HISTORICAL DEVELOPMENT OF ARTIFICIAL INTELLIGENCE IN EDUCATION: THE CHALLENGES AND PROSPECTS

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Abstract

Artificial intelligence is an age long phenomenon manifesting its usefulness with strong waves of acceptability in the 21st century in every sphere of human endeavours, education inclusive. Artificial intelligence (AI) contributes enormously in the development of education particularly in the process of teaching-learning. This paper traced the historical development of artificial intelligence, its adoption in education and the associated challenges and prospects. The study adopted historical design. Literature review was conducted systematically and data were obtained from books and the internet. The study critically reviews the development of computer aided learning, origin of artificial intelligence, development of artificial intelligence in education. The study also identifies the challenges and prospect in utilizing artificial intelligence in education. It is observed that artificial intelligence acceptability and utilization became rampant in the 21st century particularly during and after COVID-19 pandemic. It is also observed that artificial intelligence technologies are already integrated in education. The study concluded that integration of artificial intelligence in the education sector has tremendously added value to the process of teaching and learning. The study suggested that intensive efforts be made to reduce the highlighted challenges to avert negative effect of artificial intelligence on vulnerable users.

Keywords: Artificial Intelligence, Education, Challenges and Prospects.

Introduction

Artificial intelligence is no strange phenomenon in the developed countries; it has made tremendous impact in the development of various aspects of these societies, neither is it hitherto strange to developing nations like Nigeria in the 21st century. This is evident to the extent to which they are utilized in various sectors to facilitate their activities. What then is "Artificial Intelligence"? According to Hardman, (2023) Artificial Intelligence is a branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. It implies the transmission of human knowledge, intelligence and capability to computer to function in human's stead, carrying out tasks that require human intelligence such as recognizing images, understanding speech, responding to instructions or making decisions. Similarly, Karjian, (2024) astutely explained that artificial intelligence is all about the utilization of computers and systems to perform tasks which typically would require human intelligence. Karjian, (2024) further explained that the relationship between human and artificial intelligence is symbiotic; it encompasses every facet of human lives and livelihoods. McCarthy, 1958 in Ogunfunmi (2023) pointed out in his slide that artificial intelligence is the science and engineering of creating intelligent machines. This technology has been in existence for decades with considerable impact in advanced world before leaping into Nigeria several years back, it usefulness in the education section has added colour, efficiency, and facilitates the learning process.

Development of Computer Aided Learning

Before the advent of the use of computers in the area of teaching-learning, humans in the Stone Age had devised different methods of transmitting skills and knowledge effectively and efficiently to the learner. It began with the use of objects like stones, beads, pebbles, cowries, sticks and improvised materials for writing such as slates, slaps, earthen surfaces and rocks that enable them to display figures and symbols of animate and inanimate objects (Nemine and Torunarigha, 2010).

Humans have always desired better and more efficient ways of achieving results, therefore, a mobile printing machine was invented by Johann Gutenberg's in 1445 AD in Mainz, Germany. This invention

facilitated the use of books in writing and reading. It metamorphosed gradually into the use of machines to augment, improve and facilitate human activities and also to enhance performance in business, politics, economics, social, and environment. Charles Babbage is acknowledged for inventing an analytical engine, the first machine designed to perform mathematical calculations in 1837, This is an advanced development beyond the classical era where fingers, pebbles were used for counting, making additions, subtractions and division in business transactions and in the process of teaching and learning. The introduction of calculator to the education system enables the calculation of large numbers in a quick and more reliable manner. It also alleviates the burden of heaping up pebbles for counting huge amount of money in business transaction and the process of teaching-learning. Charles Babbage analytical engine serves as a springboard for the development of modern computers as it contains a computer program, data and arithmetic operations that are recorded on punch cards which are found in every computer. Lovelace is recognized as the first programmer, who wrote the first program (software) to work on his trial product (Meacham, 2021).

By the 20th century advances in technology speed up the use of computer, Audio-visual instruction, world wide web services, radio, broadcast and so on in education. Technology in the 21st century has galvanized technology in education in the areas of Information and Communication Technology (ICT) and the internet system, advanced World Wide Web (WWW), Programmed Instruction (PI), Computer Assisted Instruction (CAI) Electronic Performance Support System (EPSS), Web Based Education (WBE). The International Network of Computers (INTERNET) has tremendously accelerated accessibility of information by every learner who sought the utility of the INTERNET. The curious art and aspiration of computer engineers to transform the world into better place opens greater doors to new technological innovations (Nemine and Torunarigha, 2010). Presently, computer engineers are projecting the utilization of robotic artificial intelligence in various spheres of human endeavours, basically not for replacement of humans but to facilitate their jobs.

In the 21st century, Chatbots are available in different sectors, including education; they are web-based platforms with the ability to enhance educational experience by adapting to the behaviours of instructors and learners (Peredo, Canales, Menchaca, and Peredo, 2011). Chatbots functions as an after-hours tutor; it's said to have the ability to tailor instruction to the specific learning style of individual students. Chatbots have been programmed in such a way that they react naturally in a conversation in human tone. These futures made it so useful in the education sector. Some examples of Chatbots and their years of programing include ELIZA 1966, PARRY 1972, ALICE 1995, SmarterChild 2001, Siri 2011, Duplex 2018, ChatGPT 2022, Google Bard 2023 (Labadze, Grigolia, & Machaidze, 2023).

Origin of Artificial Intelligence

It's amazing to reckon the ability of a digital computer or computer-controlled robots reason, discern, discover meaning, and learn from past experience, solve problems, answer questions, make predictions, and even offer strategy and perform much more tasks. The functioning of artificial intelligence has been equated with human ability while some work faster than humans in performing tasks. (Britannica 2023). Nikola Tesla is an inventor and electrical engineer who had envisaged the possibility of building a machine that could be operated through a program with the characteristics of human mind and wireless communication in 1898. (Meacham, 2021). Eventually, the first robot '*Elektro'* was made public by Westinghouse in 1939. This machine was wired to convey recorded response to a limited number of questions, walk, smoke a cigarette, and blow-up balloons, this attempt attracted the potentials of artificial intelligence to the public.

Improving the functionality and effectiveness of machines, McCulloch and Pitts in 1943 begins the building of artificial neurons in a machine that could think, using the neurons' on-or –off firing system which was later known as binary code (Meacham, 2021).

The first AI programme according to Britannica, 2023, was written in 1951 basically, designed to teach a computer to checkers, the computer was made to play a game of checkers at a reasonable speed by 1952. This development stirred up the wisdom of the British logician and computer pioneer Alan Turing to explore machine intelligence in the 1930s. Turing in 1950s considered the ability of a computer to think and introduced central concepts of artificial intelligence. Turing is acknowledged as the father of artificial intelligence and modern cognitive science. His test remains the criterion for evaluating computer intelligence. (Britannica, 2023).

John McCarthy was the first to utilize the term artificial intelligence in a conference of computing scholars converged at Dartmouth College, in Hanover, New Hampshire in 1955 to make decisions on the use of human language to program computers, and the use of neural nets to create human thought processing in computers. Studies have revealed that the human brain has billions of neurons, therefore, the computer is programmed to replicate human neurons for artificial neural network, a machine that has human characteristic in thought and learning. Through this conference new ideas about artificial intelligence evolved. It creates a new wave for Artificial Intelligence (AI) technological development across the globe in recent years. (Britannica, 2023).

Concept of Education

Education in this context is seen as the transmission of knowledge, skills, values, and norms of the society to one another, basically to the younger ones. To one another because learning is a continuous process especially when it concerns technology, new innovations emerge to augment or replace existing ones from time to time, therefore, new technologies compel every user to learn and adapt to it. Osokoya in Osokoya, (2017) defines education as a continuous process which the society establishes to assist its members to understand the heritage of the past and to participate productively in the future. He further explained that education is a means of assisting the individual to actualize the in-born potentials and acquire knowledge, skills, attitude and competencies necessary for self-realization and for coping with life problems. Based on its usefulness education is seen as a fundamental instrument for national development.

Development of Artificial Intelligence in Education (AI)

Artificial intelligence is a novel innovation in technology, even though efforts have been made years past; these efforts were thwarted for different reasons ranging from lack of sponsors to fear of displacement of jobs to machines and ethical issues. The new wave of application of artificial intelligence in education appears to have dominated the fears of using artificial intelligence.

Globally, the emergence of artificial intelligence in the landscape of education could be traced to the development of an intelligence tutoring system in the 1960s. These systems were designed to adapt to students' personalized teaching, customized to their individual needs and learning styles. Students have the privilege of learning according to their level of comprehension and ability, both slow learners and fast learners learn at their own pace and convenient. Al-Smad (Nd). The system was developed by researchers at the University of Illinois at Urbana-Champaign. The Intelligent Tutoring System was known as PLATO (Programmed Logic for Automatic Teaching Operations) Bitzer,1961 in Al-Smad (nd). PLATO expose student with graphical user interface to connect with educational materials that were generated and modified by the use of artificial intelligence. Intelligent tutoring system tools

include; Intelligent tutoring system (ITS) based on Augmented Reality (AR) for Dimensional Geometry Materials, Intelligent Tutoring System for Nun Sukun or Tanwin law learning, Intelligent tutoring System for circular learning (Ghali, 2018, in Fitria, 2021).

Also, in the 1960s the automatic grader system was developed to automatically grade programming classes. (Hollingsworth, 1960, in Al-Smad (nd). This system allows teachers and tutors to automatically generate questions and make corrections easily in the process of teaching-learning. It eliminates the rigour of manually hand written question and makes correction. Time-shared, Interactive Computer-Controlled Instructional Television) (TICCIT) is another intelligent tutoring system developed basically to deliver individualized multi-media based content in mass to users at homes and schools in the 1970s in the university of Pittsburgh, the introduction of personal computers accelerated the use of Intelligent Tutoring System (Stetten, 1971 in Al-Smad (nd)).

The Intelligent Tutoring System (ITS) took a new dimension with the advancement of artificial intelligence and the introduction of micro-computers in the 1970s that influenced the training and development of ITSs (Reiser, 2001 in Al-Smad (nd).

The utilization of computer-based instruction and AI-based education has made possible the automation of several instructional activities since 1980. (Reiser, 2001 in Al-Smad (nd). In addition, the 1990's welcomed the arrival of the world-wide-web (www) which had made a remarkable contribution in the delivery of intelligent educational services. According to Chen, 2020 in Al-Smad (nd). Intelligent Tutoring System has been developed to deliver intelligent, adaptive and personalized learning services underpinned by machine learning models.

Al-Smad (nd), had viewed the awareness and widespread use of AI in the 21st century in the landscape of education as a result of the development of more sophisticated AI tools/models such Hardware capabilities and performance, big data mining and AI models and architectures (i.e. the advent of deep learning models). According to Al-Smad (nd) the introduction of Transformer deep learning architecture in 2017 had reshaped the evolution of intelligent software. There are new intelligent models being introduced such as generative pre-trained transformer, the ChatGPT was also released in 2022. Presently, generative AI-based educational tools have evolved to aid students with personalized instruction, adaptive learning and engaging learning experiences.

Challenges of Artificial Intelligence in Education

It is an established fact that, artificial intelligence integration in various aspects of human endeavours has been proven useful, efficient and effective, this is inclusive of education. In spite of its usefulness studies have also pointed out some drawbacks in the use of artificial intelligence. The aim of artificial intelligence is basically to ease and simplify the activities of human for speedy completion of task in an effective and efficient manner with better outcomes. AI is aided with diverse tools that enable it function to meet several needs of its users.

Technical Expertise: users of artificial intelligence, particularly educators are required to understand the technicality of AI tools to enable them effectively formulate question with the appropriate prompt. Lack of understanding will deter educators from utilizing AL-powered technologies (OpenLearning 2024). In order to overcome these challenges, educators must undergo AI digital training to acquire skills and integrate these skills into their teaching pedagogy. Educational institutions must ensure investing in inventive management skills to effectively manage their human resources and AI technology integration. (Birchwood, 2024)

Increased Budgeting

Technology innovation comes with enormous cost for provision and maintenance. This will cost any developing country like Nigeria a whole lot of money, thereby increasing the budget of the nation, particularly education budget. Even though the government endeavour to make possible the provision subsequent maintenance becomes a big problem consequently, the whole money spent in providing was wasted. (Awofiranye, 2024)

Ethical Challenges: ethical issues are world-wide concern in the use of artificial intelligence. These issues range from privacy, security, plagiarism, inequity, and the potential disruption of the job market (OpenLearning 2024). Awofiranye (2024) pointed out that artificial intelligence relies on data to function optimally, therefore, issues like personal data concentration, data ownership, confidentiality, transparency need to be considered. Other areas of concern include the correctness and reliability of the content that AI tools reproduce. Researchers have been concerned with this issue, due to the numerous information produced by AI tools, it takes extra time in verifying the authenticity of the information. Also, one foresees the tendency of students relying heavily on these AI-powered tools. It may expose students to the risk of cyber security in adopting these technologies. Educational institutions, parents and guardians must be responsible by enforcing stringent rules and maintain ethical concerns to ensure safety and privacy of the students, teachers and all the users (Birchwood, 2024).

Lack of basic technological infrastructure: One of the biggest challenges for adopting AI in education is the lack of technologies essential for implementing the transformative powers that AI can bring to the field of education. Problems of unavailability of modern electrical equipment, inadequacy of information technology hardware, unavailability of consistent internet, high data costs, and lack of skills are the critical challenges that limit the materialization of AI power in education. (Birchwood, 2024)

Quality Assurance

Artificial intelligence generates large amount of content when utilizing it, it presents relevant and irrelevant content, therefore, to ensure that AI-generated content aligns with educational objectives is vital to ensure a high standard. Also, an over- dependency on AI tools will result in reducing the quality and richness of educational content and stand the risk of inaccuracies or biases present in the training data of the AI model (OpenLearning 2024).

Artificial intelligence tools deter critical thinking

The tendency to depend on artificial intelligence tools for every solution is possible if not checked; this will limit students' abilities of applying their critical thinking skills and cognitive abilities in solving problems, it may also limit their innate potentials and creativity.

Fear of Job Displacement

Fear of job displacement may cause resistance in adopting AI in education. Presently, AI tools cannot take the place of human creativity, it can only complement the activities of educators and learners.

Problem of Accessibility

Integration of artificial intelligence in education may pose accessibility problems to students who are rural dwellers and also students who could not afford Smartphone and other means of accessing the internet. Power supply is a basic problem in some developing countries. Power supply is either not available or it is erratic, therefore, students' accessibility to AI is denied or partial. On the other hand, students from developed countries shall have express access to AI tools and become versatile and gain

competence in utilizing these tools with the aid of Smartphone and other means of access. Socio-economic status also comes to play as accessibility can be denied due to financial constraints.

Possibility of Technology Addiction

Again, the adoption of artificial intelligence in the educational system will in turn foster technology addiction among students and even teachers. Students and teachers will now have to use smartphones, iPads, or laptops for educational activities rather than pen, paper, or books. This will lead to increased screen time and a possible addiction to technological devices (Awofiranye, 2024)

Prospects of Artificial Intelligence

Irrespective of the challenges in utilizing artificial intelligence, there is still a light at the end of the tunnel, there are prospects. Artificial intelligence remains a game changer in the 21st century in the arena of education, its' incorporation in education has immense benefits that cannot be sidelined at a glance. Artificial intelligence has enormous potential in personalized instruction, where teaching is tailored to suit student's capacity in the teaching – learning process. This can be made possible through the use of AI-powered tools and algorithms; it can as well make education adaptive and engaging. AI has been proven to analyze huge amount s of data to provide tailored learning experiences, adapt instruction to individual needs, and offer real-time feedback to enhance student understanding. This personalized approach ensures that each student receives the support and resources they need to succeed. (teachflow.ai, 2023).

In addition, Artificial Intelligence has also been proven to relieve administrators and educators of some aspects of their job allowing them to concentrate more on instructional design, students support, and strategic decision-making by automating routine tasks and providing valuable insights through data analytics, consequently, resulting in administrative efficiency.

Creation of Learning Content

Artificial intelligence has been designed with innovations such as Natural Language Processing and Machine learning technologies that permit the user to produce and update learning content quickly and avail the user, in this context teachers and students to study materials that will facilitate the process of teaching-learning with well organized content, (Birchwood, 2024). It relieves educators from tedious tasks and also saves time and ensures correctness of content.

Easy Information Gathering

Artificial intelligence is also wired with generative tools designed with the capacity to generate a whole lot of relevant information from different websites within seconds. This enables the 21st century researchers, teachers and students to gather information within the shortest time to complete assignments, present papers and complete research work as against when researchers would search for relevant materials for weeks and months before beginning an article or school projects, thesis and dissertations. (Birchwood, 2024).

It is sometime cumbersome in combining administrative duties and the demand of teaching, but with the aid of artificial intelligence routine administrative tasks are now automated consequently, educators could effectively sieve their activities and concentrate on tasks that are more demanding and should be handled personally. In this way, educators will spend more time meeting the academic needs of students (OpenLearning, 2024).

Artificial intelligence is designed with different tools performing different functions to meet individual needs in the process of teaching-learning. One of these tools is the chatbots, which can be utilized in

sourcing study materials and also facilitate group discussions, live conversation with teachers or group leaders. It also enables students learn foreign languages through AI- powered chatbots, it enhances understanding of complex concepts. These tools also serve as an exciting alternative that enhances the student's knowledge and skills. (Birchwood, 2024)

Students are aided with artificial intelligence generative tools such as Canva, Visme, Microsoft Sway, Virtual Reality (VR) and Augmented Reality (AR) to visualize and simplify complex information for easy comprehension. These tools facilitates' students understanding of concepts and data, it also enhances student communication and collaborative skills. (Birchwood, 2024 & OpenLearning, 2024).

Virtual Tutors

It facilitates easy and instant feedback and assist students to comprehend complex concepts. Intelligent tutoring systems can adapt their instruction based on students' responses and provide targeted interventions when necessary (OpenLearning, 2024).

Facilitates Learning for Special Needs:

Artificial intelligence provides special tools to facilitate learning process for persons with special needs such tools as text-to-speech, visual recognition, speech recognition. These learning resources are adapted to persons with special needs for more inclusive lessons (OpenLearning, 2024). Another vital aspect of artificial intelligence in the learning process is the creation of feedback system for both students and teachers. It encourages instant corrections of mistake thereby improving the teaching-learning process.

Conclusion

The field of education had never been barren of innovative teaching aids, from time-to-time; different types of teaching aids evolved to enhance the process of teaching –learning. Artificial intelligence with its numerous tools is another medium in the 21st century to facilitate educational process, administration inclusive. In spite of the challenges, the integration of artificial intelligence could transform both administrative and teaching outcomes immensely. Care should be taken to avert the abuse of the system to gain the numerous benefits. Artificial intelligence is not a threat to teachers and administrative job, it will not take the place of human critical thinking, it is only a tool like every other teaching aid utilized in the process of teaching and learning and to enhance administrative job efficiency. AI bring to education intelligent learning systems, automated assessment, personalized educational content, educational assistance, learning analysis, improved social interaction, and predictive analysis. It should be embraced in the Nigeria education system for maximum impact.

Suggestion

Artificial intelligence prospects in education are enormous and it adds value to education. Its benefits cannot be overemphasized; therefore, the following suggestion are made to ensure effective utilization of artificial intelligence tools.

i. Accessibility of artificial intelligence should be made possible by the government in the education sector to avoid disparity between the rich and the poor in the use of AI, widening the gap of knowledge.

ii. Solar powered power supply should be made available to all schools in Nigeria for effective utilization of this new innovative, especially schools in rural communities.

iii. Teachers, administrators and students should undergo effective training on proper utilization of artificial intelligence tools.

iv. Teachers, parents and guardians should ensure that the use of artificial intelligence by students is not abused.

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