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Research Article

ELEMENTS OF ARTIFICIAL INTELLIGENCE COURSE CURRICULUM AND CONTENT IN GENERAL SECONDARY SCHOOLS

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ABSTRACT

This article analyzes the methods, tools, and forms of teaching the elements of artificial intelligence in general secondary schools. The process of creating a curriculum and content aimed at improving students' artificial intelligence literacy is highlighted.

KEYWORDS

Quality of education, practices in teaching, educational reforms.

INTRODUCTION

In recent years, there has been a notable focus on studying international experience to enhance the quality of education in general secondary schools. Studying international experience is crucial for effectively organizing large-scale educational reforms, including proposals to revise the content of knowledge at various stages of the educational system [1] and research focused on identifying best practices in teaching different subjects.[2] Efforts to enhance the education sector's organization of the educational process involve teaching topics related to artificial intelligence elements within computer science, implementing teaching methods utilizing digital technologies, integrating pedagogical strategies tailored to subject content, and incorporating digital educational resources to enhance overall quality. As a result, it can create a conducive environment and motivation for students to develop competencies in artificial intelligence technologies, gain a deeper understanding of current trends, and embrace and pursue related professions.

Recommendations for effectively organizing quality pedagogical activities can be found in the research

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conducted by N.I. Ryzhova and A.A. Lyash.[3] A teaching methodology model was proposed, comprising the purpose, content, method, form, and means of teaching. Its role in enhancing the quality of education was demonstrated through reliable experiences.

Primary portion

Various methods can be utilized to teach artificial intelligence to high school students. For example, these methods can encompass unplugged activities, project-based learning, live coding, and more. Through the Unplugged method, artificial intelligence can be taught without the need for a computer, enabling students to grasp content effectively. This approach facilitates the teaching of theoretical ideas and concepts in informatics and IT in a highly effective manner. This teaching method enables instructors to emphasize key concepts of artificial intelligence and elucidate its main ideas to students.[4] Furthermore, students will have the opportunity to discuss social issues surrounding artificial intelligence, thereby gaining a deeper understanding of its importance in future activities. The unplugged method does not rely on technical tools typically required for training in artificial intelligence. This enables the teaching of AI elements even in schools with limited material and technical resources. Experiments have demonstrated the effectiveness of the 'Unplugged' method in teaching programming languages, a branch of computer science closely related to artificial intelligence.[5] Bell and colleagues acknowledged the 'Unplugged' method as a pedagogical approach employed to teach computer science concepts to students without the necessity of using computers.[6]

Another effective method for teaching the elements of artificial intelligence in schools is called "Project-Based Learning." This approach offers students the chance to develop programs incorporating elements of artificial intelligence and to solve various intriguing problems. Project-Based Learning is a widely used method in teaching.[7] Project-based learning enables students to develop projects aligned with their interests and existing knowledge, fostering in-depth understanding of scientific subjects. Through this approach, students cultivate creative and critical thinking skills crucial for artificial intelligence. While implementing the project on artificial intelligence elements, students can identify intriguing problems and propose solutions using automated (no-code) tools commonly employed in creating artificial intelligence technologies. This collaboration offers teachers the chance to involve students in identifying real-world problems, conceptualizing solutions, setting goals, conducting trials to solve problems, and refining them until the creation of an artifact from both scientific and practical perspectives.

We will analyze the goals and objectives of scientific research in the field of 'Informatics and Information Technologies (IT)', along with the content of artificial intelligence elements, and explore the means, forms, and methods of teaching it.

The goals and objectives of teaching the science of "Informatics and IT" in Uzbekistan are outlined in the President's order of October 6, 2020, titled "Measures for Further Improvement of the Educational System in the Field of Information Technologies, Development of Scientific Research, and Their Integration with Industry." In accordance with Decision No. PQ-4851 on the development of the curricula for "Informatics and IT" in secondary schools based on modern trends, the

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following provisions are specified in sub-paragraph "v" of paragraph 5:

- as part of the general secondary education curriculum development, ensure alignment of educational programs in the field of "Informatics and IT" with contemporary teaching trends in information technologies;

This necessitates the incorporation of knowledge about rapidly advancing fields like artificial intelligence into the curriculum of the subject 'Informatics and IT' taught in general secondary educational institutions.

In the 2nd paragraph of Presidential Decree No. PF-5538 dated September 5, 2018, titled "On Additional Measures to Improve the System of Public Education," there is an emphasis on the continuous improvement of the content of the subject of Informatics and Information Technologies (IT) within the education system of Uzbekistan. This involves considering foreign educational experiences, integrating modern pedagogical technologies into the teaching and learning process, introducing innovative teaching methods, producing new generations of educational materials, and conducting both fundamental and applied scientific research.

Integrating the teaching of artificial intelligence elements into general secondary schools can mitigate digital inequality across various societal strata. This initiative provides students in Uzbekistan's general secondary schools with the chance to comprehend, utilize, and contribute to technologies incorporating artificial intelligence elements, while also understanding their societal roles in the technological revolution era.

Here, we will delve into the content of the "Artificial Intelligence" section of the "Informatics and IT" textbook designed for students in general education institutions.

The textbook "Informatics and IT (Information and Communications Technologies)" by Paul Long, Sarah Lawrey, and Victoria Ellis, designed for grades 10-11 in general secondary schools, explores various sub-topics related to artificial intelligence and its features. They include Chapter 2, "Hardware and Software," with subtopic 2.02 "Mental Models" under "System, Application, and User Interface"; Chapter 3, "Monitoring and Control," featuring topic 3.01 "Sensors"; Chapter 7, "Expert Systems," covering topics 7.01 "What is an expert system?" and 7.02 "How are expert systems used?"; Chapter 11, "New Technologies," encompassing topics 11.04 "Artificial Intelligence," 11.08 "Automated Translation," and 11.12 "Robotics"; and Chapter 13, "Networks," including topic 13.02 "Network Security" and discussions on Biometric Methods. In the computer science and IT textbook, topics and sub-topics related to artificial intelligence technology and its elements are dispersed across various chapters. While this approach enables students to grasp the integration of artificial intelligence into the expanding realms of informatics, it falls short in providing a comprehensive understanding of the rapidly evolving technology at an introductory level. The fragmented presentation lacks coherence, hindering readers from forming a holistic understanding of artificial intelligence, its current and future impacts on society, and its ethical implications.

Casal-Otero L., Catala A., and others, in their scientific analysis of the current state of teaching artificial intelligence in schools (2023), offer the following suggestions:

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- Topics related to artificial intelligence literacy should be incorporated into the school curriculum through an interdisciplinary and competency-based approach. Introducing a new subject dedicated solely to artificial intelligence may not be necessary. Instead, it could be beneficial to integrate content related to artificial intelligence technologies into existing school subjects.[8]

The content of Informatics encompasses several topics aimed at developing artificial intelligence literacy among students in general secondary schools. To further enhance their proficiency in this technology, it's essential to integrate artificial intelligence topics into other subjects of general secondary education or introduce additional subjects focusing on artificial intelligence-related topics.

The chapter on "Artificial Intelligence" in the 11th-grade computer science and IT textbook.

In accordance with our research objectives, we will thoroughly examine the content of the chapter on "Artificial Intelligence" in the textbook "Informatics and IT," which is developed based on the national curriculum for general education institutions in Uzbekistan.

The subject of "Informatics and IT" for the 11th grade is allocated 68 hours, with 2 hours per week in the curriculum of general secondary education schools. Practical exercises are provided for 70.6% of the topics in the textbook, indicating that 48 topics in the textbook are accompanied by practical exercises. The textbook's Chapter II is titled "Artificial Intelligence" and comprises seven topics that integrate theoretical knowledge with practical exercises (see Table 1). Thus, all topics in the chapter (100%) include practical training. Practical training emphasizes the utilization of popular programs developed based on specific elements of artificial intelligence. This approach enables students to bridge theoretical knowledge with practical applications and familiarize themselves with real-world examples of artificial intelligence. Additionally, it aims to cultivate students' interest in the field of artificial intelligence and inspire them to pursue professional careers in this domain in the future.

No	Topic title	Training type and the corresponding allocated hours		
		Total	Theoretical	Practical
1.	The concept of AI and its developmental history	1	1/2	1/2
2.	The features of AI	1	1/2	1/2
3.	The types and branches of AI	1	1/2	1/2
4.	The role of Python in AI technologies	1	1/2	1/2
5.	The Natural Language Processing Technology in Python	1	1/2	1/2
6.	Creating a text-to-speech (TTS) program in Python	1	1/2	1/2
7.	Creating a speech-to-text (STT) program in Python	1	1/2	1/2
8.	Evaluation			
	Total: 7 hours	**7**	**3.5**	**3.5**

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Table 1. The curriculum of the "Artificial Intelligence" chapter in the 11th-grade textbook "Informatics and IT".

The topic "Ethics of Artificial Intelligence" has been incorporated into the electronic methodological support developed based on the aforementioned topics. The primary objective of this integration is to instill resilience in schoolchildren against the negative aspects of artificial intelligence technologies. It aims to teach the use of artificial intelligence based on universal human values.

CONCLUSION

It is possible to cultivate artificial intelligence literacy in primary and secondary schools tailored to the age and level of computer literacy of students. To achieve this, we must delineate three criteria that denote artificial intelligence literacy: understanding of artificial intelligence concepts, utilization of artificial intelligence applications, and awareness of ethics and security in artificial intelligence [9].

We studied international experiences in crafting the curriculum and content of the artificial intelligence chapter in computer science and IT textbooks, analyzing science textbooks and curricula from several developed countries in computer science (Computer Science, ICT), and artificial intelligence. Based on this research, we developed a curriculum and content aimed at enhancing the artificial intelligence literacy of high school students in general secondary schools in Uzbekistan. Efforts were also made to align each topic with practical applications. Given the rapid evolution of artificial intelligence technologies, it is crucial to continuously enhance the curriculum and content every year.

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