Article

Methodology of Teaching the Elements of Artificial Intelligence in Schools

Normatov Sulton[1]

1. A. Avloni National Institute of Pedagogical Skills, Uzbekistan

Abstract: With a focus on AI literacy for students in resource-constrained environments, this study investigates how artificial intelligence (AI) components are incorporated into standard secondary school curricula in Uzbekistan. Even if AI is becoming more and more relevant, there is still a gap in digital abilities across different social strata due to unequal educational access. In order to teach AI principles without the use of technology, this study uses Kolb's experiential learning theory and the "Unplugged" approach. Through practical approaches, the course seeks to promote critical thinking and theoretical AI comprehension. The findings show that the Unplugged approach improves students' understanding and interest in AI subjects by clearly communicating AI concepts. With ramifications for wider implementation in technologically limited contexts, this strategy offers a viable model for inclusive AI teaching.

1. Introduction

Activities aimed at improving the education sector in the organization of the educational process, including teaching topics about the elements of artificial intelligence within the framework of computer science, teaching as a result of the use of information technologies, pedagogical technologies appropriate to the content of the subject, and digital educational resources aimed at improving quality. As a result, it can motivate the formation of artificial intelligence competencies of students, a better understanding of modern trends, their acceptance and learning of related professions.

The goals and objectives of teaching "Informatics and information technologies" in Uzbekistan are set out in the October 6, 2020 "Measures for further improvement of the educational system in the field of information technologies, development of scientific research and their integration with the IT industry" In accordance with the Resolution No. PQ-4851 on the development of the curricula of the subject "Informatics and information technologies" taught in secondary schools based on modern trends, the following is provided in sub-paragraph "v" of paragraph 5:

–   within the framework of the development of the curriculum of general secondary education, coordinate the curricula of the subject "Informatics and information technologies" with the modern trends of education in the field of information technologies;

This directly requires the introduction of knowledge about the rapidly developing field of informatics, such as artificial intelligence, into the content of the subject

"Informatics and information technologies" taught in general secondary educational institutions.

Furthermore, "Implementation of five initiatives that include comprehensive measures aimed at creating additional conditions for youth education" defined in the "Concept for the Development of the Public Education System of the Republic of Uzbekistan until 2030" In Chapter IV, the third initiative section, paragraph 27, targets are set for "increasing the share of modern circles such as robotics, information technology and programming in non-school educational institutions" [1]. This directly implies directing students to modern professions and further development of the field of information technologies in our country. This requires practical work on the creation of various courses in traditional or remote form for schoolchildren in modern and rapidly developing fields of informatics and providing the opportunity to use it for all.

The teaching of elements of artificial intelligence in general secondary schools will help to prevent the inequality of digital skills in different strata of society. It provides an opportunity for young people studying in secondary schools of Uzbekistan to understand, use and develop together with the technologies of artificial intelligence and its certain elements. can serve to find a place.

Decision No. 187 of 2017 of the Cabinet of Ministers of the Republic of Uzbekistan on the development of an educational resource on the elements of artificial intelligence integrated with the subject of "Informatics and information technologies" in general secondary educational institutions, Appendix 5, Chapter 4 "O' based on the requirements for the development of teaching-methodical complexes" [2]. Didactic, scientific-methodical, pedagogical-psychological, aesthetic, hygienic requirements were relied on.

Practical efforts to teach artificial intelligence in general secondary schools of Uzbekistan have been improved by including the chapter "Artificial Intelligence" in the 11th grade "Informatics and Information Technologies" textbook of state schools [3]. In this process, changes in the subject content require pedagogical approaches to teaching.

Recommendations on the effective organization of pedagogical activities were made by N.I. Ryzhova and A.A. It can be seen in the studies of Lyash [4]. It proposed a teaching methodology model consisting of the purpose, content, method, form and means of teaching, and its importance and role in improving the quality of education was shown in the research results through reliable experiments.

Yim et al. [5] found that project-based education, human-computer collaborative learning, and game-based approaches with constructivist methodology are widely used in the formation of artificial intelligence literacy by teaching the elements of artificial intelligence. Teachers of informatics and IT science of the general secondary school noted that artificial intelligence projects and practical exercises are effective in focusing students' attention on tasks [6]. Various projects, which are the main means of project-based education, encourage high school students to think about the personal, social, economic and ethical consequences of artificial intelligence technologies [7]. This, in turn, helps them to develop artificial intelligence literacy.

2. Materials and Methods

A number of methods can be used to teach artificial intelligence. Examples of these are Unplugged, Project-based education, and others. Kolb's Experiential Learning Theory model [8] is important in increasing the effectiveness of these teaching methods and developing deep theoretical and practical knowledge through independent practical activities.

Kolb's Theory of Experimental Education in brief Kolb's model, the cognitive activity of students in the learning process is based on the experiences with their participation. Kolb's model consists of four stages:

1) Concrete Experience - Students conduct an experience in which they participate.
2) Reflection - Students think and analyze the experience by performing cognitive activities.
3) Abstract Conceptualization - Students transform lessons learned from experiences into concepts and principles.
4) Active Experimentation - Students apply the new knowledge and skills learned in practice.

By using the Unplugged method in teaching artificial intelligence, it is possible to teach the subject without artificial intelligence technologies. Unplugged is an effective method for teaching theoretical ideas and concepts of computer science. Teaching through this method allows to illuminate the important concepts of artificial intelligence and to explain the main ideas of artificial intelligence to students [9]. In addition, students will use or create AI to discuss social issues surrounding artificial intelligence and thereby gain a deep understanding of its importance in future activities. The unplugged method does not require the technical tools that should be used in the training of artificial intelligence. This provides an opportunity to teach the elements of artificial intelligence even in schools with a poor material and technical base. It was found through scientific experiments that the "Unplugged" method gives effective results in teaching programming languages, which is a field of computer science related to artificial intelligence [10]. Bell et al. recognized the "Unplugged" method as a pedagogical method used to teach students the content of computer science without using computers [11]. The Unplugged method is important for students to study artificial intelligence and its concepts, to organize a better understanding of it through philosophical thinking. In the study of Mariela Destéfano and others [12] from Spain, it was noted that teaching theoretical concepts of artificial intelligence technologies without digital tools is more effective than teaching with them.

3. Results and Discussion

In explaining how artificial intelligence works through the unplugged method, the teaching process using the Turing test is carried out as follows.

The Turing test, developed by Alan Turing, is a technology aimed at detecting artificial intelligence. In the Turing test, the user asks the same questions to a human participant and a computer program and receives the answers. If the user cannot determine which one is a computer based on these answers, the computer program is considered artificial intelligence, that is, a program with intelligence and understanding.
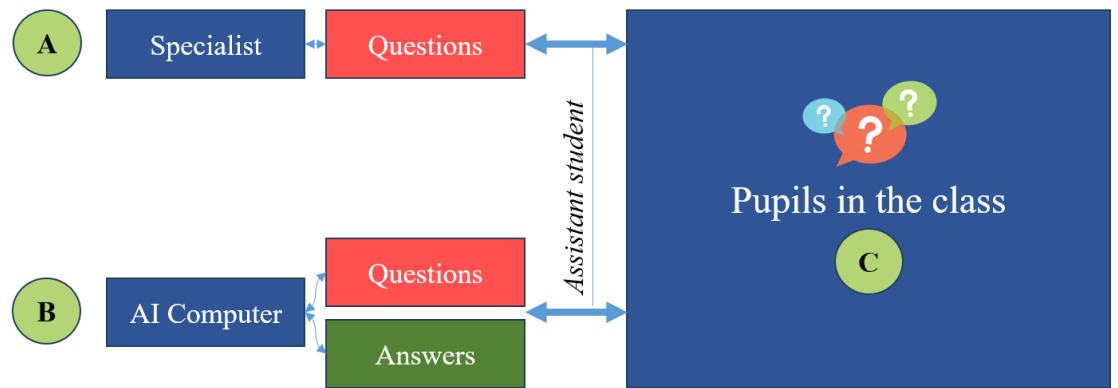
Figure 1. A model structure for teaching artificial intelligence through the unplugged method

The teacher develops a list of questions for the Turing test and answers for the computer. A student in the class (A) is selected and excluded from the class. A substitute student is appointed from among the absent students. The assistant student asks the questions in sequence to the student A outside and records the answers. Then B gets the answers prepared by the teacher for the computer. These answers are read out to students in class (C) in order. Students in class C must determine which is a computer and which is a human. If they can't figure it out, then the computer is considered an artificial intelligence technology (Figure 1). Through this Unplugged method, students will be able to understand and imagine how the general artificial intelligence used by humans today works.

Using the Unplugged method based on Kolb's Experimental Education Theory model, students can develop deep knowledge and skills on the subject. This model and method can be used in the following collaboration to organize lessons on teaching the elements of artificial intelligence:

1. Exact experience and Unplugged method:
   - Students will experience artificial intelligence concepts through hands-on Unplugged games or activities. For example, they can identify artificial intelligence software based on the characteristics and definition of artificial intelligence.
   - According to Kolb's model, this stage represents concrete experience, as students learn in practical activities in which they participate.
2. Reflection and Reflection on experience:
   - Students reflect on the conducted unplugged activities or games and analyze what results and concepts were formed. At this stage, they discuss the results of the game and clarify what they understood.
   - This corresponds to the reflection stage of Kolb's model, as students analyze their experiences.
3. Abstract conceptualization and Unplugged method (summarization of ideas):
   - Based on Unplugged activities, students form general concepts. For example, they can conclude that the artificial intelligence program used in solving a problem is based on certain elements based on general rules.
   - This stage corresponds to Kolb's stage of abstract conceptualization, because students convert the skills acquired as a result of practical activities into theoretical concepts.
4. Active experiment and Unplugged method (applying knowledge and skills in new situations):
   - Students test their knowledge by applying unplugged games or practices to new topics or situations. They apply the principles learned to solve new problems.

– This corresponds to the active experimentation stage of Kolb's model, as students try out new knowledge in practice.

Advantages of using the Unplugged method in the educational process based on Kolb's model:

1) Students learn actively through unplugged activities based on practical experiences. This, in turn, helps students to learn quickly and effectively.
2) Through Kolb's model, students reflexively review the experiences gained from the unplugged method and gain a deeper understanding of the concepts.
3) The unplugged method and the Kolb model allow students to test theoretical knowledge through practical activities and discover concepts on their own.

The use of the Unplugged method based on the Kolb model in the teaching of artificial intelligence helps to develop students' skills such as independent learning, creative and critical thinking, teamwork.

In the international experience, it can be seen that the emphasis is placed on the use and application of the acquired knowledge and skills of students in the environment outside of educational activities. In particular, Bialik et al. [13] in their research focused on the ability of schoolchildren to apply the acquired knowledge in a new context through transfer (the process of using a conceptual tool (knowledge and skills) outside of the learned context). This approach is based on the integration of theoretical knowledge and practical training, which improves the ability of students to use what they learned at school in real life. Through theoretical training, students learn about the basic concepts of the course, moral aspects, and aspects related to its importance in human life. Through practical training, they develop the skills to use knowledge correctly, timely and successfully in different situations. This approach serves to reduce uncertain or problematic learning processes such as shallow knowledge, instructional knowledge, inert knowledge, and misunderstanding of concepts.

4. Conclusion

The criteria of "Knowledge" through theoretical training and "Performance" through practical training can be expressed in four indicators at the "High" and "Low" levels. Instruction-based learning leads to the student being able to perform various tasks well, but not fully understanding and knowing the process. The development of inert knowledge means that the student has sufficient theoretical knowledge, but cannot use it in practice. If students do not know about the basic concept and cannot apply it in practice at the same time, this is judged as a mere lack of knowledge, as shown in the lower left corner of the figure. Students' effective use of the knowledge they have learned in different situations, i.e. having sufficient theoretical knowledge (knowing) and practical skills (doing), is the reason for transfer. This, in turn, is the basis for the formation of educational resources and methodical approaches to the elements of artificial intelligence within the framework of Informatics and IT science based on practical and theoretical topics. The Unplugged method based on Kolb's model is important in effective teaching of these educational resources.

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