



Students' Application of ChatGPT as an Artificial Intelligence (AI) Package in Biology Learning

Ada Grace Ikoroha & Innocent Ebere Okereke

Department of Science Education, University of Nigeria, Nsukka

Corresponding Author: innocent.okereke@unn.edu.ng

Abstract

Artificial intelligence (AI) is pervasive and has found application in all fields of human endeavours including education. This study investigated students' application of ChatGPT as an artificial intelligence (AI) package in Biology learning. Guided by four research questions, it was conducted at Ignatius Ajuru University of Education Port Harcourt, Rivers State using descriptive survey research design. It has a population of 477 first-year Biology students and a sample of 217 participants computed using the Slovin formula and drawn utilizing a simple random sampling technique. A structured questionnaire in Likert type titled "ChatGPT as an artificial intelligence package questionnaire (CAIPQ)" was used to gather data. It was face-validated and has an overall reliability of 0.90 ascertained with Cronbach Alpha. Descriptive statistics including frequency, percentage, mean, and standard deviation were used to analyze the data. The findings showed that ChatGPT and Grammarly are the two AI packages that students are most accustomed to utilizing for biology learning, with ChatGPT scoring highest. The results also demonstrated how widely undergraduate biology students use ChatGPT. Two problems that hinder ChatGPT's usefulness for biology learning are its inability to present diagrams and unavailability of network connectivity. Nonetheless, one of the solutions to these problems is the use of personal data. Among other things, it was recommended that students should enter the right prompts in ChatGPT to prevent giving inaccurate responses in Biology learning.

Key words: Artificial Intelligence, Biology, Chat GPT, Learning

Introduction

The discovery of artificial intelligence tools and their applications in different areas of human endeavour are trending phenomena. In the area of Biology learning, students could find AI packages useful in solving some learning tasks. However, effective use of AI packages could be crippled by some challenges that need to be overcome. Thus, carrying out a study in that regard becomes necessary. Artificial Intelligence (AI) is a transformative technology with the potential to revolutionize entire sectors including education (Von Garrel, Jahn & Schröter, 2022). It encompasses methods, processes, and technologies that equip IT systems such as machines, robots, or software, with the ability to interpret vast amounts of data and learn from it to replicate or mimic specific human cognitive functions (Di Vaio, Palladino, Hassan, & Escobar, 2022). Mou (2017) stated that artificial intelligence uses two bottom layers, machine learning, deep learning, physical service-oriented voice recognition, emotional computing technologies,

content-oriented natural language processing technology, and behavioural service-oriented adaptive learning technology among others to support personalized learning. Personalized learning is a key result of AI integration that improves the overall learning outcomes and increases students' engagement (Chen, Li, Li, & Li, 2021). The advent of AI in education has probably introduced a new era of personalized, efficient, and accessible learning experiences. AI has been widely applied in the education field and may have substantial advantages in impacting on the instructional process (Chassignol, Khoroshavin, Klimova & Bilyatdinova, 2018; Liua, Salehb & Huang, 2021). AI optimizes and improves learning, stimulates enthusiasm and creativity of students (Yang & Bai, 2020). Also, Ogbonnia (2017) emphasized that AI aids in generating smart content, which includes digital textbooks, guides, instructional snippets, videos, and customized environments designed to meet educational goals. This reflects the

global movement towards personalized education where AI tools support learning (Oluyemisi, 2023). It encompasses a wide range of technologies that enable machines to perform tasks that typically require human intelligence.

With the development of artificial intelligence technology, modern education tends to incorporate additional technological elements. Natural language processing, deep learning, robotics, machine learning, expert systems, and machine vision are some of the main artificial intelligence technologies (Thomas & Gambari, 2021). These technologies offer students a range of functionalities, from intelligent tutoring systems and personalized learning platforms to language learning applications and collaborative tools. These technologies not only assist in academic endeavours but also promote independent learning and critical thinking. Chen, He, and Zhong (2018) stated that the introduction of these artificial intelligence technologies can help the traditional digital intelligent teaching system achieve functional upgrades. Commonly used applications like Google Translate and chatbots incorporate natural language processing (Kolodny, 2017). Chatbots otherwise known as chatting robots allow learners to learn through the process of direct communication with a robot that tends to provide customized answers in response to learners' messages, grade their performance, and provide tips on areas learners need to improve (Pokrivcakova, 2019). Natural language processing could be embedded in presentation translator to display lecturer's spoken information below the presentation, thus allowing students to read what is being said on the lecturer's display or on their devices. With the use of customized educational software in online platforms, deep learning has improved the effectiveness of online learning by making it simple to meet each student's unique needs, promoting personalized learning and providing opportunities for additional support regarding tutors (Thomas & Gambari, 2021). These technologies are often combined to create advanced AI systems capable of performing complex task across various sectors. New large-scale AI models are released such as ChatGPT and Microsoft copilot among others with wide range of tasks, from text manipulation and analysis to image generation and unparalleled speech recognition. Microsoft Copilot (formerly called Bing Chat) uses large language model technology such as GPT-4 and DALL-E 3 to provide answers (Stephens, Jacobs, Adkins, & Booth, 2023). Chat GPT which is one of the most popular AI tools falls primarily within the domain

of processing natural language and deep learning. ChatGPT is an advanced conversational AI model developed by Open AI. It is based on the generative pre-trained transformer (GPT) architecture which is designed to understand and generate human-like text. In November 2022, Open AI released a programme called ChatGPT that makes use of artificial intelligence (Sharma & Yadav, 2022). This modern AI technology called ChatGPT has received attention for its capacity to produce text that sounds like human speech and carry-on meaningful conversations (Radford, 2019). This suggests it can harness how learners learn and communicate. ChatGPT is trained on vast data before it can function. For example, the ChatGPT-3.5 model has 175 billion parameters (Sharma & Yadav, 2022). Reinforcement learning which is based on human feedback is used to train this model. It is then fine-tuned on certain tasks, like question-answering or language translation, to get the desired results (Sharma & Yadav, 2022). Sharma et al. stated that on May 14, 2023, ChatGPT-4 was launched, featuring the capability to process both text and image inputs, including documents, photos, diagrams, and screenshots. According to its developer, it performs at a human level across various professional and academic benchmarks (OpenAI, 2023a as cited in Von Garrel & Mayer, 2024). ChatGPT does not search the internet for answers, instead, it generates sentences word by word, making educated guesses based on its prior training, which can lead it to confidently present information in a seemingly accurate manner (Sharma & Yadav, 2022). The ChatGPT engages users in natural and conversational interactions where it answers questions, corrects mistakes, and addresses wrong requests. Additionally, ChatGPT can assist in generating content such as blogs and essays. Its potential impact on education could be significant.

ChatGPT's updated memory capabilities enhance the learning process by retaining key details about ongoing lessons, schedules, and objectives. This functionality provides continuous support and improves task management, allowing for a more focused approach to complex topics. Rudolph, Tan, Tan (2023) proposed that students can gain from experiential learning through ChatGPT which can generate various problem-solving scenarios. Additionally, ChatGPT can generate topics for discussion thereby providing personalized tutoring for students. The application of ChatGPT could be useful in enhancing the learning of biology.



Biology is among the important subjects for secondary school science students, covering a wide range of topics. It systematically studies living organisms. The integration of ChatGPT into biology learning represents a significant advancement in personalized learning approaches. As a sophisticated artificial intelligence tool, ChatGPT could offer students a dynamic and interactive platform for exploring complex biological concepts. By providing immediate, context-specific explanations and addressing individual queries, ChatGPT enhances understanding of intricate topics such as genetics, cellular biology, and ecology (Liu, Ren, Nyagoga, Stonier, Wu, & Yu, 2023). Its ability to engage in detailed, conversational interactions allows students to delve deeper into subject matter at their own pace, facilitating a more tailored learning experience (Ng, Lee, Tan, Hu, Downie & Chu, 2023). Furthermore, ChatGPT can assist in generating practice questions, summarizing academic content, and clarifying challenging concepts, thus supporting a more comprehensive and individualized educational process (Smith et al, 2021). The integration of AI such as ChatGPT into biology learning could not only foster a more engaging learning environment but also could promote a more efficient and accessible means of mastering the subject. ChatGPT has conversations with users in a responsive and natural manner (King & ChatGPT, 2023). Leveraging this technology can provide students with personalized support, instant feedback, and a virtual learning companion accessible anytime and anywhere (Ali & Nnadi, 2023). Thus, the integration of AI such as ChatGPT into learning could foster a more efficient, effective, and inclusive learning environment for students across diverse disciplines as indicated in some studies.

The study carried out by Crawford, Cowling, and Allen (2023) showed that ChatGPT improves students' performance. The study though on AI such as ChatGPT did not investigate its extent of usage, challenges limiting its usage and solutions as done in this study. In a similar study, Ali and Nnadi (2023) investigated the impact of a self-regulated learning strategy using ChatGPT model 4 in Physics. Their findings revealed that students who learned Physics through this AI-driven self-regulated individualized learning strategy outperformed those who were taught using the expository method. This study though recommended the application of ChatGPT based on its findings did not investigate its extent of usage, challenges limiting its usage and solutions as done in

this study. Vindaca, Abolina and Danilane (2024) in their study on transforming higher education in the era of artificial intelligence chat tools, stated that ChatGPT is one of the most popular AI tools. Nkereuwem and Oyovwikoghene (2023) revealed that chatbots and AI-powered gamification enhanced students' motivation in the study of chemistry concepts. Also, Koć-Januchta, Schönborn, Tibell, Chaudhri and Heller (2020) examined the interactions, education, and experiences of college students utilizing an AI biology textbook as opposed to an e-book. The findings showed that both books led to learning gains and exhibited similar patterns of feature usage. Rahioui, Jouti and Ghzaoui (2024) asserted that Artificial intelligence has the potential to make biology learning more engaging, personalized, and effective by providing students with interactive simulations, personalized learning experiences, and other tools that help them understand complex biological concepts. From those studies, the extent of usage of ChatGPT as AI tool, challenges limiting its effective usage in Biology learning among students as well as solutions create lacuna that are to be closed by this study.

Specifically, the study investigated the:

1. Available AI packages students are conversant with for use in learning Biology.
2. Extent of Undergraduate students' application of ChatGPT in learning biology.
3. Challenges hampering the use of ChatGPT in learning biology among undergraduate students.
4. Solutions to the challenges hampering the use of ChatGPT in learning biology among undergraduate students.

Research Questions

The study was directed by the following research questions:

1. What are the available AI packages students are conversant with for use in learning Biology?
2. To what extent do undergraduate students apply ChatGPT in learning biology?
3. What are the challenges hampering the use of ChatGPT in learning biology among undergraduate students?
4. What are the solutions that can address the challenges hampering the use of ChatGPT in learning biology among undergraduate students?

Method

A descriptive survey research design was used in this study to look into the application of ChatGPT as an artificial intelligence (AI) package in biology learning. A descriptive survey design was suitable because this study aims at collecting data on ChatGPT as an artificial intelligence (AI) package in biology learning and describes in a systematic manner the characteristics, features or facts about a given population (Nworgu, 2015). It was conducted at Ignatius Ajuru University of Education Port Harcourt, Rivers State. The population for the study comprised 477 first-year Biology students in Ignatius Ajuru University of Education. A sample of 217 first-year Biology students was computed using Slovin formula and drawn using simple random sampling technique sample which gives the participants equal chance of being included in the sample.

The study utilized a structured questionnaire in Likert type titled “ChatGPT as an artificial intelligence (AI) package questionnaire (CAIPQ) which was developed by the researchers in collecting the data for this study. The instrument has four clusters that respectively captured the available AI packages which students are conversant with for use in Biology learning, the extent of undergraduate students’ application of ChatGPT in learning of Biology, challenges hampering the use of ChatGPT in learning Biology among undergraduate students, and the

solutions to the challenges hampering the use of ChatGPT in learning Biology among undergraduate students.

Three specialists in the fields of measurement and evaluation, educational technology, and biology education, respectively, validated the instrument. The validated instrument was pilot-tested using 30 undergraduate students in a Faculty of Education of another university in Port Harcourt and subjected to reliability measures using Cronbach Alpha. It yielded reliability values of 0.91, 0.85 and 0.87 for clusters B, C, and D respectively with an overall reliability of 0.90 which show that the instrument is reliable. Data were collected by distributing the instrument physically during scheduled lecture sessions after obtaining permission from concerned authorities. The students responded to the items of the instrument. Thereafter, the responded questionnaires were collected on the spot. This approach ensured a high percentage return of the responded instrument.

The data collected were analyzed using descriptive statistics. Frequency and percentage were used for cluster A, mean and standard deviation were used for clusters B, C and D. The percentage acceptance in cluster A is 50%, while the mean of acceptance for clusters C and D was 2.50. However, the real limit values used are 0.50-1.49 (VLE), 1.50-2.49 (LE), 2.50-3.49 (HE) and 3.50- 4.49 (HE)

Results

Table 1: Available AI Packages Students are Conversant with for Use in learning Biology

| S/N | AI Packages | Available (A) | %Availability | Not Available (NA) | % Unavailability | Decision |
|-----|---------------|------------------|---------------|--------------------------|---------------------|---------------|
| 1. | Chatgpt | 197 | 90.8 | 20 | 9.2 | Available |
| 2. | Copilot | 33 | 15.2 | 184 | 84.8 | Not Available |
| 3. | Perplexity AI | 33 | 15.2 | 184 | 84.8 | Not Available |
| 4. | Quillbot | 24 | 11.1 | 193 | 88.9 | Not Available |
| 5. | Canva | 28 | 12.9 | 189 | 87.1 | Not Available |
| 6. | Grammarly | 131 | 60.4 | 86 | 39.6 | Available |
| 7. | Otter.ai | 14 | 6.5 | 203 | 93.5 | Not Available |
| 8. | Scribe | 20 | 9.2 | 197 | 90.8 | Not Available |
| 9. | Firelies.ai | 15 | 6.9 | 202 | 93.1 | Not Available |

n= 217

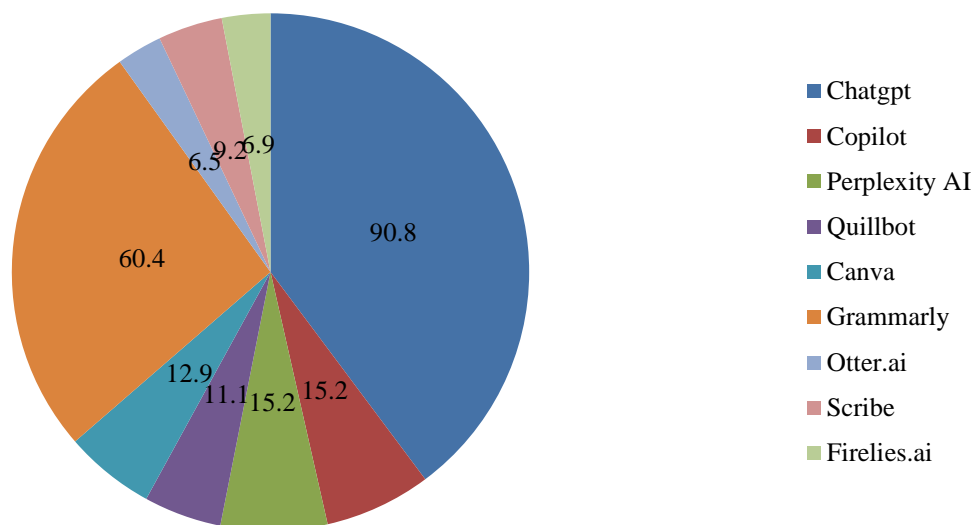


Table 1 revealed that only ChatGPT and Grammarly have percentage availability of 90.8 and 60.4 respectively which are above 50% benchmark. This is further shown in the pie chart with the two

having broad sectors. Therefore, ChatGPT and Grammarly are available AI packages which students are conversant with for use in Biology learning with ChatGPT having the highest percentage.

Table 2: Extent of Undergraduate Students' Application of ChatGPT in Learning of Biology

| S/N | Item Statement | Mean | Std. Deviation | Remarks |
|----------------------|---|-------------|----------------|--------------------|
| ChatGPT helps me to: | | | | |
| 1. | Do biology assignments/home work. | 3.18 | 1.02 | High Extent |
| 2. | Understand difficult concepts in biology. | 2.98 | 1.09 | High Extent |
| 3. | Get clarification on some technical terms in biology after learning in the classroom. | 3.03 | 1.07 | High Extent |
| 4. | Get idea on the meaning of the parts of drawn specimens in biology. | 2.77 | 1.11 | High Extent |
| 5. | Read some biology topics before its teaching in the classroom. | 2.76 | 1.16 | High Extent |
| Grand Mean | | 2.88 | .97 | High Extent |

n=217 x > 2.50

Table 2 showed that the respondents unanimously stated that undergraduate students apply ChatGPT in learning of Biology to a high extent. This is seen from the mean of items 1-5 which are above the cut off mean of 2.50. The smaller values of the standard

deviation indicated that the respondents were homogenous in their responses. The grand mean of 2.88 further revealed that the extent of undergraduate students' application of ChatGPT in learning of biology is high.

Table 3: Challenges hampering the Use of ChatGPT in Learning Biology

| S/N | Item Statement | Mean | Std. Deviation | Remarks |
|-------------------|---|-------------|----------------|-------------------|
| 1. | Unavailability of network (Wi-Fi). | 3.27 | 1.01 | Agree |
| 2. | Rules in the school do not permit the use of phone. | 1.28 | .62 | Strongly Disagree |
| 3. | ChatGPT does not show images or diagrams of biology specimens. | 3.28 | 1.01 | Agree |
| 4. | ChatGPT sometimes gives incorrect explanation to biology queries. | 2.39 | 1.00 | Disagree |
| 5. | Some lecturers do not encourage the use of ChatGPT in biology learning. | 2.79 | 1.05 | Agree |
| Grand Mean | | 2.60 | .54 | Agree |

n=217 x > 2.50

Table 3 revealed that items 1, 3, and 5 were rated as some of the challenges hampering the use of ChatGPT in learning Biology among undergraduate students as their mean are above the benchmark mean of 2.50. On the contrary, items 2 and 4 have mean values that are below 2.50 meaning that the respondents did not agree

that they are really the challenges hampering the use of ChatGPT in learning Biology among undergraduate students. The grand mean value of 2.60 shows that students have challenges that hamper their use of ChatGPT in learning Biology as revealed in table 3.

Table 4: Solutions to the Challenges hampering the Use of ChatGPT in Learning Biology among Undergraduate Students

| S/N | Item Statement | Mean | Std. Deviation | Remarks |
|---------------------|---|-------------|----------------|--------------|
| 6. | Use personal data to access ChatGPT when Wi-Fi is not available. | 3.30 | .84 | Agree |
| 7. | Get ChatGPT downloaded in students' android/smart phones and laptops. | 3.11 | 1.00 | Agree |
| 8. | Get information on the parts of drawn biology specimen in ChatGPT and follow the link it provides to access the specimen's diagram. | 2.99 | .96 | Agree |
| 9. | Give correct prompts in ChatGPT to avoid supplying incorrect answers. | 3.41 | .82 | Agree |
| 10. | Lecturers need to encourage the use of ChatGPT in biology learning. | 3.39 | .83 | Agree |
| Cluster Mean | | 3.24 | .58 | Agree |

n=217 x > 2.50

Table 4 showed the mean and standard deviation ratings of students on the solutions to the challenges hampering the use of ChatGPT in learning Biology among undergraduate students. The mean ratings ranged from 2.99 to 3.41 with standard deviation values that ranged from 0.82 to 1.00. From table 4, items 6 to 10 have mean values that are above the acceptable mean of 2.50 which indicates that the respondents unanimously rated the items as the solutions to challenges hampering the use of ChatGPT

in learning Biology among undergraduate students. The smaller values of the standard deviation indicated that the respondents were homogenous in their responses. The grand mean of 3.24 further showed that the respondents agreed that the items are the solutions to the challenges hampering the use of ChatGPT in learning Biology among undergraduate students.

Discussion

ChatGPT is the most available AI package which students are conversant with for use in Biology learning. This is likely because of its growing awareness, support for self-learning and exam preparation, simplifies complex biological concepts, assists students in their homework, its twenty-hour availability, its user-friendly interface, its accessibility through mobile phones as well as its low cost and free version. The findings align with the findings of Garrel and Mayer (2023) that students obviously see ChatGPT as an AI tool that they readily use in education due to its accessibility and versatility.

Also, ChatGPT's high availability (90.8%) and extensive application in learning tasks are consistent with studies that emphasize its role in assisting students with assignments, understanding complex concepts, and preparing for classes (Smith & Johnson, 2023). This indicates that ChatGPT is an integral part of students' learning processes, particularly in fields like biology, where interactive tools can significantly aid understanding (Crawford, Cowling & Allen, 2023). The findings of this study also support the self-determination theory propounded by Edward Deci and Richard Ryan in 1985 as it pertains to personalized learning since ChatGPT can provide customized feedback, generate practice questions and offer explanation that fosters engagement of the students.

However, similar to the challenges reported by Brown and Green (2023), students in this study face barriers such as network unavailability and limited support from educators. This could be because some schools and homes are located in areas where there is lack of reliable internet connection. The limited support from educators on the use of ChatGPT in learning of Biology could be because of concerns about academic integrity, resistance to adopt innovative ways of learning and lack of institutional support. These obstacles hinder the full potential of AI in enhancing learning experiences, as also observed by Martinez (2023), who noted that institutional restrictions and technical limitations often impede AI adoption.

The consensus among respondents in this study, in their responses on practical solutions to the challenges hampering the use of ChatGPT in learning biology among undergraduate students such as using personal data for internet access, giving correct prompts in ChatGPT to avoid supplying incorrect answers and lecturers encouraging the use of ChatGPT in biology learning among others mirrors the findings of Liu, Ren, Nyagoga, Stonier, Wu and Yu (2022) which advocated

for a more supportive environment to facilitate the effective use of AI in learning. This is because a supportive learning atmosphere promotes curiosity, collaboration and experimentation without unnecessary apprehensions. Again, students are more probable to adopt and trust tools that receive endorsement from authority figures like their lecturers.

Conclusion

The study explored the availability, extent of use, challenges, and solutions related to the application of AI tools, particularly ChatGPT in biology learning among undergraduate students. It was concluded that ChatGPT is the most utilized AI tool, followed by Grammarly, while other AI packages have limited use among students. ChatGPT is employed extensively for academic tasks, underscoring its relevance in aiding biology learning. However, challenges such as lack of internet access, inability to view biological diagrams, and inconsistent support from lecturers among others hinder its adequate utilization. Proposed solutions, such as leveraging personal data and encouraging lecturers' support among others were acknowledged by the respondents as measures to enhance the effectiveness of ChatGPT in learning biology.

Recommendations

The following recommendations are made:

1. Institutions should provide reliable Wi-Fi to ensure that students access AI tools like ChatGPT seamlessly.
2. Lecturers should actively support and integrate AI tools like ChatGPT in the learning process to enhance understanding and engagement.
3. Developers of ChatGPT should consider adding functionalities that display images and diagrams to address specific learning needs in biology.
4. Workshops and training sessions should be organized for students to improve their skills in using AI tools effectively, including crafting accurate prompts to minimize errors.
5. Schools should review policies restricting the use of phones, balancing regulations with the need to support innovative learning technologies.

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