ARTIFICIAL INTELLIGENCE, EDUCATION, AND SUSTAINABLE DEVELOPMENT IN NIGERIA

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Abstract

The paper delved into contemporary issues of technological innovations in the field of education, particularly exploring how AI products can be harnessed to bring about enhanced teaching and learning outcomes. Key sections that formed the crux of the discussion include: education in the era of AI, the use of AI chatbots in educational institutions, as well as AI and sustainable development. Findings indicate that educational systems are bracing up to the invasion of AI, not in combative but collaborative sense. The result also shows that the use of various AI chatbots in education setting has revolutionized teaching and learning experience, though there are concerns of negative outcomes. Therefore, it is recommended that proper adjustment be made as to adapt to the new reality. Also, it is imperative to carry everybody (including developing countries) along in the planning and implementation of policies.

Keywords: Artificial Intelligence, Technology, Chatbots, Education, Sustainable Development.

Introduction

The 1956 Dartmouth Conference could be described as an epoch because it marked the beginning of Artificial Intelligence (AI), a technological development that is stirring serious conversations across the world in recent years. Mostly considered a demonstration of intelligence in computers, AI is a testament to the increasing advancement that the field of technology is recording. Talking about technological innovations, this brings to mind the fact that in the history of human existence there are certain discovery or invention at various times that has improved standard of living and quality of life. Whether it was during the agrarian, industrial, or the more recent scientific or technological revolution, humans have often produced tools, equipment and machines to make things easier and have a more comfortable life. Once these instruments were introduced into the society, individuals and groups appreciated their usefulness as they brought about a whole new perspective to human experience.

In years back only few persons could have imagined that artificial intelligence (AI) would someday revolutionize various aspects of life. Observation shows that in recent years AI is rapidly gaining global acceptance with its impact being felt in almost every sphere of human life including the field of education. Bostrum (2017) is among those who think that AI is a domain of technology that is capable of altering every aspect of social interactions. This is premised on the argument that AI can do certain things more efficiently or methodically than human intelligence. The idea that intelligent machines have capacity to reach and exceed human performance on more tasks implies that AI has become a force to be reckoned with. Therefore, as it is with most innovations, various sectors of society cannot wait to harness the gains of AI.

The rise of artificial intelligence (AI) which is being celebrated globally actually began with the brilliant idea of giving machines autonomy and intelligence by using algorithms that learn from human activity and pattern recognition. Scientists engaged computer machines, programming them to think and act rationally like humans. Thus, the thought of combining human capacities with new technologies, better known as a crossbreed of a human and a machine, is a process that has been developed over the years leading to the emergence of AI (Ford, 2018). There are multiple domains of technologies that support AI including: big data, machine learning, computer vision, speech, and natural language processing (Xia, *et al.*, 2022).

Meanwhile, in the education sector, there have been several researches exploring how artificial intelligence (AI) technology will fare in classroom settings (Cumming & Mcdougall, 2000). Efforts in this regard gear towards harnessing the capability of technologies such as intelligent computer machines to emulate the roles of instructors in specific tasks which includes: test design, exam marking, as well as making available systemic feedback to students (Allam, *et al*., 2013). There is no doubt that AI is recognized as a crucial element in enhancing both teaching and learning processes through individualizing the experience and aiding the instructor (Ghoneim & Sywelem, 2024). The point is obvious that the significant impact AI technologies is having on modern society is remarkable. It appears that not much is being discussed about AI in the field of education particularly in the face of global challenges. Consequently, in bridging the gap, this paper is poised to shed valuable insights into the contributions of AI to education and its impact on sustainable development in Nigeria. The purpose of this paper, thus, is to show how leveraging AI could improve learning outcomes and play a vital role in the sustainable development of Nigeria.

Conceptual Framework

Artificial Intelligence

As a branch of computer science, artificial intelligence (AI) generally represents computer programs that are developed to perform tasks which human intelligence are required. Both Copeland (2009) and Lane (2021) are in congruence in thought that AI as the ability of a digital computer or computer-controlled robot to perform task commonly associated with intelligent beings. Ghosh and Thirugnanam (2022) expatiate by referring to AI as man-made homo-sapiens or 'computerized species' which are capable of basic skills like learning, reasoning, self-improvement, language understanding and problem solving. They emphasize that AI is simply the method of simulation of human intelligence through machines. In essence, AI can be referred to as advanced technologies in the form of sophisticated computer systems created to mimic human behaviour or replicate human intelligence for the purposes of assisting humans.

The concept of artificial intelligence (AI) also conveys the idea of machines created with the ability to understand verbal commands, distinguish pictures and function with human intelligence. Spector (2006) corroborates this view describing AI as intelligent computer systems which have the ability to perceive, analyze and react accordingly to the inputs. Allam *et al.* (2013) stretch it further by noting that AI is the brilliant work of intelligent agents and smart computers to provide tools with the ability to perceive, reason, and act like humans in several ways especially as regards learning, decision-making, problem-solving, and automating redundant and tedious tasks. Therefore, when it comes to talks of computer machines designed in a more human-like fashion with the intention to help find solutions to complex problems, AI comes to mind.

To help make a better sense of what this concept entails, Russel and Norvig (2010) cross examined several definitions on different dimensions and submit that artificial intelligence (AI) is the act of empowering computer machines to do four significant things including: to think humanly; to act humanly; to think rationally; and to act rationally. This aligns with the view of Chiu (2021) who maintains that AI is essentially digital devices designed with the capacity to carry out tasks typically associated with sentient entities. More so, the concept of AI involves how human behaviour and intelligence are integrated into machines or systems (Sarker, 2022). Thus, no matter how one looks at it, the concept of AI is understood as human intelligence demonstration through computer machines.

Moreover, two types of artificial intelligence (AI) can be distinguished namely: the weak AI and the strong AI. On the one hand, the former is so called because it is confined to one or even a few specific tasks with controlled environment and data. This is also known as narrow or applied AI. On the other

hand, the latter is also referred to as artificial general intelligence (AGI). This type has capacities that are not limited to defined tasks, environments or thresholds. It seems that this is even more sophisticated in terms of intellectual capacities (Goertzel and Pennachin, 2006).

Meanwhile, it is noteworthy that artificial intelligence (AI) comes in various categories and exhibit several characteristics. Xia *et al.* (2022) categorized notable technologies that support AI into multiple domains such as: big data, machine learning, computer vision, speech, natural language processing, and computer vision. Ghosh and Thirugnanam (2022) equally highlight other important domains of AI which include: natural language processing (NLP); neural network; robotics; expert system; and fuzzy logic system. Moreover, Hintze (2016) identifies four main characteristics of AI to include: reactive machines; limited memory machines; theory of mind; and self-awareness. Suffice it to briefly discuss these characteristics separately to glean a broader perspective of AI.

i. Reactive Machines: These AI systems basically do not have memory and are designed for specific task only. They have no concept of the past and cannot inform current decisions. However, they have the ability to process huge amounts of data (big data) and make complex calculations very quickly. Nevertheless, they lack the ability to predict future outcomes, except for the ones furnished with such adequate and appropriate information.

ii. Limited Memory Machines: Some AI are so regarded because they have memory and the capacity to improve. This implies that, according to technology language, they become smarter as they receives more data. Also, they have features that enable them to perform actions based on past and present data, because they can look into the past and monitor specific objects with time. However, they are far from being a full representation of the world since they cannot remember former experiences and learn how to handle current situation.

iii. Theory of Mind: AI in this category remains in the realm of theory or speculation. Though, if successfully developed it has the potential to be sensitive to other entities around, in terms of thoughts and emotions which eventually would influence its behaviour. While buttressing this, Lauritsen (2020) observes that current AI efforts are geared towards teaching computers to have reasonable conversations with humans, solve complicated problems, make reliable predictions, and carry out a wide variety of formerly manual tasks automatically. This perfectly fits in the concept of better representation of the world through computer system, since AI could have the ability to understand intentions and predict behaviour, as if to stimulate human relationships.

iv. Self-awareness: This is sometimes speculated as the grand finale of AI evolution. It is a situation whereby a computer system could have the potential to form representations about itself. In essence, it is a machine that has in-built self-consciousness or a sense of self. Like the theory of mind, this AI type is not yet in existence.

Education

Education is a broad term that encompasses all forms of teaching and learning process. Basically, it involves the transfer of knowledge, skill, experience, values, etc. from one person (teacher) to another (student) through various methods. In the opinion of Peters (2010), educational process involves training, instruction and learning by experience, teaching and the learning of principles, the transmission of critical thought, and conversation about the whole man. He used two key words to describe education: initiation and reform. In essence, education is the process of initiation leading to reform. Meanwhile, for Adesemowo and Sotonade (2022), education entails the whole process of learning by which knowledge is imparted, faculties are trained, and skills are developed. They emphasize

that it is the tool for inculcating in the individual the skills, abilities, and values which are necessary for functioning in the society.

The concept of education assumes clearer perspective through the lens of certain criteria. According to Peters in Sule and Okam (2011), a process can be termed education, when matched against these criteria or standards and is found to be close to their demands. The criteria include: that education implies the transmission of what is worthwhile to those who become committed to it; that education must involve knowledge and understanding and some sort of cognitive perspectives which is not inert; and that education, at least, rules out some procedures of transmission on the grounds that they lack witnessing and voluntariness on the part of the learner. Key elements to highlight in the proposed criteria are: that education involves transmission; a content; and a method. Thus, it can be accepted that education plays the essential role of passing on values to the next generation.

Furthermore, there is hardly any sector of society that the significant impact of education is not conspicuous. First of all, education is pivotal to all forms of development. It is considered the most indicator of overall development of a nation. In line with this, Molagun (2006) opines that education is the medium for the total transformation of individuals and societies. Taiwo and Ajiboye (2016) seem to agree with him by pointing to the fact that education helps to improve the quality of lives and leads to enormous social benefits both to the individual and society. The implication is that, education is seen as a dynamic instrument for engineering social change and fostering the growth of social progress.

Sustainable Development

Sustainable development is a concept said to have originated from forestry, denoting measures of afforestation and harvesting of interconnected forests in ways that do not undermine the biological renewal of forests (Črnjar & Črnjar, 2009). In recent decades, it now involves reconciliation between economic development, meeting human needs and aspirations on an equitable basis, and conserving limited natural resources and the capacity of the environment to absorb the stresses that are the consequences of human activities (Hay & Mimura, 2006).

Olaniyan *et al.* (2013) contend that sustainable development should be an issue of intergenerational equity owing to the belief that the resource base of any economy belongs to all generation. Karpagam (2014) takes it up and proposes that there should be rules of sustainable development: that the next generation should inherit a stock of environmental assets no less than that inherited by previous generation and that the components of the inherited stock should of utmost necessity comprise of man-made assets, natural assets and human assets. Similarly, Jungwirth and Haluza (2023) view sustainable development as a complex construct with the aim to finding equilibrium between economic growth and protection of the environment, while addressing social issues.

It should be underscored also that there is an accepted framework for the concept of sustainable development known as the sustainable triangle or the three pillars of sustainability. Elkington (cited in Svensson & Wagner, 2015) refers to this in the triple bottom line as the 3P's of sustainability, namely: People, Planet and Profit. This concept of sustainable development clearly distinguishes between three dimensions which include: environmental dimension (planet), economic dimension (profit), and social dimension (people). To further buttress this, Kastenhofer and Rammel (2005) note that the cornerstones of sustainability are economic vitality, environmental integrity, and social equity. They insist that these applications underscore the pivotal role of AI in education.

Education in the Era of Artificial Intelligence

It is a statement of fact that with the emergence of artificial intelligence (AI), education systems are being altered globally. A lot of persons subscribe to the assertion that AI is reshaping the educational landscape as well as repositioning it for the future. Bostrum (2017) observed this and remarked that with AI, new teaching and learning solutions are currently under trial and undergoing restructuring in different contexts. This is coming as a result of the introduction of AI technologies such as chatbots, robots, intelligent tutoring systems, and automated evaluation of all forms of digital artifacts that support and improve education (Pedró, 2019). Besides, Zuboff (2019) is of the opinion that there are four key applications of AI as regards teaching and learning and they include: profiling and prediction, intelligent tutoring systems, assessment and evaluation, adaptive systems and personalization. Ghoneim Sywelem (2024) further identifies notable applications of AI in education to include: intelligent learning systems, automated assessment, personalized educational content, educational assistance, learning analysis, improved social interaction, and predictive analysis.

In many parts of the world artificial intelligence (AI) is being embraced particularly in the education environment. Probably, this is largely due to its goals in the sector as Bates (2018) has clear outlined: to increase outcomes; to increase access; to increase retention; to lower cost, and decrease time to completion. A careful analysis of this reveals the benefits that AI brings to education, which are enormous. It all centers on the perception that AI has the ability to improve learning outcomes. Akinwalere and Ivanov (2022) enumerate some of the benefits as follow: fostering teachers' understanding of students' learning processes, offering students more personalized and adaptive learning, and providing instantaneous feedback and machine-supported queries anywhere, anytime.

AI technologies have potentials to help education systems use data to improve educational quality and equality, especially as it pertains to the developing countries. Stancheva-Todorova (2018) underpins this view observing that AI has what it takes to improve academic performance once it succeeds in increasing students' cognitive engagement and lessen educational disparities by helping students from disadvantaged backgrounds. More so, there is the argument that AI is capable of improving teaching and learning in two specific areas including: student assessment or evaluation and educational administration (Abulibdeh *et al.*, 2024). The bottom line is that AI can serve the best interest of all stakeholders in the educational spectrum.

Meanwhile, concerning the subject of student assessment, education is gradually coming to terms with the use of automated grading system. It is arguable that AI has the ability to provide better data analysis and enable educators to make data-driven decisions (Harry, 2023). Thus, through pre-defined criteria, AI can help analyze students' work and provide immediate feedback on their performance (AlAli *et al.*, 2023). In this way, the stress involved in the assessment and evaluation process is completely eradicated. Jain *et al.* (2023), went further to state that this system excels in expediting grading thereby saving time, providing uniformity, and improving the overall learning experience. They emphasize that, to the credit of AI technology, manual evaluation is eliminated as discrepancies and possible biases are minimized.

The Use of Chatbots in Educational Institutions

Artificial intelligence (AI) referred to as chatbots are computer machines designed to mimic human conversation through the use of voice or text interaction. This implies that they are basically created for human-artificial intelligence communication. Chatobots are found in various sectors, including education. It is observed that most of them are web-based platforms with the capacity to enhance educational experience, by adapting to the behaviours of instructors and learners alike (Peredo, *et al.*, 2011). Chatbots can serve as an after-hours tutor, since the technology has the ability to tailor

instruction to the specific learning style of individual students. The significant point established here is that the general usefulness of AI chatbots in education is that they can react naturally and in a conversational tone.

Table Showing AI Chatbots

S/N	*Chatbot*	*Year Designed*	*Designer*
1.	ELIZA	1966	Joseph Weizenbaum
2.	PARRY	1972	Kenneth Colby
3.	ALICE	1995	Richard Wallace
4.	SmarterChild	2001	ActiveBuddy Inc.
5.	Siri	2011	Apple
6.	Duplex	2018	Google
7.	ChatGPT	2022	OpenAI
8.	Google Bard	2023	Google AI

Source: Labadze *et al.* (2023).

Furthermore, the special features and functions of AI chatbots have raised certain concern that are very germane in the educational field. Allam *et al*. (2023) observe that faculty, teaching assistants, student counselors, and administrative personnel have expressed concern that intelligent tutors, expert systems, and chatbots may replace them. Therefore, the integration of chatbots into schools should be seen as a useful tool and not a replacement for instructors.

Table Showing Chatbots used by Educational Institutions

S/N	*Chatbot*	*Year Launched*	*Function*
1.	Bard	2022	Generates text, translates language, responds to questions.
2.	ChatGPT	2022	Generates text, produces creative content, answers questions.
3.	Ada	2017	Provides personalized tutoring, facilitates individualized learning, answers questions, provides feedback.
4.	Replika	2017	Listens to students' problems and offers advice.
5.	Habitica	2013	Helps students to develop good reading habit, manages tasks, assignments, and study schedules in a game-like experience.
6.	Piazza	2009	Facilitates discussion and interaction in classroom in relation to course content and assignments.
7.	Pounce		

Source: Labadze *et al.* (2023).

Artificial Intelligence and Sustainable Development

The interaction of AI with sustainable development in education is highly complicated and requires thorough and detailed research. Primarily, the triple bottom line model proposed by John Elkington (cited in Rios-Campos *et al*., (2024) makes the application of AI to sustainable development more profound. Based on this, one can measure and manage the sustainability impacts of adopting AI in the educational milieu. In other words, this model can be deployed to ascertain if the three-dimensional framework of evaluating the impact of AI in terms of economic growth, social equity, and environmental conservation align with sustainable development. Therefore, in addition to playing a pivotal role in advancing teaching and learning process, the use of AI technology in education can ensure sustainability in the real sense.

Findings indicate that on the overall, AI can have dual impact on sustainable development (Vinuesa *et al.*, 2020). On the hand, AI can facilitate and bring numerous benefits to society, economy, and environment. On the other hand, AI can become a hindrance if humans decide to misuse or abuse it. However, it is suggested that for AI to support sustainable development, there must be tight regulation

and oversight in order to ensure that there is transparency, safety, and that ethical standards are highly upheld. Be it as it may, the potential promises of adopting AI for sustainable development are immerse. Observation shows that AI is becoming a real game-changer across almost all sectors critical to sustainable development; education, agriculture, infrastructure, energy, construction, manufacture, etc. (Thanyawatpornkul, 2024).

Advancement in AI has presented new approaches for sustainable development, one of which is data value chain. Through this, it is understood that various AI approaches contributes immensely to the monitoring and achievement of sustainable development especially in terms of impact assessment. In addition, AI can enhance sustainable development in the context of statistics, by becoming more efficient. Relying on the advance analytics and automation, AI is capable of enhancing efficiency, promoting innovation, and improving on environmentally conscious practices, and foster robust sustainable future (Obaideen *et al*., 2022; Rios-Campos *et al*., 2024).

Hosseini and Rajabipoor (2023) express fears that there is negative impact of widespread use of AI in education which could lead to job loss, privacy violation by data collection and surveillance, rapid spread of misinformation through social media, and further aggravation of the already existing social and economic inequality. On this, Ghoneim Sywelem (2024) strongly suggest that if educational services are to be sustained in the era of AI, then the following measures must be implemented including: technological infrastructure, data provision, data protection, software development, effective leadership, ambitious financing, ethical controls, and continuous evaluation. Moreover, there is the possibility that education amidst the prevalence of AI can be enhanced and sustainable development can be advanced through effective collaboration between humans and machines, none should be sacrificed for the other (UNESCO, 2019).

Conclusion

It is very unlikely that the advances technological developments such as artificial intelligence (AI) are making can be halted anytime soon. In fact, there is the potential of AI sweeping across every sphere of human endeavour in the nearest future. The option left is to give a 'hand of fellowship' in order to maximize the embedded benefits. This is exactly what educational systems have resorted to amidst the prevalence of AI technologies. As clearly observed in this paper, notable chatbots and other relevant AI applications have been found to be useful in the field of education. Through the integration of these applications in educational institutions learners, instructors, and administrators are counting their gains in multiple folds. However, serious concerns are being raised pertaining to negative outcomes with the use of AI in education. Some of these issues can be put to rest when the right measures are taken to mitigate them.

Recommendations

1. It is recommended that proper adjustment be made as to adapt to the new reality. That is people, organizations and societies should make necessary changes -in skills, policies, attitudes and systems, so as to keep up with the way Artificial intelligence (AI) is changing the world. For instance, updating workplace practices to include AI tools and creating laws or ethical guidelines to manage AI use responsibly.

2. It is imperative to carry everybody (including developing countries) along in the planning and implementation of policies. That is, including all people and nations, especially developing countries, when making decisions and rules about how AI is used. Different countries have different needs and values that should be represented.

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