

ARTIFICIAL INTELLIGENCE IN BASIC SCIENCE EDUCATION: A NIGERIAN PERSPECTIVE ON ENHANCING ASSESSMENT

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ABSTRACT

This study focused on the potential of Artificial Intelligence (AI) in enhancing assessment in Basic Science Education in Taraba State, Nigeria. Three research questions guided the study. The study adopted descriptive survey research design. The population for the study comprised 1449 Basic science teachers. The sample size of 150 and a Simple random sampling technique was applied in selecting 20 schools in Jalingo Education zone. A structured questionnaire titled 'Artificial Intelligence Basic Science Assessment Questionnaire (AIBSAQ)' was used as the instrument with reliability index of 0.86 obtained from Cronbach Alpha statistical measure. The research questions were answered using mean and standard deviation. The study highlights the potential benefits of AI tools in improving assessment practices, but also highlights challenges such as lack of training, high costs, and inadequate infrastructure. It underscores the need for science educators and policymakers to address these limitations and contribute to ongoing research on AI in education. The report recommends that science educators receive training to effectively use Artificial Intelligence tools in their assessments, and that policymakers should develop and implement AI-based assessment tools.

Keywords: Artificial Intelligence, Basic Science Education, Assessment, Nigeria, Education Technology

INTRODUCTION

Basic science is the study of the nature and behaviour of natural things and the knowledge that we obtain about them. According to Okolo (2018), basic science is the study of science in a way that presents scientific concepts as a cohesive whole. Basic Science education in Nigeria is essential for enhancing students' understanding of scientific concepts and developing critical thinking and problem-solving skills. It serves as a foundation for advanced studies in technology and science-related fields, aligning with the National Policy on Education (FRN, 2020). Recent research by Nicolaou and Petrou (2023) highlights the Basic Science curriculum's role in preparing students for a technologically advanced future, particularly through the integration of Artificial Intelligence (AI).

Artificial intelligence (AI) involves developing computer systems that perform tasks requiring human intelligence, such as learning, problem-solving, and decision-making. According to Pedro et al. (2019), AI simulates human intelligence processes through learning, reasoning, and self-correction. The impact of AI extends beyond specific industries, significantly affecting contemporary societies (Brynjolfsson & McAfee, 2014). This shift presents both opportunities and challenges in education, highlighting the need for institutions to prepare students with relevant skills as automation and AI-driven processes become more prevalent (EdSurge, 2018).

In order to promote innovation and meet the changing needs of the workforce, there is a growing awareness on a global scale that AI must be incorporated into education (UNESCO, 2019). Numerous nations are experimenting with AI-powered educational technologies,

with a focus on developing critical thinking, problem-solving, and adaptability skills—all of which are necessary for succeeding in the Fourth Industrial Revolution (Schleicher, 2018). Artificial intelligence (AI) has been increasingly integrated into various aspects of science education, including assessment, to enhance teaching and learning experiences. In Basic science education, AI technology could be utilized to create personalized and adaptive assessment tools that cater to the individual learning needs of students. By utilizing AI in assessment, science educators can gain valuable insights into student performance and tailor instructional strategies accordingly (EdSurge, 2018). This will enhance assessment activity, providing effective feedback and motivating teachers to identify students' need in the subject. However, the implementation of AI in Basic science education in Nigeria is still in its nascent stages (Olatunde-Aiyedun & Hamma, 2023), warranting further research to explore its potential benefits and challenges. There is growing agreement that integrating AI technology into education will enable teachers conduct assessment and support students' self-directed learning (Caswell & LaBrie, 2017, Connolly, Logue & Calderon, 2023). This implies that the technology could bring about improvement in teaching and learning outcomes in Basic science as well as foster creativity in understanding concepts and collaborations.

Statement of the Problem

Despite efforts by Basic science teachers to explore all assessment options on students, it is still obvious that science education in Nigerian secondary schools encounters a complex array of obstacles that impede teachers' efforts and effective operations. The traditional assessment methods in Basic science education in Nigeria are often subjective, time-consuming, and limited in scope. The adoption of Artificial Intelligence (AI) -driven assessment tools could address these challenges, but research has shown that the effectiveness of AI in enhancing assessment in Basic science is understudied. It is against this background that this study seeks to explore the potential of AI in enhancing assessment in Basic Science Education in Taraba State, Nigeria.

Purpose of the study

The main purpose of the study is to explore the potentials of Artificial Intelligence (AI) in enhancing assessment in Basic Science Education in Nigeria. Specifically, the study intends to:

- i. Assess the perceptions of Basic Science teachers regarding the use of Artificial Intelligence tool for assessment in Basic science education
- ii. Examine the impact of Artificial Intelligence tool on assessment practices in Basic science education in Taraba State
- iii. Identify the challenges in implementing Artificial Intelligence technology for assessment in Basic science

Research Questions

The following research questions were raised to guide the study:

- i. What are the perceptions of Science educators regarding the use of Artificial Intelligence tool for assessment in Basic science education?
- ii. What is the impact of Artificial Intelligence tool on assessment practices in Basic science education in Jalingo metropolis, Taraba State?

- iii. What are the challenges and limitations in implementing Artificial Intelligence technology for assessment in Basic science?

Literature Review

Artificial intelligence (AI) is being integrated into basic science education in Nigeria to enhance assessment practices and improve student outcomes. Research indicates that AI technologies, like machine learning and natural language processing, can personalize feedback, increase student engagement, and improve performance. Studies by Adekunle et al. (2020) and Agarry et al. (2022) highlight the effectiveness of AI-powered assessment tools and reveal that while some students are proficient in using AI for learning, many lack the necessary skills. Additionally, research by Onyema et al. (2019) emphasizes the role of mobile devices in stimulating learner interest, while Okeke and Obinna (2019) show that AI-based grading systems offer more accurate and consistent evaluations than traditional methods, promoting fairer assessments of students' knowledge and skills.

Even though AI has the potential to improve assessment practices in basic science education, there are significant concerns about privacy, bias, and ethical issues. Adegbite and Adebisi (2021) emphasized the importance of having transparent and accountable AI systems that protect student data and avoid biases in the assessment processes. Tackling these challenges is essential for fostering trust in AI technologies and encouraging their responsible application in education. Additionally, it is important to recognize that one of the major hurdles faced by users of Artificial Intelligence is inconsistent electricity supply (Nnamdi & Nwanyanwu, 2021). A reliable power source is vital for effectively operating AI applications, which are increasingly important in modern technology. This technology depends heavily on computational processes, and regular power outages hinder the smooth functioning of AI tools, rendering them unreliable for assessments in basic science education.

The current landscape of AI adoption in the Nigerian education sector is intricate, as noted by Afolabi and Oluwatimilehin (2021), even though discussions surrounding AI integration are becoming more prominent on a global scale. Empirical research has not thoroughly explored the effectiveness and challenges associated with incorporating AI into specific academic fields, particularly in science education.

In conclusion, the literature review reveals a rising enthusiasm for utilizing AI to improve assessment practices in basic science education in Nigeria. Future studies should aim to investigate innovative AI-driven assessment tools, consider ethical implications, and assess the long-term effects of AI on student performance in science subjects.

METHODOLOGY

The study utilized a descriptive survey research design to gather data through a questionnaire. The population comprised 1,449 Basic Science teachers in the Jalingo Education zone, with a sample size of 313 determined using the Taro Yamane formula. A structured questionnaire titled 'Artificial Intelligence Basic Science Assessment Questionnaire (AIBSAQ)' was employed for data collection, consisting of four sections: Section A gathered demographic information such as academic qualifications and years of teaching experience. Section B included 10 items on the "Impact of AI on Assessment Practices." Section C contained 10 items on the "Perceptions of Science Educators." Section D focused on the "Challenges and Limitations in Implementing AI Technology for Assessment." Responses were rated on a four-point scale, and mean values of 2.50 and

above were considered 'accepted,' while values below 2.49 were deemed 'rejected.' Mean and standard deviations were used to analyze the responses and address the research questions.

Results

The results are presented based on the research questions.

Research Question one: What are the perceptions of Science educators regarding the use of Artificial Intelligence tool for assessment in Basic science education?

Table 1: Statistical mean and standard deviation on Perceptions of Science educators on the use of Artificial Intelligence tool for assessment in Basic science education, N= 150

S/N0	Items	Mean	SD	Decision
1.	How would you rate your confidence in using AI for assessment in Basic Science education?	3.35	0.79	Accepted
2.	To what extent do you agree that AI improves the validity of assessment results in Basic Science education?	3.31	0.67	Accepted
3.	To what extent do you agree that high costs limit the adoption of AI in Basic Science assessment?	2.94	0.94	Accepted
4.	How would you rate your willingness to adopt AI for assessment in Basic Science education?	3.26	0.73	Accepted
5.	To what extent do you perceive AI-based assessment tools as being able to reduce the workload of teachers in grading and assessing student assignments?	3.16	0.98	Accepted
6.	How would you rate your satisfaction with AI-based assessment tools?	3.10	0.88	Accepted
7.	Do you agree that AI improves teacher professional development?		3.53	0.76 Accepted
8.	How would you rate AI's potential for automating grading?	2.95	0.78	Accepted
9.	To what extent do you agree that AI-based assessment tools can enhance the accuracy of evaluating student learning outcomes	3.22	0.92	Accepted
10.	To what extent do you think AI enhances teacher-student interaction?		3.29	0.77 Accepted

Table 1 shows Statistical mean and Standard deviation on perceptions of Science educators regarding the use of Artificial Intelligence tool for assessment in Basic science education. The Table shows that the participants' responses indicate that the mean value of all the

identified items were within the acceptable range. Based on the results presented in Table 1, it can be concluded that science educators generally have a positive perception of using Artificial Intelligence (AI) tools for assessment in Basic Science education. The mean scores for all items are above 2.5, indicating a level of agreement and acceptance among the respondents. Findings of the study indicate that science educators generally have a positive perception of using Artificial Intelligence (AI) tools for assessment in Basic Science education

Research Question Two: What is the impact of Artificial Intelligence tool on assessment practices in Basic science education in Jalingo metropolis, Taraba State?

Table 2: Statistical mean and standard deviation on Impact of Artificial Intelligence tool on assessment practices in Basic science education, N=150

S/N0	Items	Mean	SD	Decision
1.	To what extent has AI improved the accuracy of assessment results in Basic Science education?	3.49	0.81	Accepted
2.	How effective is AI in reducing assessment bias in Basic Science education?	2.92	0.89	Accepted
3.	To what extent has AI enhanced the efficiency of assessment processes in Basic Science education?	3.07	0.76	Accepted
4.	To what extent does AI enhance the objectivity of assessments in Basic Science education?	3.36	0.83	Accepted
5.	To what extent has AI facilitated personalized assessment in Basic Science education?	2.81	0.99	Accepted
6.	What is the extent of AI's ability to provide immediate feedback to students in Basic Science education?	3.47	0.85	Accepted
7.	How would you rate the impact of AI on improving student engagement in assessments?	3.27	0.79	Accepted
8.	To what extent does AI facilitate the use of multimedia resources in assessments?	3.37	0.91	Accepted
9.	How would you rate AI's impact on reducing assessment time?	2.98	0.89	Accepted
10.	To what extent does AI provide insights into student learning behaviour?	3.48	0.68	Accepted

Table 2 shows Statistical mean and Standard deviation on the Impact of Artificial Intelligence tool on assessment practices in Basic science education. Based on the results presented in Table 2, it can be concluded that Artificial Intelligence (AI) tools have a positive impact on assessment practices in Basic Science education. The mean scores for all items are above 2.5, indicating a level of agreement or acceptance among the respondents. Findings from the study revealed that Artificial Intelligence (AI) tools have a positive impact on assessment practices in Basic Science education.

Research Question Three: What are the challenges and limitations in implementing Artificial Intelligence technology for assessment in Basic science?

Table 3: Statistical mean and standard deviation on challenges and limitations in implementing Artificial Intelligence technology for assessment in Basic science, N=150

S/N0	Items	Mean	SD	Decision
1.	To what extent do you agree that lack of training hinders effective use of AI in Basic Science assessment?	3.03	1.06	Accepted
2.	How would you rate the availability of AI-compatible infrastructure in your school	3.03	0.85	Accepted
3.	To what extent do you agree that high costs limit the adoption of AI in Basic Science assessment?	2.91	0.97	Accepted
4.	How would you rate the reliability of AI-generated assessment results?	3.17	0.77	Accepted
5.	To what extent do you agree that lack of standardization hinders AI-based assessment in Basic Science?	3.09	0.92	Accepted
6.	To what extent is inadequate infrastructure a challenge for AI-based assessments?	3.10	0.94	Accepted
7.	How would you rate the difficulty in integrating AI technology into existing assessment systems?	3.45	0.88	Accepted
8.	To what extent is lack of technical support a challenge in Basic Science assessment?	3.11	0.88	Accepted
9.	What is the extent of concern regarding AI replacing human teachers?	3.21	0.79	Accepted
10.	What is the extent of concern regarding AI bias in assessments?		2.87	0.91
	Accepted			

Table 3 shows Statistical mean and Standard deviation on challenges and limitations in implementing Artificial Intelligence technology for assessment in Basic science. Based on the results presented in Table 3, it can be concluded that there are several challenges and limitations in implementing Artificial Intelligence (AI) technology for assessment in Basic Science education. The mean scores for all items are above 2.5, indicating a level of agreement or acceptance among the respondents.

Discussion of findings

The first findings of the study indicate that science educators generally have a positive perception of using Artificial Intelligence (AI) tools for assessment in Basic Science

education. The findings of the study agree with the findings of Adekunle et al., (2020) whose study revealed that found that AI-based assessment methods not only saved time for educators but also improved students' engagement and performance. The finding of this study also agrees with the findings of Okeke and Obinna (2019) whose study investigated the use of AI in grading and scoring assessments in Basic science education and revealed that AI-based grading systems could provide more accurate and consistent evaluations compared to traditional manual grading methods. The findings of this study have implications for the adoption and implementation of AI tools in Basic Science education. Science educators' positive perceptions of AI tools suggest that they are willing to adopt and use these tools in their teaching practices.

The second finding of the study revealed that Artificial Intelligence (AI) tools have a positive impact on assessment practices in Basic Science education. The finding of this study agrees with the findings of Agarry et al., (2022) whose findings revealed how proficient students were at using Artificial Intelligence tool to learn and in responding to assessments. The findings of this study have implications for the adoption and implementation of Artificial Intelligence tool in Basic Science education.

Finally, the findings of the study revealed that there are several challenges and limitations in implementing Artificial Intelligence (AI) technology for assessment in Basic Science education. The finding of this study agrees with the findings of Nnamdi and Nwanyanwu (2021) who found that one of the most fundamental challenges faced by Artificial Intelligence users is erratic supply of electricity. The findings of this study have implications for the adoption and implementation of AI technology in Basic Science education as the challenges and limitations identified in this study implies that science educators and policymakers need to consider addressing these issues to ensure the effective and efficient use of AI in Basic science assessment.

CONCLUSION

Based on the findings of this study, science educators have positive perceptions of Artificial Intelligence tools for assessment in Basic Science education. This implies that science educators are open to adopting and using AI tools to improve assessment practices. Furthermore, Artificial Intelligence tools have a positive impact on assessment practices in Basic Science education, including improving accuracy, efficiency, and objectivity. It implies that AI tools can be a valuable addition to existing assessment methods.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. In order to address the favorable opinions about Artificial Intelligence tools, Science educators should be given the assistance and training they need to successfully incorporate Artificial Intelligence tools into their assessment procedures. This could include workshops, online courses, or peer mentoring programs.
2. To leverage the positive impact of Artificial Intelligence on assessment practices, science educators and policymakers should develop and implement AI-based assessment tools that can improve accuracy, efficiency, and objectivity. This could involve collaborating with AI developers or researchers to create customized assessment tools.

3. To overcome the challenges and limitations identified in the study, educators and policymakers should prioritize addressing issues such as lack of training, high costs, and inadequate infrastructure.

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