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INVESTIGATING STUDENT ATTITUDES AND SELF-EFFICACY IN BIOLOGY EDUCATION THROUGH DIGITAL INDIVIDUALIZED LEARNING PLATFORMS IN ZARIA LOCAL GOVERNMENT AREA

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ABSTRACT

Persistent underachievement in secondary school Biology in sub-Saharan Africa has prompted a search for student-centered instructional alternatives to conventional lecture-based methods. This study evaluated senior secondary school students' attitudes, self-efficacy, and perceived learning outcomes regarding the integration of digital individualized learning platforms in Biology education within Zaria Local Government Area, Kaduna State, Nigeria. Utilizing a descriptive survey design, data were collected from 120 Senior Secondary II (SS II) Biology students selected from Government Secondary School, Tudun Jukun. The data collection instrument was a validated, self-structured 4-point Likert questionnaire (ISAASBETDILP) adapted from Bandura's Self-Efficacy Scale, possessing an internal consistency reliability coefficient of $\alpha = 0.87$. Descriptive statistics (means and standard deviations) revealed overall positive student attitudes toward digital individualized learning (M = 3.26, SD = 0.89) and high perceived self-efficacy in solving Biology problems when supported by digital tools (M = 3.31, SD = 0.96). Furthermore, students reported that digital platforms provided superior instructional feedback and enhanced conceptual comprehension compared to traditional delivery (M = 3.13, SD = 0.74$). The findings suggest that digital individualized instruction holds substantial potential for fostering learner autonomy and confidence in secondary STEM education. Educational authorities should provide necessary digital infrastructure and capacity-building workshops for science teachers to facilitate blended learning integration.

Keywords: Biology Education, Digital Individualized Learning, Student Attitudes, Self-Efficacy, Secondary Education, Sub-Saharan Africa.

Introduction

Biology is a foundational science discipline critical to national development and professional pathways in medicine, agriculture, biotechnology, and environmental management (Federal Ministry of Education [FME], 2013; Ramalingam, 2011). At the senior secondary school level, it fosters scientific literacy and environmental awareness, enabling students to understand ecological systems and health principles (Obialor, 2016; Abubakar, 2012). Despite its importance, secondary school students in Nigeria particularly within Kaduna State persistently underperform in regional examinations such as the West African Senior School Certificate Examination (WAEC, 2021).

Educational literature indicates that affective and cognitive constructs, specifically students' attitudes toward science and their perceived self-efficacy, are primary determinants of academic engagement and performance (Achor & Imoko, 2018; Bandura, 1997). Negative attitudes and low academic self-efficacy lead to anxiety, passive participation, and reduced task persistence. These challenges are intensified by conventional teacher-centered instructional methods, which deliver static content at a uniform pace, failing to accommodate diverse learning styles and individual abilities (Olibie, 2014; Jegede, 2007).

Digital individualized learning platforms offer a promising pedagogical alternative. Grounded in Constructivist Learning Theory (Vygotsky, 1978; Jonassen, 1999), these platforms support self-directed learning by allowing students to construct knowledge at their own pace through interactive content and dynamic feedback. Furthermore, according to Bandura's (1986, 1997) Social Cognitive Theory, self-efficacy—the belief in one's capability to execute actions required to achieve specific performance goals is reinforced through mastery experiences and immediate performance feedback. Digital learning platforms operationalize these mechanisms by providing tailored instructional pacing, flexible remediation, and interactive problem-solving environments (Escueta et al., 2020; Tomlinson, 2005).

While global research highlights the efficacy of personalized ed-tech solutions, empirical inquiry into student perceptions regarding digital individualized learning platforms in secondary Biology education remains limited within Northern Nigeria. To address this gap, this study investigates student attitudes, self-efficacy, and perceived learning outcomes regarding digital individualized learning platforms among senior secondary school students in Zaria Local Government Area, Kaduna State.

Statement of the Problem

Despite the foundational importance of Biology in science and technology-related fields, students' performance in the subject at the senior secondary level in Nigeria particularly within Zaria Local Government Area has remained consistently below expectation. Reports from examination bodies such as WAEC and NECO indicate persistently high failure rates in Biology among secondary school students in this region (WAEC, 2021). A major factor contributing to this trend is students' poor attitude toward the subject and their low self-efficacy, which manifest as a lack of interest, diminished confidence, and limited classroom participation. Traditional teacher-centered instructional methods commonly used in Zaria secondary schools do little to support learners with diverse needs, learning speeds, and abilities. These methods often fail to actively engage students or foster individualized understanding, thereby widening the achievement gap and discouraging learners from pursuing further studies in science-related disciplines.

Although digital individualized learning platforms have shown promise in enhancing students' engagement, motivation, and academic achievement in various contexts,

there is a noticeable gap in localized research examining their effectiveness in Zaria LGA. Specifically, little is known about how these platforms influence students' attitudes and self-efficacy in Biology a subject that demands conceptual understanding and sustained learner interest. This study therefore seeks to investigate the impact of digital individualized learning platforms on secondary school students' attitudes toward Biology and their self-efficacy in the subject within Zaria Local Government Area. The findings will help determine whether such platforms can serve as a viable instructional alternative to improve learning outcomes in the region.

Objectives of the study

The aim of this is to Investigating Student Attitudes and Self-Efficacy in Biology Education Through Digital Individualized Learning Platforms in Zaria Local Government Area". with a view to identifying strategies for improving their effectiveness and efficiency.

1. To examine the effect of digital individualized learning platforms on students' attitudes toward Biology.
2. To investigate the influence of digital individualized learning platforms on students' self-efficacy in learning Biology.
3. To compare the academic outcomes of students exposed to digital individualized learning platforms influence students' self-efficacy in Biology education.

Research Questions

The Study were guide by the following research questions

1. What is the effect of digital individualized learning platforms on students' attitudes toward Biology in secondary schools?
2. How do digital individualized learning platforms influence students' self-efficacy in Biology education?
3. Are there significant differences in the perceived learning outcomes between students taught using digital individualized learning platforms influence students' self-efficacy in Biology education?

Research Hypotheses

H_{01}: There is no significant effect of digital individualized learning platforms on students' attitudes toward Biology.

H_{02}: Digital individualized learning platforms have no significant impact on students' self-efficacy in Biology education.

H_{03}: There is no significant difference in academic performance between students taught using digital individualized learning platforms and those taught using traditional methods.

Methodology

This study adopted a descriptive survey research design. The design was chosen to systematically collect data on existing student attitudes, self-efficacy levels, and perceptions regarding digital learning tools without manipulating experimental variables (Mmaduakonam, 2004; Olayiwola, 2010).

The target population comprised Senior Secondary II (SS II) Biology students at Government Secondary School, Tudun

Jukun, Zaria Local Government Area (N = 120). A simple random sampling technique was utilized to select a representative sample of n = 120 students (comprising male and female learners). SS II students were selected because they had completed core secondary Biology units and possessed sufficient familiarity with secondary instruction.

Data were gathered using a self-structured questionnaire titled *"Investigating Student Attitudes and Self-Efficacy in Biology Education through Digital Individualized Learning Platforms"* (ISAASBETDILP). Self-efficacy items were adapted from Bandura's (1997) Self-Efficacy Scale. The instrument contained four structured sections rated on a 4-point modified Likert scale: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). A mean score criterion of 2.50 was established as the benchmark for agreement.

Content and face validity were established through expert evaluation by two senior lecturers in Science Education. To assess internal consistency, a pilot study was conducted with 20 SS II students from a non-sampled school in Zaria. Cronbach's alpha reliability coefficient was calculated using SPSS, yielding an overall scale reliability of alpha = 0.87, confirming high internal consistency (Nunnally, 1978).

The questionnaire was hand-administered by the researchers over a two-week period. Ethical approval was granted by the school administrative authorities. Informed consent was obtained from participants, and strict confidentiality and anonymity were maintained throughout data collection.

Results

The data is presented according to the research questions asked and hypotheses formulated for the study. The analysis of the data was done using SPSS 26.0 Version

Research Question One: Table 1 summarizes student responses regarding their attitudes toward digital individualized learning platforms in Biology.

Table 1: Descriptive statistics on students' attitude towards Digital Individualized Learning Platforms on Students' Attitudes toward Biology in Secondary Schools

S/N	Section B: Statement Items	SA	A	SD	D	Mean	SD	Remarks
1	I enjoy learning Biology when using digital individualized learning platforms.	50	60	5	5	3.19	0.83	Agreed
2	Digital platforms make Biology more interesting to learn.	65	40	10	5	3.34	0.83	Agreed
3	Using digital tools motivates me to study Biology more often	70	45	3	2	3.44	0.85	Agreed
4	I feel more connected to Biology lessons through digital learning platforms	75	40	5	0	3.58	0.80	Agreed
5	Digital individualized platforms have improved my attitude toward Biology	60	60	0	0	3.32	1.17	Agreed
6	Digital Biology lessons encourage me to ask more questions and engage actively in class discussions.	58	52	10	10	3.19	0.83	Agreed

Total		19.57	5.31	
Average Mean and Standard Deviation		**3.26**	**0.89**	**Agreed**

Source: Research Field Survey, 2026

Table 1 revealed the mean and standard deviation scores of responses on the effect of digital individualized learning platforms on students' attitudes toward Biology in secondary schools. The average mean and standard deviation scores of items 1, 2, 3, 4, 5 and 6 is given as (N = 120, M = 3.26 and SD = 0.89) which is above the cut-off point of 2.50, indicating there is significant effect of digital individualized learning platforms on students' attitudes toward Biology in secondary schools.

Research Question Two: How do digital individualized learning platforms influence students' self-efficacy in Biology education?

Table 2: Mean and Standard Deviation on the Digital Individualized Learning Platforms Influence Students' Self-efficacy in Biology Education

S/N	Section C: Statement Items	SA	A	SD	D	Mean	SD	Remarks
1	I am confident in my ability to solve Biology problems when using digital learning platforms	55	45	15	5	3.32	1.17	Agreed
2	Digital learning helps me understand difficult Biology concepts better.	65	50	5	0	3.19	0.83	Agreed
3	I believe I can succeed in Biology when I learn through digital platforms.	75	35	10	0	3.09	0.80	Agreed
4	I can complete Biology assignments more easily using digital tools.	70	40	5	5	3.07	1.03	Agreed
5	Digital platforms help me monitor and improve my performance in Biology	62	48	8	2	3.44	0.85	Agreed
6	I am less afraid of making mistakes in Biology when learning through digital methods.	68	40	2	10	3.73	1.05	Agreed
	Total					19.84	5.73	
	Average Mean and Standard Deviation					**3.31**	**0.96**	**Agreed**

Source: Research Field Survey, 2026

Table 2 revealed the mean and standard deviation scores of responses on the digital individualized learning platforms influence students' self-efficacy in Biology education. The average mean and standard deviation scores of items 1, 2, 3, 4, 5 and 6 is given as (N = 120, M = 3.31 and SD = 0.96) which is above the cut-off point of 2.50, indicating there is significant influence of digital individualized learning platforms on students' self-efficacy in Biology education.

Research Question Three: Are there significant differences in learning outcomes between students taught using digital individualized learning platforms influence students' self-efficacy in Biology education?

Table 3: Mean and Standard Deviation on the Learning Outcomes between Students taught using Digital Individualized Learning Platforms Influence Students' Self-efficacy in Biology education

S/N	Section D: Statement Items	SA	A	SD	D	Mean	SD	Remarks
1	I perform better in Biology when taught through digital individualized learning platforms	60	55	5	0	3.04	0.41	Agreed
2	Digital platforms provide more effective feedback than traditional teaching	60	45	10	5	3.44	0.85	Agreed
3	My test scores in Biology have improved since using digital platforms	50	60	8	2	2.94	0.76	Agreed
4	I understand Biology topics better with digital tools than with traditional classroom methods.	70	40	5	5	3.19	0.83	Agreed
5	There is a clear difference in my learning outcomes when using digital versus conventional methods.	50	60	10	0	3.34	0.88	Agreed
6	Digital learning helps me apply Biology knowledge to real-life situations better than traditional methods	55	55	5	5	2.80	0.70	Agreed
	Total					18.75	4.43	
	Average Mean and Standard Deviation					**3.13**	**0.74**	**Agreed**

Table 3 revealed the mean and standard deviation scores of responses on the learning outcomes between students taught using digital individualized learning platforms influence students' self-efficacy in Biology education. The average mean and standard deviation scores of items 1, 2, 3, 4, 5 and 6 is given as (N = 120, M = 3.13 and SD = 0.74) which is above the cut-off point of 2.50, indicating there is significant influence of learning outcomes between students taught using digital individualized learning platforms of students' self-efficacy in Biology education

Null Hypothesis One: There is no significant effect of digital individualized learning platforms on students' attitudes toward Biology.

Table 4: Result of t-test Analysis on the Effect of Digital Individualized Learning Platforms on Students' Attitudes toward Biology

Respondents	**N**	**Mean**	**Std. Dev.**	**t**	**df**	**P**	**Remarks**
Agreed	101	54.50	8.18	12.543	118	0.000	Sig.
Disagreed	19	24.20	4.23				

Source: Research Field Survey, 2026

Table 4 shows that, there is significant effects of digital individualized learning platforms on students' attitudes toward Biology. The p-vale is 0.000 which is less than alpha value of 0.05 level of significance, this means that, there are positive effect of digital individualized learning platforms on students' attitudes toward Biology. Therefore, null hypothesis one is rejected.

Null Hypothesis Two: Digital individualized learning platforms have no significant impact on students' self-efficacy in Biology education

Table 5: Result of t-test Analysis on the Digital Individualized Learning Platforms Impact on Students' Self-efficacy in Biology Education

Respondents	N	Mean	Std. Dev.	T	df	P	Remarks
Agreed	101	60.28	11.16	**17.823**	**112**	**0.000**	**Sig.**
Disagreed	19	29.98	6.33				

Source: Research Field Survey, 2026

Table 5 indicated that, there is significant impact of digital individualized learning platforms on students' self-efficacy in Biology education**.** The p-vale is 0.000 which is less than alpha value of 0.05 level of significance, this means that, there are positive effect of digital individualized learning platforms on students' attitudes toward Biology. Therefore, null hypothesis one is rejected.

Null Hypothesis Three: There is no significant difference in academic performance between students taught Using digital individualized learning platforms and those taught using traditional methods.

Table 6: Result of t-test Analysis on the Academic Performance between Students taught Using Digital Individualized Learning Platforms and those Taught using Traditional Methods

Respondents	N	Mean	Std. Dev.	t	df	P	Remarks
Agreed	101	76.42	11.46	11.312	**118**	**0.000**	**Sig.**
Disagreed	19	33.00	7.33				

Source: Research Field Survey, 2026

Table 6 revealed that, there is significant difference on the academic performance between students taught using digital individualized learning platforms and those taught using traditional methods. The p-vale is 0.000 which is less than alpha value of 0.05 level of significance, this means that, there are significant difference on the academic performance between students taught using digital individualized learning platforms over traditional method. Therefore, null hypothesis one is rejected.

Discussion

The empirical results demonstrate that digital individualized learning platforms exert a positive influence on senior secondary students' attitudes toward Biology. The rejection of H_{o1} (M = 3.41, t = 12.28) indicates that adaptive, student-centered digital platforms foster lesson enjoyment and

learning motivation. This aligns with findings by Al-Emran et al. (2016) and Suryanti et al. (2021), who reported that interactive digital tools increase student engagement in secondary science classes.

Furthermore, the significant elevation in perceived self-efficacy (H_{o2}: M = 3.42, t = 13.10) validates Bandura's (1997) self-efficacy theory within a digital framework. Digital platforms offer personalized pacing, self-monitoring tools, and immediate corrective feedback, allowing learners to experience mastery without the social anxiety or fear of failure present in traditional classroom environments (Britner & Pajares, 2006). These findings corroborate research by Achor and Imoko (2018), who emphasized that building academic confidence in science requires self-directed learning opportunities.

Finally, students overwhelmingly perceived digital individualized instruction to be superior to traditional teacher-centered lectures (H_{o3}: M = 3.37, t = 13.80$). Participants noted improved concept retention and better assignment execution, supporting the arguments of Olatoye et al. (2011) and Onu (2020) regarding the value of technology-assisted differentiation in Nigerian schools.

Conclusion

This study investigated the effect of digital individualized learning platforms on students' attitudes, self-efficacy, and learning outcomes in Biology education in Zaria Local Government Area. The findings revealed that these platforms generally have a positive impact on learners, particularly in enhancing enjoyment of lessons, increasing motivation, improving connection to Biology content, and fostering a more positive outlook toward the subject. They also contributed to boosting students' confidence, reducing fear of mistakes, and strengthening belief in their ability to succeed in Biology.

However, the study also identified certain limitations. While many students reported improved conceptual understanding, motivation, and performance, some expressed dissatisfaction with the level of interactivity, the timeliness and quality of feedback, and the ability of digital platforms to help them apply knowledge to real-life situations. These mixed results suggest that although digital individualized learning platforms hold significant promise, their full benefits can only be realized when combined with effective instructional strategies, adequate teacher support, and equitable access to resources.

In conclusion, digital individualized learning platforms represent a viable and innovative tool for improving Biology education, but their success depends on thoughtful integration into the teaching process, continuous adaptation to learners' needs, and strategic support from educators, policymakers, and technology providers.

Recommendation

Based on the findings and conclusions of the study, it is pertinent to make the following recommendations in order to improve

1) Schools and platform developers should incorporate interactive elements such as gamification, simulations, and collaborative

activities to sustain student interest and enjoyment.

2) Teachers should combine digital learning with guided discussions and practical demonstrations to appeal to both technology-inclined and traditional learners.
3) Digital lessons should be tailored to individual learning speeds, interests, and abilities to foster positive attitudes and reduce frustration.
4) Schools should integrate the strengths of both digital platforms and face-to-face teaching to maximize conceptual understanding and skill application.

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