



Artificial Intelligence Applications in Education

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Abstract

The concept of artificial intelligence was first introduced by John McCarthy at the Dartmouth Conference in 1956. Over the years, artificial intelligence has become a significant research area in various fields and has emerged as a leading force in technology in this century. Finding application in education among many other domains, artificial intelligence in education is divided into three main categories: expert systems, intelligent tutoring systems, and dialogue-based tutoring systems. In today's world, artificial intelligence has entered classrooms, transforming education worldwide under the umbrella of "smart, adaptive, or personalized learning systems." Artificial intelligence has opened new dimensions in education by collecting and analyzing vast amounts of data generated by each student. Numerous studies aim to integrate artificial intelligence applications into education, fostering active participation in the learning and teaching processes. This review examines artificial intelligence in the context of education, addressing four fundamental questions: What is artificial intelligence? How does artificial intelligence contribute to education? What are the uses of artificial intelligence in the field of education? What are the areas of use for artificial intelligence applications in education? It is expected that this review will strengthen the overall understanding of artificial intelligence in the field of education and shed light on its practical use for teachers and students in the literature.

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INTRODUCTION

In the ever-changing and evolving world of today, artificial intelligence (AI), undergoing a transformation in terms of technology in recent years, integrates into various fields rapidly (Copeland, 1998). These areas not only encompass industrial sectors but also have a significant impact on fields such as healthcare, transportation, agriculture, energy, communication, architecture, and education (Arslan, 2020; Bütüner & Calp, 2022). The extensive impact of AI, spanning across various domains, also includes education. With the ongoing development of technology in education, the concepts of artificial intelligence and education have been gaining momentum in recent times. As this development translates into the classroom environment, educational and learning technologies have become of paramount importance. The 2018 Horizon Report highlighted the integration of artificial intelligence and adaptive learning technologies as a significant development in educational technologies (Becker et al., 2018).

This study focuses on the integration of artificial intelligence (AI) in education, emphasizing its evolving impact on teaching, learning, and educational technologies. The significance of this research lies in addressing AI's potential to create personalized, adaptive, and efficient learning environments by meeting individual student needs and optimizing learning outcomes. In addition to existing studies on the use of AI in education, this research uniquely categorizes AI applications in education into expert systems, intelligent tutoring systems, and dialogue-based teaching systems, offering a comprehensive review of these areas. The study aims to contribute to the field by analyzing the role and impact of AI tools used in education in providing teachers and students with flexible, data-driven educational solutions.

This review consists of three parts: The first part will focus on defining artificial intelligence and providing a historical overview. The second part will delve into artificial intelligence applications used in education, presenting an introduction to these applications. The final part will summarize the information obtained through a literature review, providing conclusions on the topic.

DEFINITION OF ARTIFICIAL INTELLIGENCE

Before defining artificial intelligence (AI), let's break down the term by examining its individual components. The Turkish Language Association defines the term of artificial as "made or produced by human hands by likening it to the examples in nature; artificial, composite, synthetic, and opposite of natural." The term of intelligence in the definition by Turkish Language Association is presented as "the entirety of a person's abilities and skills in thinking, reasoning, learning, imagining concepts and objects in the mind, perceiving objective realities, judging, and drawing conclusions" (Turkish Language Society, 2023). In light of these definitions, artificial intelligence can be described as the ability to mimic human intelligence through computers (Timms, 2016; Adalı, 2017; Doğankaya, 2023). While there isn't a universally applicable definition for artificial intelligence due to its diverse applications, each field has its own definition of AI. Brachman (2006) argues in his study that artificial intelligence should be considered multidimensional, and interpretations should be made based on these dimensions. In the definition provided by Nabiyevev (2012), artificial intelligence is described as intelligent programs capable of solving complex problems and generating solutions for both old and new situations. Say (2020) defines AI as the branch of science that examines how artificial systems can perform every cognitive activity that natural systems can do at higher levels of achievement. Sebastian Thun, known as an AI expert, defines AI as data science, emphasizing that this definition will help dispel fears and biases associated with AI (Öztürk & Şahin, 2018; Rouhiainen, 2020).

From a technical perspective, artificial intelligence is considered a computer program, and its function is defined as having the ability to learn. The goal is to write code through data provided by

programmers, eliminating the need for humans. With the ever-increasing volume of data created by humans, AI processes this data to perform its tasks (Rouhiainen, 2020). AI, which has its fundamental source in humans and has a lower error rate than humans, continues its functioning by learning and making decisions like humans (Altun & Telli, 2019).

HISTORY OF ARTIFICIAL INTELLIGENCE

The concept of artificial intelligence (AI) first emerged with a question posed by Alan M. Turing, the pioneer of computers, in his article "Computing Machinery and Intelligence," where he inquired about the possibility of machines thinking. The term was officially coined in 1956 during the Dartmouth Workshop by John McCarthy (Sterne, 2017; Acar, 2020). Before the emergence of the concept of artificial intelligence, in 1943, McCulloch and Pitts developed the "Boolean Circuit Model of the Brain," explaining the working principles of the brain mathematically through certain assumptions. This marked a significant step towards artificial intelligence (Chen, Wang & Hsu, 2020; Pirim, 2006). By 1948, American mathematician Claude E. Shannon suggested that computers could play chess or solve complex mathematical problems using specific algorithms. Building on this assumption, Alan Turing focused on the ability of machines to think, introducing a new question. This focus on machines solving complex mathematical problems led to the creation of the "Turing Test," and in the discussions that ensued, the concept of "artificial intelligence" was first proposed during the 1956 Dartmouth Conference (McCarthy, 2007; Turing, 1950). By the 1960s, as computers became more sophisticated, new features were added. Two key features emerged during this period: the "general problem solver" feature developed by Newell and Simon and the "ELIZA" program developed by MIT, which introduced natural language processing for the first time.

The 1980s is considered a period when computers could establish connections between pieces of information. The concept of "deep learning," introduced as a new idea and still evolving today, was proposed by John Hopfield and David Rumelhart. Deep learning refers to the ability of computers to reuse information they use or store in the construction of new knowledge (Negnevitsky, 2005). In the 1990s, artificial intelligence continued its rapid development, particularly focusing on artificial neural networks to enable AI to function like a human brain. Emphasis was placed on the development in the field of cybernetics. In this context, "learning systems" came into play, allowing the system to acquire knowledge and provide descriptive information based on a specific example or label (Rumelhart & McClelland, 1986; Russell & Norvig, 2010). An interesting development in the field of artificial intelligence occurred in 1997 when the world chess champion Gary Kasparov faced off against Deep Blue, a chess-playing AI developed using artificial intelligence. Deep Blue emerged as the winner, drawing society's attention to thinking intelligent machines (Coşkun & Gülleroğlu, 2021). Additionally, during these years, Dragon Systems, the first "speech recognition software" used by Windows, was introduced to the market. In the 2000s, the first robot mimicking human facial expressions and behaviors was developed in MIT laboratories (Breazel, 2004).

In the present day, as we live in the era of Big Data, and with the diverse development of artificial intelligence in different fields, applications such as personal assistants like Siri, robotics, smart education, intelligent transportation, smart healthcare systems, autonomous vehicles, language translations, etc., have undergone significant changes and improvements (Arslan, 2020). Furthermore, technologies like GPT-3 and DALL-E, which are becoming increasingly popular, are considered among the most important artificial intelligence tools of today.

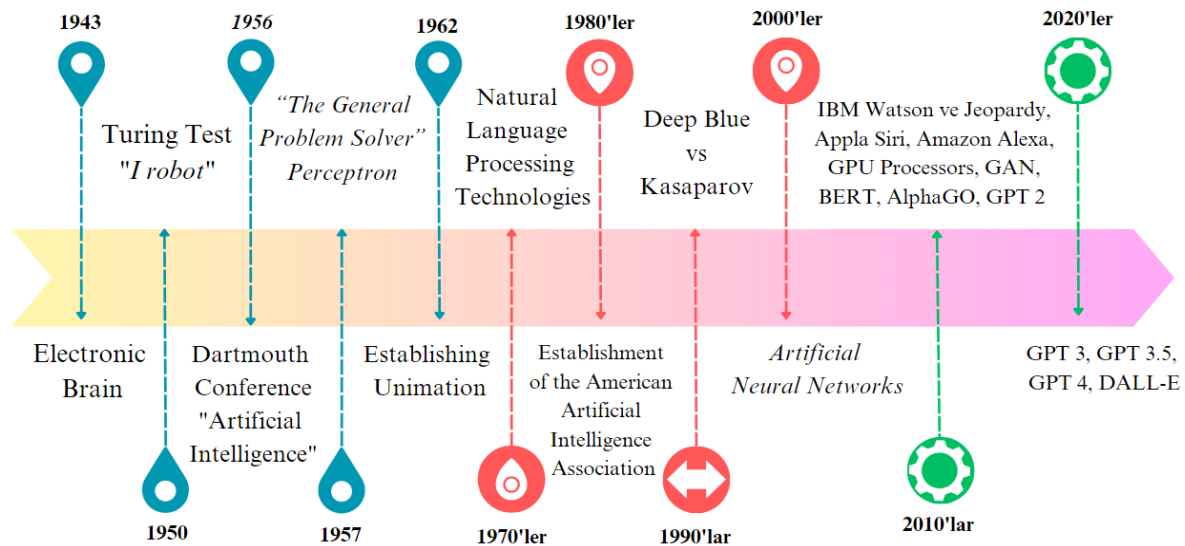


Figure 1. Chronology of Artificial Intelligence

Evaluating the development of artificial intelligence in education, it can be observed that studies conducted towards the late 1980s pioneered the use of learning management systems and intelligent education systems, along with the emergence of artificial intelligence applications, theories, and models (Chassignol, Khoroshavin, Klimova & Bilyatdinova, 2018). With this transformation, artificial intelligence has offered various advantages in the field of education. Artificial intelligence can provide more personalized, customized, and flexible learning opportunities by not only focusing on the subject matter but also on how the learning process takes place and the emotional state of the learner (Luckin, Holmes, Griffiths & Forcier, 2016). In this context, artificial intelligence in educational settings is evaluated from different perspectives for teachers and students, offering unique advantages to each stakeholder in education and leaving various impacts on the roles in the educational process (Kuprenko, 2020).

THE IMPORTANCE OF ARTIFICIAL INTELLIGENCE IN EDUCATION

It is observed that artificial intelligence, with its evolution and changes over time, has demonstrated its impact in various fields (Alan & Zengin, 2023). While progress in education has been relatively limited compared to other sectors, recent studies have shown an increase in the use of artificial intelligence in education, leading to significant achievements (Murphy, 2019; Yang, Ogata, Matsui & Chen, 2021). Efforts are ongoing to integrate artificial intelligence into education, particularly to provide a more personalized learning experience (Çetin & Aktaş, 2021). Talat (2021) examined the studies in the literature on the use of artificial intelligence in education in terms of bibliometric characteristics and concluded that most of the studies were conducted in the USA. As a result of the research, it was observed that the number of studies on the use of artificial intelligence in education fluctuated between 2003-2014; Moreno-Guerrero et al. (2020) concluded that artificial intelligence research has evolved in the field of education and has focused on the performance and impact of artificial intelligence in educational processes in recent years. With the increase in learning needs and the development of artificial intelligence, it is seen that the use of artificial intelligence in the field of education is becoming more and more important day by day (Rus, D'Mello, Hu, & Grasser, 2013). Chiu et al. (2023) stated that artificial intelligence plays various roles in the fields of learning, teaching, assessment, and management and that artificial intelligence in education provides positive learning outcomes for students and instructors. Doğan, Doğan & Bozkurt (2023) conducted a systematic review of the use of artificial intelligence technologies in online learning and found that artificial intelligence

plays an important role in the development of personalized and adaptive learning environments. Among the findings of the study are that the algorithmic decision-making processes of artificial intelligence raise ethical and justice issues and that personalized feedback can be provided on students' learning processes. In the study conducted by Korucu and Biçer (2020), the purpose of using artificial intelligence in education is emphasized as supporting learning, enhancing the quality of education by introducing new technologies to the learning environment, and making education more efficient. Additionally, it is highlighted that one of the goals is to support students in their future use of technology, and in this context, to ensure that students have a knowledge base in the field of artificial intelligence by understanding the logic of AI technologies. Considering the studies in the literature, it is observed that efforts are made to increase the use of artificial intelligence in education with these objectives in mind, and information about this process continues to be collected based on data gathered from students (Alan & Zengin, 2023).

The use of artificial intelligence in education has significantly influenced the key elements of the education process, namely students, teachers, and the learning environment. In a study that examined the perceptions of school administrators and teachers regarding the concept of artificial intelligence using metaphors, data were collected through semi-structured interviews with 76 administrators and 220 teachers. The study revealed that administrators generated 53 metaphors, with the most common metaphors being 'robot, child, and assistant, computer.' Teachers, on the other hand, produced 108 metaphors, with the most common ones being 'robot, computer, child, machine, and artificial human.' Based on the responses from administrators and teachers, common metaphors were examined in a conceptual framework, revealing that participants perceive artificial intelligence as a 'mechanical structure' and lack sufficient knowledge in this regard (Aktaş, 2021). In another study aimed at examining the effects of artificial intelligence in education, the dimensions of AI in terms of education, teaching, and management were explored. The study emphasized the importance for school administrators to possess digital leadership competencies, especially with the increased relevance of digitalization during the pandemic. It was suggested that remotely controlled AI-based schools could become a plausible idea (Küçükali & Coşkun, 2021).

Looking at the development of artificial intelligence from past years to the present, it is evident that its increased use in the field of education has led to a wide range of applications. When examining current studies, it is concluded that the research is not solely knowledge-based but also adopts a logic-based perspective by utilizing data (Uzun, Tümtürk & Öztürk, 2021). With artificial intelligence finding its application and integration into education, concepts such as "intelligent systems, adaptive systems, and personalized systems" have been introduced into the educational environment (Alan & Zengin, 2023).

ARTIFICIAL INTELLIGENCE APPLICATIONS IN EDUCATION

Artificial intelligence, by integrating the rapid transformation seen in many sectors into education, provides an opportunity for the use of AI technologies in education. Debates about the use of artificial intelligence applications in education often focus on potential changes in the roles of teachers. Despite these discussions, it is observed that artificial intelligence has indeed begun to be used in educational settings (Akdeniz & Özding, 2021).

Işler and Kılıç (2021) emphasize that artificial intelligence applications provide each student with the opportunity to learn according to their own capacity. They highlight that due to flexible working conditions, students can engage in studying at their convenience, leading to increased productivity. Addressing the goals of artificial intelligence in education (Küçükali & Coşkun, 2021) state that the most important of these goals is to provide personalized learning experiences for students.

They emphasize that the use of artificial intelligence in education will lead to more productive organization of learning activities and will provide an opportunity to enhance learning applications and arrange instructional environments using technology.

With the development of artificial intelligence and its integration into education, the use of certain applications has become widespread. In this context, the application areas of artificial intelligence in education are divided into three main categories: expert systems, intelligent tutoring systems, and dialogue-based tutoring systems.

EXPERT SYSTEMS

In contrast to the development of artificial intelligence, the history of expert systems dates back quite far. Expert systems can be defined as the use of artificial intelligence algorithms to perform tasks of individuals specialized in a particular field, replacing human experts (Arslan, 2017; Uzun et al., 2021; Küçükali & Coşkun, 2021; Engin, 2021). Unlike artificial intelligence, which mimics human intelligence, expert systems imitate individuals specialized in specific topics (Engin, 2021). While artificial intelligence approaches problem-solving by thinking like a human, expert systems focus on problems that individuals specialized in that field can solve. In this regard, the effective construction of the database is crucial for expert systems (Alkhatlan & Kalita, 2018). Expert systems, based on knowledge and inference, require four main modules to operate effectively. These are;

1. Knowledge base,
2. Knowledge acquisition module,
3. Inference engine,
4. User interface

These components are distinguished (Önder, 2003; Uzun et al., 2021).

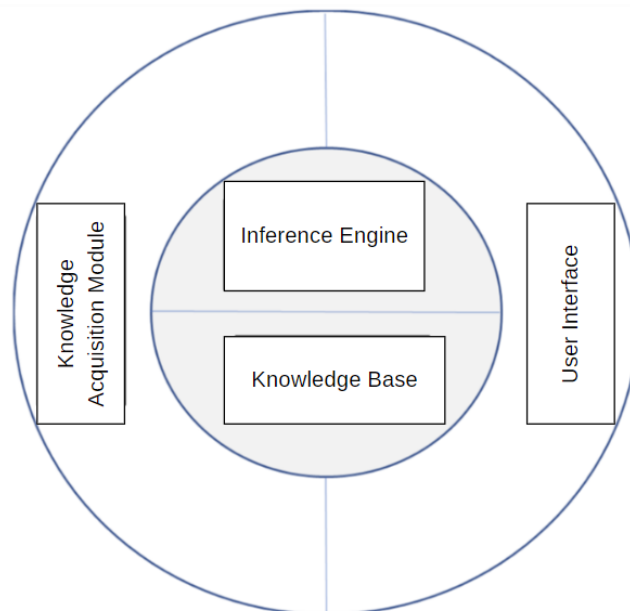


Figure 2. Basic Structure of Expert Systems

If we provide an example of the use of expert systems in education and classroom settings, a teacher seeking to solve a classroom management-related problem approaches the solution using their own knowledge. Expert systems, in this context, utilize various solutions from different teachers in the

database, uploading them as data to the system and presenting all possible solutions to the problem as data for resolution (Arslan, 2017). Önder (2003) emphasized that expert systems are built upon the experiences acquired by humans, distinguishing them from artificial intelligence. Expert systems have found application in distance education in education. In this context, expert training expands the database for solving problems arising in distance education by providing personalized feedback to students and offering structures that enhance decision-making situations. One of the most well-known examples of expert systems is MYCIN, developed by Prof. Feigenbaum and colleagues at Stanford University for the diagnosis and treatment of bacterial diseases in the field of medicine (Doğaç, 2015). The intended situation with this system is that doctors using the system respond to general questions posed by the system as expert system users, marking unknown data as "not yet known." An interface named DEC-20 was used in the development of this system. One feature of the developed system is to employ a three-stage process, perceiving, comprehending, and acting like an expert human in the subject, to formulate a diagnosis and treatment method with incomplete data (Holmes et al., 2019).

There are many advantages of using expert systems in distance education. By its nature, it provides personalized feedback to students and presents problems. It enables the identification of different student groups by expanding error libraries based on the responses received from students (Önder, 2002; Önder, 2001; Timms, 2016). Önder (2003) lists the functioning of modules in expert systems as follows:

Decision mechanism: based on the information it receives as the decision mechanism of the program; it makes decisions and functions as the main program.

Knowledge base: this module, which explains why it answers questions to the student, consists of information that the student needs to learn. This information essentially serves as an effective tool for the student to understand the given information, consisting of rule-based systems, semantic networks, frames, and similar elements.

Student module: it dynamically compares the given information with student information, continuously updates the system's capacity to reflect what the student has learned throughout the course, and developments related to the course.

Student-Computer interface; it focuses on graphics, visual language, and symbols, besides text, to enable students to easily access information and develop mastery over the program.

Educational module: also known as the pedagogical module, its fundamental role is to provide guidance to the teacher, offer new solutions to problems, suggest materials, and monitor the student's progress. In short, it is responsible for the interaction between the student and the computer.

The benefits provided by the implementation of expert systems in education are as follows:

- 1) providing a personalized learning environment,
- 2) offering general practice through applications,
- 3) controlling students' progress as needed,
- 4) presenting statistical data on situations at desired times,
- 5) creating a trial environment through simulations,
- 6) preparing an engaging learning environment using gamification in the instructional program,
- 7) nurturing creativity and imagination,

8) modeling and symbolizing solution paths for problems (Burns, Parlett, and Redfield, 1991).

INTELLIGENT TUTORING SYSTEMS

Intelligent Tutoring Systems, one of the significant application areas of artificial intelligence in education, is considered the second step in computer-assisted instruction (Küçükali & Coşkun, 2021; Ekin, 2022). Computer-assisted instruction became widespread, especially in the 1960s and 1970s, experiencing its heyday during this period. The PLATO application, developed by the University of Illinois, was one of the most well-known applications of that time, providing an interactive environment that allowed thousands of students to access materials from their universities. Present-day active applications such as email, remote desktop connections, user forms, and active messaging applications were part of the PLATO system. This application, which included the condition that every student had to be at the same level in terms of instructional content and operation type, laid the groundwork for later works focused on supporting individual learning by John Seif and William Clancey (Arslan, 2020). In response to the importance given to individual learning, Jaime Carbonell's doctoral thesis shifted the focus to new studies with the first application of Intelligent Tutoring Systems, called SCHOLAR (Carbonell, 1970).

Intelligent Tutoring Systems support individual learning by organizing instructional environments and the learning-teaching processes according to the personal characteristics of each student (Engin, 2021). They provide personalized learning environments that progress step by step and are tailored to each student in well-structured subjects such as medicine, physics, and mathematics (Alkhatlan & Kalita, 2018). The definition given by Murray (2003) states that Intelligent Tutoring Systems are computer-based instructional systems that provide outcomes based on different databases and knowledge structures, depending on students' mastery of subjects, regarding instructional content and strategies to be used in teaching. The aim here is to tailor the system according to the correctness of students' responses, guide the student through learning materials, and continuously update feedback based on the student's performance, ensuring that it meets the student's needs (Bahçeçi & Gürol, 2010).

The first Intelligent Tutoring System, SCHOLAR, operates on the basis of the Socratic dialogue system from a fundamental pedagogical approach. SCHOLAR utilizes artificial intelligence to provide individualized responses to students' questions by starting from semantically related concepts within the topic (Karlgrén, 2015). An example dialogue from SCHOLAR, as outlined by Carbonell (1970), is provided below:

*SCHOLAR: Use one of the following to answer the question. Sucre, French, Argentinian, Spanish.
What is the language of Chile?*

SCHOLAR: You're wasting too much time.

STUDENT: Spanish.

SCHOLAR: You should have written "Spanish." Very good.

Figure 3. Sample dialogue of the intelligent tutoring system named SCHOLAR

Looking at the present day, it is observed that the foundation of numerous Intelligent Tutoring Systems has been laid, including WHY, BUGGY, SOPHIE (Sophisticated Instructional Environment), and LISP TUTOR. Despite involving different technologies and subject areas, these applications fundamentally utilize three main modules. The Domain module provides information about the

subject, the Pedagogy module encompasses effective instructional approaches, and the Learner module contains information about the students. The basic structure of Intelligent Tutoring Systems is outlined as follows:

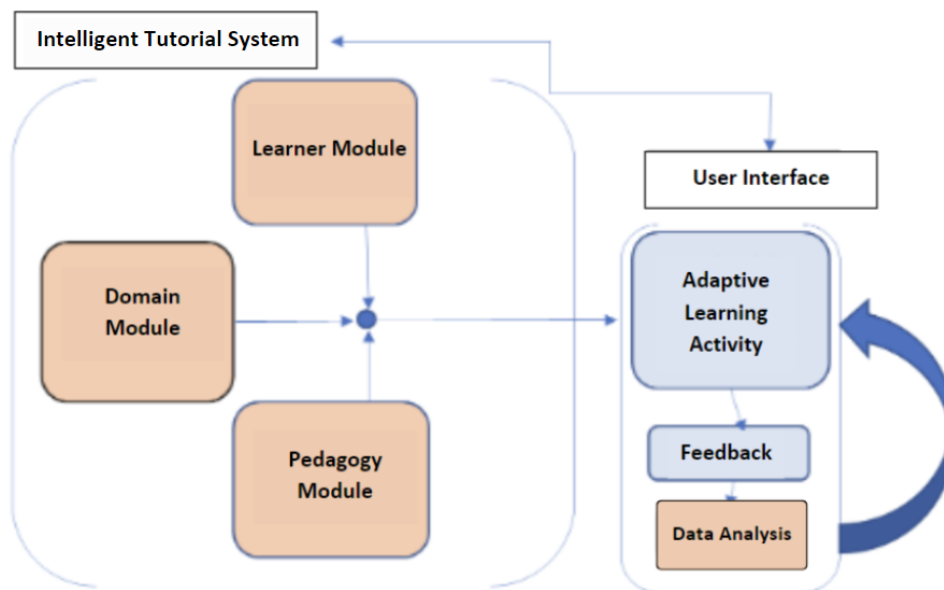


Figure 4. *Structure of Intelligent Tutorial Systems*

As seen in the figure, adaptive learning activities rely on the domain, learner, and pedagogy modules. Adaptive learning activities involve determining how course content will be presented, considering the needs and expectations of students (Guan, Mou & Jiang, 2020). The learner module is continuously updated based on information from the user interface. The task of the learner module is to organize and present instructional content in the most suitable way in terms of content and pedagogy, considering the learning experiences of students on specific topics. In doing so, it collects data from registered students in the system, creating learning activities while paying attention to possible misconceptions that students may have based on the data obtained (Yang & Ogata, 2021). Another important task of intelligent tutoring systems is to provide information about how students use the system interface. For example, information about how long a student spends on the system, what they write, or where they navigate in the system is provided to prevent misconceptions that students may have in the future (Burns, Luckhardt, Parlett & Redfield, 1991). In summary, the goal of intelligent tutoring systems is to guide students through the active learning process by providing learning resources and activities, continuously updating and adapting based on the responses from the student and being organized according to the individual needs of the student (Uzun et al., 2021; Günel, 2006).

DIALOG-BASED TUTORING SYSTEMS

The emergence of SCHOLAR, a subset of intelligent tutoring systems, has paved the way for the development of dialog-based systems. In addition to the fundamental feature of intelligent tutoring systems, which involves presenting instructional materials and learning activities in a personalized manner, dialog-based tutoring systems present topics to students in a dialog-based format by SCHOLAR (Wiemer et al., 1998). The first example of dialog-based systems using fuzzy logic to achieve this goal is CIRCSIM, developed by Rovick and Michael in 1986. The purpose of this system is to identify misconceptions of first-year medical students about the subjects and provide explanations

to correct these misconceptions (Rovick & Michael, 1986). Operating on the principle of evaluating the student's responses to questions posed by the system and providing feedback to the student, dialog-based systems aim to facilitate more effective learning by offering notes related to the subject based on the feedback (Bayburt & Eğin, 2021). CIRCSIM utilizes constrained natural language processing and generation mechanisms to establish a dialogue between the student and the system, creating an effective learning environment (Holmes et al., 2019). The rules used by dialog-based tutoring systems are provided in the algorithm in the diagram below:

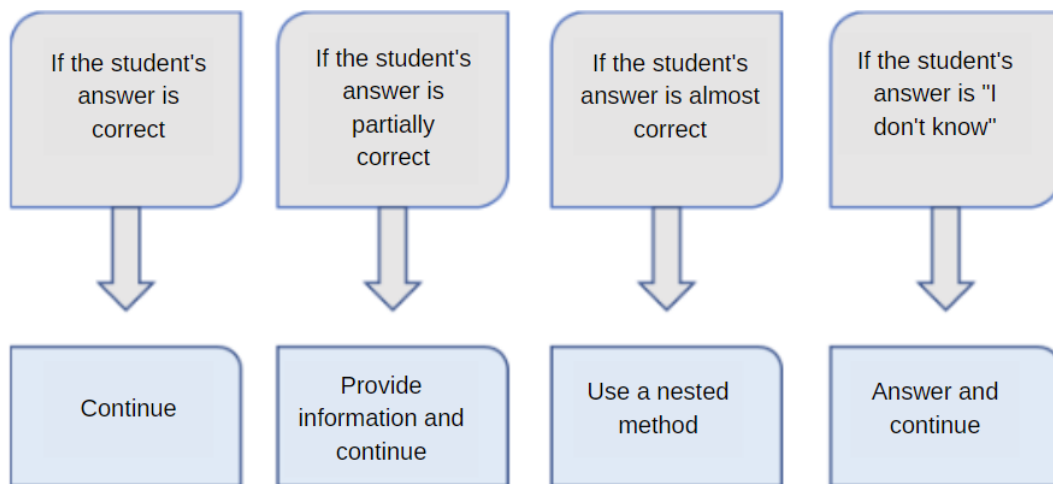


Figure 5. Roles and Techniques Employed by Artificial Intelligence Applications Used for Educational Purposes

Another example of dialog-based tutoring systems is Autotutor, developed at the University of Memphis. This system is considered one of the most effective systems that mimics dialogues between a 'human tutor' and a 'student' to complete online tasks in the fields of computer science, physics, and biology (Graesser et al., 2001). Autotutor aims to encourage students to ask detailed questions, engage in deep thinking, and acquire knowledge about the given topic. The Autotutor system and tutoring responses in the system consist of five stages: 1) a problem or question presented by Autotutor, 2) expressions used by the student to answer the question, 3) the system's evaluation of the answers provided by the student, 4) feedback from the system, and 5) repeating the second and fourth steps to enhance the student's response. An example dialog visual from this system is shown below (Nye, Graesser & Hu, 2014; Shah, 2021).

- **AutoTutor** <Main Question>: A child is in a free-falling elevator and suppose he holds his keys motionless in front of him and lets go. What about the keys? Explain why.
- Student: The keys would not move, but would be above the starting point.
- **AutoTutor** <More information>: I bet you can explain a little more.
- Student: Due to gravity, the speed of the keys remains the same.
- **AutoTutor** <Hint : So what about the acceleration of the included objects?
- Student: What is acceleration?
- **AutoTutor** <Answer:Let me try to answer the problem. Acceleration in time the change in speed is the rate, for example, going faster or slower. Momentum it is a vector quantity, so it must have an aspect.
- **AutoTutor** <Hint: Let's try again. So what is the acceleration of the objects involved will it be?
- Student: The acceleration of objects in the elevator is the acceleration of the earth's gravity, which is it is the same as the acceleration of the elevator.
- **AutoTutor** <Short Feedback>: Good job!
- **AutoTutor** <Redirect>: Try this. Which way are the objects going? Objects falling <hand gesture to direct the student to mean something>?
- Student: down the line
- **AutoTutor** <Short Feedback>: Correct.
- **AutoTutor** <PROCESSING - Completion>: Objects are falling down.

Figure 6. *Sample Dialogue for Dialogue-Based Tutorial Systems*

The dialog that takes place in the system records the conceptual misconceptions the student holds and the answers they provide to questions. In this context, the system generates feedback for the student regarding correct answers, errors, or conceptual misconceptions they may have about the topic.

EDUCATIONAL USE OF ARTIFICIAL INTELLIGENCE TOOLS AND APPLICATION AREAS

With the advancement of technology and the widespread use of the Internet, many platforms in the field of education today effectively utilize artificial intelligence techniques. These platforms and applications, designed using artificial intelligence, continuously evolve and develop with changing technology (Popenici & Kerr, 2017). Along with this transformation, these increasingly important applications in the field of education quickly identify and solve problems that arise in education (Nabiyev & Erümit, 2012). Artificial intelligence tools used in education have undergone changes and improvements from the past to the present. Some artificial intelligence tools used in education include:

Classcraft: A gamified and effective intelligence-based online e-learning system that enables students to work in teams (Haris & Sugito, 2015). Students receive + points for positive behaviors and - points for negative behaviors in the game. The game enhances classroom interactions by allowing students to choose characters that represent them.

Chatbot: An artificial intelligence application used in education that provides dialog or text-based communication with users. Using natural language processing, this application aims to provide instant responses to questions by mimicking the stages people go through when communicating (Köse, 2016).

Utifen: An application in education that tracks students' learning experiences and offers personalized topics and recommendations (İşler & Kılıç, 2021).

Amazon Alexa: Developed by Amazon, this application with virtual assistant features supports dynamic and interactive learning beyond traditional methods (Öztuna, 20X17). With versatile features such as

voice interaction, podcasts, audiobooks, and news, the program can control connected devices and has the ability to add new skills (Alexa, 2014).

Table 1. Explains other artificial intelligence applications in education, their features, and their roles in education

Software / Application Names	Software / Application Features	Role in Education	Artificial Intelligence techniques used
1. ALEKS 2. MATHia 3. Dreambox Learning 4. IBM Watson Sparrow	1. Learning progress tracking 2. Development assessment 3. Performance improvement suggestions	1. Automation 2. Description	1. Machine Learning 2. Data mining
1. EdX 2. Coursera 3. Udemy 4. Edmodo	1. Automatic scoring of assignment and exams 2. Suggesting content to interest 3. Access to educational context 4. Lifelong learning from all fields, including artificial intelligence	1. Description 2. Universal access 3. Equality of opportunity 4. Lifelong learning	1. Machine Learning 2. Data mining
1. Presentation translator	1. Live presentation instantly translating different languages	1. Integration 2. Equality of opportunity	1. Machine learning 2. Artificial neural network 3. Natural language processing
1. Evernote 2. Google keep 3. Microsoft OneNote	1. Convert audio to text 2. Detecting characters in handwriting	1. Integration 2. Equality of opportunity	1. Artificial neural network 2. Natural language processing 3. Image processing
1. Elementsofai.com 2. Ocw.mit.edu 3. Udacity		1. Universal access 2. Equality of opportunity 3. Lifelong learning	
1. NAO, Keepon, Kaspar, Romibo, Tito, Troy, Robonova, Probo, Lego Nxt and iRobi	1. Ability to imitate behaviors 2. Ability to dance 3. Ability to sing 4. Matchmaking 5. Sorting 6. Answering some questions 7. Perceiving emotions	1. Equality of opportunity	1. Machine Learning 2. Robotics
1. Grammarly 2. Virtualwritingtutor	1. Grammar and spelling taking into account the rules suggest corrections	1. Integration 2. Universal access 3. Equality of opportunity	1. Machine Learning 2. Data Mining
1. Google Translate 2. Amazon Translate 3. Yandex Translate	1. Perceiving language 2. Transcribe the image turning 3. Convert audio to text 4. In your handwriting detecting characters	1. Integration 2. Equality of opportunity	1. Deep learning 2. Artificial neural networks 3. Natural language processing 4. Image processing
1. Ithenticate 2. Tunitin	1. Documents comparing the similarity rates in their contents with existing documents (including manuscript documents)	1. Integration	1. Machine learning 2. Artificial neural networks 3. Natural language processing

CONCLUSION

With the recent development of technology, artificial intelligence (AI) has become prevalent in various aspects of our lives (Spector & Ma, 2019). AI, finding new applications in the field of education, continues its rapid evolution and transformation in this area (Murphy, 2019; Rus et al., 2013). When examining the literature, AI in education is divided into three categories: expert systems, intelligent tutoring systems, and dialogue-based tutoring systems. Unlike AI, which has the ability to mimic human intelligence by providing personalized feedback to students in distance education, expert systems imitate individuals specialized in certain subjects and their tasks (Engin, 2021). Acting like a person specialized in the relevant field when solving a given problem, it provides a solution path. It creates a database for solving problems based on the personalized feedback given to students and improves it with each problem solution (Alkhatlan & Kalita, 2018). Intelligent tutoring systems, on the other hand, support individual learning by organizing learning environments according to students' personal characteristics and regulating the teaching-learning processes (Murray, 2003). The aim of this system is to provide continuous feedback to students based on their correct and incorrect answers and to update learning environments according to the individual needs of the student (Bahçeci & Gürol, 2010). The working principle of the last of these systems, dialogue-based tutoring systems, is to evaluate the answers given by the student to the questions posed by the system, provide feedback to the student, and present notes on the topics based on this feedback to offer an effective learning experience (Graesser et al., 2001). The system records dialogues between the "human tutor" and the "student," imitating them to capture the conceptual misconceptions the student has about the subject. By recording incorrect answers and conceptual misconceptions provided by the student, it organizes the learning processes (Nye et al., 2014).

The development of technology has impacted various fields, and recently, it has found its place in education as well. Artificial intelligence tools used in education aim to track students' progress, improve their performance, organize content based on students' misconceptions, automatically grade exams and assignments, and provide information on presentations (Nabiyev & Erümit, 2012; Popenici & Kerr, 2017). AI-supported educational environments are evaluated from various perspectives for teachers and students, providing specific advantages to each stakeholder involved in education and influencing the roles in the educational process (Kuprenko, 2020). Currently, research is ongoing to explore the potential of artificial intelligence in education to offer a more personalized experience. The increasing learning needs and the development of artificial intelligence indicate that the use of AI in education is becoming increasingly important. This review study, providing a literature review on the use of artificial intelligence in education, is expected to contribute to the field.

LIMITATIONS AND RECOMMENDATIONS

This study draws attention to the increasingly popular use of artificial intelligence (AI) in education and provides comprehensive information on the integration of AI into educational environments. As a literature review, the study does not present experimental data on the effectiveness of AI applications in educational settings and examines AI subtypes within a narrow scope. Although expert systems and intelligent tutoring systems are addressed, studies related to machine learning or deep learning for adaptive learning are not presented in detail. Furthermore, the study focuses on the positive aspects of using AI in education and does not address ethical concerns associated with AI in educational settings. Readers seeking empirical data on AI may consider researching field studies examining the effectiveness of AI in education, and those interested in ethical considerations may focus on studies highlighting ethical concerns about the use of AI in education. As the use of AI and its applications in education continues to grow, exploring AI technologies beyond the

types covered in this study could provide researchers with a more comprehensive understanding of AI's potential in education.

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The first author has contributed to the writing, editing, and development of the content of the article. The second author has contributed to the creation, development, and organization of the design related to the study.