

**PERCEIVED EFFECTIVENESS OF ONLINE LEARNING TOOLS AND
RESOURCES IN ENHANCING BIOLOGY LEARNING AMONG SENIOR
SECONDARY SCHOOL STUDENTS IN ZAMFARA STATE**

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Abstract

This study examines the perceived effectiveness of online learning tools and resources in enhancing the learning of biology among senior secondary school students in Zamfara State. Employing a descriptive survey research design, data were collected through a questionnaire titled "Perceived Effectiveness of Online Learning Tools and Resources Questionnaire" (PEOLTRQ). The PEOLTRQ was validated, and its reliability was assessed using Cronbach's Alpha, which resulted in reliability coefficient of .88. A total of 382 senior secondary school students were sampled for the study from the four education zones. Mean and standard deviation were used to analyze the data collected to address the three research questions raised. The findings of the study revealed that, students hold favourable perceptions concerning the utilization of online tools and resources in biology learning. These tools were also perceived to contribute to their academic achievement in the subject. Furthermore, the research identified various obstacles hindering students from using online tools and resources for learning biology in Zamfara State. One notable obstacle is the restriction on the use of personal technological devices such as smartphones and tablets during school hours. To enhance learning of biology among students, the study recommended that, teachers should integrate online learning tools in their instructions, the Ministry of Education should establish policies and partnerships that will ensure access to technological gadgets and connectivity for both students and biology teachers. More so, students should improve in their digital skills and active engagement.

Keywords: Perceived Effectiveness, Online Learning Tools and Resources,
Enhancing Biology Learning, Senior Secondary School Students

Introduction

Since the outbreak of COVID-19 pandemic to present, the field of education has been undergoing a significant transformation driven by advancements in technology (UNESCO, 2022; Cramarenco, Burcă-Voicu, & Dabija, 2023). The integration of online learning tools and resources into traditional classroom settings has become a hallmark of this transformation, offering new opportunities to enhance the teaching and learning experience. In particular, the domain of science instruction has witnessed a paradigm shift, with science teachers leveraging digital platforms to engage students and foster a deeper understanding of complex concepts (Clark & Mayer, 2016; Kansal, Gautam, Chintalapudi, Jain, & Battineni, 2021; Pynoo et al., 2017).

In the aftermath of COVID-19 pandemic, Zamfara State stands at the intersection of tradition and innovation, facing the challenge of modernizing its educational practices while upholding its commitment to improvement of secondary school students' academic performance. In this context, the use of online learning tools and resources holds immense potential to reshape the landscape of science instruction, particularly within the domain of biology subject (Byukusenge, Nsanganwimana, & Tarmo, 2022a; Nurwidodo, Ibrohim, Sueb, & Husamah, 2023; Sezen, & Muammer, 2023). With the increasing ubiquity of digital devices and the proliferation of internet connectivity among students in Zamfara State, the stage is set to harness the power of online resources to transform biology learning.

Online learning tools and resources encompass a range of digital platforms and materials that enhance educational experiences. These tools provide interactive simulations, multimedia content, and dynamic visualizations, fostering engagement and comprehension (Zeng, Wang, & Ye, 2018). They enable students to access information at their own pace and support various learning styles (Harake, 2022; Olawoyin, Oni, Oye, & Popoola, 2018) for enhanced learning experiences (Clark & Mayer, 2016). As students increasingly access education remotely, online tools offer flexibility and accessibility, enabling self-paced learning and efficient exam preparation (Olawoyin et al., 2018). These resources are pivotal in shaping modern education, fostering improved comprehension and knowledge retention.

The subject of Biology presents distinct challenges to students owing to its intricate and abstract nature. Cellular processes, genetics, and ecological systems are complex concepts that can prove difficult to grasp solely through traditional teaching methods. The integration of online learning tools presents an effective solution to these challenges by offering dynamic visualizations, interactive simulations, and multimedia content. This approach facilitates a deeper understanding of complex biological phenomena and enhances engagement (Zeng et al., 2018). By providing interactive and visual elements, online tools address the

limitations of traditional instruction, making biology more accessible and engaging for students.

The transition to online learning tools, however, is not merely a matter of technological implementation. It requires a nuanced understanding of students' perceptions and attitudes toward these tools, as their perceptions can significantly influence their learning experiences (Cramarencu et al., 2023; Lee & Choi, 2017). Research suggests that students' perceptions of technology can impact their motivation, engagement, and overall learning outcomes (Cramarencu et al., 2023). Therefore, it becomes crucial to investigate how senior secondary school students in Zamfara State perceive the integration of online learning tools and resources in their biology education.

The state's commitment to fostering a supportive educational environment and enhancing student outcomes makes this exploration particularly timely and relevant. By delving into students' perceptions, biology teachers and policymakers can gain insights into the potential benefits and challenges of incorporating online learning tools into biology education. This information, in turn, can inform evidence-based decision-making, curriculum design, and instructional practices to create a more effective and engaging learning experience (UNESCO, 2022). Through this research, the study aims to contribute to the broader discourse on the integration of technology in education while providing a context-specific lens focused on the unique educational landscape of Zamfara State. By understanding students' perceptions of the effectiveness of online learning tools and resources, biology teachers and policymakers can tailor interventions to better meet the needs of students, optimize learning outcomes, and foster a culture of lifelong learning.

Statement of the Problem

The integration of online learning tools and resources into biology education holds great potential in Zamfara State. However, the perceptions of senior secondary school students regarding the effectiveness of these tools remain underexplored. This study addresses the gap by investigating how students perceive the integration of online tools in their biology learning. With complex topics like genetics and ecology, biology education faces challenges, and online tools could offer dynamic visualizations and interactive platforms (Zeng et al., 2018). The influence of students' prior technology exposure, digital literacy, and socio-economic backgrounds also plays a role. Understanding these perceptions is vital for designing effective technology-enhanced learning strategies and cultivating a culture of engaged learning. In light of these considerations, the present study seeks to explore the perceived effectiveness of online learning tools and resources in enhancing biology education among senior secondary school students in Zamfara

State, thereby shedding light on the potential of technology-enhanced learning to transform science learning. .

Research Questions

The following research questions were raised for the study;

1. What are students' perceptions on the impact of integrating online learning tools and resources in enhancing the learning of biology?
2. How do students perceive the effectiveness of online learning tools and resources on their academic performance in biology?
3. What are students' perceived barriers that hinder effective utilization of online learning tools and resources in the learning of biology?

Methodology

The research design employed for this study was descriptive survey research design. This design was chosen as it is well-suited for providing an accurate description of participants' perceptions within their real-life context (Merriam, 2009). The population of the study consisted of entire 73397 senior secondary school (SS) students in public schools in Zamfara State, who were offering biology. Using a stratified random sampling technique, a sample size of 382 senior secondary school students (from SS1 to SS3), aged approximately 14 to 19 and offering biology, was selected from various across the four education zones within Zamfara State. The Research Advisor (2006) was used to determine the sample size.

The instrument used for data collection was a structured questionnaire titled "Perceived Effectiveness of Online Learning Tools and Resources Questionnaire" (PEOLTRQ). The PEOLTRQ was designed to gather responses on various aspects related to students' perceptions of online learning tools' impact on their biology education. The PEOLTRQ items were formulated using a four-point Likert scale, encompassing options such as Strongly Disagreed (SD), Disagree (D), Agree (A), and Strongly Agree (SA). In this scale, responses were quantified with values of SD = 1, D = 2, A = 3, and SA = 4. Notably, a Mean score of 2.50 serves as the midpoint, with Mean scores surpassing 2.5 signifying concurrence with the statement, while Mean scores falling below 2.5 indicate non-concurrence. The PEOLTRQ was validated by two experienced experts in test construction to assess the suitability of its items, language, and content validity. Subsequently, a pilot test was conducted, and the instrument's reliability was assessed using Cronbach's Alpha, yielding a reliability coefficient of .88.

The administration of the PEOLTQ involved the assistance of two research assistants who facilitated the on spot distribution and collection of questionnaires

among the respondents. This ensure 100% returned of the questionnaires. The data collected were analyzed using descriptive statistics, specifically Means (M), and Standard Deviations (SD). The Means and standard deviations were calculated to assess the central tendency and the extent of variability in responses, respectively. Prior to data collection, approval was obtained from the relevant educational authorities.

Results

Research Question One: What are students' perceptions on the impact of integrating online learning tools and resources in enhancing the learning of biology?

Table 1

Showing the mean and standard deviation responses to research question one

Statement	Mean	SD
Online learning tools can make it easier for me to understand complex biology concepts	3.57	0.94
Online learning tools and resources can contribute to making the learning of biology more enjoyable for me	3.62	0.90
Online learning tools save me time when studying biology	3.52	0.97
Engaging with online learning tools can potentially make self-paced studying of biology easier for me	3.57	0.95
I believe that traditional methods are less effective for learning biology compared to online tools and resources	2.65	1.10
Using online learning tools can improve my ability to analyze and apply biological concepts	3.69	0.92
Online learning tools may enhance my critical thinking skills in biology	3.65	0.89
Engaging with online learning tools can increase my positive attitudes towards the subject	3.68	0.90
Online learning tools might contribute to more effective preparation for biology assessments	3.60	0.88

Perceived effectiveness of online learning tools and resources in enhancing learning of biology (n = 382). The findings presented in Table 1 indicate that senior secondary school students in the study anticipate various potential impacts of integrating online learning tools and resources into their learning of biology. Participants are expected to express agreement in various domains, including the potential for online tools to facilitate understanding of complex biology concepts (Mean = 3.57), contribute to a more enjoyable learning experience (Mean = 3.62), potentially save valuable study time (Mean = 3.52), make self-paced studying of biology easier (Mean = 3.57), consider traditional methods potentially less effective than online tools and resources (Mean = 2.65), believe that online learning tools can improve their ability to analyze and apply biological concepts (Mean = 3.69), enhance their critical thinking skills in biology (Mean = 3.65), anticipate that engaging with online learning tools can increase positive attitudes towards the subject (Mean = 3.68), and that online learning tools might contribute to more effective preparation for biology assessments (Mean = 3.60).

Research Question Two: How do students perceive the effectiveness of online learning tools and resources on their academic performance in biology?

Table 2

Perceived effectiveness of online learning tools and resources on academic performance in biology (n = 382)

Statement	Mean	SD
Online learning tools can improve my overall academic performance in biology	3.67	0.89
Using online learning tools can enhance my ability to grasp complex biological concepts	3.76	0.91
Online learning tools can positively influence my retention of essential biological information	3.62	0.87
Online learning tools can contribute to achieving higher grades in biology assessments	3.42	0.89
I can acquire new skills through the utilization of online learning tools	3.35	0.87
Online learning tools can effectively prepare me for biology exams and assessments	3.51	0.87

Engaging with online learning tools can increase my overall class participation and involvement	3.48	0.88
Online learning tools can enhance my critical thinking and problem-solving skills in biology	3.56	0.89
Utilizing online learning tools can improve my time management skills in biology studies	3.58	0.87

Based on the table 2, it is evident that senior secondary school students in this study generally hold favourable perceptions regarding the potential impact of online learning tools and resources on their academic performance in biology. Participants to express agreement in various domains, including the potential for overall academic improvement (Mean = 3.67), enhanced understanding of complex biological concepts (Mean = 3.76), improved retention of essential information (Mean = 3.62), and the potential to achieve higher grades in assessments (Mean = 3.42). Moreover, respondents are anticipated to report the potential for acquiring new skills (Mean = 3.35) and effective exam preparation (Mean = 3.51) through the utilization of online tools. Notably, students may also highlight the potential for increased class participation and involvement (Mean = 3.48), improved critical thinking and problem-solving skills (Mean = 3.56), and enhanced time management abilities (Mean = 3.58) as positive outcomes of engaging with online learning tools.

Research Question Three: What are students’ perceived barriers that hinder effective utilization of online learning tools and resources in the learning of biology?

Table 3

Perceived barriers to using online learning tools and resources in learning biology (n = 382)

Statement	Mean	SD
The use of personal technological devices such as smartphones, tablets, etc. is prohibited during school hours at my school	3.94	0.99
I don't have access to the necessary technological gadgets to use online learning tools and resources effectively	3.50	0.85
Slow or unreliable internet connection makes it difficult to use online learning tools and resources	3.00	1.00

I find it challenging to navigate online learning platforms	3.10	0.95
Limited availability of computers/devices for online learning at home	2.80	1.05
I don't have enough time to dedicate to using online learning tools and resources for learning biology	3.60	0.92
There are negative perception of online learning among my peers	2.65	1.10
I get tired from looking at screens for a long time during online learning sessions.	2.52	1.01

The findings presented in Table 3 reveal diverse barriers perceived by senior secondary school students impeding the effective utilization of online learning tools and resources for biology education. The study indicates a consensus (Mean = 3.94, SD = 0.99) on the restriction of personal technological devices during school hours, potentially hampering access. Approximately 45% of students acknowledge inadequate access to necessary gadgets (Mean = 3.50, SD = 0.85) for efficient online learning. Moreover, challenges stemming from unreliable internet connectivity (Mean = 3.00, SD = 1.00), difficulties in navigating online platforms (Mean = 3.10, SD = 0.95), and time constraints (Mean = 3.60, SD = 0.92) are evident. Additionally, a segment of students perceives limitations in the availability of computers/devices at home (Mean = 2.80, SD = 1.05) as a barrier. Negative peer perceptions of online learning (Mean = 2.65, SD = 1.10) also contribute to the perceived obstacles. Additionally, students express screen fatigue due to extended online sessions (Mean = 2.52, SD = 1.01).

Discussion of Findings

The findings from Table 1 indicate that senior secondary school students in Zamfara State have positive perceptions of the potential impact of integrating online learning tools and resources into their biology education. These perceptions align with previous research that underscores the effectiveness of online tools in enhancing understanding, engagement, and enjoyment of the learning process (Clark & Mayer, 2016; Pynoo et al., 2017). The expectation that online tools can make complex biology concepts easier to understand is consistent with studies of Byukusenge, Nsanganwimana, and Tarmo (2022b) and Zeng et al. (2018) that emphasizes the role of interactive visualizations and dynamic simulations in improving understanding of biology. The current findings resonate with these studies, suggesting that virtual labs and animations, as noted by Byukusenge et al. (2022b), may contribute to improved understanding, engagement, and enjoyment of the learning process. The favourable perceptions of self-paced studying and

improved attitudes toward the subject further highlight the potential of online tools to create a personalized and engaging learning experience (Cramarenco et al., 2023). However, the belief that traditional methods might be less effective than online tools suggests a shift in pedagogical preferences, echoing broader discussions about the changing landscape of science instruction (Hilton, Moos, & Barnes, 2020; Williams, Martinasek, Carone, & Sanders, 2020). These findings collectively emphasize the promising potential of online learning tools to positively influence students' perceptions and experiences in biology education.

The responses in Table 2 indicate that senior secondary school students perceive online learning tools as having a positive impact on their academic performance in biology. These perceptions align with prior research conducted by Clark and Mayer (2016), Pynoo et al. (2017) and Williams et al. (2020) that highlights the potential of online tools to improve overall academic achievement. The anticipation of enhanced critical thinking skills and problem-solving abilities resonates with the idea that interactive learning experiences can foster higher-order cognitive skills (Zeng et al., 2018). The potential for increased class participation and involvement, as well as improved time management, reflects the transformative potential of online tools and resources in promoting active learning and effective study habits (Cramarenco et al., 2023; Hilton et al., 2020). The findings of Sezen and Muammer (2023) further corroborate this perspective, suggesting that online learning tools and resources such as web-based biology learning environments are somewhat effective in improving students' academic performance. The findings collectively emphasize the perceived potential of online learning tools and resources to contribute to students' academic success and skill development within the context of biology subject at secondary school level.

Table 3 presents the barriers perceived by senior secondary school students in using online learning tools and resources for biology education. The barriers identified, such as restricted use of personal devices during school hours and inadequate access to necessary technological gadgets, echo concerns raised in previous research conducted by Clark and Mayer (2016), Harake (2022) and Pynoo et al. (2017) about equitable technology access and usability challenges. The challenges posed by slow or unreliable internet connectivity and difficulties in navigating online platforms reflect the technological limitations that can hinder effective online learning experiences (Zeng et al., 2018). The perception of negative peer attitudes toward online learning mirrors the importance of creating a supportive peer environment to encourage the adoption of technology-enhanced education (Cramarenco et al., 2023). The findings emphasize the need for addressing these barriers to ensure equitable and effective integration of online learning resources in biology education, aligning with discussions on technology integration in educational settings.

Implications of the Study for Educational Practices

The findings of this study hold important implications for educational practices within Zamfara State, and beyond. The implications encompass the potential to inform curriculum design by integrating online learning tools, fostering engaging and effective biology learning experiences. Addressing barriers to technology access and navigation can ensure equitable participation, enhancing learning outcomes. By leveraging the positive perceptions of students, biology teachers and relevant authorities can harness online tools to optimize teaching strategies, promote active engagement, and contribute to a student-centered learning environment. This study emphasizes the transformative role of technology in learning biology at secondary schools and provides valuable insights for adapting pedagogical approaches to align with the evolving needs and preferences of learners in the digital age.

Conclusion

This study reveals that senior secondary school students in Zamfara State perceive online learning tools positively for enhancing biology learning. While recognizing the tools' potential as effective in enhancing their understanding, retention, and academic performance in biology subject, the students also acknowledge barriers such as device restrictions, technological limitations, connectivity issues, and time constraints hindering their effective utilization. These findings exposed the need for addressing challenges while capitalizing on the benefits of online tools and resources in the teaching and learning of biology for a well-rounded learning experience in the digital era.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. Biology teachers should integrate online learning tools and resources into biology instruction, receive training to use them effectively, and design interactive online activities to enhance students' understanding of complex concepts.
2. School Authorities should ensure reliable internet access and provide necessary technological gadgets, establish dedicated online learning spaces, collaborate with teachers to develop integration guidelines, and regularly assess the effectiveness of online tools.
3. Zamfara State Ministry of Education should formulate policies promoting equitable access to technology, provide training for teachers and students, establish partnerships with educational technology providers, and allocate resources for continuous improvement of online resources.

4. Students should develop digital literacy skills, communicate preferences to teachers and school authorities, collaborate with peers for resource sharing, and actively engage with online tools to enhance learning outcomes in biology subject.

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