

PERCEIVED IMPACTS OF ONLINE RESOURCES ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ENGAGEMENT IN BIOLOGY

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Abstract

The study investigated the perceived impacts of online resources on the academic engagement of senior secondary school Biology students. Three research questions guided the study. The study employed a descriptive survey design. A sample of 350 SS II Biology students was selected from 31 public secondary schools in Nsukka Local Government Area. Data were collected using Impact of Online Resources on Students' Academic Engagement in Biology Questionnaire (IORSABEQ), developed by the researcher. The reliability yielded coefficients of 0.92, 0.96 and 0.94 for clusters A, B and C respectively, with overall index of 0.86 using Cronbach Alpha indicating high internal consistency. The data were analyzed using mean and standard deviation. The findings of the study revealed that online resources positively influence students' academic engagement in Biology, particularly by enhancing understanding of complex topics and sustaining learning interest. The study concluded that online resources enhance Biology learning but require improved digital infrastructure and teacher involvement for maximum effectiveness. It recommended collaboration among government, schools, and stakeholders to promote equitable access to digital learning resources.

Keywords: Biology, online resources, academic engagement

Introduction

Biology as one of the science subjects at the senior secondary school is concerned with the study of living organisms, their structures, functions, and interactions within the environment. It encompasses the exploration of life processes, diversity, evolution, and ecology, providing critical insights into the natural world. According to Ajayi (2018), biology equips students with scientific literacy necessary for understanding health, disease prevention, and environmental conservation, which are vital for national development. Biology fosters critical thinking and problem-solving skills through practical experiments and inquiry-based learning, which are essential for scientific progress (Chukwuemeka & Olusegun, 2019). In Nigeria, biology forms a core part of the senior secondary school science curriculum and is foundational for careers in medicine, agriculture, environmental science, and biotechnology.

Despite the importance of biology, the status of biology teaching in Nigerian secondary schools faces several challenges. Several studies (Ojo, 2017; Nwafor, 2020) point to inadequate instructional materials, insufficient laboratory facilities, and poorly trained teachers as significant barriers to effective biology education. The National Commission for Colleges of Education (NCCE) report (2019) similarly emphasizes that many biology teachers lack the requisite pedagogical skills and access to modern teaching aids, which negatively impact students' understanding and interest in the subject. This situation often leads to students performing poorly in internal and external examinations, as reflected in the West African Examinations Council (WAEC) reports, and results in a decline in the number of students pursuing biology-related fields at tertiary levels (Adewale, 2021). This decline may be as a result of the voluminous nature of biology terminologies used in biology content or use of traditional methods of teaching neglecting

the innovative methods which include the ineffective use of ICT resources such as online resources.

Online resources are digital instructional materials that include videos, simulations, animations, interactive modules, virtual laboratories, e-textbooks, educational websites, and learning management systems (LMS), which are used to supplement traditional classroom instruction. These tools can be integrated into biology teaching in multiple ways. For example, 3 teachers can use interactive simulations to illustrate biological processes such as photosynthesis and mitosis, while virtual labs provide students with opportunities to perform experiments when physical laboratory access is limited. Animations and educational videos simplify abstract topics like genetics and ecology, while digital quizzes and discussion forums encourage participation and allow teachers to monitor understanding. According to Eze and Nwosu (2020), online resources provide flexible, engaging, and accessible content that caters to different learning styles and improves comprehension of difficult concepts. Similarly, Okafor (2021) observed that virtual experiments and visualizations enhance experiential learning, compensating for inadequate laboratory facilities. Beyond Nigeria, studies such as that of Mthembu and Nkosi (2018) in South Africa highlight that online resources promote self-directed learning and expand teacher-student interaction beyond the classroom, increasing motivation and participation. These potentials underscore the need to examine research evidence on how effectively online resources have been applied in biology education. The effectiveness of online resources in teaching biology has been increasingly validated through empirical research. In Nigeria, Oladipo (2019) found that students exposed to computer-based simulations significantly outperformed those taught through conventional methods, reporting improved achievement and retention. Similarly, in a study conducted by Bello and Yusuf (2022), the use of animated biology tutorials enhanced students' understanding of difficult topics like genetics and cell biology. These findings align with the work of Nwankwo and Eze (2021), who reported that integrating online instructional materials with face-to-face teaching resulted in higher student engagement and academic success. However, the effectiveness of online resources depends heavily on factors such as teacher competence in ICT integration and the availability of reliable infrastructure, including internet connectivity and electricity (Akinola, 2020). When online resources are properly used, they can enhance students' participation in biology, making them more academically engaged. This connection between online learning tools and student participation highlights the crucial role of academic engagement as a key factor in improving biology education outcomes.

Academic engagement is widely recognized as a critical factor influencing students' learning experiences and outcomes. It refers to the level of behavioral, emotional, and cognitive involvement that students demonstrate in the learning process (Fredricks, Blumenfeld, & Paris, 2004). Behaviorally, engagement is reflected in participation, attendance, and effort toward academic tasks; emotionally, it involves students' interest, enthusiasm, and sense of belonging in learning; while cognitively, it entails the investment of mental effort, self-regulation, and persistence in problem-solving. In the context of biology education, academic engagement determines whether students approach the subject with curiosity and active participation or with passivity and disinterest. High levels of engagement enhance critical thinking, foster deeper understanding of complex biological concepts, and promote long-term retention. Conversely, disengagement often manifests as low participation, boredom, and poor achievement, thereby reinforcing the persistent challenges observed in secondary school

biology classrooms. Therefore, this study seeks to investigate the perceived impact of online resources on senior secondary school students' academic engagement in Biology.

Purpose of the Study

The main purpose of this study is to investigate the perceived impact of online resources on senior secondary school students' academic engagement in Biology in Nsukka Local Government Area. Specifically, the study aims to:

1. determine the impact of online resources on the academic engagement of senior secondary school biology students.
2. determine the challenges faced in the utilization of online resources during students' engagement in biology.
3. determine the possible solutions to enhance the use of online resources in promoting academic engagement in biology.

Research Questions

The following research questions will guide the study.

1. What is the impact of online resources on the academic engagement of senior secondary school biology students?
2. What challenges are faced in the utilization of online resources during students' engagement in biology?
3. What possible solutions can be provided to enhance the effective use of online resources in improving students' engagement in biology?

Methods

The study adopted a descriptive survey research design. The population of the study comprised 2,350 SS II senior secondary school Biology student in public secondary school across Nsukka Local Government Area. A sample size of 350 SSII Biology students from the population was drawn. Simple random sampling technique (balloting without replacement) was used to select 350 students from the public schools in the area. An instrument designed by the researcher was used for data collection which is Impact of Online Resources on Students' Academic Engagement in Biology Questionnaire (IORSABEQ). The instrument was validated by two experts, one from Measurement and Evaluation unit, while the other is from Biology unit, all from Science Education Department, University of Nigeria, Nsukka. The reliability coefficient of the instrument was determined using Cronbach Alpha. The reliability coefficient for clusters A–C was 0.92, 0.96 and 0.94 respectively. The overall coefficient of 0.86 was obtained, and this indicated that the instrument was reliable and suitable for the study. The research questions were answered using Mean and Standard.

Results

Table 1: Mean and Standard Deviation Analysis of the Impact of Online Resources on Academic Engagement (N=350)

S/N	Item Statement	Mean	Std. Dev.	Decision
1	Online videos (e.g., on YouTube) make biological processes (e.g., photosynthesis, digestion) lively.	2.98	0.91	A
2	Interactive simulations and apps help me to pay attention to complex Biology concepts better.	3.12	0.87	A
3	Using online resources increases my involvement in	3.34	0.75	A

	learning of Biology topics.			A
4	I am motivated to spend more time studying Biology when I use online materials.	3.02	0.87	A
5	Online quizzes and practice questions help me to stay focused in Biology lessons.	3.32	0.77	A
6	Access to online resources (e.g., past questions, tutorials) helps me to complete my Biology assignments.	3.36	0.83	A
7	I often use online resources to explore Biology topics further, beyond what is taught in class.	3.12	0.94	A
8	Using online resources makes me participate more actively in Biology class discussions.	3.28	0.81	A
Grand Mean/Overall Standard Deviation		3.19	0.84	A

The results in Table 1 indicate that all eight items, as well as the overall perception (Grand Mean = 3.19), have mean scores significantly above the acceptance criterion of 2.50. This leads to the conclusion that students perceive online resources as having a positive impact on their academic engagement in Biology. The highest-rated impact is that online resources help them complete their Biology assignments (Mean = 3.36), followed by increasing their involvement in learning topics (Mean = 3.34) and helping them stay focused (Mean = 3.32). The relatively high Grand Mean of 3.19 on a 4-point scale underscores a strong consensus on this positive impact. The standard deviations, all below 1.00, suggest that the respondents' opinions were generally consistent and did not vary widely around the mean for each item.

Table 2: Mean and Standard Deviation Analysis of Challenges Posed by Online Resources (N=350)

S/ N	Challenge	Mean	Std. Dev.	Decision
1	Unstable or poor internet connectivity.	2.92	0.94	A
2	High cost of mobile data.	3.34	0.59	A
3	Limited access to personal smartphone, computer, or tablet for learning Biology.	3.26	0.60	A
4	Constant distractions from social media and entertainment sites while studying online.	3.22	0.84	A
5	Difficulty in finding relevant and credible information for my Biology topics.	2.94	0.79	A
6	Information overload (too much information, making it confusing).	2.98	0.84	A
7	Some online resources are difficult to understand or do not actively support my engagement in Biology.	3.24	0.74	A

8	Poor power supply to charge my devices.	3.18	0.77	A
9	Insufficient skill in using online tools for learning.	2.92	0.83	A
10	Teachers seldom incorporate online resources in ways that enhance our engagement in Biology lessons.	3.30	0.74	A
Grand Mean / Overall Standard Deviation		3.13	0.77	A

The results in Table 2 show that all ten listed challenges are perceived as significant by the students, with all mean scores well above the acceptance criterion of 2.50. The high Grand Mean of 3.13 indicates that, overall, these challenges pose a substantial barrier to using online resources for Biology. The most pressing challenges, as ranked by the mean scores, are the high cost of mobile data (Mean = 3.34), the lack of teacher incorporation of online resources (Mean = 3.30), and limited access to personal digital devices (Mean = 3.26). The standard deviations, particularly for the top challenges (all below 0.85), suggest a strong consensus among students regarding the prevalence of these issues. This analysis confirms that students face a multifaceted set of infrastructural, economic, pedagogical, and self-efficacy challenges when attempting to use online resources for academic engagement in Biology.

Table 3: Mean and Standard Deviation Analysis of Solutions to Enhance the Use of Online Resources (N=350)

S/N	SOLUTION	MEAN	STD.DEV	DECESION
1	The school should provide free or subsidized Wi-Fi for students.	3.48	0.79	A
2	Recommending specific, reliable websites and apps for Biology learning by the teacher	3.42	0.67	A
3	Providing data subsidies to students by the government to support the use of online resources in learning Biology.	3.36	0.78	A
4	Establishing a digital library with computers and internet access for student use by the schools.	3.32	0.84	A
5	Providing support (e.g., data, smartphone, computer, tablet) to students by parents to facilitate effective engagement with online learning of Biology.	3.28	0.67	A
6	Organizing of training for students on how to find and use online educational resources effectively.	3.16	0.84	A
7	Integrating online activities (e.g., quizzes, videos) into regular Biology lessons by teachers to enhance students' engagement.	3.16	0.84	A
Grand Mean / Overall Standard Deviation		3.31	0.78	A

The results in Table 3 indicate that students perceive all seven proposed solutions as effective, with all mean scores significantly above the acceptance criterion of 2.50. The high Grand Mean of 3.31 signifies a strong overall consensus on the effectiveness of these strategies. The solution deemed most effective is for schools to provide free or subsidized Wi-Fi (Mean = 3.48), directly addressing the top challenge of high data cost. This is closely followed by the need for teachers to recommend specific, reliable websites and apps (Mean = 3.42), which tackles the challenges of information credibility and lack of guidance. The third most endorsed solution is

government-provided data subsidies (Mean = 3.36), further emphasizing the critical barrier of cost. The relatively low standard deviations across most items suggest a strong agreement among respondents regarding the potential effectiveness of these solutions.

Discussion of results

The study found a strong consensus that online resources have a significant positive impact on students' academic engagement in Biology with the overall perception highly positive. Specifically, students reported that online resources were most effective in helping them complete assignments, increasing their involvement in topics, and maintaining their focus during lessons. This result aligns with the foundational perspective of Wieman (2017), who defined science as a continuous cycle of testing and refining understanding. Online resources, through interactive simulations and videos, provide a dynamic platform for this very process, allowing students to visually test and refine their understanding of complex biological processes like photosynthesis and mitosis, making them more "lively" as reported by the students. Despite the recognized benefits, students face considerable obstacles. The most severe challenges are economic and infrastructural: the high cost of mobile data and limited access to personal digital devices. A critical pedagogical challenge was also identified, with students reporting that teachers seldom incorporate online resources in ways that enhance engagement. These were compounded by other issues like constant distractions from social media and poor power supply. This aligns with the weakness identified in Ezeudu's (2016) study, where cognitive gains from ICT tools were moderate due to limited teacher training. It also resonates with Akinola's (2020) assertion that effectiveness depends heavily on teacher competence. This indicates that providing resources is insufficient; it must be coupled with what Ugwu and Aniakwu (2022) implied is needed: effective pedagogical integration. Also, Students identified a clear set of solutions to overcome these challenges.

The most strongly endorsed strategies focused on reducing cost and improving access. The top solution was for schools to provide free or subsidized Wi-Fi. Furthermore, students saw great value in direct guidance from their teachers, such as recommending specific, reliable websites and apps. Government intervention through data subsidies was also highly supported. Concurrently, the high value placed on teachers recommending reliable resources underscores students' desire for guided, curated learning experiences. This finding reinforces the role of the teacher as a "More Knowledgeable Other" (Vygotsky), who is essential for scaffolding learning in a digital environment filled with potential information overload. This solution directly addresses the challenge of teachers not incorporating resources effectively and aligns with the recommendations stemming from Anyaegbu's (2019) and Ruado and Cortez's (2024) work, which showed that structured, teacher-led integration of digital tools is key to boosting engagement. The collective support for these solutions underscores that the effective use of online resources is not a technological fix but a socio-technical challenge requiring coordinated action from schools, government, and teachers themselves.

Based on the findings of your study, the following **Contribution to Knowledge** is suitable for a journal article or thesis:

Contribution to Knowledge

This study contributes to knowledge by providing empirical evidence that the utilization of online resources significantly enhances students' academic engagement in Biology in secondary schools. It establishes that online resources improve students' interest, attention, participation, and involvement in Biology learning. The study further contributes by identifying the major barriers to the effective utilization of online resources, including the high cost of internet data, inadequate access to digital devices, poor infrastructure, and limited teacher integration of digital resources. Additionally, it offers practical strategies for improving the use of online resources, such as providing subsidized internet access, strengthening digital infrastructure, enhancing teachers' digital competencies, and promoting the use of credible online educational platforms. These findings enrich the existing body of knowledge on technology-enhanced Biology education and provide useful information for educators, school administrators, policymakers, and curriculum planners seeking to improve students' academic engagement and learning outcomes.

Conclusion

Based on the findings and subsequent discussion, this study concludes that online resources hold significant potential to transform the teaching and learning of Biology in Nsukka Local Government Area by positively impacting students' academic engagement. Students perceive these digital tools as powerful catalysts for enhancing their interest, focus, and active participation in the subject. However, this potential remains largely untapped due to a critical combination of infrastructural, economic, and pedagogical barriers. The high cost of data, limited access to devices, and insufficient integration of these resources by teachers collectively hinder the effective utilization of online platforms. Therefore, the successful implementation of online resources in Biology education is not merely a technological issue but a complex challenge that necessitates a collaborative, multi-stakeholder approach addressing accessibility, affordability, and pedagogical capacity to fully harness its benefits for improved student engagement.

Recommendations

In view of the findings and conclusion of this study, the following recommendations are made:

1. School authorities should provide affordable and reliable internet access by establishing free or subsidized Wi-Fi services and improving digital infrastructure to enable students to access online Biology resources without financial constraints.
2. Government and relevant educational stakeholders should support digital learning by providing subsidies for internet data, improving electricity supply, and ensuring that schools are equipped with adequate digital devices and other ICT facilities.
3. Biology teachers should be trained regularly through workshops, seminars, and other professional development programmes on the effective integration of online resources into classroom instruction to enhance students' academic engagement and learning outcomes.
4. Biology teachers should guide students in the effective use of credible online educational resources by recommending appropriate websites, educational applications, videos, and interactive learning platforms that promote meaningful learning and improve students' academic engagement in Biology.

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