International Journal of Advanced Research in Information and Communication Engineering (IJARCSA) ISSN: 2321-8940 Vol.5, Issue No 1, 2025

Artificial Intelligence in Education: A Review

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ABSTRACT:

The purpose of this study was to assess the impact of Artificial Intelligence (AI) on education. Premised on a narrative and framework for assessing AI identified from a preliminary analysis, the scope of the study was limited to the application and effects of AI in administration, instruction, and learning. A qualitative research approach, leveraging the use of literature review as a research design and approach was used and effectively facilitated the realization of the study purpose. Artificial intelligence is a field of study and the resulting innovations and developments that have culminated in computers, machines, and other artifacts having human-like intelligence characterized by cognitive abilities, learning, adaptability, and decision-making capabilities. The study ascertained that AI has extensively been adopted and used in education, particularly by education institutions, in different forms. AI initially took the form of computer and computer related technologies, transitioning to web-based and online intelligent education systems, and ultimately with the use of embedded computer systems, together with other technologies, the use of humanoid robots and web-based chatbots to perform instructors' duties and functions independently or with instructors. Using these platforms, instructors have been able to perform different administrative functions, such as reviewing and grading students' assignments more effectively and efficiently, and achieve higher quality in their teaching activities. On the other hand, because the systems leverage machine learning and adaptability, curriculum and content has been customized and personalized in line with students' needs, which has fostered uptake and retention, thereby improving learners experience and overall quality of learning.

INTRODUCTION:

As illustrated by Henry Ford in the analogy, innovation does not mean working that the society should work only with what has been the norm, such as finding ways of making horses faster. Sometimes, it is necessary to search beyond the norm, develop new ways of doing things. Instead of making horses faster, build the automobile, which will be faster than the horse and take a person from Point A to Point B faster. These principles and approaches have driven the rapid developments in technology experienced over the years, particularly in the education sector.The year is 1950. Dr. Potter, a tenured professor at a local university shuffles to a class, a heavy load of papers under his arm. He has just marked all the papers, after reading.The associate editor coordinating the review of this manuscript and approving it for publication was Xiaochun Cheng.and assessing the grammar and content of each of the papers handed in by the 40 students in his class. Going through some of the papers, Dr. Potter felt that

the content in there had been plagiarized from other sources, but he had no sure way of ascertaining from where the student had copied the content materials. Fast forward, in 2019, Dr. Potter now walks into a class, barely carrying any papers, but having read, flagged incidents of plagiarism for disciplinary action, and graded papers for an even larger number of students. Sometimes, when he is off campus, he can dial-in or video conference into the class and can still perform his duties and responsibil- ities leveraging technology. The introduction, advancements, and proliferation of technology, more particularly, artificial intelligence, has made it easier for instructors to dispense their duties more effectively and efficiently. These techno- logical innovations have also permeated other sectors of the academia, fostering effectiveness and efficiency.

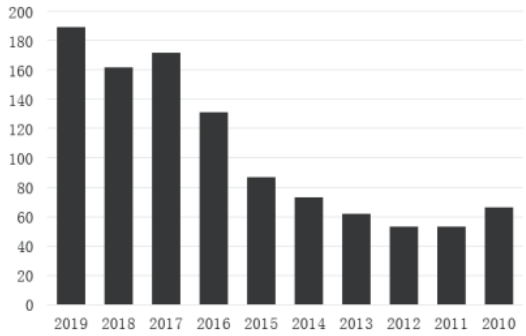

FIGURE 1. Papers in Web of Science and Google Scholar in the last ten year with key words "AI" and "Education".

indexed. As education evolves, researchers are trying to apply advanced AI techniques, i.e., deep learning, data mining, to deal with complex issues and customize teaching method for individual student.

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 manage- ment, 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.

NATURE OF ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is conventionally heavily associ- ated 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 intelli- gence. Embedded computers, sensors, and other emerging technologies have facilitated the transfer of artificial intel- ligence to machines and other items, such as buildings and robots [11]. 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 [11]. As a the- ory, 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, intelli- gence and the ability to perform tasks that require human intelligence, including visual perception, speech recognition, decision-making, and translation

between languages .

TABLE 1. Techniques for scenarios of AI education.

Scenarios of AI education	AI-related techniques
Assessment of students and schools	Adaptive learning method and personalized learning approach, academic analytics
Grading and evaluation of paper and exams	Image recognition, computer-vision, prediction system
Personalized intelligent teaching	Data mining or Bayesin knowledge interference, intelligent teaching systems, learning analytics
Smart school	Face recognition, speech recognition, virtual labs, A/R, V/R, hearing and sensing technologies
Online and mobile remote education	Edge computing, virtual personalized assistants, real-time analysis

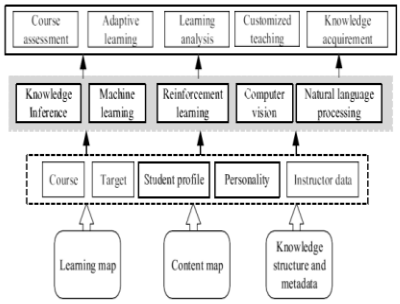

FIGURE 2. Technological structure of AI education.

AI IN INSTRUCTION:

From the analysis of the articles identified and included in the analysis, one of the key areas that have seen an influx of AI systems, is teaching or instructions. AI has facilitated the cre- ation and deployment of systems that are evidently very pow- erful pedagogical tools. These tools have fostered improved instructional quality. Different platforms and applications of AI as an instructional tool are discussed and highlighted in the various articles evaluated. Timms discusses various applica- tions of AI as a pedagogical tool or instructional platforms; simulation-based instructions, which include using different

technologies, such as virtual reality to demonstrate or show students concepts or practically demonstrate materials, giv- ing students an experiential or practical learning experience [7]. The same concept or the application of virtual reality elements as an element of AI in education is discussed in other studies. For example, Mikropoulos and Natsis highlight the use of virtual reality as well as including 3-D technology.

AI IN LEARNING:

Learning, which is an integral part of education, is another aspect of education that is within the scope of the study. From an evaluation and analysis of the different articles included in the study, different ways in which AI has been adopted and implemented or leveraged in fostering students' learning were identified. Further, specific programs or applications that leverage AI to improve student learning were identified. An important way in which AI has been applied in improving students' learning is the customization and personalization of curriculum and content in line with the learners needs, abilities, and capabilities [15]. Other approaches give learners a more pleasant and involving or experiential learning experi- ence, therefore improving the learners' uptake and retention of information, the foundation of learning [15], [17]. From another perspective, AI in education has also eliminated some barriers to access to learning opportunities, such as national and international borders, enabling global access to learning through online and web-based platforms .

IMPACT OF AI IN EDUCATION:

A recap of the objective or purpose of the study; the study aims at assessing the impact of AI in education. The eval- uation of the different ways in which AI has been imple- mented in the education, focusing on administration tasks, instruction, and learning, only partly answers the implied research question. Sharma et al observed, the use of AI in education presents an opportunity to majorly revolutionize different aspects of education [13]. An exploration of the uses of AI partly shows how the impact of AI in education In this section, a more focused exploration of the actual effects of AI on administration, instructions, and learning is explored and explained premised on the findings from the articles analyzed technologies, such as virtual reality to demonstrate or show students concepts or practically demonstrate materials, giv- ing students an experiential or practical learning experience [7]. The same concept or the application of virtual reality elements as an element of AI in education is discussed in other studies. For example, Mikropoulos and Natsis highlight the use of virtual reality as well as including 3-D technology. Learning, which is an integral part of education, is another

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DISCUSSION OF THE RESULTS:

From the different articles and studies reviewed, it is evi- dent that with technological innovations and advancements, computers and computer related technologies, and other inno- vations have encouraged the development of artificial intelli- gence, which has permeated different sectors of the society, and will potentially have a major impact on different indus- tries in which it is used. One of these areas in which AI has been applied, and is resulting in a major impact, is the educa- tion sector. As a foundation, and basis for understanding how AI has impacted education, a definition and description of AI was deemed essential. Different tenets and characteristics and nature of AI were gleaned from the different definitions derived from the studies evaluated. A key characteristic and tenet of AI, as the name intimates, is having some level of intelligence, a characteristic that has only been the preserve of human beings until the onset of AI [4], [5], [7], [11],

[16], [24], [35]. Intelligence gives the AI, computers and by extension, embedded systems, such as robots and facili- ties, with human like abilities, including cognition, learning, adaptability, and decision-making functions [6], [13], [16], [19], [22]. The innovations and developments, culminating in the development and use of AI, have accorded the educa- tion sector, more particularly, academic institutions, with an opportunity to leverage and use of AI.

Indeed, as adduced from the different sources reviewed and analyzed, the uptake and use of AI in education has taken various forms. AI in education was initially in the form of computers and computer related technologies, used to perform a wide range of administrative tasks, instruction, and to foster learning among students, scope areas deter- mined from the description of AI application in technology [11], [15], [19]. Continuous developments and innovations, particularly, with the transitioning of AI from computers only, to include embedded systems, as well as online and web-based platforms, harbingered the development and use of AI in web-based platforms and online platforms, and robotics, evidenced by the development and use of humanoid robots (cobots and chatbots), which perform, independently or working with human instructors, educators' duties, includ- ing dissemination of learning materials to learners at vari- ous levels of education. In addition, from the analysis, and the descriptions of the platforms provided in the different evaluated articles, it is apparent AI application, in educa- tion, in its different forms, has accorded learners a richer

and more rewarding learning experience [19], [22], [25],

[31], [34], [35].

Implied therefore, and as adduced from the analysis, is that AI has majorly affected or had a major impact on the education sector in general, and in particular, in application in particular educational institutions. Teachers or instruc- tors using AI or leveraging AI are able to achieve greater efficiency and effectiveness in the performance of different tasks, including completion of administrative tasks, such as reviewing, grading, and providing feedback to students on submitted assignments. In addition, working with AI or the different forms of AI, such as web-based and online intel- ligent systems, cobots, and chatbots, teachers are able to achieve improvements in instructional quality. Students on the other hand, because AI uses machine learning as adduced from the different studies, are able to have a better and richer learning experience because AI uses machine learning to assess capabilities and needs, and subsequently, with the findings of such an analysis, develop and disseminate per- sonalized or customized content, which ensures higher uptake and retention, thereby improving learning.

Further, AI provides students with practical or experiential learning experiences, particularly when used together with other technologies, such as virtual reality, 3-D, gaming, and simulation, thereby

improving the students' learning experi- ences. One study discussed or highlighted the adverse impact of AI, degradation of academic integrity and cheating using paper churning and paper mill services facilitated by AI. Most of the studies analyzed demonstrated and explained the different ways in which AI, including integration, benefits, and impact on administration, instruction, and learning when used in education. The positive effects, the pros, outweigh the cons, or the negative effects.

AI learning is currently considered as education assistant at the early stage, while AI-enable education will play a more important role as learning requirements changes. It now provides courses of different difficulty based on simple rule judgement and has not reached the best intelligence level in intelligent education. There are education studies for AI sys- tems involving knowledge map and probability model. With increasingly frequent interaction of the educational process, AI systems will generate more and more data to provide a clearer picture of the process of teaching and learning, which enables more accurate information recommendation. Aided by learner analytics, machine learning and data mining, AI systems will provide high-quality contents to teachers and students, to support both teaching and learning and make the whole process measurable. In this stage, users will have access to multiple approaches to the correct answer to any question. In the future, the desirable AI system would shape students' imagination and creativity, analyzing their learning style and emotional condition and initiative, to improve learn- ing capabilities and creativity and stimulate subjective initia- tive. AI systems are likely to be used more widely, which is expect to thrive on all aspects of students, i.e., personal skill, knowledge mastery, learning ability and career development, instead of just assisting students in understanding of specific knowledge.

CONCLUSION:

The objective or the purpose of this study was to assess the impact of AI on education. A qualitative research study, leveraging literature review as a research design and method was used. Journal articles, professional publications, and pro- fessional conference reports were identified and used in an analysis that facilitated the realization of the study purpose. The development and use of computers and computer related technologies harbingered research and innovations that have led to the development and use of AI in different sectors. Particularly, the development of the personal computers, and later developments that have increasing the processing and computing capabilities, as well as the ability to integrate or embed computer technologies in different machines, equip- ment, and platforms, have encouraged the development and use of AI, which has been shown to have a major impact on the sectors it permeates. AI has been extensively adopted and used in the education sector, particularly, in education institutions, which were the focus of this study. The analysis focused on evaluating the impact of AI on administrative, instruction, and learning aspect of education, with a focus on assessing how AI has been applied and the effects it has had.

AI in education initially took the form of computers and computer-related systems, and later, the form of web-based and online education platform. Embedded systems have made it possible to use robots, in the form of cobots or humanoid robots as teacher colleagues or independent instructors, as well as chatbots to perform teacher or instructor-like func- tions. The use of these platforms and tools have enabled or improved teacher effectiveness and efficiency, resulting in richer or improved instructional quality. Similarly, AI has provided students with improved learning experiences because AI has enabled the customization and personaliza- tion of learning materials to the needs and capabilities of students. Overall, AI has had a major impact on education, particularly, on administration, instruction, and learning areas of the education sector or within the context of individual learning institution.

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