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THE REVOLUTION OF THE EDUCATIONAL SECTOR BY MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

[1]Nnenna Harmony Nwobodo-Nzerebe, [2]Aghaizu Herman Chijioke
[1,2]Department of Computer Engineering, Enugu State University of Science and Technology
Authors Email: [1]nnennanwobodo8@gmail.com, [2]haghaizu@imopoly.net

Abstract

This paper reviews the impacts of machine learning and artificial intelligence technology to improve the educational sector and teaching/learning efficiency. In the study, a systematic review and meta-analysis methodology was implemented for development, which involves the development of inclusion and exclusion criteria, adoption of search strategy, selection of study, quality assessment, and interpretation of the outcome. Then, from the review, the various challenges that face the Nigerian educational system, such as funding inadequacies, corrupt academic operations, inadequate infrastructural facilities, shortage of academic staff, strike actions, insecurity, brain drain, and poor research, are presented. Finally, the ways in which machine learning and artificial intelligence can be assistive in solving these challenges, such as collaborative learning, monitoring of student forums, continuous assessment, artificial intelligent learning companions and teaching assistants, and a research tool to improve further learning sciences, are also identified. Based on the identified situations in the study, it is recommended that the ML and AI approach is adopted in the educational sector to improve equity and inclusion in education, serve as ethical frameworks and guidelines in teaching and learning, make empirical impacts in AI, develop the teacher professions effectively, preservation of privacy, engage stakeholders and create long term impacts in the educational system.

Keywords: Artificial Intelligence; Collaborative Learning; Education; Intelligent Tutoring System; Machine Learning; Intelligent Tutoring System; Student Performance and Administrative Automation.

1. INTRODUCTION

A subfield of Artificial Intelligence (AI) called Machine Learning (ML) has shown exponential growth in the last several years. Because educational tools enhanced with smart technology have the potential to completely transform teaching and learning processes, the scientific community is becoming more and more interested in them (Wiston and Francisca, 2024). The use of ML and AI in education research and delivery channels for higher education has grown in popularity. In educational institutions, artificial intelligence and machine learning are now popular topics of discussion (Ahmad et al., 2021).

Even while ML and AI both concentrate on using the notion of prediction, their differences in education are not always evident. While AI enables systems to carry out tasks independently, ML is concerned with systems learning from data (Luan and Tsai, 2021; Zhai et al., 2021). The goal of AI and

ML is to build machines that can perform tasks that are typically associated with humans. These fields analyse and process data using mathematical and statistical methods. They have the potential to completely change how we interact with the outside world. Lastly, there has been an exponential increase in research on these topics between February 2021 and February 2023.

With proper data processing and filtering, machine learning (ML) has produced a variety of methods or algorithms in recent years to forecast scenarios based on vast volumes of information. These methods may provide extremely accurate forecasts. To assist instructors, some writers have created machine learning algorithms (ML) (Duzhin and Gustafsson, 2018; Yu et al., 2022). This has made it possible to use these clever strategies in the field of education and to fight against the ever-changing issues that arise in a variety of settings.

AI in education presents a variety of opportunities for educators, administrators, and students. As an illustration, ChatGPT's most recent version, GPT-4, optimises educational duties by integrating with programmes like Microsoft Office, Edge, and Bing. According to Zafari et al. (2021), AI and ML have been used in educational activities, which emphasizes the necessity of enhancing Teachers' Digital Competency (TDC).

All educational actors have benefited greatly from the digital revolution of education due to the integration of ML, which has made the system more comfortable for both instructors and students (Nafea, 2018). But, school administrators and families who serve as crucial points of reference in any educational community and are intimately involved in the advantages these new technologies might produce would also greatly benefit from it. The issue for educational institutions is to train instructors in AI and ML. Teachers must be ready to integrate technology into their lesson plans in order for digital transformation in the classroom to become a reality (Almeida et al., 2021). This calls for a strong foundation in these subjects. A lack of such information hampers the best use of AI and ML in education. As a result, it will be up to school administrators to spearhead the TDC's training.

This paper aims to find ways to apply artificial intelligence and machine learning to improve educational management and teaching-learning processes at all levels of the educational setting.

2. LITERATURE REVIEW

Marlina (2023) researched on the use of artificial intelligence in education. The purpose of this study is to look at the creation and use of artificial intelligence (AI) in education, as well as the difficulties associated with doing so. This study assesses the benefits of artificial intelligence (AI) in improving learning effectiveness, offering individualised learning experiences, and expediting the process of educational administration through a thorough analysis of the literature. However, there are other difficulties with using AI in education. These difficulties include the loss of human connection, privacy concerns pertaining to student data, and the evolving role of educators in the AI age. Moreover, there are infrastructure and budgetary limitations that may prevent AI from being used in public schools. The research's referenced publications go over a number of

approaches that may be used to solve this problem. The study's results emphasise how crucial it is to encourage the use of AI in education by making sure that appropriate rules are in place, that educators are well prepared, and that there is a greater knowledge of how educators are using AI.

Shaikh et al., (2022) presented a study on the role of ML and AI for making a digital classroom and its sustainable impact on education during COVID-19. The use of AI and ML in pandemics, their efficacy in trying to address human issues, especially those related to learning, their ability to provide COVID-19 pandemic-specific teaching solutions, and their crucial role in pandemic education, as long as future citizens and machinery continue to rely on disease outbreaks, data patterns, and artificial intelligence (AI) machines. If the function and comprehension of AI&ML are unclear, it enables many people focus more on experimentation and mistakes. The study's key finding is that, in the modern day, teachers have a lot of help when it comes to evaluating students' academic performance.

Jagwani (2019) presents review on the application of machine learning in education. The research is entirely focused on how new machine technologies and intelligence are developed within the educational system. The machines of today are in charge of enhancing intellect and are prepared to provide knowledge-based schooling. We won't consider or envisage how education technology will advance in the future if it weren't for machine learning. In the near future, machine learning and artificial intelligence in education will transform the game. Along with lowering effort and closing learning gaps between students and teachers, it will also present a number of new chances for management maintenance. Machine learning will become even more effective and yield even better outcomes soon.

Okagbue et al., (2022) presents a comprehensive review of the application of machine learning and artificial intelligence in education. A bibliometric technique was used in the study to collect and analyse data from the Scopus database in order to investigate the field of machine learning and artificial intelligence. The obtained data was analyzed using R packages, VOS Viewer, Bibliometrics, and Bibliometrics analytic tools. The investigation found an intriguing vacuum in the literature: the application of ML and AI to classroom activities and other pedagogically relevant programs. These papers had not addressed this topic before.

Munir et al. (2022) present a systematic revision of the application of artificial intelligence and machine learning approaches in digital education. This work makes two primary contributions. First, the study examines the literature using a dependable and impartial procedure. Second, the paper summarises and clarifies the themes found in the literature about the application of AI-based algorithms in digital education. Six topics about the employment of computers in digital education are presented by the study's findings. The study's synthesised data indicates that a number of digital learning topics make use of deep learning and machine learning methods. Using intelligent tutors, performance and dropout predictions, adaptive and predictive learning and learning styles, analytics and group-based learning, and automation are some of these themes. Across

all the themes that have been found, algorithms for artificial neural networks and support vector machines seem to be used the most, followed by those for random forests, decision trees, naive Bayes, and logistic regression.

3. RESEARCH METHODOLOGY

The methodology adopted in this study is the systematic reviews and meta-analysis methodology. The methodology is used to synthesize evidence from the multiple literatures reviewed on the application of machine learning and artificial intelligence in educational sector. The methodology involves the development of inclusion and exclusion criteria, adoption of search strategy, selection of study, quality assessment and interpretation of the outcome. A systematic review gathers all potential research on a certain subject and methodology, evaluates the studies, and synthesises the findings (King, 2015). A statistical meta-analysis of the research results is carried out based on the quality of the studies, which is assessed throughout the systematic review process. According to Ahn and Khang (2018), a meta-analysis is a reliable, impartial, and scientific technique for evaluating and integrating disparate findings.

4. CHALLENGES FACING THE NIGERIA EDUCATIONAL SYSTEM

Given the value of education and its significance in a nation, Nigeria's strong demand for education should receive the attention it merits in order to raise the standard of its institutions relative to those worldwide. Nonetheless, there are a number of difficulties facing Nigerian higher education (Ogunode and Musa, 2020; Monday and Mallo, 2021), including:

Figure 1: Challenges of education in Nigeria

a. Inadequate Funding

According to Udida et al. (2009), a lack of funding is the main problem in educational growth. A major issue endangering educational systems' existence is the decreasing amount of public financing in response to growing demand and, consequently, rising higher education costs. The institution's expansion and work performance are impacted by this funding shortfall. Without finance, higher education institutions cannot function at their best. In order to maintain the pace and expansion of the education sector, this scenario need greater financial initiative from the government and educational partners.

b. Corruption

According to Ogunode (2020), one more issue impeding the efficient management of

Nigeria's public universities is corruption inside the educational system. Effective university management has been hampered by the high level of corruption at Nigeria's public institutions. The current state of many public colleges is a result of systemic corruption. The money allocated for programme development, personnel hiring, infrastructure provision, and programme execution was either pilfered or transferred into private accounts.

c. Inadequate Infrastructural Facilities

According to Udida et al. (2009), there has been a significant setback in the accomplishment of higher education goals due to the inadequate infrastructure in our institutions. In an establishment without sufficient classrooms, staff rooms, resource rooms, lab equipment, computers, and similar amenities, effective and efficient teaching and learning cannot take place. Inadequate facilities for infrastructure are a major issue facing the management of public institutions in Nigeria, according to Ogunode (2020).

d. Shortage of Academic Staff

According to Ahaotu and Ogunode (2021), there are significant differences between Nigerian universities and their international counterparts, with one main obstacle for administrators of higher education in Nigeria being the lack of academic and non-academic staff. Harvard University has a staff-to-student ratio of 1:4, Massachusetts Institute of Technology has a ratio of 1:9, and the University of Cambridge has a ratio of 1:3. According to Ogunode et al. (2020) and NEEDS (2014), insufficient lecturers provide a significant challenge to Nigeria's higher education institutions.

e. Strike actions

According to Okoli et al. (2016), it is now well known that students at Nigeria's universities are frequently subjected to labour actions carried out by the Academic and Non-Academic Staff Unions of different establishments. The impasse that typically interrupts the academic calendar is caused by the government and unions' disagreement or lack of understanding stemming from the non-implementation of the agreement struck.

f. Brain-drain

According to Ogunode (2020), the brain-drain issue is another issue impeding the efficient management of public institutions in Nigeria. The term "brain-drain" describes the exodus of experts seeking better employment opportunities in affluent nations from underdeveloped ones. A phenomenon known as "brain-drain" occurs when professionals leave their home nations in search of better opportunities elsewhere. In quest of better employment opportunities and more hospitable work environments, a large number of professors and researchers are departing public institutions in Nigeria and moving to other parts of Africa and Europe.

g. Poor Research

According to Okoli et al. (2016), given the issues Nigerian universities are now facing, it is critical to make research the centre of university education. Research conducted at higher education institutions helps people develop and in still the right values that are necessary for both individual and societal survival. These days, this job is burdened by governments' dismal attitudes towards research and their underfunding of research initiatives. In a similar vein, Okafor (2001) contended that university research is being hampered by a lack of funding and that there

is no sign that these issues will go away. Universities are expected to do research in order to further knowledge as well as to provide solutions to societal issues.

h. Insecurity

According to Ogunode (2020), insecurity is just another issue that Nigeria's public university administrators must deal with. Nigeria is experiencing a problem with insecurity, which has an impact on all of the nation's educational institutions. The Islamic group known as Boko Haram, which forbids Western education, is targeting educational establishments in northern Nigeria. In Northern Nigeria, several public colleges have been subjected to ongoing violence. Numerous educators, administrators, and students have died, and some have been abducted. Due to the numerous attacks on institutions, classes were closed, which resulted in an unstable curriculum.

5. MACHINE LEEARNING AND ARTIFICIAL INTELLIGENCE SOLUTIONS TO THE CHALLENGES

Machine learning and artificial intelligence have a big potential to change education in the future. We are departing from the one-size-fits-all approach with machine learning. Its flexibility in providing individualised courses makes it a useful teaching tool. Machine learning-enabled technologies assist in determining a person's present level of comprehension, pointing out areas where students still need to study, and offering immediate answers. Additionally, according to Jagwani (2019), the technology can pinpoint places where students outnumber instructors and design learning plans that have the greatest possible impact on the greatest number of pupils. These benefits and applications of ML and AI demonstrate how they are revolutionising the sector of education (Holmes et al., 2023). Figure 2 presents ML and AI solution to challenges of education

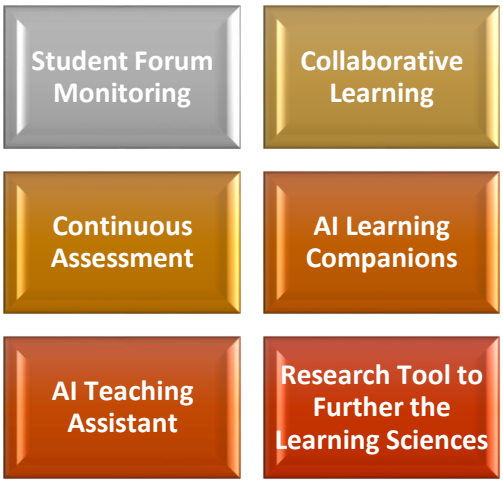

Figure 2: AI solution to challenges of education

1. Collaborative Learning

Though successful cooperation among learners can be challenging to establish, collaborative learning where students work together to solve problems is well-documented to be able to contribute to superior learning outcomes (Luckin, 2017). AI and ML provide a number of opportunities. Firstly, an AI tool could use individual student models each of which contains information about the student's past learning experiences and accomplishments, what the student is learning in other classrooms, their personalities, and more to intelligently connect and recommend groups of students best suited for specific collaborative tasks.

After gathering the teacher's requirements, the tool may also recommend mixed-or similar-ability student groups, groups that allow

specific students to assume leadership roles, groups that prevent personality or temperament conflicts, and so on. The tool also allows the teacher to quickly and easily override any of its recommendations, which the AI will consider for future use (Alberola et al., 2016).

2. Student Forum Monitoring

Students of all ages are engaging in online learning more and more, and this typically entails using discussion boards. In order to participate in collaborative learning opportunities or to respond to assigned assignments, students can post on forums. Alternatively, they can get in touch with their tutors with any questions they have regarding the course materials or the requirements. As a result, these online forums may produce enormous volumes of forum entries, all of which need to be watched over, regulated, and responded to, particularly when there are big cohorts of students (which can be characteristic of some distant colleges and MOOCs). But when more and more postings are made on forums, this becomes, at best, an ineffective use of a tutor's time (as they address small, recurring practical difficulties) and, at worst, an increasingly unachievable undertaking. Additionally, it makes it challenging for students to stay up to date on posts from other students that could be related to their interests.

Again, research has previously been done in this area. AI and ML may be helpful in many ways, but one manner in which they could be most helpful is in assisting instructors and tutors in providing greater assistance for their students (Goel and Joyner, 2017). The forum posts might first be sorted by an AI and ML tool to determine which ones can be answered automatically (perhaps useful inquiries about the dates of the course, like "When do I need to submit...") and which ones need to be answered by a human tutor (like those that go into greater detail about core subject matters). Simple posts, those that AI and ML can handle would be automatically responded to in a timely manner, sparing human instructors from a great deal of repetitive labour and allowing pupils to proceed more swiftly to more complex assignments. In order to guarantee that students, regardless of the type of post they make, receive suitable and high-quality replies, other submissions would be automatically forwarded to a human instructor.

3. Continuous Assessment

Psychologists and educators are aware that judgments should be based on a comprehensive, balanced knowledge of each student rather than a single test result. If we don't take the big picture into account, numbers and scores can be quite deceiving. To achieve this, we must use both a qualitative and quantitative approach (Gunzelmann, 2005).

Despite the paucity of data supporting their validity, reliability, or correctness, high-stakes exams remain an essential component of educational institutions worldwide. This could be due to a number of factors, including the fact that the systems are currently in place, the fact that they have always ranked students effectively, the lack of a workable, widely applicable alternative, or the fact that those in charge of the systems are usually the most successful test takers and do not personally feel that change is necessary. For whatever reason, because of the high-stakes tests, educational institutions all too frequently find

themselves teaching to the test, giving regular cognitive abilities and information acquisition precedence over in-depth comprehension and real-world application. Put another way, what is taught and learned is determined by the tests rather than by the requirements of the students or the larger community. Ironically, in the meantime, artificial intelligence (AI) technologies are automating precisely the knowledge that exams primarily evaluate: "There are many aspects of human intelligence that are not automatable, but one aspect that we have been able to automate is the part that we have tended to value, and that is related to passing academic exams." (Luckin, 2018a).

However, the majority of AI and ML research in this field has been modestly ambitious. Rather than questioning the fundamentals, it has concentrated on enhancing the current test systems (creating AI-driven methods to verify the identities of students taking examinations online). But as we've seen, standard Intelligent Tutoring Systems (ITS) and other AI and ML technologies already continuously track student progress in order to provide them personalised feedback and determine if they've mastered the material.

4. AI Learning Companions

The original motivation behind the creation of ITS was the desire for each student to have a personal instructor. However, what if we could carry this idea through to its inevitable conclusion? With AI, each student could have a personalized learning assistant that can act as a guide through the vast array of learning opportunities, an instructor, or a learning partner. All the while, the student's interests and progress would be recorded in a smart, blockchain-protected resume. The emergence and swift advancement of Siri, Cortana, Google Home, and Alexa indicate that this prospect is very near.

A learning partner like that opens up a lot of opportunities. After selecting a topic of interest, the student can use their speech-activated smartphone (as well as all of their other devices) to receive targeted feedback and guidance, track their progress, remind them when tasks need to be finished, and participate in some instructional activities. Put differently, it may serve as what we have referred to as an ITS+.

5. AI Teaching Assistant

As we have often stated, the majority of AI and ML technologies are created with the intention of freeing educators from the tedious tasks associated with teaching (usually by automating time-consuming tasks like grading homework or classroom assignments). But even with the best of intentions, a lot of AI and ML technologies effectively replace teachers by providing more personalised and tailored learning activities than they can, or at the very least, they relegate teachers to a functional role (perhaps their only responsibility is to follow rigidly defined procedures or make sure the technology is ready for students to use). However, as we and our colleagues have already stated: Notably, we do not envision a time when instructors are replaced by AI and ML. What we do see is a future in which the teacher's position will continue to develop and ultimately change; a future in which teachers' time will be spent more wisely and effectively, and in which their knowledge will be more effectively utilised, enhanced, and leveraged (Luckin and Holmes, 2017).

Corresponding Author Tel: +234 806 913 9936

This may be more of an emotive appeal than a reasoned argument, but it makes the assumption that teaching is a primarily social activity that entails more than just imparting knowledge. According to this viewpoint, one of AI's main functions is to assist professors in instructing and assisting pupils. This could be accomplished, for example, by enhancing teachers' knowledge and abilities with an artificial intelligence (AI) teaching assistant that would function in tandem with students' AI learning companion. This would go much beyond the helpful but comparatively basic teacher dashboards found in a lot of educational technology. This is a crucial way that ML and AI may help teachers help pupils. The short story "A.I. is the New T.A in the Classroom" explores this very idea by imagining a classroom of the future where the instructor is assisted by a devoted and customised AI Teaching Assistant (AI-TA).

6. Research Tool to Further the Learning Sciences

As has undoubtedly been observed, any potential application of AI and ML in the future is deeply anchored in current research and methodologies in these fields. This also applies to our last example, which is the application of ML and AI as research instruments to further the learning sciences. Any technology that is used to implement education must first be better understood before being systematised. Consequently, the technology functions akin to an electronic spotlight, drawing attention to problems that have been present for years but have been concealed or disregarded (such as those pertaining to the most efficient methods of instruction). This is especially true with regard to the integration of AI into education, which is starting to shine a very bright light on a number of learning sciences-related concerns. Though there have been significant advancements in this field of AI and ML research, most of them have been at a theoretical level, leaving their potential and ramifications rather unknown.

As learning sciences research tools, in reality, AI and ML are frequently associated with two additional distinct but related academic areas, learning analytics and educational data mining, that employ statistical methods derived from big data research (Luckin, 2018b). While educational data mining "is concerned with gathering and analysing data so as to understand, support, and improve students' learning," learning analytics is "the measurement, collection, analysis, and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs" (Siemens, 2011; Herodotou, 2017).

6. CONCLUSION

The use of artificial intelligence (AI) and machine learning (ML) in the field of education poses noteworthy obstacles in addition to encouraging prospects. The possibility of making already-existing disparities in access to high-quality education worse is one urgent issue. While AI and ML have the ability to improve educational results, tailor learning experiences, and optimise teaching strategies for all students, if not applied fairly, there is a chance that these technologies could increase the gap between affluent and marginalised groups. In addition, worries about data security, privacy, and moral ramifications emerge when sensitive student

data is gathered and used. To fully utilise AI and ML in education, these issues must be resolved in order to provide fair access, protect student privacy, and encourage appropriate technology use in the classroom.

This paper presents a review of implementing machine learning and artificial intelligence technology in the field of education to improve the educational sector and teaching/learning efficiency. In the study, systematic review and meta-analysis methodology was implemented for development which involves the development of inclusion and exclusion criteria, adoption of search strategy, selection of study, quality assessment and interpretation of the outcome. Then, from the review, the various challenges that face the Nigeria educational system such as funding inadequacies, corrupt academic operations, inadequate infrastructural facilities, shortage of academic staff, strike actions, insecurity, brain drain and poor research are presented. Finally, the ways in which machine learning and artificial intelligence can be assistive in solving these challenges such as collaborative learning, monitoring of student forum, continuous assessment, artificial intelligent learning companion and teaching assistants and a research tool to improve further learning sciences are also identified. Based on the identified situations in the paper, it is recommended that the ML and AI approach is adopted in the educational sector in order to improve equity and inclusion in education, serve as ethical frameworks and guidelines in teaching and learning, make empirical impacts in AI, develop the teacher professions effectively, preservation of privacy, engage stakeholders and make long term impacts in the educational system.

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