

Undergraduate Students' Perception of the Role of Generative AI in Biology Education

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ABSTRACT

This study explored undergraduate students' views on Gen AI, focusing on their perceived advantages in improving understanding of complex biological concepts and their concerns about the tools' potential inaccuracies and biases in academic work. A descriptive research design was used and the study was guided by two research questions. The population of the study was all undergraduate students from all universities in Ondo and Oyo States. The sample size of the study was 1,360 undergraduate students randomly selected from five universities in Ondo and Oyo States. A self-designed questionnaire was employed to gather data for the study. It was adequately validated. Data collected were analyzed using mean score. The results indicate a generally positive perception of these tools in enhancing students' understanding of complex biological content ($M=3.26$, $SD=1.95$), particularly in terms of their ability to help students better visualize difficult biological concepts and complete biology assignments on time. However, the study also highlights concerns about the potential biases and inaccuracies of Gen AI. Undergraduate students showed moderate awareness of these biases ($M=2.09$, $SD=1.78$), particularly regarding the limited emotional intelligence of these tools, which may result in inappropriate outputs. It is recommended that higher education institutions establish resource libraries or toolkits offering tutorials, guides, and case studies on effectively using AI tools for learning. Additionally, they should provide dedicated courses or modules on the ethical implications of AI, covering issues related to bias, fairness, and transparency.

Keywords: Generative Artificial intelligence tools (Gen AI), perception, Bias, Artificial intelligence (AI)

INTRODUCTION

The traditional teaching methods used in many higher institutions may not always engage and motivate undergraduate students, potentially reducing their interest in science-related disciplines, including Biology. Limited access to modern educational tools and resources may further exacerbate these challenges, highlighting the need for innovative approaches to transform science instruction (Okunade, 2024). The emergence of new communication technologies has led to the development of tools that facilitate interaction with users, commonly referred to as virtual information assistants. These tools use computer programmes to simulate aspects of human intelligence and interaction, allowing users to communicate with them in ways that resemble human conversation. This concept is broadly associated with Artificial Intelligence (AI) (Yang, Du, Hung, & Tu, 2021).

Artificial Intelligence is defined as the ability of computer systems to perform tasks that are normally associated with human intelligence, including reasoning, language understanding, learning, and problem-solving (Nilsson, 2009). In higher education, AI can analyse large volumes of educational data and provide valuable information about students' learning patterns and academic performance. By identifying areas in which undergraduate students experience difficulties, AI can assist lecturers in adapting instructional strategies to meet students' learning needs. This capability is particularly relevant to Biology, which involves the understanding of complex concepts, processes, systems, and relationships. AI may also help address educational challenges such as large student populations, inadequate instructional resources, and unequal access to educational facilities (Stoeffer, Rosen, Bolsinova, & von Davier, 2020).

AI technology therefore offers scalable opportunities for improving the quality and accessibility of Biology education across different socioeconomic and geographical contexts. One important development in AI is Generative Artificial Intelligence (GenAI), which refers to AI systems capable of producing human-like outputs in different formats, including text, images, audio, and video (Feuerriegel, Hartmann, Janiesch, & Zschech, 2024). GenAI produces such outputs through technologies involving artificial neural networks, natural language generation, machine learning, and deep learning (Anantrasirichai & Bull, 2022). Its applications extend across different fields, including education, creative design, content development, entertainment, and marketing. In education, GenAI can contribute to more personalised learning experiences by providing students with information and learning materials in different formats (Kalota, 2024). Studies have also suggested that these tools can improve learning outcomes (Sullivan, Kelly, & McLaughlan, 2023) and make the learning process more engaging and enjoyable (Jauhiainen & Guerra, 2023).

The increasing availability of GenAI, particularly ChatGPT, has generated considerable interest among higher education institutions. These tools provide undergraduate students with services such as translation, summarisation, grammar and style checking, writing assistance, content generation, automated interaction, support for group projects, assistance with essays and reports, and feedback on learning materials (Huang, Zou, Cheng, Chen, & Xie, 2023). These applications may enhance students' learning experiences (Pesovski, Santos, Henriques, & Trajkovik, 2024), support personalised learning, improve communication and collaboration between students and lecturers (Nikolopoulou, 2024), increase access to educational resources (Baidoo-Anu & Ansah, 2023), improve learning efficiency, support critical thinking and analysis (Yilmaz & Yilmaz, 2023), and encourage creativity and innovation (Dai, Liu, & Lim, 2023).

The integration of AI into Biology education is therefore increasingly relevant to undergraduate students. AI-powered learning platforms can provide personalised learning experiences by adjusting learning content, pace, and difficulty according to students' individual needs and performance. Such tools can also provide immediate feedback, enabling students to identify areas of weakness and improve their understanding. In Biology, AI-supported simulations, virtual laboratories, three-dimensional models, and augmented reality applications can make abstract and complex biological concepts more concrete and interactive. For example, virtual dissections and three-dimensional representations of cells, organisms, and ecosystems can provide undergraduate students with opportunities to explore biological structures and processes without depending entirely on physical specimens or laboratory resources.

Despite these potential benefits, the use of GenAI in higher education is associated with several challenges. Studies have identified concerns relating to data privacy, algorithmic bias, plagiarism, academic integrity, intellectual property, and the reliability of AI-generated information (Mellado, 2024; Giannakos, Brusilovsky, Cukurova, Dimitriadis, & Rienties, 2024). Another concern is the possibility that undergraduate students may use GenAI to complete academic tasks without sufficiently engaging in independent learning. AI-generated responses may also contain inaccurate or misleading information, which could negatively affect students' understanding of Biology if such information is accepted without verification. Excessive dependence on AI may further reduce opportunities for students to develop analytical thinking, creativity, problem-solving abilities, and academic writing skills.

These concerns make it important to understand undergraduate students' perceptions and awareness of GenAI in the learning process. Undergraduate students are important stakeholders in the successful adoption and effective use of emerging technologies in higher education. Their perceptions can provide useful information for lecturers, university administrators, curriculum developers, and policymakers when developing appropriate strategies, guidelines, and policies for the responsible use of GenAI. Students' views can also help institutions identify the educational benefits of these tools while addressing potential risks associated with their use.

Understanding undergraduate students' perspectives is particularly important in developing countries such as Nigeria, where higher education institutions may face challenges relating to inadequate instructional resources, large student populations, and unequal access to educational technologies. Examining students' experiences and perceptions can therefore contribute to the development of contextually appropriate approaches to integrating GenAI into Biology education. Against this background, the present study investigated

undergraduate students' views on the use of Generative Artificial Intelligence tools, with particular attention to their perceived benefits in enhancing Biology learning and academic work. The study also examined undergraduate students' awareness of the potential biases, limitations, and inaccuracies associated with the use of GenAI in education.

Significance of the Study

Gaining insight into undergraduate students' perceptions of Gen AI in improving learning will shed light on their potential advantages and drawbacks. The results of this study can guide the development of instructional materials and strategies that effectively incorporate Gen AI into biology education, as well as assist institutions in making informed decisions about investing in Gen AI and infrastructure to enhance biology education.

Purpose of the Study

The purpose of this study is to determine students' perception of the role of generative in biology education, specifically

- 1 To determine the role of generative AI in enhancing students understanding of complex biological concept
- 2 To determine students' level of knowledge and awareness of the biases of AI Generated tools

Research Question

1. What are tertiary students' perceptions of the role of generative AI in enhancing biology education?
2. What is the level of awareness among tertiary students about the potential inaccuracy or bias of Generative AI?

METHODOLOGY

The study used descriptive survey research design and was guided by two research questions. The population of the study was all the undergraduate students in Ondo and Oyo State. The sample size of the study was 1,360 undergraduate students. The participants were randomly selected through simple random technique from five universities in Ondo and Oyo States. The instrument used to gather data for the study was self-developed questionnaire titled: Questionnaire on undergraduate students' views on Gen AI (QUSVGEAT). The questionnaire was validated by two experts in Test and Measurement, University of Ibadan, Ibadan Oyo-State. Corrections and modifications were carefully made on the instrument and final draft was obtained. A Cronbach Alpha reliability method was employed to ascertain the reliability coefficient of the instrument by administered it on undergraduate students in some universities in Osun State that does not constitute the participants used for the study. When the responses of the students were correlated, it yielded $r = 0.81$, which the researcher adjudged reliable since it has high coefficient. The questionnaire comprised two (2) sections. Section A consists of respondents' biodata while Section B contained 17 statements/items: 8 items focused on students' perceptions of the role of generative artificial intelligence tools in enhancing biology education, while 9 items aimed to assess their awareness of potential inaccuracies or biases in AI-generated resources for biology education. Participants were asked to indicate their level of agreement with each statement using a 4-point Likert scale (strongly agree = 4, agree = 3, disagree = 2, strongly disagree = 1 respectively). Data were analyzed using mean score.

RESULTS

Research Question 1

What are tertiary students' perceptions of the role of generative artificial intelligence tools in enhancing biology education?

Table 1: Participants' responses regarding their perceptions of the role of generative artificial intelligence tools in enhancing biology education

S/N	Items	$\bar{X}$	SD	LE	RA
1	Generative AI helps biology students to understand complex concepts	3.21	2.04	High	5
2	Generative AI helps biology students to develop a deeper understanding of biology concepts	3.16	1.83	High	6
3	Generative AI helps students to save time in completing biology assignments	3.57	2.01	High	2
4	Generative AI helps students improve their grades in biology courses	3.45	2.8	High	4
5	Generative AI could help biology students to develop skills in critical thinking and problem solving	2.91	1.35	Moderate	7
6	Generative AI supplements biology coursework	3.53	2.04	High	3
7	Generative AI helps students to identify patterns and relationships in complex biological data	2.52	1.02	Moderate	8
8	Generative AI helps students to better visualize complex biological concepts	3.75	2.51	High	1
	Overall score	3.26	1.95	High	—

Table 1 revealed an overall mean score of 3.26, indicating relatively high satisfaction with these tools. Notably five out of the eight statements received high mean scores, reflecting positive perceptions of how these tools enhance biology education and their potential benefits in various educational contexts. The major one being improving biology students' understanding of complex concepts and helps students save time in completing biology assignments. It supplements biology coursework and helps biology students to develop a deeper understanding of biology concepts.

Research Question 2

What is the level of awareness among tertiary students about the potential inaccuracy or bias of Generated AI tools?

Table 2: Participants' responses regarding their awareness of the potential inaccuracy or bias of Generated AI tools.

S/N	Items	$\bar{X}$	SD	LE	RA
1	Gen AI can generate inaccurate output	2.39	2.09	Moderate	1
2	Gen AI can generate output out of context	2.13	1.8	Moderate	5
3	Gen AI can generate outdated output	2.18	1.88	Moderate	3
4	Gen AI have limitations in handling complex tasks	2.02	1.7	Moderate	6
5	Generative AI can lead to a reliance on technology rather than critical thinking	2.3	1.99	Moderate	2
6	Generative AI are suited for all biology topics/concepts	2.01	1.7	Moderate	7
7	Generative AI can lead to lack of students' understanding of underlying biology concepts	1.94	1.64	Low	8
8	Generative AI have limited emotional intelligence	1.75	1.43	Low	9
	Overall Score	2.09	1.78	Moderate	—

Table 2 illustrates a comprehensive analysis of participants' knowledge and awareness of the bias of Generated AI tools. Measurement of this aspect sought to gain a deeper understanding of participants' knowledge and awareness of generated AI tools in terms of their content, quality of output, and limitations. The data

demonstrate a high level of agreement among participants, as indicated by an overall mean score of 2.09 ± 1.78 . This finding confirms that participants are aware of the potential biases of Gen AI. Among the eight statements evaluated, Six received moderately high mean scores, with the two lowest-rated aspect being, “Generative AI can leads to lack of students’ understanding of underlying biology concepts and Generative AI have limited emotional intelligence, which may lead to inappropriate output,” achieving a mean score of 1.94 ± 1.64 and 1.75 ± 1.43 respectively. This finding implies that participants do not agree that Gen AI have limited emotional intelligence and that it may lead to inappropriate output.

DISCUSSION OF FINDINGS

In discussing the findings of this study, the researcher followed a sequence of data analyzed using relevant literature to support the findings. Research question one revealed that students hold favourable view toward the potential value of Generative tools in improving biology education. This emphasizes the importance of understanding both the capabilities and significance of Gen AI within educational settings. Students seem to recognize and appreciate the potential advantages of integrating AI into biology education, such as promoting deeper understanding of biology concepts, saving time in completing assignment, increasing productivity, and encouraging critical thinking and analysis. The finding is congruent to that of Chan & Hu (2023) who reported that students recognized the potential of GenAI for personalized learning support, writing, brainstorming assistance and research and analysis capabilities. Also the finding support the assertion of Arowosegbe, Alqahtani, & Oyelade, (2024) who revealed that students perceived generative AI writing tools as beneficial to their academic work, it offers an edge when used for academic purposes, it is helpful and innovative.

Likewise, research question two revealed the potential inaccuracy or bias of Generated AI tools in learning biology as perceived by undergraduate students. Accordingly, the findings reveal notable apprehension among participants regarding the use of Gen AI in education. Limitation in the area of handling complex task, generation of outdated output and output out of content are some of the major concerns. Participants oppose the opinion that Generative AI can leads to lack of students’ understanding of underlying biology concepts. Participants do not concur that Generative AI have limited emotional intelligence, which may lead to inappropriate output. This finding aligned with the findings of Markos, Prentzas & Sidiropoulou (2024) which showed that students believed that the Gen AI have strengths and concerns. The main strengths were related to the tool’s adaptability and its role in enhancing learning experiences, academic research, and collaboration. The main concerns were related to data privacy, the originality of work, and the potential introduction of biases or inaccuracies. These findings emphasize the necessity for proactive measures to address these apprehensions effectively. There is need to foster aware in Understanding AI bias by Educating students about the

The finding that students did not agree that Generative AI leads to a lack of understanding of underlying Biology concepts is important and deserves a more nuanced interpretation. It does not necessarily contradict the literature on over-reliance. Rather, it may indicate that students distinguish between using GenAI as a learning support and using it as a substitute for their own thinking and learning.

Likewise, research question two revealed that students did not concur with the statement that the use of Generative AI could lead to a lack of understanding of underlying Biology concepts. At first sight, this finding may appear inconsistent with literature warning that excessive dependence on GenAI can encourage superficial learning and weaken students’ independent thinking. However, the apparent contradiction may be explained by the distinction between GenAI use and GenAI over-reliance. The use of an AI tool does not automatically result in reduced understanding. When students use GenAI to obtain explanations, ask follow-up questions, compare different explanations, generate examples or clarify difficult Biology concepts, the technology may function as a supplementary learning resource rather than a replacement for cognitive engagement. Studies of students’ experiences with GenAI similarly indicate that students value the technology for obtaining alternative explanations and improving their understanding of difficult topics.

The students’ disagreement with the statement may also be associated with the fact that students are aware of the limitations of GenAI. The present findings show that participants were able to identify inaccurate, outdated and out-of-context responses as limitations. This awareness could make students less likely to accept AI-

generated information uncritically. In other words, students who know that GenAI can make mistakes may be more inclined to compare its responses with textbooks, teachers' explanations and other credible sources. Such critical engagement could reduce the possibility that GenAI undermines their understanding. Research among students has similarly demonstrated that familiarity with GenAI can be associated with greater awareness of both its benefits and limitations.

The issue of over-reliance may also depend on how students engage with the technology. When GenAI is used to stimulate thinking, provide hints, explain difficult ideas or give feedback, it can complement students' cognitive activities. However, when students routinely request complete answers and reproduce them without questioning, researching or explaining the ideas in their own words, the technology may reduce opportunities for active learning. Recent research has identified excessive reliance on GenAI as a concern because it may affect critical thinking, problem-solving and independent learning. Thus, the absence of agreement among participants that GenAI causes lack of understanding should be interpreted as an indication that students may not perceive their current use of the technology as replacing their learning process, rather than as evidence that over-reliance has no educational consequences.

The finding is consistent with Markos, Prentzas and Sidiropoulou (2024), who reported that students recognised both strengths and concerns associated with GenAI. The major strengths identified included adaptability and the ability of GenAI to enhance learning experiences, academic research and collaboration, while concerns included data privacy, originality of academic work, and the possibility of generating biased or inaccurate information. Similarly, recent research has shown that students appreciate the accessibility and usefulness of GenAI while simultaneously expressing concerns about its reliability, accuracy, privacy, ethics and excessive reliance. These similarities suggest that students are developing a relatively balanced perception of GenAI: they do not necessarily perceive it as either completely reliable or completely harmful, but rather as a technological resource whose educational value depends on how it is used.

CONCLUSION

The study concluded that students positively perceive the role of Gen AI in enhancing education and are highly aware of the role of Gen AI in improving their understanding of complex academic concepts, help them to develop a deeper understanding of biology concepts, save their time in completing biology assignment, supplement biology coursework and help improve their grades in biology courses. The results also confirm their general awareness of the inaccuracy and biases of these tools. The study further concluded that there is a concerning trend as regard the biases of these such as generation of inaccurate/ outdated output, limitations in handling complex tasks and reliance on technology rather than critical thinking. The high and positive perception underscores the importance of the continued integration of Gen AI in biology education, and refinement of AI tools in academic settings to maximize their benefits while addressing students' concerns as regard their biases and inaccuracy.

RECOMMENDATIONS

Based on the findings of this study, it was recommended that:

- i. Tertiary institutions should develop resource libraries or toolkits that offer tutorials, guides, and case studies on how to effectively utilize AI tools for learning. This would assist students in understanding how to apply AI in areas like research design, problem-solving, or writing academic papers.
- ii. Tertiary institutions should incorporate courses that emphasize the ethical use of AI, its applications in science, and the potential biases within AI systems. These courses would guide students on how to responsibly use AI tools in their academic work, including recognizing the limitations and biases of AI-generated content.
- iii. Tertiary institutions should provide specialized courses or modules that educate students on the ethical implications of AI, covering topics like bias, fairness, and transparency. These courses should explore the sources of biases in AI models, how they develop, and their potential impact on individuals and society.

- iv. Students should be encouraged to explore and compare various generative AI from different providers, as each may exhibit different biases. This comparison will help students gain a deeper understanding of how AI systems vary and the types of biases they may reinforce.

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