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ARTIFICIAL INTELLIGENCE ADOPTION AND SENIOR SECONDARY BIOLOGY STUDENTS' ACADEMIC PERFORMANCE IN PORT-HARCOURT METROPOLIS

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ABSTRACT

The study investigated artificial intelligence adoption and senior secondary Biology student's academic performance in Port-Harcourt Metropolis. The study was guided by three specific objectives and three corresponding research questions. The study adopted a descriptive survey research design with a population of 8321 SS II Biology students from 31 public secondary schools in Port-Harcourt Metropolis. The sample for the study consisted of 382 students determined using Taro Yamen formula. The respondents were randomly selected drawing 13 SS2 Biology students from each of the 31 schools, resulting in a total of 403 respondents. The instrument for data collection was a questionnaire titled "Artificial Intelligence Applications and Academic Performance Questionnaire (AIAPQ)"structured on a four-point rating scale. The instrument was validated by three experts and had an overall reliability coefficient of 0.82 established using Cronbach Alpha. Data were collected from 375 students, representing a 93% return rate, and analyzed using frequency count and criterion mean of 2.50. The results revealed that the extent of utilization of artificial intelligence among biology students was low with a grand mean of 2.32. Similarly, the adoption of AI on continuous assessment scores and examination scores was also low with grand means of 2.45 and 2.48 respectively. Based on these findings, it was recommended that schools should develop comprehensive digital literacy programs to enhance students' utilization of AI tools for biology learning, teachers should incorporate AI-enhanced learning activities into their continuous assessment framework, and educational stakeholders should develop structured examination preparation programs that leverage AI applications to improve students' performance in biology examinations.

Keywords: Artificial Intelligence, Adoption, Biology Students, Academic Performance, Secondary School

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INTRODUCTION

Artificial Intelligence (AI) is one of the most transformative technological advancements in modern education. It is defined as computer systems capable of performing tasks that typically require human intelligence (Grewal, 2014; Wang, 2019). AI has application in various sectors. In the educational sector, AI has application in various areas including intelligent tutoring systems, adaptive learning applications, virtual laboratories, and educational chatbots that provide personalized learning experiences (Sajja, Sermet, Cikmaz, Cwiertny & Demir, 2024). The integration of AI technologies in education has gradually increased globally, with educational systems increasingly recognizing their potential to address longstanding pedagogical challenges. These technologies offer unprecedented opportunities to transform traditional teaching methodologies into more dynamic, responsive, and individualized learning experiences (Abubakar, Onasanya, Aliyu & Abdulrahman, 2025). For Science Education and Biology Education, in particularly which requires visual and practical learning components has a lot to benefit from the features that AI can provide. (Akhtar, Matloob & Nawaz, 2024).

Biology education presents unique challenges: complex terminology, intricate processes requiring visualization, and the need for practical applications which traditional teaching methods sometimes may provide adequate help to address effectively. The content-heavy nature of Biology curricula demands innovative approaches that can simplify complex concepts, provide visual representations, and offer students opportunities for repeated practice and immediate feedback (LaDue, Libarkin & Thomas, 2015). AI tools offer promising solutions to these challenges through their capacity to personalize learning pathways, provide instant assessment feedback, visualize complex biological processes, and maintain high levels of student engagement through interactive content (Koć-Januchta, Schönborn, Tibell, Chaudhri & Heller, 2020).

Biology is a complex and dynamic subject that involves the study of living organisms, their interactions, and their environments. The subject encompasses complex taxonomic classifications, intricate cellular and molecular processes, detailed anatomical structures, and extensive ecological systems (Fowler, Roush & Wise, 2024). These elements often require visualization capabilities beyond traditional textbook illustrations. Students frequently struggle with Biology's specialized vocabulary, conceptual abstractions, and the integration of micro and macro perspectives of living systems (Etobro & Fabinu, 2017).

AI technologies demonstrate particular relevance to Biology education through their capacity to address these specific challenges. Virtual dissection platforms eliminate ethical concerns while providing realistic anatomical learning experiences. Intelligent tutoring systems identify knowledge gaps in concepts like genetics or metabolism and deliver targeted remediation. AI-powered visualization tools render three-dimensional representations of biological structures and processes that are difficult to conceptualize from static images. Adaptive quiz platforms adjust question difficulty based on individual student performance, ensuring appropriate challenge levels while building confidence (Ross, Chase, Robbie, Oates & Absalom, 2018).

Several AI applications have shown potential for Biology education in secondary schools. These include tools like Labster, which provides immersive virtual laboratory experiences (Smith & Coleman, 2017); Quizlet's adaptive flashcard system for terminology mastery (Baptist, 2018); BYJU'S personalized learning platform with 3D animations of biological processes (Sruthi & Mukherjee, 2020); and intelligent tutoring systems like Carnegie Learning that provide step-by-step guidance through complex problem-solving. Even general AI tools like ChatGPT can function as learning companions, offering explanations of difficult concepts, suggesting study strategies, or providing immediate feedback on practice questions (Nnaemeke & Ogunbadejo, 2024).

Port-Harcourt Metropolis, the capital of Rivers State in Nigeria, is an urban centre. The city is home to a mix of public and private secondary schools, many of which are equipped with basic digital infrastructure such as computer labs and internet connectivity. The urban nature of Port-Harcourt facilitates access to smartphones, computers, and digital learning platforms among students, making it an ideal setting for studying the use of AI tools in education. Furthermore, with an increasing number of students exposed to digital technologies both in and out of the classroom, there is a need to evaluate how these tools are being utilized for academic purposes particularly in science subjects where digital interactivity can enhance understanding. Given the educational and technological potential within Port-Harcourt Metropolis, the study aimed to assess the extent to which AI tools are used by Biology students and how such usage affects their academic performance.

Statement of the Problem

In today’s rapidly evolving digital age, the integration of artificial intelligence (AI) in education has emerged as a transformative force with the potential to enhance learning outcomes, personalize instruction, and improve student engagement. Globally, students and educators alike are increasingly

leveraging AI-powered tools such as intelligent tutoring systems, automated feedback applications, virtual labs, and adaptive learning platforms to facilitate effective teaching and learning (Arya & Verma, 2024). However, the extent to which these innovations are being applied or utilized and their actual impact on students' academic performance, particularly at the secondary school level, remains under investigated in Port-Harcourt Metropolis.

In Secondary schools, where the study of Biology is fundamental to students' preparation for careers in health, science, and technology, the integration and application of AI into the learning process may hold significant promise. Yet, there is a noticeable gap in empirical evidence regarding the types of AI tools being employed by secondary school students, the frequency and depth of their use, and more importantly, how such usage impacts academic outcomes such as continuous assessment and examination scores.

Without a clear understanding of these dynamics, educators and policymakers may struggle to make informed decisions on adopting and supporting AI technologies in schools. Therefore, it became crucial to investigate the patterns of AI applied among Biology students in Port-Harcourt Metropolis and assess its impact on their academic performance. This study therefore sought to bridge this gap by identifying the AI tools in use, examining the extent of their adoption, and evaluating their influence on both continuous assessment and examination scores.

Significance of the Study

This research offers significant value to multiple stakeholders in the educational ecosystem. These include students, teachers, policy makers in education and the research community. For students, findings will illuminate effective AI-enhanced learning strategies that could improve conceptual understanding, retention, and examination performance in Biology. By identifying which AI tools correlate with improved academic outcomes, this study can provide students with evidence-based recommendations for leveraging technology in their studies.

For Biology teachers, results will provide actionable insights regarding which AI applications merit classroom integration and how these tools might complement traditional teaching methodologies. Understanding the relationship between specific AI tools and learning outcomes will empower educators to make informed decisions about technology adoption rather than following technological trends without clear pedagogical justification.

Educational policymakers and administrators will benefit from empirical evidence that can guide curriculum development, resource allocation for educational technology, and implementation of digital literacy initiatives. This research may inform the development of educational policies that promote equitable access to beneficial AI technologies while addressing potential challenges like over-dependence or disparities in digital access.

For the research community, this study will establish baseline data regarding AI utilization patterns among Nigerian secondary school students, addressing a significant gap in the literature. Findings will provide a foundation for future comparative studies, longitudinal research tracking technology adoption over time, and more focused investigations of specific AI applications in Biology education.

Purpose of the Study

The purpose of the study is to find out the adoption of artificial intelligence and its impact on academic performance of biology students in secondary schools in Port-Harcourt Metropolis. The specific objectives are to:

1. determine the extent of adoption of artificial intelligence among biology students in secondary schools in Port-Harcourt Metropolis.

2. ascertain the influence of adoption of artificial intelligence on continuous assessment scores among biology students in secondary schools in Port-Harcourt Metropolis.
3. ascertain the influence of adopting artificial intelligence on examination scores among biology students in secondary schools in Port-Harcourt Metropolis.

Research Questions

The study provided answer to the following research questions.

1. What is the extent of adoption of artificial intelligence among biology students in secondary schools in Port-Harcourt Metropolis?
2. What is the influence of adopting artificial intelligence on continuous assessment scores among biology students in secondary schools in Port-Harcourt Metropolis?
3. What is the influence of adopting artificial intelligence on examination scores among biology students in secondary schools in Port-Harcourt Metropolis?

Methodology

The study adopted a descriptive survey research design. The population of the study comprised 8321 SS II Biology students from 31 public secondary schools in Port-Harcourt (16 from Obio/ Akpor and 15 from PHALGA) Metropolis (Source: Rivers State Post Primary Schools Board 2025). The sample for the study was 382 determined using Taro Yamen formula. The sampling technique used was simple random sampling technique. This was achieved by randomly selecting 13 SS II Biology students from each of the 31 schools. This resulted to a sample sized of 403. The instrument used for data collection was a questionnaire titled, "Artificial Intelligence Adoption and Academic Performance Questionnaire AIAPQ". It had four sections used in data collection for each of the research questions respectively. It was structured on a four-point rating scale. The instrument was validated by three experts. One was the research supervisor; another was a measurement and evaluation expert and the third was a senior biology lecturer. The internal consistency reliability for the instrument was established using Cronbach Alpha which yielded reliability coefficients of 0.82 for section A used to elicit data on AI tools used by students; 0.87 for section B used to elicit data on extent of utilization of AI, 0.78 for section C used to elicit data on the influence of AI usage on continuous assessment scores; 0.77 for section D used to elicit data on the influence of AI usage on examination scores and an overall reliability coefficient of 0.82. A total of 403 copies of the instrument were administered and a total of 375 were retrieved and used for data analysis. This constituted 93.75% return rate. Data gathered were analysed using frequency count and criterion mean of 2.50.

Results

Research Question 1: What is the extent of utilization of artificial intelligence among biology students in secondary schools in Port-Harcourt Metropolis?

Table 1: Extent of Utilisation of Artificial Intelligence

S/N	Extent of Utilization of Artificial Intelligence	Mean	S.D	Remark
1	I utilize AI tools for completing Biology homework assignments.	2.42	0.88	LE
2	I employ AI applications for preparing for Biology tests and examinations.	2.37	0.9	LE
3	I use AI platforms to clarify confusing Biology concepts during self-study.	2.45	0.87	LE
4	I utilize AI tools to generate additional practice questions beyond what is provided in class.	2.28	0.92	LE
5	I employ AI applications to visualize complex biological processes that are difficult to imagine.	2.19	0.94	LE
6	I use AI tools to translate complex Biology terminology into simpler language.	2.39	0.89	LE

7	I utilize AI platforms to create study schedules and learning plans for Biology.	2.14	0.93	LE
	Grand Mean	**2.32**	**0.90**	LE

Source: Survey Data, 2025.

Table 1 shows the results on the extent of utilization of artificial intelligence among biology students in secondary schools in Port-Harcourt Metropolis. As shown, students reported low extent of utilization of AI tools across all measured aspects. This is evident by mean responses being less than 2.50 for all items in the table. This indicates that students are not extensively utilizing AI for their biology studies. The highest utilization as reported for using AI platforms to clarify confusing Biology concepts during self-study (M = 2.45, SD = 0.87), while the lowest utilization was for using AI platforms to create study schedules and learning plans for Biology (M = 2.14, SD = 0.93). The grand mean of 2.32 (SD = 0.90) confirms that the overall extent of AI utilization among biology students in secondary schools in Port-Harcourt Metropolis is low.

Research Question 2: What is the influence of utilizing artificial intelligence on continuous assessment scores among biology students in secondary schools in Port-Harcourt Metropolis?

Table 2: Influence of AI Utilisation on Continuous Assessment Scores

S/N	Influence of Artificial Intelligence on Continuous Assessment Scores	Mean	S.D	Remark
1	Using AI tools has improved my scores in Biology class activities and assignments.	2.52	0.86	HE
2	My performance in Biology practical assessments has improved since I started using AI tools.	2.41	0.89	LE
3	AI tools have helped me better prepare for Biology quizzes, resulting in higher scores.	2.48	0.87	LE
4	The personalized feedback from AI applications has helped me identify and correct misconceptions, improving my continuous assessment scores.	2.54	0.85	HE
5	Using AI visualization tools has enhanced my understanding of biological structures, reflected in improved scores on diagram-based assessments.	2.39	0.9	LE
6	My scores in Biology projects have improved due to the utilization of AI research and organization tools.	2.45	0.88	LE
7	AI tools have helped me develop better study habits that positively impact my overall continuous assessment performance in Biology.	2.37	0.91	LE
	Grand Mean	**2.45**	**0.88**	**LE**

Source: Survey Data, 2025.

Table 2 presents findings on the influence of utilizing artificial intelligence on continuous assessment scores among biology students in secondary schools in Port-Harcourt Metropolis. The results indicate a mix of high and low extent of influence, with two items showing high influence: improved scores in Biology class activities and assignments (M = 2.52, SD = 0.86) and personalized feedback from AI applications helping to identify and correct misconceptions (M = 2.54, SD = 0.85). However, the remaining five items showed low extent of influence with mean scores below 2.50. The grand mean of 2.45 (SD = 0.88) indicates that overall, the influence of AI utilization on continuous assessment scores is of low extent, though it is approaching the threshold for high extent.

Research Question 3: What is the influence of utilizing artificial intelligence on examination scores among biology students in secondary schools in Port-Harcourt Metropolis?

Table 3: Influence of AI Utilisation on Exam Score

S/N	Influence of Artificial Intelligence on Examination Scores	Mean	SD	Remark
1	My performance in Biology term/semester examinations has improved since I started using AI tools.	2.49	0.87	LE
2	AI tools have enhanced my ability to answer complex Biology examination questions that require deep understanding.	2.53	0.85	HE
3	Using AI applications for practice tests has better prepared me for the format and difficulty of actual Biology examinations.	2.56	0.84	HE
4	AI-powered explanations of difficult concepts have improved my ability to answer application-based examination questions in Biology.	2.51	0.86	HE
5	My confidence during Biology examinations has increased due to better preparation with AI tools, positively affecting my scores.	2.46	0.88	LE
6	AI-assisted revision techniques have improved my retention of Biology information during examinations.	2.41	0.89	LE
7	The personalized learning paths suggested by AI tools have addressed my specific weaknesses, resulting in improved examination performance in Biology.	2.38	0.91	LE
	Grand Mean	**2.48**	**0.87**	**LE**

Source: Survey Data, 2025.

Table 3 displays the results on the influence of utilizing artificial intelligence on examination scores among biology students in secondary schools in Port-Harcourt Metropolis. The data reveals that three items showed high extent of influence: enhanced ability to answer complex Biology examination questions (M = 2.53, SD = 0.85), better preparation for actual Biology examinations through practice tests (M = 2.56, SD = 0.84), and improved ability to answer application-based examination questions (M = 2.51, SD = 0.86). The remaining four items showed low extent of influence with mean scores below 2.50. Despite having multiple items with high extent ratings, the grand mean of 2.48 (SD = 0.87) indicates that the overall influence of AI utilization on examination scores is of low extent, though it is very close to the threshold for high extent.

Discussion of Findings

Research question one sought to ascertain the extent of utilization of artificial intelligence among biology students in secondary schools in Port-Harcourt Metropolis. The result showed that utilization of AI tools for completing Biology homework assignments was low. Again, employment of AI applications for preparing for Biology tests and examinations was also low. Similarly, the use of AI platforms to clarify confusing Biology concepts during self-study was to a low extent. Also, utilization of AI tools to generate additional practice questions beyond what is provided in class was to a low extent. Additionally, employment of AI applications to visualize complex biological processes was to a low extent. Use of AI tools to translate complex Biology terminology into simpler language was to a low extent. Lastly, the result showed that utilization of AI platforms to create study schedules and learning plans for Biology was to a low extent.

This result was expected and not surprising. It is common for secondary school students in Nigeria to have limited access to technological resources and digital literacy skills needed to effectively utilize AI tools. In addition, school rules and regulations may not allow students to use their personal phones in school and at home, some parents may not allow their wards to use smart phones for fear of accessing unauthorized sites. This could have contributed to the low extent of utilization of artificial intelligence

among biology students in the results obtained. The low extent of AI utilization among biology students in secondary schools in Port-Harcourt Metropolis implies that students may not be benefiting from the potential advantages that AI tools offer for enhanced learning experiences. This may limit the development of digital competencies necessary for 21st century education. This result aligns with the findings of Oyawole, Agada, Oladipupo and Okunlola (2025) who found low level of utilization of AI among secondary school students in secondary school in Afijio, Oyo State.

Research question two sought to determine the influence of utilizing artificial intelligence on continuous assessment scores among biology students in secondary schools in Port-Harcourt Metropolis. The results indicated that while AI tools had a high extent of influence on improving scores in Biology class activities and assignments, and on providing personalized feedback to identify and correct misconceptions, the overall influence on continuous assessment scores was to a low extent. This finding suggests that despite some positive impacts in specific areas, AI utilization has not yet significantly transformed overall performance in continuous assessments.

This result could be attributed to the low extent of utilization of AI which could have hindered benefits from such utilization in continuous assessment activities. In addition, some teachers may lack the training ability to effectively integrate AI tools into their instructional delivery to encourage utilization for optimum benefits among students. The low extent of influence on continuous assessment scores despite some high-impact areas suggests that more structured and comprehensive approaches to AI integration are needed to realize its full potential in improving academic outcomes. This result agrees with that of Arannilewa and Kelvin-Nwanwa (2025) who found that utilization of artificial intelligence had positive influence on students' academic performance.

Research question three investigated the influence of utilizing artificial intelligence on examination scores among biology students in secondary schools in Port-Harcourt Metropolis. The findings revealed that AI tools had a high extent of influence on enhancing students' ability to answer complex questions, preparing them for actual examinations through practice tests, and improving their ability to answer application-based questions. However, the overall influence on examination scores was to a low extent, though very close to the threshold for high extent.

This result reflects the current transitional state of AI integration in Nigerian secondary education. Although, AI tools offer significant advantages for examination preparation, their impact may be limited by inconsistent utilization patterns and varying levels of digital literacy that may exist among students. The high extent of influence on complex question-handling and test preparation demonstrates the potential of AI tools when effectively utilized. The findings suggest that with more structured implementation and support, AI tools could potentially transition from having a low to high extent of influence on examination scores. This result aligns with that of Vieriu and Petrea (2025) who found that utilization of AI enhances students' academic performance.

Conclusions

Based on the findings of this study on artificial intelligence adoption and academic performance among biology students in secondary schools in Port-Harcourt Metropolis, it was concluded that the extent of utilization of artificial intelligence among biology students in secondary schools in Port-Harcourt Metropolis was low. This indicates that despite the potential benefits of AI tools for biology education, students are not extensively utilizing these resources for their learning activities. The influence of artificial intelligence on continuous assessment scores among biology students is low. Although some aspects such as improved scores in class activities and personalized feedback showed high effects, the overall impact on continuous assessment is limited. Similarly, the influence of artificial intelligence on examination scores among biology students is low. While AI tools enhanced students' ability to answer complex questions and better prepared them for actual examinations in some respects, the overall impact on examination performance remains limited.

Recommendations

Based on the findings and conclusions of this study, the following recommendations are made:

1. Since the extent of adoption of artificial intelligence among biology students is low, schools and educational authorities in Port-Harcourt Metropolis should develop and implement comprehensive digital literacy programs that specifically train students on how to effectively use AI tools for biology learning. These programs should focus on integrating AI applications that visualize complex biological processes, translate technical terminology, and generate additional practice resources to enhance student engagement with the subject.

2. To improve the influence of AI on continuous assessment scores, biology teachers should adopt AI-enhanced learning activities into their continuous assessment framework by designing assignments that require students to use AI visualization tools, research assistants, and concept explanation platforms. Furthermore, teachers should provide guidance on how these tools can be used to improve practical assessments, projects, and quizzes which currently show limited impact from AI utilization.

3. To enhance the impact of AI on examination scores, educational stakeholders should adopt structured examination preparation programs that leverage AI applications for practice tests, concept explanations, and personalized learning paths. Schools should establish AI-enabled revision centers where students can access tools that address specific weaknesses in their biology knowledge, improve retention of information, and build confidence for examinations, thereby addressing the current low influence of AI on overall examination performance.

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