

POST-COVID-19 ASSESSMENT OF STUDENTS' INTEREST IN THE USE OF ONLINE MODES OF BIOLOGY INSTRUCTION IN PRIVATE SECONDARY SCHOOLS IN ENUGU STATE

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Abstract

This study assessed post-COVID-19 students' interest in the use of online modes of Biology instruction in private secondary schools in Enugu State, Nigeria. The study was guided by two research questions and one hypothesis tested at the 0.05 level of significance. An ex-post facto research design was adopted. The population comprised 8,040 SSIII students from 185 private secondary schools in Enugu and Nsukka Education Zones. A sample of 447 students (206 males and 241 females) was selected using a multistage sampling procedure. Data were collected using a 29-item structured questionnaire with a reliability coefficient of 0.86 determined using Cronbach's alpha. Mean and standard deviation were used to answer the research questions, while t-test was employed to test the hypotheses at the 0.05 level of significance using SPSS version 20. Findings revealed that students generally expressed a high level of interest in the use of online modes of Biology instruction based on their learning experiences during the COVID-19 pandemic. The findings further indicated that students' interest did not differ significantly by gender. The study concluded that students maintained a positive disposition towards online Biology instruction in the post-COVID-19 period. It was recommended among other things, that schools should strengthen the integration of technology-supported instructional approaches in Biology teaching.

Keywords: Post Covid-19 pandemic, online biology instruction, students' interest

Introduction

The COVID-19 pandemic brought unprecedented disruptions to educational systems worldwide (Sumitra & Roshan, 2021; WHO, 2020). In response to the rapid spread of the virus, governments implemented measures such as lockdowns, social distancing, and school closures to limit physical contact among citizens (Bedford et al., 2020; Gostin & Wiley, 2020; NCDC, 2020; Olayemi et al., 2021; Sumitra & Roshan, 2021; Zhao & Watterston, 2021). In Nigeria, educational institutions at all levels were temporarily closed, resulting in interruptions to conventional face-to-face teaching and learning (Ilodibe & Patrick, 2020; TED, 2020). To ensure continuity of education during this period (Agbele & Oyelade, 2020), many schools adopted alternative instructional approaches, particularly online modes of teaching and learning (Zhao & Watterston, 2021; Butoi et al., 2022).

Online instruction refers to the delivery of educational content through digital technologies and internet-based platforms that enable teaching and learning outside the traditional classroom environment. Online learning may occur through synchronous platforms, where teachers and students interact in real time (Mohamad et al., 2020), asynchronous platforms that allow learners to access instructional materials at their convenience, or blended approaches that combine online and face-to-face interactions (Team Leverage Edu, 2023). Ming-Hung et al. (2017) stated that the above three online learning techniques can also involve interactive television (TV), radio and satellite

broadcasting. TED (2020) and Zhao (2020) highlighted the advantages of the use of online tools as well as TV/radio in teaching and learning especially where physical contact becomes impossible. Apart from carrying out studies anywhere, these learning tools offer the convenience of time and space, cost-effectiveness and flexibility (Sadiku et al., 2018). According to Li (2022), the online learning experience has not only changed the state of teaching and learning from traditional method to interactive and student-centred but created a digital learning community, improving students' learning skills as well as staying connected during tough time.

During the COVID-19 pandemic, private secondary schools in Nigeria were among the educational institutions that increasingly relied on these online instructional modes to sustain academic activities (Tokede & Appah, 2020). The adoption of online instruction during the pandemic represented a significant shift in the teaching and learning process. Prior to COVID-19, online learning was not widely utilized in many Nigerian secondary schools (Tokede & Appah, 2020), particularly as a primary mode of instruction. Consequently, students and teachers were compelled to adapt to new technologies and learning environments within a relatively short period. This experience exposed learners to new opportunities for accessing educational resources, communicating with teachers, and participating in learning activities beyond the physical classroom.

Biology is one of the core science subjects taught in secondary schools and plays a crucial role in helping students understand living organisms, environmental interactions, and health-related issues. The teaching of Biology often requires active learner participation, observation, practical activities, and continuous interaction between teachers and students. Consequently, students' interest in learning Biology is an important factor that influences their engagement, persistence, and academic achievement. The extent to which online instructional modes support or hinder students' interest in Biology learning therefore remains an important educational concern.

Interest has been widely recognized as a significant determinant of learning outcomes. Educational psychologists view interest as a psychological state characterized by focused attention, increased engagement, and a positive disposition toward a particular activity or subject (Harackiewicz & Knogler, 2017; Rowland et al., 2019). Interest motivates learners to participate actively in instructional activities, sustain concentration, and invest effort in academic tasks Kpolovie *et al.* (2014). Studies have shown that students who possess a high level of interest in a subject are more likely to demonstrate persistence, deeper understanding, and improved academic performance than those with low interest. Paul (2013) posited that when one is interested in what he is learning, he pays closer attention; processes the information more efficiently; and employs more effective learning strategies, such as engaging in critical thinking, making connections between old and new knowledge, and attending to deep structure instead of surface features. In the context of online learning, students' interest becomes particularly important because the learning process often requires greater self-regulation, motivation, and independent engagement.

Research on online learning during and after the COVID-19 pandemic has produced mixed findings. Some studies reported positive outcomes associated with online instruction, including flexibility, accessibility, learner autonomy, and opportunities for continuous learning during periods of disruption (Gustia & Suhartini (2021; Anguirre *et al.*, 2022; Li *et al.*, 2023). Online platforms enabled students to access educational materials from different locations (Yazgan, 2022), and allowed schools to maintain instructional activities despite restrictions on physical interactions. Researchers have also

argued that online learning promotes learner-centred instruction by providing students with greater control over the pace and timing of learning activities.

However, other studies have highlighted several challenges associated with online instruction. These include inadequate internet connectivity, limited access to digital devices, high data costs, poor electricity supply, reduced teacher-student interaction, and difficulties in maintaining learners' attention and motivation due to home environment (Agbele & Oyelade (2020); Owusu-Fordjour *et al.* (2020); Uzorka & Makeri (2020); Olayemi *et al.*, 2021; Stoian *et al.*, 2022). Some researchers observed that students experienced challenges adapting to online learning environments and often preferred conventional face-to-face instruction (Barzani & Rayan, 2021; Li *et al.*, 2023), because of opportunities for direct communication and immediate feedback. Such findings suggest that students' perceptions and experiences of online learning may vary considerably depending on contextual factors such as educational level, learning environment, subject area, and access to technological resources. Although private schools generally demonstrated greater capacity to adopt online instructional platforms than many public schools, students' experiences were not uniform. Variations in access to digital resources, home learning environments, parental support, and technological competence may have influenced the extent to which students benefited from online instruction (Agbele & Oyelade, 2020). Consequently, the experiences of private secondary school students warrant specific investigation rather than broad generalization from studies conducted in other educational contexts.

Notwithstanding the growing body of literature on online learning, existing studies have largely concentrated on issues such as accessibility, challenges, academic performance, technology adoption, and general effectiveness of online instruction. Furthermore, much of the available research focused on experiences during the COVID-19 lockdown period. Comparatively fewer studies have examined students' interest in online learning after the pandemic, particularly within specific subject areas such as Biology. Subject-specific investigations are important because students' perceptions and levels of engagement may differ across disciplines depending on the nature of the subject and instructional requirements. In addition, limited empirical evidence exists regarding the post-COVID-19 interest of private secondary school students in the use of online modes of Biology instruction in Enugu State. While previous studies provide valuable insights into online learning generally, they do not adequately explain whether students who were exposed to online instruction during the pandemic developed sustained interest in using such instructional modes for Biology learning. This gap is important because students' interest is a critical determinant of engagement, participation, and successful learning outcomes. Understanding students' interest in online Biology instruction can also provide useful information for educational planners, school administrators, curriculum developers, and teachers seeking to integrate technology-enhanced learning into secondary school education. Therefore, the present study seeks to assess post-COVID-19 students' interest in the use of online modes of Biology instruction in private secondary schools in Enugu State. By focusing on students' interest within a specific subject area and educational context, the study contributes to the growing literature on online learning and provides evidence that may guide future instructional planning and educational innovation.

Statement of the Problem

The COVID-19 pandemic resulted in the closure of schools worldwide and compelled many private secondary schools in Enugu State to adopt online modes of instruction for the first time. Although the use of online learning platforms enabled

continuity of teaching and learning during the lockdown period, the extent to which students developed and sustained interest in learning Biology through these platforms remains uncertain. Existing studies on online learning during the COVID-19 era have largely focused on accessibility, challenges, effectiveness, and academic performance. However, there is limited empirical evidence on students' interest in the use of online modes of Biology instruction, particularly among private secondary school students in Enugu State after the COVID-19 pandemic. Consequently, it is unclear whether the experiences gained during the pandemic have encouraged or discouraged students' interest in online Biology learning. This lack of evidence constitutes a gap in the literature and limits the ability of educators, school administrators, and policy makers to make informed decisions regarding the integration of online instructional modes into Biology teaching in secondary schools. Therefore, the problem of this study is the paucity of empirical information on post-COVID-19 students' interest in the use of online modes of Biology instruction in private secondary schools in Enugu State. This study seeks to fill this gap by assessing students' interest in the use of online modes of Biology instruction in the post-COVID-19 era.

Purpose of the Study

The main objective of this study is to assess private secondary school students' interest in the use of online modes for Biology instruction in the post-COVID-19 pandemic era in Enugu State. Specifically, the study seeks to:

1. determine students' interest in the use of online modes for Biology instruction in private secondary schools in Enugu State in the post-COVID-19 pandemic era.
2. determine the influence of gender on students' interest in the use of online modes for Biology instruction in private secondary schools in Enugu State in the post-COVID-19 pandemic era.

Research Questions

The following research questions guided the study:

1. What is the level of students' interest in the use of online modes for Biology instruction in private secondary schools in the post-COVID-19 pandemic era?
2. What influence does gender have on students' interest in the use of online modes for Biology instruction in private secondary schools in the post-COVID-19 pandemic era?

Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

H₀₁: There is no significant difference between the mean interest scores of male and female students regarding the use of online modes for Biology instruction in private secondary schools in the post-COVID-19 pandemic era.

Methods

The study adopted *ex-post facto* research design; a non- experimental design was employed in the study in that the relevant variables have already occurred, thus investigating the undependable variables in retrospect for their possible relations to, and effects on, the dependent variables. The study was carried out in Enugu and Nsukka Education zones, Enugu State, Nigeria. There are 141 private secondary schools in three (3) LGAs (Enugu East, Enugu North and Isi-Uzo) that make up the Enugu Education Zone, and 44 private secondary schools in three (3) LGAs (Igbo-Etiti, Nsukka and Uzo-uwani) in Nsukka Education Zone (Ministry of Education, Enugu, 2023). The sample for the study consisted of 447 SSIII students (206 males and 241 females) selected from a

population of 8,040 SSIII students enrolled in 185 private secondary schools in Enugu and Nsukka Education Zones of Enugu State. A multistage sampling procedure involving purposive, stratified, and simple random sampling techniques was employed. In the first stage, the private secondary schools were stratified according to Local Government Areas (LGAs) within the two Education Zones. Thereafter, purposive sampling was used to select only those private secondary schools that implemented online teaching and learning during the COVID-19 pandemic. The purposive selection was necessary because the study focused specifically on students who had prior exposure to online modes of instruction. In the second stage, disproportionate stratified sampling was used to allocate participants across the selected schools and Education Zones in order to ensure adequate representation. In the final stage, simple random sampling (lottery method) was employed to select the participating students from the eligible schools. Through this procedure, a total of 447 SSIII students comprising 206 males and 241 females were selected for the study.

Structured questionnaire was used as the research instrument for collecting the data. It was developed by the researchers in line with the objectives of the study to elicit information from the respondents. The instrument is divided into two Sections: Section A is on demographic data where the respondents are required to indicate their gender and name of school, while Section B christened Private Secondary School Students' Interest in Use of Online Modes (PSSSIUOM) consist of 17 items on four-point Likert scale type in which the respondents are required to indicate their level of agreement or disagreement against each questionnaire item as follows: "Strongly Agree" (SA), "Agree" (A), "Disagree" (D) and "Strongly Disagree" (SD) which are adopted to address the research questions guiding the study. The questionnaire used were validated through face validity by three research experts from Department of Measurement and Evaluation and Department of Science Education in Enugu State University of Science and Technology (ESUT), Enugu. By trial testing using Cronbach's alpha technique, 0.86 was obtained as the reliability value of the research instrument which is considered good enough for the study.

The researcher with the help of research assistants, administered the questionnaire directly to the respondents at the various private secondary schools sampled. Having trained the research assistants on how to administer and collect the questionnaire, there was on the spot distribution and collection of the research instrument in each school visited, and thus recording 100% return rate! Arithmetic mean ($\bar{x}$) and standard deviation (SD) were employed to answer the research questions while the null hypotheses were tested using the t-test at 0.05 level of significance in SPSS version 20. The decision rule for the research questions is that any item that has the mean of 2.50 and above is regarded as agree, while mean score below 2.50 is regarded as disagree. For the decision rule in the application of t-test, the null hypothesis is rejected if the significant value is less than 0.05 level of significance but not rejected if it is greater than 0.05.

Results

Research Question One: What is the level of students' interest in the use of online modes for Biology instruction in private secondary schools in Enugu State in the post-COVID-19 pandemic era?

Table 1: The Mean and Standard Deviation Response Scores of Private Secondary School Students' Interest in the use of Online Modes (PSSSIUOM)

S/N	Students' interest in online Biology instruction amid COVID-19 pandemic	Mean	SD	Decision
1	The sudden shift from traditional face-to-face to remote platforms during COVID-19 era seems relevant to students	2.51	1.16	Agree
2	One enjoyed the online modes (synchronous e.g. zoom, video conferencing and asynchronous e.g. Whatsapp, e-mailing, message boards) as well as radio/TV lessons used in Biology instruction during COVID-19	2.52	1.11	Agree
3	A variety of media and digital tools used by instructors has made online learning more exciting and effective	2.53	1.13	Agree
4	Online and radio/TV lessons were very important and interesting in Biology instructions during the COVID-19 lockdown	2.59	1.13	Agree
5	The online tools as well as radio/TV lessons kept learners engaged in learning science subjects (Biology) within the sit-at-home due to COVID-19 lockdown and they were happy about that	2.51	1.11	Agree
6	Online modes and radio/TV lessons in Biology instructions during the lockdown due to COVID-19 pandemic was all fun	2.66	1.16	Agree
7	My school supported online education before the emergence of COVID-19 pandemic and that boosted my interest	2.84	1.10	Agree
8	The school authority is highly appreciated for providing sufficient technical support for the online learning during the pandemic	2.56	1.15	Agree
9	One is happy with online distance learning because it facilitates interaction with Biology teacher	2.49	1.106	Disagree
10	One feels that taking Biology online instruction helps one to study the subject and master it better	2.48	1.10	Disagree
11	One is excited because engaging in online learning during COVID-19 lockdown led to enhanced motivation for Biology study	2.64	1.16	Agree
12	One likes the online learning and radio/TV lessons during COVID-19 lockdown because it led to one's increased self-study habit	2.52	1.10	Agree
13	One would prefer online learning to continue being used and to become new norm post COVID-19 pandemic	2.60	1.12	Agree
14	One likes online modes of instruction because it			

	helped to cover school syllabus	2.57	1.10	Agree
15	Sometimes, one had difficulty in focusing attention in online Biology instructions due to domestic works and home distraction	2.50	1.11	Agree
16	One easily gets bored in radio/TV lessons than other online modes during sit-at-home due to COVID-19 pandemic	2.56	1.11	Agree
17	One dislikes remote Biology learning by online and use of radio/TV because it is time consuming	2.79	1.13	Agree
Grand Mean & SD		2.58	1.12	Agree

Table 1 showed that students generally expressed interest in the use of online modes for Biology instruction. The item mean scores ranged from 2.48 to 2.84. Out of the 17 items, 15 had mean ratings above the criterion mean of 2.50 and were accepted, while only two items (Items 9 and 10) were rejected with mean scores of 2.49 and 2.48 respectively. The highest mean score (Mean = 2.84, SD = 1.10) was recorded for the item indicating that schools supported online education before the emergence of COVID-19, thereby boosting students' interest. The lowest mean score (Mean = 2.48, SD = 1.10) was recorded for the item stating that online Biology instruction helped students master the subject better, on the contrary. The grand mean score of 2.58 with a standard deviation of 1.12 exceeded the criterion mean of 2.50, indicating that students had a generally positive interest in the use of online modes for Biology instruction.

Research Question Two: What influence does gender have on students' interest in the use of online modes for Biology instruction in private secondary schools in post-COVID-19 pandemic era?

Table 2: The Mean and Standard Deviation Response Scores of Gender Influence on Students' Interest in the Use of Online Modes in Biology Instruction post- COVID-19 Pandemic era

Variables	Gender	N	Mean	SD
Students'_interest_in_use_of_online_modes_in_Biology_instructions_in_private_secondary_schools_post_COVID-19_pandemic_era	Male	206	2.57	1.20
	Female	241	2.52	1.12

Table 2 shows that male students had a mean interest score of 2.57 (SD = 1.20), while female students had a mean interest score of 2.52 (SD = 1.12). The difference in the mean scores was only 0.05, indicating a negligible difference in students' interest based on gender. Therefore, this indicates that gender had little influence on students' interest in the use of online modes for Biology instruction.

Hypothesis One: There is no significant difference between the interest of male and female private secondary school students in the use of online modes in Biology instructions post-COVID-19 pandemic

Table 3: Independent Samples t-Test Extract of Male and Female Students' Interest in the Use of Online Modes in Biology Instructions in Private Secondary Schools post- COVID-19 pandemic

Gender	N	Mean	SD	F	t	Df	Sig (2-tailed)
Male	206	2.57	1.20	3.292	.427	445	.670
Female	241	2.52	1.12				

The independent samples t-test results in Table 3 revealed a t-value of 0.427 with 445 degrees of freedom and a significance value of 0.670. Since the p-value (0.670) is greater than the 0.05 level of significance, the null hypothesis was not rejected. Therefore, there is no significant difference between the mean interest scores of male and female students regarding the use of online modes for Biology instruction.

Discussion

The findings of the study revealed that students demonstrated a positive interest in the use of online modes for Biology instruction, as evidenced by the grand mean score of 2.58. This finding suggests that the online learning experiences provided during the COVID-19 pandemic were generally perceived favourably by students. The students appreciated the flexibility and accessibility of online learning platforms as well as radio and television instructional programmes used during the period. The positive interest observed may be attributed to the opportunities that online learning provided for continuity of education despite school closures. The finding is in line with the results of the investigations by Olayemi *et al.* (2021) and Butoi *et al.* (2022) which indicated that most students found online modes of teaching and learning during COVID-19 pandemic very interesting, exciting and effective. The finding further suggests that students recognized the relevance of digital technologies in supporting Biology learning and maintaining academic engagement during the pandemic. Also, the finding of the study coincided with that of Aguirre *et al.* (2022) which noted that online learning is a viable stimulating method for instructional and service delivery in that it provides great flexibility. This is quite understandable in the sense that the private secondary school students in Enugu State who may have experienced the application of the online learning platforms for the first time in life, had it in their comfort homes.

However, some students expressed reservations about the effectiveness of online learning in promoting interaction with teachers and enhancing mastery of Biology concepts, as reflected in the rejection of Items 9 and 10. This indicates that although students appreciated online learning, they still perceived limitations in achieving the same level of interaction and understanding obtainable in conventional face-to-face instruction. The finding is in line with results of Barzani & Rayan (2021) and Li *et al.* (2023) which indicated that students preferred face-to-face classes to online classes as against online learning. Also, the finding as in Table 1 revealed that some private secondary school students sometimes had difficulty in focusing attention to online Biology instructions during COVID-19 pandemic due to home distractions. This is in line with the study of Owusu-Fordjour *et al.* (2020) who indicated that most Ghanaian students were unable to study effectively from home during the disease pandemic thus making the online system of learning ineffective because they failed to receive the needed assistance from their parents. The distractions from home environment could be attributed to the fact that the

home was noisy during the COVID-19 pandemic because the students' siblings (both young and old) were at home. Also, Stoian *et al.* (2022) research finding indicated that some students rejected online teaching and learning due to varied problems associated with it, such as internet connectivity, teachers' inexperienced, lack of physical interaction between the students and teachers, limitations to real laboratory practical engagement, and home-environmental distractions.

The findings further revealed that gender had little influence on students' interest in online Biology instruction. Although male students recorded a slightly higher mean score than female students, the difference was very small. Furthermore, the independent samples t-test showed that the difference was not statistically significant. This finding implies that both male and female students responded similarly to online Biology instruction and shared comparable perceptions regarding its usefulness and effectiveness. This is collaborated with the work of Mohamad *et al.* (2020), in which they found that there is no significant difference in satisfaction and intention to continue usage of online distance learning among male and female students. The result suggests that the adoption and acceptance of educational technologies among secondary school students may not be determined by gender but rather by factors such as access to digital devices, internet connectivity, and quality of instructional delivery.

Conclusion

Based on the findings of the study, it was concluded that students in private secondary schools in Enugu State generally showed positive interest in the use of online modes for Biology instruction. The experiences gained during the COVID-19 pandemic appear to have enhanced students' appreciation of technology-supported learning. The study further concluded that gender does not significantly influence students' interest in online Biology instruction. Both male and female students demonstrated comparable levels of interest, indicating that online learning opportunities are equally acceptable across gender groups.

Recommendations

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

1. Private secondary schools should continue to integrate online instructional strategies into Biology teaching as part of a blended learning approach.
2. School administrators should provide adequate technological infrastructure, including reliable internet facilities and digital learning resources, to sustain students' interest in online learning.
3. Biology teachers should be trained regularly on innovative online teaching methods that enhance interaction, engagement, and understanding of scientific concepts.
4. Educational stakeholders should develop policies that encourage the effective integration of technology into secondary school science education.
5. Efforts should be made to address challenges associated with online learning, particularly issues relating to student-teacher interaction and effective mastery of Biology concepts.

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