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# Artificial Intelligence and Curriculum Development: Implication for Basic Science Education

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## Abstract

The meteoric rise of artificial intelligence (AI) has sent shockwaves through society on both economic and cultural levels. Seemingly poised to become as ubiquitous as email, this rapidly evolving technology is transforming many aspects of teaching and learning. Due to its growing significance, the writer has researched on AI technologies to offer personalized learning guidance and support for individual students in a variety of courses, including engineering, computer science, science education, informatics and philosophy of education and many more. AI technologies have evolved thus far as the writer addressed the promise and challenges they present. The writer maintained that artificial intelligent systems can achieve tasks that are universally associated with human reasoning such as interpreting speech, playing games and identifying patterns. They typically learn how to do so by processing massive amounts of data, looking for patterns to model in their own decision-making. In many cases, this work observed that human beings are always in charge of AI's learning process, reinforcing good decisions and discouraging bad ones. Thus the Ministry of Education has proposed the inclusion of robotics and artificial intelligence in post basic and secondary education curricula in the academic system to help in standardizing some of the teaching and learning processes aimed at aligning students to 21st century technological advancement so as to improve the educational standards of students which is in line with UNESCO framework. This work also states that when incorporating artificial intelligence (AI) into Basic Science Education and curriculum development, despite the numerous advantages it offers, ethical issues should be considered. The work also maintained that when implementing AI-powered assessment systems, it is imperative to take into account the fundamental principles of privacy, fairness, transparency, and accountability. In Conclusion, there is need to make commitment towards making sure that artificial intelligence technologies is critically looks into before its utilisation on Basic Science Education and curriculum development in Nigerian schools

## Introduction

In recent years, the meteoric rise of artificial intelligence (AI) has sent shockwaves through society on both economic and cultural levels. Seemingly poised to become as ubiquitous as email, this rapidly evolving technology is transforming many aspects of daily life including how we teach and learn. Due to its growing significance, researchers have recently adopted AI

technologies to offer personalized learning guidance and support for individual students in a variety of courses, including engineering, computer science, informatics and philosophy of education (Kose 2015), and many more. Because AI technologies are constantly evolving, the educational community is addressing the promise and challenges they present.

premised on above submission, recently the Federal Government of Nigeria through its ministry of education proposed the inclusion of robotics and artificial intelligence in post basic and secondary education curricula in the academic system to help in standardizing some of the teaching and learning processes aimed at aligning students to 21st century technological advancement as to improve the educational standards of the nation. This was expected to begin with the Basic Science and Technology Curriculum, (BSTC) to enable the learners develop interest in Science and Technology. In this vein, a significant pupil knowledge improvement will be achieved, as it is expected to broaden the horizon of pupils in public schools and prepare them for the knowledge driven global economy.

Integrating artificial intelligence in the Basic Science and Technology Curriculum (BSTC) would expose an average secondary school student to the opportunities enjoyed by counterparts in private schools, thus gaining skills relevant for life in this changing world. However, the challenges of academic corruption, school politics, policies and other bureaucratic discrepancies arising from underfunding in government schools may to a great extent jeopardize its successful integration if not properly managed.

Phoebe & Keith (2017) observed that variety of tools and applications, including intelligent tutoring systems, teaching robots, adaptive learning systems, and other emerging technologies being integrated with AI for various learning supports, are currently used by students and educators in institutions of higher learning. AI technologies with their flexibility, effectiveness, and realization of individualized learning for students to fulfill their specific needs. Techniques from AI and soft computing are being used in various aspects of our lives to address pressing issues (Khan, et al., 2018). Salem (2015) identified seven key areas of AI in education, including intelligent educational systems, teaching aspects, learning aspects, cognitive science, knowledge structure, intelligent tools, shells, and interfaces. Intelligent tutoring systems, educational robotics, and multimedia systems make up the Intelligent Educational Systems.

### **What is Artificial Intelligence (AI)?**

The writer sees AI technology in general terms as machines which execute tasks that have traditionally required human cognition. AI-powered programmes and devices can make decisions, solve problems, understand and mimic natural language and learn from unstructured data. Open AI's release of ChatGPT-a natural language processing chatbot in the fall of 2022 brought AI too many people's attention for the first time. However, AI tools have been part of the tech landscape for years. If you have ever played chess against a bot, consulted a virtual assistant like Siri or Alexa or even scrolled through your social media feed, you have already interacted with artificial intelligence. According to Bali (2024), artificial intelligence (AI) refers to the creation of computer systems capable of performing tasks that historically only human beings could do, such as reasoning, making decisions, or solving problems. It is also the mechanical stimulation of human intelligence processes especially computer systems. Specific

application of AI includes expert systems, natural language processing, speech recognitions, and machine visions. Artificially intelligent systems can achieve tasks that are universally associated with human reasoning such as interpreting speech, playing games and identifying patterns. They typically learn how to do so by processing massive amounts of data, looking for patterns to model in their own decision-making. In many cases, human beings supervise an AI's learning process, reinforcing good decisions and discouraging bad ones, but some AI systems are designed to learn without supervision. Artificial intelligence enables educators to create and update content more efficiently and effectively, ensure learning materials are always up to date and relevant. For the students, it helps them to stay informed on latest developments around the world and prepare them for future challenges.

### **Curriculum development**

Curriculum development is where an educator plans learning activities and assessments that create meaningful and engaging learning experiences. The goal of curriculum development is to deliver high quality lesson that help students achieve set learning outcomes. With input from their department, educators plan units of study, design evidence based teaching practices to engage students, and select courses reading and exercises to meet the needs of the students with various interests and abilities. Curriculum development includes crafting learning outcomes, assessments and activities to create high quality course experiences. This multi-step-process may also include amending the existing course shell created by previous instructors. There are three widely accepted models for curriculum development including subject-centered, teacher-centered and learner-centered.

The above statement means that the school curriculum is a dynamic and open document that is constantly changing with the needs, challenges and aspirations of the society. That is why Federal Government of Nigeria (FGN) through its ministry of education has proposed the inclusion of robotics and artificial intelligence in post basic and secondary education curricula in the academic system to help in standardizing teaching and learning processes aimed at aligning students to 21st century technological advancement. To improve the educational standards of the nation in line with UNESCO framework of the Beijing Consensus, Holmes (2023) a publication aimed at fostering the readiness of education policy-makers in artificial intelligence. This publication, *Artificial Intelligence and Education: Guidance for Policy-makers* aimed at practitioners and professionals in the policy-making and education communities to generate a shared understanding of the opportunities and challenges that AI offers for education, as well as its implications for the core competencies needed in the AI era through curriculum development in Nigeria

On this note, the writer maintains that every learner who has gone through the 9 years of basic education should have acquired appropriate levels of literacy, numeracy, manipulative, communicative and life skills; as well as the ethical, moral and civic values needed for laying a solid foundation for a life-long learning; as a basis for scientific and reflective thinking. Here, it is of interest to examine the rationale, objectives and structure of the Basic Science and Technology Curriculum as a typical case of what the federal government of Nigeria desired to achieve which was a composite or cluster subject in the Revised 9-Year BEC. The BSTC (revised, 2012) is a product of the restructuring and integration of four Primary and Junior Secondary School (JSS) BEC, namely: Basic Science, Basic Technology, Physical and Health

Education, and Computer Science/Information Technology (IT). The integration of these science curricula became necessary for the following reasons:

- a) Need to encourage innovative teaching and learning approaches and techniques that promote creativity and critical thinking in learners;
- b) Need to promote the holistic view of science at the Basic Education level for better understanding of contemporary and changing world.

### **Objectives of Basic Science and Technology Curriculum**

The Basic Science and Technology Curriculum, BSTC (Revised: 2012) is expected to enable the learners: Develop interest in Science and Technology;

- a) Acquire basic knowledge and skills in science and technology;
- b) Apply scientific and technological knowledge and skills to meet contemporary societal needs

Further to these, the Federal Government of Nigeria through NERDC has produced very detailed teachers guides in each of the ten subjects for effective implementation of the Revised 9-Year BEC. The teachers guide in each subject covers the following seven (7) units on how to:

### **Understand the revised curriculum with the AI insight;**

- a) Break the curriculum into syllabus, scheme of work, unit of work and lesson plan;
- b) Plan lesson using Modern Teaching Approaches;
- c) Teach topics and concepts that learners find difficult to learn;
- d) Find, access and develop resources for teaching; and
- e) Assess learners in each subject area.

### **Specific innovative classroom practices illustrated in the teachers' guides include:**

- a) Purposive learner-learner; teacher-learner and school-school collaborations;
- b) Deployment of ICT and other technologies to support learning;
- c) Quality interactions (learner-learner, learner-teacher, learner-resource material interactions) taking place in the classroom;
- d) Issues arising from the learners' environment as the focus of teaching and learning activities.

These measures are being taken to ensure effective delivery of the curriculum and hence make artificial intelligence (AI) technologies in curriculum provides valuable insights based on data, which can be utilized to inform instructional strategies and facilitate decision-making processes. Through the examination of extensive datasets, artificial intelligence (AI) systems possess the capability to discern trends, patterns, and correlations pertaining to the academic performance of students. Consequently, Wilson & Thomas (2021) opined that educators are empowered to acquire significant insights into the areas of proficiency and areas of improvement exhibited by their students. These insights have the potential to inform the design and implementation of focused interventions, curriculum improvements, and individualized learning strategies, ultimately leading to enhanced educational outcomes.

In addition, ethical considerations must be taken into account when incorporating artificial intelligence (AI) into curriculum development, despite the numerous advantages it offers. When implementing AI-powered assessment systems, it is imperative to take into account the fundamental principles of privacy, fairness, transparency, and accountability. Ensuring the security of data, safeguarding the privacy of students, and mitigating potential biases inherent in artificial intelligence (AI) algorithms are imperative (Adams & Johnson, 2023). The responsible utilization of artificial intelligence (AI) in the curriculum development necessitates meticulous supervision, continuous evaluation and adherence to ethical principles.

### **Impacts of AI in Basic Science and Technology Curriculum (BSTC)**

The importance of Basic Science Education and Technology curriculum in schools is vital in developing the cognitive and practical abilities of students. It acts as a basis for developing a more profound comprehension of the natural world, promoting the development of critical thinking, problem-solving, and analytical skills. Science education provides students with the necessary information and abilities to manage a world that is becoming more intricate and reliant on technology (Okeke, 2017). In Nigeria, where there is a growing need for Basic Science and Technology Curriculum (BSTC) personnel, it is crucial to have a strong scientific education system. It not only fosters the growth of a population knowledgeable in science, but also tackles the difficulties presented by worldwide progress and creativity. Science education has a significant impact beyond just academic success. It shapes job decisions, promotes inquisitiveness, and cultivates a scientific attitude that is crucial for tackling social problems, promoting creativity, and contributing to the progress of a society (UNESCO, 2021).

The use of Artificial Intelligence (AI) in Basic Science and Technology Curriculum (BSTC) has several potential advantages. AI technologies have the ability to customise learning experiences, tailoring them to the specific needs and learning preferences of each individual learner. This flexibility facilitates the accommodation of a wide range of student's capabilities and promotes a more inclusive educational setting. Furthermore, AI-driven technologies enhance dynamic and captivating learning experiences by integrating simulations, virtual experiments, and practical applications. This not only improves students' understanding of scientific topics but also ignites curiosity and excitement for the subject. Moreover, AI has the capability to promptly offer feedback to both students and teachers, facilitating quick intervention and adaptation of teaching tactics (Ross and Kim 2018). This feedback loop enhances the efficiency and effectiveness of the teaching and learning process. In Nigeria, where access to high-quality education may vary, the potential advantages of AI in scientific education include narrowing educational disparities, enhancing educational achievements, and equipping students for a future when technology is more integrated into every part of life. The use of AI in Basic Science and Technology Curriculum (BSTC) is very pertinent to the Nigerian educational system as it corresponds with national objectives and ambitions. Nigeria, along with several other nations, is now progressing towards technical progression and economic growth. In order



to ensure sustainable development, it is crucial to have a skilled and knowledgeable workforce that is equipped with the necessary technology.

Nigeria can cultivate a cohort of students curriculum planners that have the expertise in both conventional scientific ideas and advanced technology by integrating AI into Basic Science and Technology Curriculum (BSTC). This is in line with the government's educational strategy, which prioritises (BSTC) courses and technical literacy in the national curriculum (Smith, 2018). Furthermore, the significance of AI in Nigerian schools encompasses the resolution of issues such as overcrowded classrooms, inadequate resources, and unequal allocation of educational facilities (Stoeffler et al., 2019). AI technology can offer scalable solutions, guaranteeing the accessibility of high-quality scientific education in many geographical and socio-economic settings. AI in Basic Science and Technology Curriculum (BSTC) in Nigeria is not just about improving educational procedures, but also about strategically equipping students for a future where science, technology, and innovation play a crucial role in social advancement and wealth.

The writer is still learning how AI technologies will be integrated into the curriculum as they develop, and do not yet have a full picture of how AI will affect critical issues of ethics, equity and data safety. However, the writer has observed that from 2013 to 2024, the trend accelerated. Globally, the trend towards integrating AI tools into educational systems. This includes the use of AI for content delivery, personalized learning experiences, and adaptive learning platforms, to tailor educational content to individual students' needs, helping them learn at their own pace hybrid models (Gbolagade et al., 2015). The implementation of AI-powered chatbots and virtual assistants in education started gaining traction during this period. These tools were used for answering student's queries, providing information, and facilitating communication within educational institutions (Idris, 2020; Kelechi, 2021).

In addition, Gbolagade (2015); Oguine. (2022), maintained that the impact is on data analysis and decision-making: Educational institutions began leveraging on AI for automated data analytics to make informed decisions in teaching processes. AI technologies, such as machine learning algorithms were applied to analyzing student's performance data, assessment processes, and consistent evaluation in a short time. The last stage was characterized by a rapid growth phase from 2017 to 2023, during which the number of research publications increased in comparison to earlier stages as a result of the increased use of AI technology. Most of their notable AI studies related to the study have increased significantly during the past few years.

The trend analysis demonstrates that there is a growing body of knowledge about the use of AI technologies in education. The examination of AI technology trends in publications in the education sector reflects changes in interest and production as well as advancements in science on a worldwide scale and sector development patterns. In general, an increase in publications typically indicates that the field's global science system is growing.

### **Benefits of integrating AI into curriculum in Nigeria**

Salem (2015), states that the need to match our economy with the western counterparts is eminent in this fast developing world. To achieve this, the background of our education system needs to be redefined, reviewed and fine-toned to meet the global economic demands, to this

extent, depriving students the knowledge to leverage on artificial intelligence either consciously or unconsciously, will have negative impact on the society at large. The dangers of this, are stated but not limited to:

**Economic inequality;** - Recently in Nigeria, employees who are not computer literates are employed with low grade salaries and often times considered as unskilled, even to find a job becomes very excruciatingly difficult for such employees. But with the knowledge of computer and other AI knowledge and competences, getting good job becomes very easy even with the scarce job opportunities. Lack of AI knowledge will always increase salary or wage inequalities and restrict social mobility for employees in this AI driven job market.

**Digital divide:** Non-inclusion of artificial intelligence in our educational system will short change and limit the students' knowledge and the dexterity to manipulating or navigating artificial intelligence driven technologies in daily operations; even accessing digital information, participating perfectly and efficiently in online discussions becomes so cumbersome for them, which is absolutely unacceptable in this digital world.

**Wider skills gap;** - In this digital world, the knowledge and demand for artificial intelligence is extremely significant. Non-inclusion of AI in our education system will negatively increase the skill gaps, which will adversely affect business, industries and organizations in AI driven economy in getting the required skills and talents needed to complete in the global economy.

**Loss of creativity and innovation:** – Adequate AI knowledge will impact positively on workforce in all fields of endeavour, create more active creative problem-solving and innovative solutions. To this end, non-inclusion of AI in Nigeria education system will generate a huge challenge of losing great insights and ideas of creativity and innovation in our economic development in this digital world.

## Challenges

As for the downsides, AI technologies come at a great cost, not every nation can meet the expense (Iqbal et al., 2020). Another bottleneck is that applying AI in a curriculum can create a lot of difficulties (Lexcelent, 2019). That is to say that before moving towards artificial intelligence, challenges like lack of monetary resources, lack of interest on the part of administrations, lack of knowledge about successful involvements in the field, and lack of studies addressing assertions must be deliberated and resolved. Considering the significance of developing technology in tutoring and learning, Nigeria is still far from adopting it. The effective integration of AI technologies into teaching and learning is hampered by several issues. Epileptic power supply, lack of knowledge or skills, problems with availability and accessibility, funding, inadequate professional development, disinclination to change, unreliable internet connections, and so on to name a few. Actors and stakeholders in the education sector like educators, policymakers, curriculum planners and students can all work together to overcome these obstacles (Enang, 2022). AI algorithms and systems have been increasingly popular and well-known in recent times, particularly in the field of education. At many educational installations, tablets have largely taken the role of books in the learning process and internet-based learning

has become more common (Kairouz et al., 2021). Digital tools have transformed education and made learning more active and independent. New technology has also changed the way people communicate, so and educators must find new ways to inspire learners and adapt to this new century.

### **Conclusion**

There is need to renew this commitment toward an era in which artificial intelligence, a convergence of emerging technologies is transforming every aspect of basic science education and curriculum development, and researchers, teachers and students need to steer this revolution in the right direction. To improve livelihoods and promote basic science and technology education for inclusive globalization is critically necessary.

### **Recommendations**

The writer recommends among others, that schools in Nigeria should adopt some of the best practices of some of the world's most advanced nations that encourage the use of AI in Basic Science and Technology education, enhance student's learning opportunities, and boost student engagement. There should be more focus on implementing educational software using AI techniques like Data mining techniques and machine learning approaches.

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