Applications of Artificial Intelligence in Education: A Descriptive Analytical Study

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Abstract:

In recent years, the world has witnessed a revolution in the field of Artificial Intelligence (AI), which has had an impact on various aspects of life. AI has been applied and utilized in all scientific, technical, and even humanistic fields. It plays a crucial role in modern educational and pedagogical processes and is deemed essential, with many studies and research highlighting the importance of AI applications in the educational realm. To fully benefit from AI technologies in education, educational institutions require expertise in creating and managing AI systems on a large scale. They also need to provide the necessary infrastructure, tools, and processes to ensure the successful implementation of AI technology, along with clear guidelines for the duration and manner of online lesson follow-up. This way, AI applications can effectively fulfill their designated functions.
Keywords: Education, Educational Institutions, Artificial Intelligence, Applications, Utilizations.

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Introduction:

The rapid pace of progress in all countries and various fields of science has led to the study and simulation of human intelligence systems and their development. Scientists hoped to transfer the characteristics and methods of natural intelligence and human experience to computer programming systems in order to benefit from them in various aspects of life. This requires a level of intelligence and practical experience to keep up with the developments in industrial, agricultural, and commercial applications.

Based on this, there emerged a trend towards artificial intelligence to simulate human intelligence and study its mental capabilities in an attempt to understand the processes of human intelligence. Thus, we see that the science of artificial intelligence seeks to build intelligence according to its systems, which have transitioned from artificial intelligence methods to computer programming systems. These systems have contributed to the construction of expert systems that encompass some of the expertise held by the human mind.

It is not hidden from many researchers that artificial intelligence has become one of the important topics discussed at present and attracts extensive coverage in academic fields. The field is witnessing a broad democratization due to rapid technological reasons on one hand, and economic reasons that have asserted themselves, further bolstered by the emergence of big data in recent years.

It is expected that advancements in artificial intelligence and machine learning will have a profound impact on the future job market and competency requirements. This will also influence teaching and learning practices as educational systems adapt to the demands of the industrial era. Artificial intelligence may render certain educational jobs obsolete while creating new ones, and it could introduce new methods of teaching and learning as it becomes increasingly integrated into various fields in our current era.

As a result, there is a need to provide specialized artificial intelligence programs in schools, alongside computer learning programs such as programming languages, algorithm design, and data structures. Additionally, basic mathematics, statistical analysis, numerical analysis, mathematical modeling, engineering programs, natural sciences, and humanities should be included.

Considering the above, artificial intelligence is one of the most significant modern educational trends that require considerable efforts and resources to implement in the educational field, despite the potential negative consequences it might entail for humans in the future.

1-Artificial Intelligence (AI):

Despite the differences among academics, philosophers, and scholars in defining and determining the concept of intelligence itself, there has been a consensus on the concept of artificial intelligence since the emergence of early research in the early 1950s. Artificial Intelligence is the scientific and technical field that includes methods, theories, and technologies aimed at creating machines capable of simulating intelligence[1]. Specialists in mechanics and informatics consider this definition clear and relevant to their field, while others point out that this definition is not comprehensive as AI is a modern science that relies on innovation, creativity, and change.

The term "Artificial Intelligence" is composed of two words: "intelligence" and "artificial":

Intelligence is the ability to understand new and changing conditions, meaning the ability to perceive, understand, and learn from new situations or circumstances. The keys to intelligence are perception, understanding, and learning.

As for the word "artificial," it is related to the verb "to make" or "to create," and the term is used for all things that are produced as a result of activity or action through the creation and shaping of things, distinguishing them from things that already exist and are naturally generated without human intervention. Based on this, artificial intelligence, in general, means the intelligence that

is made or created by humans in machines or computers. Therefore, artificial intelligence is the science of modern machines[2].

It is known as that branch of computer science through which computer programs can be created and designed to simulate human intelligence, allowing the computer to perform some tasks instead of humans that require thinking, understanding, hearing, speaking, and movement in a logical and organized manner[3].

Artificial Intelligence is also defined as the field that seeks to understand the nature of human intelligence through creating computer programs that imitate intelligent actions, behaviors, or activities[4].

In its simplest definitions, Artificial Intelligence refers to the ability of a machine to simulate human intelligence through computer programs designed to perform activities that typically require intelligence. It deals with developing machines and adding this capability to them. It can be defined as a subfield of computer science concerned with symbolic reasoning concepts and methods through computers and representing symbolic knowledge for use in making inferences. Artificial Intelligence can also be seen as an attempt to model aspects of human thinking on computers[5].

Moreover, Artificial Intelligence is one of the most important modern sciences resulting from the convergence of the technological revolution in the fields of systems, computers, and automation on one hand, and logic, mathematics, languages, and psychology on the other hand. It aims to understand the nature of human intelligence through computer programs that enable solving a specific problem or making a decision in a given situation. Artificial Intelligence involves finding the method that allows solving the problem or reaching the appropriate decision by referring to various diverse reasoning processes fed into the program. The use of Artificial Intelligence is favored due to its remarkable speed in providing inferences that surpass human capacity[6].

From this, it can be said that Artificial Intelligence is a relatively modern science in the field of computer science aimed at inventing and designing intelligent computer systems that simulate human intelligence itself. It makes the machine think like a human, that is, a computer with a mind. Artificial Intelligence encompasses all algorithms and theoretical methods, both practical and applied, which involve making decisions in place of humans, whether that is done entirely or partially in conjunction with human interaction, with the ability to adapt and predict.

2-The importance of Artificial Intelligence in the educational process:

Artificial Intelligence and its applications play a significant and evident role in enhancing and developing various aspects of life. This is achieved by developing computer systems that operate with exceptional efficiency, resembling the expertise of human professionals. With its diverse uses, Artificial Intelligence has become one of the practical sciences that are deeply intertwined with human daily life and future. It has evolved into an undeniable reality, not just a tangible concept, especially in the face of the enormous technological advancements witnessed in the world today. This progress could lead to complete reliance on computers in every detail of daily

life, driven by the information revolution and technological trends, which facilitate cultural communication and technical interaction among people from different parts of the world[7].
Indeed, if Artificial Intelligence plays a significant role in various fields, it is equally essential in modern education and becomes a necessity in the current era. Its applications have been highlighted as crucial in the educational process, enabling several advantages to be achieved, including:
- Improving decision-making processes.
- Enhancing the quality of education.
- Developing life skills.
- Enhancing students' cognitive achievements.
And many other advantages that greatly contribute to strengthening the educational process and producing generations capable of facing the challenges of their time. Additionally, Artificial Intelligence provides a representation of teachers' expertise by simplifying essential teaching tasks and addressing them in the educational domain[8].
-When universities lack expert professors, Artificial Intelligence representing their expertise can enhance their effectiveness. Research shows that providing high-quality curricula and online educational materials to less qualified professors can improve students' academic performance.
-Moreover, when expert professors need to address diverse student needs, even highly competent instructors sometimes struggle to meet various educational requirements. In such cases, Artificial Intelligence can provide essential content aspects, teaching skills, and better assessment data.
-Deep learning and non-cognitive skills play a significant role alongside academic content in determining academic outcomes and students' lives. AI, embodying professors' expertise, empowers them to assist students in developing crucial skills.
-Expert professors are a valuable resource in the education system. Ensuring excellent education for every student requires simplifying teaching innovations through Artificial Intelligence.
-AI applications help relieve teachers' administrative burdens, such as exam grading and assignment evaluation, allowing them to dedicate more time to research and developing course content for students.
The available digital technological means, through artificial intelligence, will help overcome many structural barriers that make it difficult to ensure effective teachers' access to all learners. Educational systems face several challenges, such as a shortage of teachers and the lack of clear methods to develop highly qualified educators. Artificial intelligence provides expertise to teachers by simplifying and complementing their fundamental teaching tasks, and it has several positive effects on the educational process[9].
As academics and university professors agree, the application of artificial intelligence in the education sector can lead to a revolution that corrects the educational trajectory, breaking away from traditional teaching methods and transforming the role of teachers from mere employees to experts. The future of education with AI technology introduces what is known as "robot teachers," which will assist both students and teachers in accessing the necessary information for

learning. Furthermore, this technology will potentially change the evaluation of students in various academic fields.

Despite the broad benefits of artificial intelligence in education, as well as in other areas, it remains a non-human technology, lacking a certain level of consciousness that humans possess. Many researchers assert that AI and machine learning can improve the level and quality of education, but it cannot entirely replace or compensate for the role of a teacher. The importance of AI lies in creating a dynamic relationship between the student and the teacher, enhancing the pedagogical process, rather than solely substituting for either party.

Contributions of artificial intelligence in education include[10]:

1. Automatic grading of certain types of schoolwork, saving teachers time for other tasks.
2. Continuous assessment of students, empowering independent learning and improving classroom management, data collection, and storage. Students with special needs can also benefit from AI.
3. Flexibility for teachers to modify their courses, providing smart tutoring platforms for remote learning.
4. Introducing new ways to interact with information and offering educational feedback while adapting teaching content.
5. Expanding opportunities for learners to communicate and collaborate with each other, increasing interaction between students and academic content.
6. Improving education by facilitating access to resources instead of just transferring content and providing home assistance.

3-Educational applications of artificial intelligence:

The use of artificial intelligence is diverse with various applications in the educational field. One of the areas where artificial intelligence is employed is in the electronic management of educational institutions. These institutions are considered a significant source of data, and as a result, enterprise systems capable of managing the data of employees are created, storing it in extensive databases that can predict individual learners' weaknesses and anticipate deficiencies in material and human resources at the level of educational institutions before they occur[11].

It is also used in building smart rules and training programs that can identify and measure teachers' learning methods and assess their knowledge. Then, personalized exercises are provided based on each student's electronic evaluation. Specialized companies offer some programs capable of conducting training exercises and tests, correcting answers, and immediately informing students of their performance. Artificial intelligence applications can also identify the problem of students' lack of understanding of certain questions and the reasons behind their inability to answer them.

The employment opportunities for artificial intelligence applications extend to include early childhood education, starting with understanding a child's learning stages through artificial neural networks that simulate the brain's neural connections. They are programmed and trained

for specific tasks while observing the impact and quality of the training. With advancements in artificial intelligence technology, there are now robots capable of engaging in early education with children, reading and understanding their interactions, performing gestures, and other actions that facilitate learning for the child.

These practical applications are translated into several tools and platforms that solidify the use of artificial intelligence. Robots, also known as humanoid robots, nanotechnology, quantum computing, biotechnology, Internet of Things (IoT), 3D printing technology, and autonomous self-driving vehicles are all fields where artificial intelligence is involved. These technologies are built on software that can operate independently without direct human control and can perform tasks that humans can do due to their ability to sense the surrounding factors such as light, heat, sound, or motion through special sensors. In recent years, there has been a significant advancement in open education platforms that utilize smart teaching systems, following various machine learning techniques and self-learning algorithms that gather and analyze vast datasets. This data gathering allows the systems to decide the type of content that should be delivered to the learner based on their abilities and needs.

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Some of these platforms focus on teaching mathematics, such as the "Atkalam Wa Ata'allam" platform, which teaches fractions and utilizes a learner model that stores data about the student's mathematical knowledge, cognitive needs, emotional state, and responses to feedback. Among these platforms are those that consider the various concerns of different learners, like the "Mika" platform, which provides AI-based teaching tools for busy learners who lack personalized attention. Mika specializes in teaching university students to fill gaps in overcrowded classrooms, and it guides each learner through personalized learning processes, allowing them to track their daily progress and enabling lesson adjustments according to each student's needs.

Some platforms are dedicated to designing and producing books and educational materials, tailored either for individual learners or groups. For example, the "Future Learning" platform allows teachers to design curricula across multiple digital devices, incorporating interactive elements like audio, images, and self-assessment in their digital lesson plans. They can create personalized educational materials ready for publishing on any digital platform during video

conferences, digital discussions, personalized assignments, and educational analyses that illustrate invisible presentations of each learner's personal growth.

Other platforms specialize in answering learners' questions in their classrooms, enabling users to ask questions about homework and receive automatic answers. Over the past twenty years, many intelligent tutoring systems have evolved, proving to be successful AI projects and widely tested on students, especially in mathematics, science, technology, and computer languages[12].

Intelligent tutoring systems represent one of the educational technologies that play a crucial role in acquiring the necessary skills for success, as they are a form of expert systems, where each teacher is an expert in their knowledge field and has a different teaching style[13].

Many researchers believe that there are several criteria that should be met by an artificial intelligence-based teaching program, including:

- The program should be able to generate problems that take into account the student's scientific abilities.
- The program should be capable of adapting to the student's environment by self-modification based on the real knowledge the student acquires during learning.
- The program should encompass various types of knowledge that can be represented, including knowledge specific to each student.
- The ability to detect common mistakes and identify any gaps in the student's understanding that may arise from these mistakes.
- The program should utilize a flexible interactive interface that allows users to interact with the computer through mutual dialogue.

The components of intelligent teaching systems consist of the following elements[14]:

1. Expert module: This unit contains teaching strategies, basic instructions, and desired information to be taught to the student, including concepts, topics, facts, and procedural knowledge. It represents a model or formulation of how an expert in specialized knowledge represents information.

2. Student module: This unit records information related to each student and monitors the student's performance level in the provided scientific material. It reflects the current state of knowledge, progress in learning a specific lesson, time and frequency of attempts in various exercises, requests for help and explanations, etc.

The student unit monitors the student's performance in the subject matter presented and reflects the following:

- The current level of knowledge of the student.
- The student's progress in learning a specific lesson.
- Time and frequency of attempts to perform various exercises, seeking help, and explanations, etc.
- The student's performance regarding answering system questions, problem-solving, and ability to recall previous lessons.

- The educational behavior of the student (the number of times they follow the correct paths to understand a concept).

3. Educational principles module: This unit presents the process of learning, such as identifying necessary information for review or introducing new topics. Based on the information from the student module, the educational principles module makes instructional decisions that reflect the different needs of each student in terms of teaching, examination, and review.

4. Explanation module: This unit utilizes all available information from the specialized knowledge base (lesson content, objectives, topics, and exams) as well as information from the student module to answer student questions and provide suitable explanations. It handles tasks such as determining the content of the answer or explanation, specifying the presentation style (notes, illustrations, referring to related concepts, etc.), and organizing information for better comprehension.

This unit can handle the following tasks:

- Identifying the content of the answer or explanation.
- Determining the style of presenting the explanation, such as notes, clarifications, referencing related concepts, etc.
- Compiling information and organizing sentences to ensure comprehensibility.

5. Communication module: This unit manages interactions with the student, such as conducting dialogues and designing screens to present scientific material to the student in the best possible manner. It includes knowledge browsers, summarization tools for lesson sequencing, and browsing previous or subsequent lessons and objectives. The module may also contain additional tools for the student, such as a notebook for taking notes, voice signals, a timeline, or direct assistance.

The positive effects of using artificial intelligence in the educational process include:

- AI systems can handle school administration tasks to reduce administrative burdens by transforming management systems into electronic systems. This contributes to making accurate administrative decisions, distributing courses and class schedules to teachers according to their abilities and preferences, and identifying and supporting talented students and students with learning difficulties by providing specialized programs.
- Smart learning applications allow students to learn in a personalized manner based on their inclinations, preferences, and needs. They break free from one-size-fits-all teaching methods, as intelligent lesson applications and diverse educational platforms are now compatible with each student's individual characteristics.
- AI programs, such as educational robots, logic teaching, self-correction, and self-programming, offer the opportunity for self-education and personal development.
- Establishing an organized knowledge database where information is efficiently stored, allowing employees, especially those in knowledge management departments, to access knowledge and learn experimental rules not available in books or other information sources.

- Storing information and knowledge related to artificial intelligence helps protect proprietary knowledge from leaking or being lost due to employee resignations, transfers, or deaths.
- AI can find solutions to complex problems, analyze and address them in a timely manner.
- AI can assist people with special needs using multiple methods, especially by translating text from writing to speech and vice versa. This can help visually or hearing impaired individuals use information and communication technology.
- When expert teachers need to address the diverse educational needs of students, it can sometimes be challenging to implement varying instructions on a daily basis. AI-based instructions that adapt on a daily basis can be helpful in such situations[15].

Potential drawbacks of using artificial intelligence in education include the significant reliance on students' feedback and feedback loops, which may result in algorithms offering them easy academic material instead of challenging content that helps them reach their potential. Additionally, the unexpected outcomes produced by artificial intelligence may require careful examination to determine if it encountered these potential pitfalls[16].

In conclusion:

Undoubtedly, artificial intelligence is no longer limited to a specific segment of society; it has become accessible to everyone and has infiltrated various aspects of our daily lives, including education. Many researchers claim that AI and machine learning can elevate the quality of education by providing personalized learning, assessments, and feedback to learners at all educational levels, from preschool to university, catering to their individual challenges and identifying knowledge gaps.

Artificial intelligence presents a significant challenge for developing countries as it encompasses a complex field of science that can be better navigated through its implementation in education. It offers numerous supportive methods for teachers, enhancing their performance and improving educational outcomes. Specialists in the field emphasize that applying AI in the education sector can revolutionize the learning process by breaking free from traditional teaching methods based on rote memorization and paving the way for the future of education with AI-powered educational robots that have significantly impacted the field of education.

Despite the numerous benefits of artificial intelligence, it does have some drawbacks, including ongoing debates about comparing robots to humans.

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