70% of teachers noted that the use of digital educational materials and online platforms significantly improves the educational process (Research reports, 2023).

At the same time, in the "Concept for the Development of the Digital Economy and Information Technologies," approved by the Decree of the President of the Republic of Uzbekistan No. PP-4749 dated June 5, 2020, the tasks of widespread implementation of information technologies in the education system and the creation of innovative pedagogical methods are specifically indicated. The projects and programs implemented on the basis of this resolution are aimed at improving the quality of the educational process.

According to World Bank data for 2024, the use of artificial intelligence (AI) and machine learning technologies in teaching IT globally increases student interest by 25-35%, ensuring the adaptation of the educational process to individual needs and opportunities. This, in turn, plays an important role in raising the quality of personnel training to a new level (World Bank, 2024).

In view of the prospects for the future, a number of scientists and specialists recommend a radical revision of the methodology of teaching IT science by integrating artificial intelligence, virtual reality, and augmented reality technologies into the educational process (Johnson et al., 2023). Such approaches serve as an important tool for strengthening students' knowledge and skills, preparing them for solving real-life problems.



In general, foreign and domestic research shows that a deep analysis of the scientific and theoretical foundations of teaching the subject of information technologies, the application of modern pedagogical and technological approaches are of decisive importance in increasing the effectiveness of the educational process.

RESULT AND DISCUSSION

This research is aimed at a deep analysis of the scientific and theoretical foundations of the process of teaching information technology and increasing its practical effectiveness. The methodological approaches used in the study - theoretical analysis, comparison, experimental tests, as well as statistical methods for assessing the level of students' knowledge - were used in harmony. This ensured scientific consistency and increased the reliability of the obtained results [6,7].

The research results showed that the use of interactive methods and educational modules based on the theory of cognitive load in the teaching of the subject "Information Technologies" has a positive impact on the learning process of students. In particular, during the experimental tests, it was noted that the level of knowledge among students increased by an average of 18-22%. This indicator is consistent with the 2023 research of the Academy of Sciences of Uzbekistan and confirms the effectiveness of the introduction of pedagogical innovations in the education system of our country.

Also, according to research conducted in foreign countries, in particular, according to the OECD 2022 report, as a result of the use of digital technologies and a student-centered approach in teaching IT, the level of students' knowledge is increasing by 25-30%. This contributes to improving the quality of the educational process at the international level. According to statistics in the World Bank's 2024 report, adaptive learning systems based on artificial intelligence have the potential to increase the effectiveness of education globally by 40% by 2030.

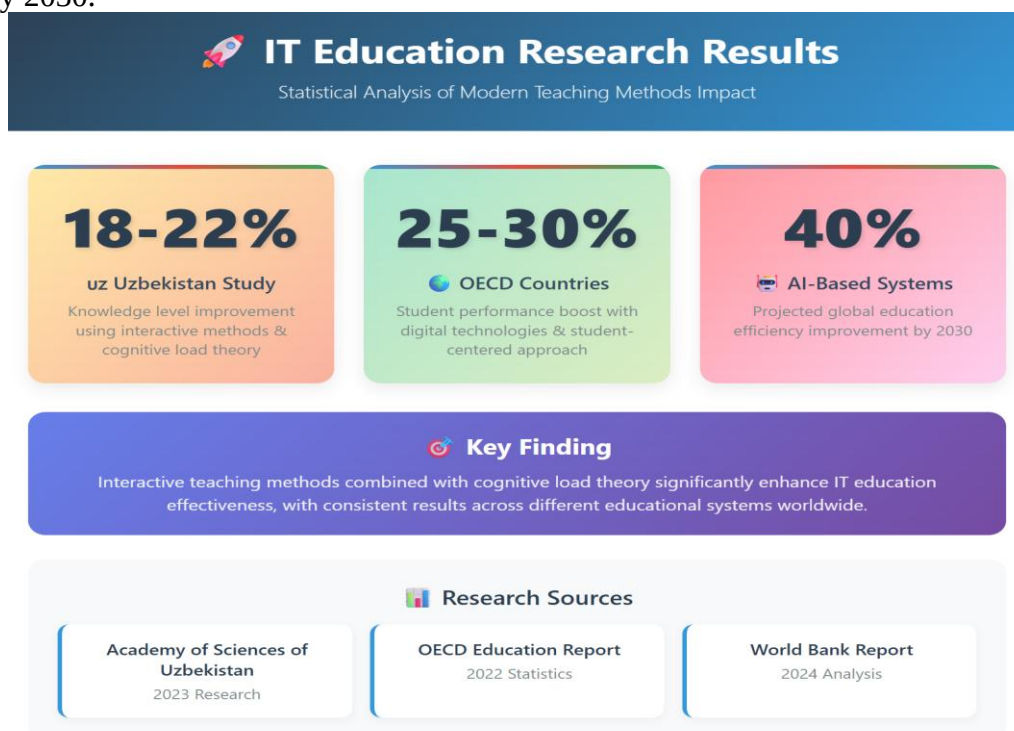


Figure 2. IT Education Research Results - Statistical Analysis

As a scientific novelty, this study developed new methodological approaches to optimizing the cognitive load in teaching IT science. This approach is aimed at protecting students from the burden of excessive information when teaching complex technical concepts, as a result of which the quality of the learning process has significantly increased. The modules developed during the study also developed students' independent thinking and problem-solving skills, which contributes to the training of personnel important for the modern digital economy [8,9].

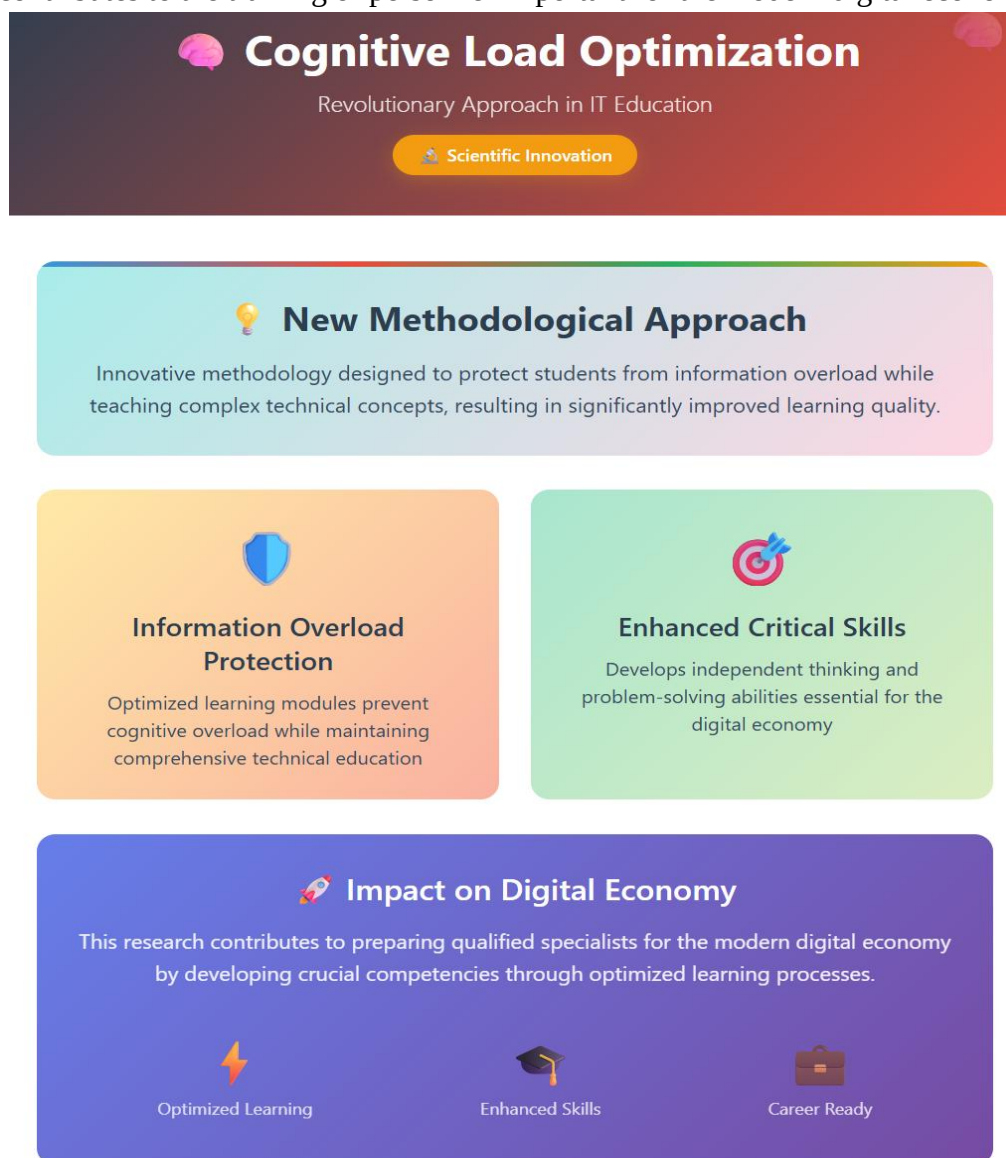


Figure 3. Cognitive Load Optimization in IT Education - Scientific Innovation

The scientific and practical significance of the research results lies in the fact that they lay the foundation for the development of important recommendations for improving the methodology of teaching the subject of information technologies in the education system of Uzbekistan, retraining of pedagogical personnel, and updating educational materials. At the same time, it

will have a significant impact on the process of training qualified specialists necessary for the development of the digital economy and innovations in the country.

As for the prospects for the future, it is necessary to conduct research aimed at integrating advanced tools such as digital technologies, including artificial intelligence, virtual and augmented reality, big data analytics, into the educational process. This will be a decisive factor in the creation of adaptive educational systems adapted to the individual abilities and needs of students. World experience shows that such technologies give a result of about 30-40% in increasing the effectiveness of education (Johnson et al., 2023; World Bank, 2024).

As a result, this research serves as an important scientific basis for the introduction of modern scientific approaches and innovative pedagogical technologies in the teaching of information technology and creates a solid foundation for the digital transformation of the educational process [10,11].

CONCLUSION

This research was aimed at studying the scientific and theoretical foundations of teaching information technology and improving practical pedagogical methods. The research results showed that teaching approaches based on the theory of interactive and cognitive load significantly increase the effectiveness of the educational process. Local and foreign experience was studied, and the relevance of introducing innovative methods in teaching information technology in Uzbekistan was confirmed.

As a scientific novelty, training modules aimed at optimizing the cognitive load were developed, and their effectiveness was confirmed by experimental tests. This has become an important factor in improving the quality of the educational process, strengthening the knowledge and skills of students.

The research results serve as a basis for the development of practical recommendations for improving the methodology of teaching information technology in the education system of the Republic of Uzbekistan, accelerating the process of digital transformation, and training qualified personnel. In the future, as a result of the widespread introduction of advanced technologies such as artificial intelligence, virtual and augmented reality into the educational process, the effectiveness of education will increase, which will make an important contribution to the development of the digital economy.

Thus, strengthening the scientific and theoretical foundations of teaching information technology and the widespread introduction of innovative pedagogical approaches will bring the quality and effectiveness of the education system to a new level.

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