CHAPTER 4

Promoting Quality Education in Nigeria through the Adoption of Artificial Intelligence and Machine Learning Systems

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Preamble

Artificial Intelligence (AI) and Machine Learning (ML) have become the most promising significant tools for addressing the challenges of the world. Besides its use in understanding physical and complex systems, these tools have demonstrated unmatched potential applications in numerous research disciplines and sectors such as banking, finance, social networks, cybersecurity, and health. This chapter looks at promoting quality education through the adoption of AI and ML. Artificial intelligence is intelligence demonstrated by machines. This is in contrast to the natural intelligence displayed by humans and other animals. Some of the activities that AI is designed to do are speech recognition, learning, planning, and problem-solving. AI addresses the crucial questions of what knowledge is required in any aspect of thinking; and how this knowledge can be represented and utilized. Today, the AI and ML paradigms have gained much popularity, especially, in the educational sector. Its algorithmic models are employed in every field, such as natural language processing, pattern recognition, object detection, image recognition, earth observation, and many other research areas. AI and ML technologies and their inevitable impact suffice in many technological transformation agendas currently being propagated by many nations, for which the already yielded benefits are outstanding. From a regional perspective, several studies have shown that machine learning technology can help address some of Nigeria's most pervasive problems, such as poverty alleviation, improving education, delivering quality healthcare services, and addressing sustainability challenges like food security and climate change. However, this chapter will focus on improving education through AI and ML technologies using Nigerian soil.

Keywords: Artificial intelligence, Machine learning, Education, Promoting, Nigeria

Introduction

Quality education constitutes the engine for the growth and progress of any society, Nigeria inclusive. The practice of education, widely referred to as the teaching and learning process imparts knowledge and skills, inculcates values, and is also responsible for building human capital which

breeds and drives technological innovation and economic growth. Education may take place in different environments, which may be considered conducive, unconducive, or distracting. In the digital era, quality education stands out as a very important and critical input for growth and survival. Rather than look at education simply as a means of achieving social uplift, education could be viewed as an engine of advancement (growth and development). If education fails to inculcate professional knowledge, self-discipline, and commitment in the student, it is as good as dead and irrelevant, hence not referred to as quality education. To this end, efforts ought to be made to enhance quality education in Nigeria through the incorporation of certain technologies that have the potential to drive the required gains of education and enhance its quality. This is the gain of artificial intelligence and machine learning.

The term "Artificial Intelligence" was coined from the combination of two independent terms, and it has dominated the academic world of technological growth over the years. It is defined as anything manufactured out of imitation, something not natural, lacking spontaneity, assumed, and not sincere (Owoyemi et al., 2020). The phrase can also refer to any machine that demonstrates human-like characteristics like learning and problem-solving. It is a branch of computer science concerned with the creation of computers capable of human-like mental processes such as learning, reasoning, and self-correction. According to Hamdoun and Rguibi (2019), machine's notion may be refined to include some skills generally associated with human intelligence, such as learning, adapting, and self-correction. The goal of AI is to create computers that can think, see, hear, walk, communicate, and feel, and the beauty of this technology is that it can recognize patterns at a size and pace that humans cannot. Artificial intelligence is a replica of knowledge obtained through the use of computer peripherals and programmed to become actual and valuable to mankind due to its technical application and usage. It is a technology that has provided the globe a boost in terms of human knowledge progress and applicability across all disciplines.

Artificial Intelligence (AI) has driven development in technology in many societies and economies of developing countries to enforce sustainable human development. Artificial Intelligence (AI) is a domain of computer science that deals with the development of intelligent computer systems, which are capable of perceiving, analyzing, and reacting accordingly to the inputs (Cioffi et al., 2020). AI has also been defined as the "science and engineering of making intelligent computer systems" to enhance learning and decision-making for solving problems. Many countries have benefited from applications of AI, which provided faster performance and efficiency in conducting tasks better than humans. At present, AI systems can understand human expressions, recognize images, predict traffic, and many others. It has aided technological innovation as digitalized data continues to grow.

According to Ezugwu et al. (2021), machine Learning (ML) is an emerging field encompassing system learning without being programmed or modified. As data grows massively, better computing storage and performance are required to achieve accurate results faster. Therefore, ML enhances systems through superposition and entanglement tools to solve complex

systems and perform operations on large data. It has also been successful in optimizing classical machine-learning algorithms. Such applications of AI and ML are transparent across sectors such as banking, finance, social networks, cybersecurity, and health. Since AI and ML are elementary technologies, various developing countries have been committed to developing their competencies.

AI and ML have both aimed at sustaining human development in many countries; however, there is a wide variation between developing countries and Nigeria in applying these tools. The Nigerian education system has been falling behind with visions of accessing these tools due to some challenges; among them is poor growth of human capital, which leads to poor productivity. On the other hand, these tools can bring industrialization opportunities that have considerable potential to improve the economies in Nigeria so they could be more efficient and competitive in their industrial processes. As Nigerian academia leans towards the acquisition of these tools for their teaching, learning, and research activities, it will address various challenges that hinder the promotion of quality education. All these are necessary for technological progress to achieve a successful transformation in the educational sector. AI and ML can impact this education sector to close the technological gap between Nigeria and other developed countries.

From Artificial Intelligence to Machine Learning: An Evolutionary Process

Technology has invaded everywhere (workplaces, markets, homes and schools, etc.). In rich, industrialized, and developed nations (like the United States of America, United Kingdom, China, Germany, Canada, Japan, Australia, etc.) and some developing countries, computers and the Internet are abundant in schools and classrooms. Consequently, technological innovation has been viewed by different people as a positive or negative catalyst - depending on their experience and perception. The positivity of the innovation depends on its ability to overcome the challenges it creates in the minds of people. This perception of technological innovation as negative, on the other hand, is based on the challenges that come with the innovation and the inability of the innovation created to withstand and overcome those challenges. Today, every sector of the economy, in Nigeria and beyond, is experiencing technological innovations in the operation and performance of its statutory and subsequent duties. Most prominent and visible among all these technological innovations is, perhaps, the adoption of artificial intelligence and machine learning.

It is therefore, believed that the drive to replace human capability with machine intelligence led to the evolvement of various methods of AI, which is now defined as the science and engineering of achieving machine intelligence as often exhibited in the form of computer programs and often in controlling and receiving signals from hardware (Cioffi et al., 2020). An upsurge of research in AI has resulted in the outstanding performance of machines that now perform complex tasks intelligibly. Several AI paradigms have now evolved, including natural language processing (NLP), constraint satisfaction, machine learning (ML), distributed AI, machine reasoning, data mining, expert systems, case-based reasoning (CBR), knowledge-representation, programming,

robotics, belief revision, neural network, theorem proving, theory computation, logic, and genetic algorithm (Bachri et al., 2019).

The field of machine learning (ML) branched out of AI and is focused on evolving computational methods and algorithms learning and building learning machines to leverage an object's natural pattern of learning features. ML has been reputed to advance AI dramatically because of its problem-solving approach of recognizing patterns in domain-specific datasets to gather artificial experience from the observed data. This follows a data extraction pipeline through training and prediction using new data. This learning has evolved into different perspectives, including popular supervised, unsupervised, semi-supervised, and reinforcement learning. Over the years, algorithms have been designed and further evolved in each aspect of learning. These algorithms address real-life problems involving classification and regression problems using supervised learning methods, clustering and association using unsupervised learning methods, and the problem of understanding and maneuvering an environment using reinforcement learning.

The learning process in ML uses both symbolic and numeric methods as incorporated into some of its popular algorithms such as linear regression, nearest neighbor, Gaussian Naive Bayes, decision trees, support vector machine (SVM), random forest, K-Means, density-based spatial clustering of applications with noise (DBSCAN), balanced iterative reducing and clustering (BIRCH), temporal difference (TD), Q-Learning, and deep adversarial networks. The design of these algorithms includes a broad domain of statistics, genetic algorithms, computational learning theory, neural networks, stochastic modeling, and pattern recognition. The resulting algorithms have demonstrated state-of-the-art performances in email filters, NLP, pattern recognition, computer vision, and autonomous vehicle design (Essien et al., 2021).

Benefits of AI and ML: All-Round-Sectors Developmental Drivers

Aside from the impact of AI and ML on the educational sector, leading to the promotion of quality education, AI and ML are significant in interacting with people such that they acquire data to perform cognitive activities such as learning, understanding, and giving feedback on the best course of action. AI can be used in the 4th Industrial Revolution (4IR) to strengthen cybersecurity in Nigeria by detecting data breaches to remove unwanted data or malware from systems being developed to lower the cyber-attack. This is done by analyzing patterns from input data and recognizing unusual patterns of behavior. These could enable quality protection through ML in systems or accessories when using artificial neural networks and data mining techniques such as classification, clustering, and regression- to ultimately give better security services. Through ML, it could be relatively easy and faster to determine how vulnerable or exposed the system is, guided by how the pattern behaves to recognize the infiltration points. This will therefore alert authorities much sooner to protect sensitive data from being swindled from their computers. Nowadays, AI provides more intelligent biometric authentication systems such as face or voice recognition and fingerprint scanning across various devices. As a result, authentication is

improved; for example, in voice recognition, tone, accent, and pitch are analyzed much faster, and biometric systems can identify unique voice impressions accurately (Nnadozie, 2016).

According to Ezugwu et al. (2021), ML will assist in storage and performance challenges, wherever systems contain large data, and also build systems that will transform current security initiatives, such as quantum sensors, quantum radars, and location detection, which cannot be interfered with easily. Furthermore, since these systems also use communication systems, they will be secured through quantum encryption. It is also believed that AI can theoretically contribute to counterterrorism operations. Therefore, with the continued activities of terrorist groups such as Boko Haram and al-Shabaab in Africa, AI can provide a potent tool for counterterrorism. Additionally, AI and ML play a significant role in making cost-effective algorithms to diagnose patients effectively by learning from past cases or reports to enhance clinical decisions. This technology can also monitor multiple patients at the same time through medical algorithms. These algorithms can also offer self-service to patients with health-related inquiries and thus save time, effort, and most importantly, lives. Moreover, AI machines are capable of analyzing data from past surgeries recorded, and they could be more precise at detecting illnesses and even discovering some new surgical procedures, which could improve the health facilities in Africa. Finally, in battling current medical concerns, AI and ML can track the spread of a virus by effectively evaluating existing data to make predictions on infection rates across countries; this provides viable information and meaningful future guidance across the Nigerian information, health, and educational sectors.

Consequently, there is widespread research using ML to address contextual problems across African countries. In most cases, this is promoted by a local conference called Indaba, which promotes the application of AI and ML to help ensure that knowledge, capacity, recognizing excellence in ML research, and application are well harnessed to develop the continent. It is reported that AI-based research is improving communities across the Sub-Saharan Africa (SSA) regions In Kenya, it is being applied to aid health worker–patient interaction to detect blinding eye disorders, and in Egypt, in aiding automated decision-making systems for health-care support. In South Africa, it is aiding drug prescription, and with a multinomial logistic classifier-based application, it is being applied to human resource planning. ML-trained models are primarily deployed in medicine in Nigeria, and an example is their use in the diagnosis of birth asphyxia and identification of fake drugs. Other cases are the use of ML to diagnose diabetic retinopathy in Zambia and the diagnosis of pulmonary tuberculosis in Tanzania (Owoyemi et al., 2020).

ML application cut across medicine, solar power, and climate. In particular, deep learning models, CNN, have been proposed for detecting and classifying breast cancer cases using histopathology samples. The Recurrent Neural Networks (RNN) variant of a Deep Learning (DL) model has been adapted to address the problem of daily streamflow over the Ait Ouchene watershed (AIO) (Boutahir et al., 2022). In the financial sector, the use of ML is revolutionizing the banking ecosystem for precise credit scoring, regulation, and operational approaches. In another study, the country's location motivates research on using ML to harness solar power in

grid management at power plants. Both ML algorithms and DL have been drafted for predicting solar radiation using models such as ANN, multilayer perceptron (MLP), back propagation neural network (BPNN), deep neural network (DNN), and LSTM (Boutahir et al., 2022). In Egypt, research in ML has enjoyed application to learner-ship, face recognition, visual surveillance, and optical character recognition (OCR).

In another study, the rate of school dropout has been investigated and predicted using ML algorithms, specifically a Logistic classifier. The model can identify students at risk of dropping out of school and isolate the causes of this challenge. Similarly, the need to harness the deployment of Internet of Things (IoT) devices to curb the spread of COVID-19 using ML algorithms has been advocated (Ezugwu et al., 2021). On the issue of security, an investigative study has been carried out assessing the level of deployment of AI and its associated ML methods in curbing terrorism and insurgency in Nigeria. The use of artificial neural network (ANN) and logistic regression (LR) models have also been used to predict floods in susceptible areas in Nigeria. Regarding finance and the digital economy, AI-based methods have been recommended for innovation and policy-making. Researchers in Uganda have also employed AI in healthcare management by observing the performance of an AI algorithm called Skin Image Search, applied to dermatological tasks. The algorithm was trained using a local dataset from The Medical Concierge Group (TMCG) to diagnostically analyze and extract the gender, age, and dermatological diagnosis.

Artificial Intelligence and Machine Learning for Teaching and Learning

Central to current trends in teaching and learning in Nigeria, are twin issues of globalization, digitalization, and quality assurance. These trends have fundamental implications in nearly all spheres of life, especially, in educational and learning life. The vision of the adoption and use of AI and ML for teaching and learning is to make for an educational society, that develops and utilizes the opportunities inherent in the information society to improve the quality of life, knowledge, international competitiveness, and interaction in an exemplary, versatile and sustainable way. These ideas have been used to develop the Global University System (GUS) within the UNESCO Chair in global e-learning at the University of Tampere. Since then, there have been several innovations in technology for teaching and learning. These technologies have improved lecturers' competence, deepened the curriculum, widened students' learning experience, and generally improved the quality of university graduates. Hence, the overall purpose of quality education is not merely to make the professional-in-training competitive in a rapidly changing world. Rather, contemporary quality education adds rational thinking, job creation (entrepreneurship), and self-sufficiency. This is the reason why the chapter tried to look at the application of artificial intelligence and machine learning in promoting quality education in Nigeria.

Nnadozie and Chukwueke (2016) write that courtesy of the digital era and the consequent global village, there have emerged many innovative technologies that enhance teaching and learning. Today, education and educational resources are on the Internet where everybody sees it,

and lectures are being delivered online instead of the traditional teaching in regular classrooms. Lecturers have offices equipped with interactive whiteboards which make such offices double as classrooms, and further deploy different AI tools and ML algorithms in delivering their lectures (Ross et al., 2010). On the other hand, students can now participate or listen and receive lectures without their physical presence in class or lecture rooms and also have access to varied information resources for self-learning and development. The absence of these tools returns us to the traditional approach to education, where there is a mismatch between what is taught to the students and what the industry needs. As such, many institutions and their various departments are moving towards problem-based learning as a means to producing graduates who are analytical, imaginative, creative, and independent, through the adoption of artificial intelligence and machine learning processes. Today, the use of artificial intelligence and robotics for teaching and learning is gradually becoming the order of the day. Examples of such AI for education may include but are not limited to

1. ***Writeful***: It uses Artificial Intelligence to correct grammar, punctuation, word use, and more, tailored to research writing. Writefull also offers language feedback and widgets for writing in Overleaf.
2. ***Unriddle***: It is a tool that generates an AI assistant on top of your uploaded documents, helping you quickly find and understand information. It can answer specific questions about the text, summarize content, and simplify complex jargon. Additionally, you can highlight text in the editor and use the 'Cite' feature to link to relevant information from your library.
3. ***Elicit***: It is used for literature review automation, data extraction, summarization, finding related papers, custom queries, and analyzing PDFs. It can be used for literature and systematic reviews.
4. ***Jenni***: It serves as a dependable AI-driven **writing companion**, primed to enhance content creation process while ensuring speed and quality. With Jenni AI, tasks such as drafting essays, preparing reports, or any academic writing are simplified. It's equipped to handle a vast array of subjects, be it academic, scientific, or general knowledge.
5. ***Scispace***: It is an all-in-one tool for literature reviews that offers features such as semantic search, analyzing existing PDF collections, detailed insights for a single paper, and academic writing assistance. It leverages state-of-the-art methods in vector-based search, reranking, and large language models to deliver customizable
6. ***Connected-papers***: This is useful for researchers. It helps students discover new and relevant academic papers that might be under the radar. This is done through a visual graph of papers, showing a starting point and connections based on similarity.
7. ***Research-rabbit***: It is an AI-powered research app that helps researchers save time and improve the quality of their research. It allows users to visualize papers, discover author networks, and receive personalized digests of the latest research related to their interests.
8. ***Co-pilot***: Used in writing and editing text, summarizing documents, generating formulas, analyzing data, creating presentations, taking notes, and drafting replies and summaries.

9. Gemini: This tool can interpret and respond to various types of content, including text, video, audio, and code. It enhances patient care, optimizes operations, accelerates research, and improves public health preparedness

10. *ChatGPT*: It is an AI chatbot that can answer questions, assist with composing emails, essays, code, and more. It can engage in human-like conversations and follow up on questions.

11. *Scribbr*: This is an AI-powered paraphrasing tool that helps the user rewrite the text in their own words. It is used to paraphrase articles, essays, and other pieces of text. It can also be used to rephrase sentences and find synonyms for individual words

12. *Zerogpt*: It is a reliable AI content detector that accurately identifies if a text is human-written or generated by AI tools such as ChatGPT or Google Bard

13. *Quillbot*: It is an online paraphrasing tool that uses natural language processing (NLP) to rephrase sentences while preserving their meaning. It can help users improve their writing by suggesting alternative phrasing, correcting grammar, and enhancing overall clarity

Furthermore, audio conferencing, chat rooms, instant messaging, web conferencing, whiteboarding, online forums, streaming audio, and streaming video are part of the products in the digital era for education in information science.

Conclusion

For a long time, there have been discussions around AI and ML, including those around benefits but also the ethical challenges associated with the technology. This chapter has sought to contribute to the discourse of AI and ML from a Nigerian perspective by focusing on using AI an ML to promote quality education. Going further, AI and ML, a product of information technology is dramatically altering the way students, faculty, and staff learn and work. Internet-ready phones, handheld computers, digital cameras, MP3 players, and other AI tools are revolutionizing life in the university environment and education in Nigeria. As the demand for technology continues to rise, colleges, polytechnics, and universities are moving all sorts of student services, from laundry monitoring to snack delivery online. Lectures can be organized outside the classroom. It is now possible to have a classroom in the cloud. To this end, the existence of artificial intelligence and machine learning may be able to provide knowledge to students.

The digital era is also changing the classroom experience, as the classrooms now feature all sorts of conveniences for students and teachers. For instance, the classroom is wired with cameras for photographing whiteboards, so students can receive the images as digital files. In addition, tablet PCs and compact computers that allow the user to write notes directly onto the screen with a special pen, have replaced the archaic projector. With the tablet technology, professors and lecturers can now make notes on charts and spreadsheets and send same directly to their students' PCs and get feedback from each student. To this end, there is a need to embrace the concept of artificial intelligence and machine learning. In particular, AI is being applied in healthcare, finance, security, education, transport and logistics, telecommunication, public service delivery, and agriculture as well as being used in politics. By cultivating the understanding of AI

and ML in our educational sector, we can then begin to explore the possibilities that lie ahead in the future of AI in Nigeria and as a consequence what can be learned and shared by Nigeria in the global discourse of AI. Nonetheless, the right application of AI tools and ML approach goes a long way in promoting the quality of education in Nigeria.

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