

# The Role of Artificial Intelligence (AI) In Education

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## ABSTRACT

Artificial Intelligence technology is invading human life with its numerous leverages. Like all other fields, education also adopted AI tools and techniques to enhance student learning capabilities and other features of the education sector. The role of AI in education is widespread, covering learning, instruction, and administrative features. In this research, we carefully discuss the role of AI in education. We discussed the superior AI technologies and briefly described each that can play a vital role in the education sector. This research comprehensively analyses all aspects of the education sector innovated by AI tools and technologies. Our research can play an anchor role in the research of AI in education since we covered all critical areas of the education sector that AI influences.

**Keywords:** Artificial Intelligence, Education, Machine Learning.

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## I. INTRODUCTION

Artificial Intelligence (AI) gains rapid response in all aspects of human life. Day-to-day life has changed after the wide-spreading adaptability of AI. Using AI tools and techniques, researchers and AI scientists are making their unstinting efforts to make human life more comfortable and technologically advanced. When peeping into the past, we see university professors loaded bundles of student paper under their arms while entering the classroom. They had to manually evaluate the student's papers and assign an award list for the whole class. Even after suspecting students' content about plagiarism, they did not have any valuable sources to check for plagiarism. The current decade scenario is entirely different from those mentioned earlier. Now Professors have web-enabled tools to evaluate student papers and versatile means of plagiarism checking. With modern video conferencing technology, the teacher can now even conduct meetings with their students' on-off timing of university. The education sector warmly adopts Information Communication Technology (ICT) landscapes; AI is one of the most used ICT paradigms in the education industry (Holmes et al, 2019).

Over the past decade, researchers have drastically improved AI in education. In this section, we presented a past decade analysis of the research trend of our related topics. This data is gathered from a web of science and Google scholar research database while searching for the terms "AI" and "Education."

## ARTIFICIAL INTELLIGENT IN EDUCATION

This section will discuss AI in the education sector from our literature overview. As mentioned, we took data from Google scholar's web of science research papers. This section will discuss AI related to its history, branches, and its role in the education paradigm.

### History of Artificial Intelligence

The history of AI in education can be started with the first teaching machine by Sidney Pressey in 1924. That machine works to help students find correct answers to multiple-choice questions (Xing et al, 2017). Skinner's teaching machine in 1954 can bethink as the next step to AI in education. Skinner's machine is the first commercial machine for the education sector. This machine was based on the idea that the human mind constantly changes its response to an external element. These machines are composed chiefly of fill-in-the-blanks worksheets. If the student gives the correct answer system will ask the following question; otherwise, it is reinforced by providing the correct answer.

## **ARTIFICIAL INTELLIGENCE IN CURRENT EDUCATION**

The mention of artificial intelligence brings to mind a super-computer, a computer with immense processing capabilities, including adaptive behavior, such as inclusion of sensors, and other capabilities, that enable it to have human-like cognition and functional abilities, and indeed, which improve the supercomputers interaction with human beings. Indeed, different motion pictures have been made to showcase the abilities of AI, such as in smart buildings, such as the ability to manage air quality in a building, temperatures, and or playing music depending on the sensed mood of the occupants of the space. Within the education sector, there has been increased application of artificial intelligence, going over and above the conventional understanding of AI as a supercomputer to include embedded computer systems.

For example, embedded into robots, AI, or computers and supporting equipment enable the creation of robots that improve the learning experience of the student, from the most basic unit of education, early childhood education. Indeed, Timms posited that cobots or the application of robots, working together with teachers or colleague robots (cobots) are being applied to teach children routine tasks, including spelling and pronunciation and adjusting to the students' abilities [7] [9]. Similarly, the web-based and online education, as enumerated in different studies, has transitioned from simply availing materials online or on the web for students to simply download, study, and do assignments to just pass, to include intelligent and adaptive web-based systems that learn instructor and learner behavior to adjust accordingly, to enrich the educational experience (Ahmadi, 2020). Artificial intelligence in education, according to Chassignol *et al.* has been incorporated into administration, instruction or teaching, and learning [11]. These areas, which Chassignol *et al.* identify as the framework for analyzing and understanding artificial intelligence in education, will form the scope of this study.

## **PURPOSE OF THE STUDY**

With the continued application or use of information technology, it is inevitable that it has impacted the education in different ways. This study seeks to assess how the use of AI, in its different forms, in education, has impacted or affected different aspects of education. More particularly, the study will seek to assess how AI has affected teaching, learning, and administration and management areas of education. It is anticipated that the study will ascertain that AI has fostered effectiveness and efficiency in the performance of administrative tasks in education, and overall fostered improved instructional and learning effectiveness in education.

This study will benefit various stakeholders in the education sector. It will contribute to the growing study and development of knowledge, theory, and empirical findings that identify and discuss the different ways in which AI has affected education. It will benefit scholars, professionals, and policy makers, such as administrators, management and leadership of educational institutions and the education sector, by fostering evidence-based decision-making and management and leadership practices in the sector. The findings will also augment the findings by other studies and inform government policy and actions aimed at fostering meaningful use of information technology, particularly, AI, in the education sector. For example, with an understanding of the impact of AI on education sector, and an evaluation of the exact nature of such impact, including improved instructional and learning effectiveness, the government, working with educational institutions can develop a policy, strategy, and initiatives that promote the beneficial impact or effects and mitigate the possible adverse effects of AI on education

## **II. MATERIALS AND METHODS**

The study seeks to assess the impact of AI on education. More particularly, it seeks to ascertain how AI has affected education, looking at various aspects of education, including administration, instruction, and learning. Accordingly, the study takes a retrogressive approach, entailing assessing secondary data and materials or studies that have been undertaken. Indeed, Snyder posited that a systematic or semi-systematic literature review, a review of secondary data, provides a deeper understanding of the study phenomenon (Ahmadi, 2021). This approach ensures that the study is premised on empirical or is evidence backed because only studies, including meta-analysis, that have been conducted on the subject matter, support the identification, analysis, understanding, and synthesis of the ways in which AI has affected and impacted education. Generally, a qualitative research design, incorporating qualitative content and thematic analysis is used to assess the different ways. Thematic and content analysis entails undertaking a thorough critique of each piece of text and identifying themes from a review of different texts, which then form the basis for inferences and conclusions for descriptive studies [10]. It is an appropriate research design and strategy considering the aim of this study, to assess the impact of AI on education.

## **ARTIFICIAL INTELLIGENCE IN EDUCATION**

From a review of the convergence of AI with education as discussed by Chassignol *et al.*, the scope of this study will cover the impact of AI on the administration and management, instruction or teaching, and learning functions or areas in the education sector. This section of the report provides an overview and brief discussion of the results of the study from a review of various articles that have assessed the nature and impact of artificial intelligence in the education sector.

### **A. NATURE OF ARTIFICIAL INTELLIGENCE**

Artificial intelligence (AI) is conventionally heavily associated with computers. However, it is evident, from a review of the various articles, particularly within the context of the education sector, that while computers may have formed the basis the development of artificial intelligence, there is a gravitation away from the computer alone, the hardware and software, or the equipment, as being artificial intelligence. Embedded computers, sensors, and other emerging technologies have facilitated the transfer of artificial intelligence to machines and other items, such as buildings and robots. Indeed, Chassignol *et al.* provides a two-faceted definition and description of AI. They define AI as a field and a theory. As a field of study, they define AI as a study area in computer science whose pursuits are aimed at solving different cognitive problems commonly associated with the human intelligence, such as learning, problem solving, and pattern recognition, and subsequently adapting. As a theory, Chassignol *et al.* defined AI as a theoretical framework guiding the development and use of computer systems with the capabilities of human beings, more particularly, intelligence and the ability to perform tasks that require human intelligence, including visual perception, speech recognition, decision-making, and translation between languages (Chassignol *et al.*, 2018).

Other scholars and in other studies, the definition of AI provided brings to the fore near similar elements or characteristics of AI. Sharma et al, defined AI as machines that have the ability to approximate human reasoning (Chassignol *et al.*,2018).. Similarly, Pokrivcakova, with a definition and description orientated to the education sector, observed that AI is as a results of many decades of research and development bringing together system designers, data scientists, product designers, statisticians, linguists, cognitive scientists, psychologists, education experts and many others to develop education systems with some level of intelligence and ability to perform different functions, including to help teachers and support learners to develop their knowledge and exible skills for a constantly changing world (Chassignol *et al.*,2018). The author posited that AI uses improved capabilities of programs and software, such as algorithmic machine learning, which provides the machines with an ability to perform different tasks that require human-like intelligence and ability to adapt to the immediate environment. Similar observations are made by Wartman *et al.*, who defined artificial intelligence as the ability of computers and machines to mimic human cognition and actions. Generally, artificial intelligence, from these definitions and descriptions, encompasses the development of machines that have some level of intelligence, with the ability to perform human like functions, including cognitive, learning, decision-making, and adapting to the environment. As such, there are specific characteristics and tenets that come out as key for AI. Intelligence or machine ability to demonstrate some level of intelligence and perform a wide range of functions and capabilities that require human-like abilities, comes out as a key characteristic of AI from this definition and discussion of AI.

Recently, AI and machine learning are widely studied to be applied in mobile devices, which aim to enhance computation quality and create possibilities for new applications, such as face unlock, speech recognition, natural language translation, and virtual reality. However, machine learning requires huge computation capability to perform complex training and learning. To address this issue, some platforms for running computationally efficiently were proposed. In 2016, Qualcomm introduced the Snapdragon Neural Processing Engine to accelerate the execution of neural networks with their GPU processors. HiSilicon proposed the HiAI platform for running neural networks. It should be noted that Android Neural Networks API was designed to quickly execute machine learning models on mobile devices. This API brings a lot of utility to the mobile by reducing network latency and complexity. With respect to AI-related learning network, Squeeze Net, Mobile Net, and Shufenet are well developed for mobile phones. The technical development of AI in mobile devices takes mobile education to the higher level, which provides convenience by helping student in less time and achieves interactive and personalized learning. For instance, virtual reality facilitates the learning process beyond the learning space to create a global class-room since AI can connect students to the virtual classroom. In addition, AI-based chatbots provide a personalized online learning, and also turn instructor into chat conversations. This technology can assess the students' level of understanding.

## AI EDUCATION MODEL

In AI learning system, learner model is critical for improving independent learning capabilities. It is established based on behavior data of learners generated from the learning process. Learners' thinking and capability is analyzed to assess their learning abilities. Then knowledge analysis is mapped to obtain learners' knowledge mastery. Learner modeling establishes connections between learning results and various factors including learning materials, resources and teaching behaviors Knowledge model establishes (Chassignol *et al*,2018).

## INTELLIGENT EDUCATION TECHNOLOGIES

Machine learning, learning analytics, and data mining are closely related technologies for education. At present, two communities have evolved based on learning analytics and educational data mining. They overlap in objectives and techniques and benefit from a variety of disciplines, including machine learning, data mining, psychometrics of statistics, and data modeling. The field of learning analytics is more focused on learning content management systems and large-scale test results. Data mining originates from the community of intelligent tutoring systems, work on very small-scale cognition.

### A: Machine Learning

The early stage of AI involves instructing how to complete a brilliant job. Machine learning in advance promises to make computer programs so intelligent that it does not need to train for the next step; instead, machine learning algorithms teach themselves with the help of an input training set. Nevertheless, machine learning algorithms need extensive input data to predict further steps. Machine learning plays its unsurpassed role in the education industry, like in other areas, to improve the efficiency of learner and learning software. Abundant applications of today's world are leveraging machine learning techniques. Self-driving cars, natural language processing applications, and stock exchange forecasts are examples of machine learning applications. The widespread nature of machine learning makes it as popular as it seems to be a competitor technology of AI; in essence, it is the subfield of AI Machine learning can be further distributed into supervised, unsupervised, and reinforcement learning.

**Supervised learning** deals with input data and labels. The input data values are given pre-defined tags, supervised learning algorithm, in turn, can predict the future label of similar data. One easy example of supervised learning is Facebook's photo recognition algorithm.

**In contrast with supervised learning**, unsupervised learning does not have labels of data values. An unsupervised learning algorithm attempts to reveal a hidden pattern from the data cluster. DNA recognition and human signature recognitions are examples of unsupervised learning applications.

**Reinforcement learning** can be assumed to be the most powerful category of machine learning that deals with continuously changing data. In supervised and unsupervised learning, the algorithm needs to transform itself by the programmer as the data changes. In contrast, reinforcement learning algorithms self-change from the feedback of previous execution.

### B. LEARNING ANALYTICS

Learning analytics focuses on data from the characteristics of students and knowledge objects from learner model and knowledge field model. The concept of learning analytics introduces new technology, i.e., machine learning, being applied to a non-technical world as education. The purpose is to tailor educational method to the individual learner's need and ability, such as intervening with students at risk or providing feedback and instructional content. It uses techniques related to machine learning, data visualization, learning sciences, and semantics. For instance, AI-based competency learning, which generates critical data from the students, can effectively and insights on the students and predict the critical competencies they can pursue, which enables institutions to act proactively. In addition to a competency-based learning, learning analytics also exploit the versatile capability of AI to learn. With respect to drop-out issues, AI can consider various parameters to classify incoming students in likelihood of dropping-out generating early warning systems and actionable data for the institutions. The next challenge for learning analytics is to move out of the comfort zone towards a broader scope including interpersonal skills, arts, literature, among others that raise a whole new level of complexity in terms of measurement and assessment of competencies or learning outcomes. A challenge for learning analytics is to be applied in specific learning contexts, but at the same time need to be general enough

to be used across different courses and institutions. Learning analytics will be increasingly used and integrate advanced techniques to support learning for students, instructors, administrators, and institutions.

### **C: DATA MINING**

Educational data mining tries to generate systematic and automated responses to learners. AI-based educational data mining aims for developing inherent association rules, and offering knowledge objects to students to meet their personal needs. For instance, students' demographic characteristic data and grading data can be analyzed from a small number of written assignments. It can be achieved by a machine learning regression method that can be also used to predict a student's future performance. Furthermore, data mining is becoming a powerful tool to improve the learning process and knowledge mastery, leading to a better understanding of the educational settings and learners. In other words, data mining can be seen as pattern discovery and predictive modeling applied in extract hidden knowledge, which allows instructors to make adjustments to improve curriculum development in educational system. One of important applications is that data mining-based AI can achieve personalized learning from knowledge eld data, where students perform their own learning, at their own pace and deciding their own learning method aided by AI. Ideally, using personalized learning, students choose what they're interested in, and instructors adjust teaching course and method to the students' interests. With data mining, AI can build its intelligence (e.g., using machine learning) more accurately and outcome is more reliable.

### **THE ROLE OF AI IN EDUCATION**

AI is very powerful and has the potential to permeate and heavily cause changes in different sectors of the society, with the education sector being one that is likely to be majorly impacted by AI. Indeed, from the different articles reviewed, it is evident that AI has been adopted and applied in the education sector, where it has fostered improvements in different areas of the sector. More specifically, within the context of the narrative and framework proposed by Chassignol *et al.*, which also forms the scope of the study, it is evident that AI has been applied in education, more particularly in administration and teaching, and subsequently, influencing or impact students' learning.

An analysis of the scholarly sources selected for the study showed that AI has indeed been applied in educational institutions in different ways, including in the form of automation of administrative processes and tasks, curriculum and content development, instruction, and students' learning processes. AI has improved efficiency in the performance of administrative tasks, such as reviewing students' work, grading, and providing feedback on assignments through automation using web-based platforms or computer programs. Other areas in which AI has been applied in the education sector include curriculum and content development, and instructions lever-aging technologies such as virtual reality, web-based plat-forms, robotics, video conferencing, audiovisual les, and 3-D technology, which have made it possible for students to learn better. Teachers are more effective and efficient and students have a personalized and richer learning or educational experience.

### **RESEARCH AREAS OF AI IN EDUCATION**

Our literature review investigates how AI influences the education industry in multiple ways. We categorized the areas of the education industry influenced by AI in the following areas

- Education administration
- Instruction Design
- Learning outcomes

Following is the detail of the research challenges for particular areas.

### **AI IN EDUCATION ADMINISTRATION**

Education administration is a crucial area influenced for every educational institute; despite the study level, educational institutes are schools, colleges, or universities that need intense intension on administration tasks. The administration of the educational institute, along with inherited organizational administration challenges,

also need to tackle some specified challenges. For instance, in any other organization, products can be good or services, but humans are the key in educational institutes.

These specified administration challenges can span the evaluation process of students' exams and assignment to the proper feedback. Sharma et al. discussed the potential research challenges related to educational administration mainly. According to him, AI can play a great part in online and distance education administrative services (Renz et al, 2020). Some AI-based educational programs like Newton give a new way of educational administration by reducing the load on teachers because it offers a feedback platform for students. There is still a need to focus on educational administration research.

### **Instructional design**

Preparing instructional stuff such as tutorials, lecture notes, and handouts have been very easy with AI-driven tools. Jasper, ai is a leading AI tool that helps writers with all kinds of writing services. Other services like spell and grammar check have been made easy with tools like Grammarly. Along with other industries, education also leverages AI-driven tools of writing. Furthermore, different simulation platforms help an instructor prepare instruction material by creating a simulation that is more affected than text-based lecture notes. Technologies like Virtual Reality (VR) and Augmented Reality (AR) helps in demonstrating difficult concept to students by simulation. Since VR and AR are evolving their canvas rapidly, there is a lot of cushion to enhance those technologies for instructional design.

### **AI in learning:**

Learning is the pivotal part of the education industry, based on which all industries stand. Our literature review finds widespread AI aspects that can influence student learning. AI is involved in designing and developing numerous study programs that help students in their learning ability and facilitate them to learn new stuff [3]. Simulations and other learning material also help students quickly learn new topics. With the help of AI-based tools, it has been possible to learn across the border over web-based platforms.

## **III. CONCLUSION**

Artificial Intelligence makes its impact on almost every field of life. Education is one of the leading areas leveraged by AI technology. Like all other fields, education also adopted AI tool and technique to enhance student learning capabilities and other features of the education sector. The role of AI in education is wide-spreading and covers learning, instruction, and administrative features. In this research, we carefully discuss the role of AI in education. In this research, we categorized the areas in the education industry into educational administration, instructional design, and learning. We reviewed literature and explored research aspects of AI in education.

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