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EDITORIAL

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Thank you to all contributors, reviewers, and readers for the successful production of this edition. Their engagement strengthens science education globally, while I solicit for continued support for future production.

O. I. Oginni Ph.D

Editor-in-Chief

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EFFECTS OF ARGUMENTATION-BASED SCIENCE TEACHING APPROACH ON STUDENTS' LEARNING OUTCOMES IN SENIOR SECONDARY SCHOOL CHEMISTRY IN ONDO STATE

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Abstract

The study investigated the effects of Argumentation-Based Teaching Approach (ABSTA) on students' learning outcomes in Senior Secondary School Chemistry. Specifically, the study determined the effects of Argumentation-Based Science Teaching Approach (ABSTA) on students' academic achievement in Senior Secondary School Chemistry. The study adopted the pre-test, post-test control group quasi- experimental research design. The sample comprised 80 Senior Secondary School three (SSSIII) Chemistry students in their intact classes from two schools purposively selected from two Local Government Areas (LGAs) of Ondo State. The research instruments used for collection of data were Chemistry Achievement Test (CAT), Scholastic Ability Test in Chemistry (SATC) and worksheets developed by the researcher about Argumentation-Based Science Teaching Approach (ABSTA). Data collected were analysed using Analysis of Variance (ANOVA). The results of the analysis showed that there was a significant difference in the academic achievement of Chemistry students exposed to Argumentation-Based Approach Science Teaching Approach (ABSTA) and Conventional Teacher Expository Method (CTEM). Argumentation-Based Science Teaching Approach (ABSTA) improved the academic achievement of the learners. It was found that both male and female Chemistry students achieved equally when taught using Argumentation-Based Science Teaching Approach (ABSTA). Based on the findings, it was recommended that Argumentation-Based Science Teaching Approach (ABSTA) should be encouraged for teaching and learning of Chemistry.

Keywords: Argumentation-Based Science Teaching Approach, Conventional Teacher Expository Method, Achievement, Secondary School Chemistry

Introduction

Chemistry is a core science subject and as such a credit pass in it is required before a student can be admitted in any tertiary institution for most science-related disciplines like Medicine, Pharmacy, Bio-Chemistry, Microbiology, Agriculture, Metallurgy and all the fields of Engineering. Learning Chemistry means

not only learning facts and concepts that describe the physical world at the atomic level, but also learning how to examine the physical evidence of chemical principles in a laboratory learning environment. Chemistry education does not just aim in chemical concepts. It also aims to develop student's scientific inquiry abilities. The study of Chemistry involves the learning of concepts, established principles, laws and theories and also substantial activity-oriented laboratory work. These laboratory experiments are to demonstrate practically some of the principles taught in theory, test the validity of certain empirical chemical laws and illustrate properties of substances taught theoretically in the classroom.

Argumentation is derived from the latin word *"**argumentum***, meaning a "logical argument" or "proof," which is derived from the verb *arguere*, meaning **"to make clear"** or "to prove". Thes argument is the reasons for supporting a chain (Merald, Sahin and Akbas, 2021). The argumentation is described as a process that aims to express opinion by thinking or writing about a subject individually or as a group to support the idea with data, to reach a conclusion by criticizing and evaluating, and to persuade the other person. The adoption of the constructivist approach in science programmes aimed to develop learning environment centered on the students where the teacher acts as a counsellor (problem-solving, argumentation method, collaborative, cooperative and competitive learning strategies). Argumentation plays an important role in science education since with the heuristic approach, students can reach conceptual and epistemic goals, and the argumentation process can forster students scientific thinking and reason. There are some studied in the literature which focus on argumentation-based approach in science education (Ural and Gencoglan, 2020; Memis and Ergun, 2023; Isiker and Embre, 2021; Kocak an Seven, 2021; Ates and Ozdemir, 2021, Milmaz Ozcan and Tabak, 2019)

According to Kuhn's (2010 cited in Costa, 2015), argumentation has both procedural and metalevel components that regulate its use. The procedural components involve the cognitive skills that support the execution of argumentation, whereas the metalevel components involve both metastrategic understanding of the goals of argumentation and more general epistemological understanding, that is, understanding of what is scientific knowledge and how one knows. Scientific argumentation enables the learners to understand how to assess scientific knowledge and generate new knowledge. Thus, argumentation reflects the nature of science as inquiry and discussion, guides students through activities, and functions as a metacognitive support that asks students to reason about their data (Kizkapan and Bektas, 2021).

Argumentation-based learning is important for individuals to gain a place in social life, to adapt themselves to social life, to solve the problems they encounter and to use critical and scientific approaches (Yilmaz-Ozcan and Tabak, 2019). The Argumentation-Based Science Teaching Approach (ABSTA) is a learning approach that aims to cultivate students as individuals who have strong social skills, develop collaboration and communication skills, are open-minded, can conduct research, ask questions, collect and share information, and critically evaluate arguments and justifications in discussions (Gьler, 2016).With this approach, students can use different strategies including asking questions, creating claims, testing claims, creating new claims, and comparing their claims with existing scientific information (Isiker and Embre, 2021). The argumentation-based approach helps individuals express their ideas about a subject and see their missing points (Duran, Doruk and Kaplan,2017).

Argumentative interaction in its epistemological dimension according to Smyrnalou, Petropoulou and Sotiriou, (2015) involves three aspects of knowledge: (1) the intrinsic properties of knowledge which involve alternative solutions or conceptual points of view due to its inherent ambiguity, (2) the knowledge domain which reflects and addresses the knowledge possessed by domain experts and (3) the source of the knowledge which involves the learner's attained current knowledge and the social-institutional status of the person from whom knowledge is acquired (e.g, teacher, scientist, etc.).

Statement of the Problem

In Nigeria, some researches have been carried out through the use of carefully planned instructional strategies and models to improve the status of Chemistry teaching and learning. Despite all these efforts, students' performance in Chemistry has remained consistently poor at the Senior Secondary Certificate Examination. (SSCE). All these strategies gave a little improvement over the conventional lecture method, which is being used in our secondary schools.

The students require learning environments where they could actively participate in teaching-learning processes at an early age, participate in activities as a researcher and questioner in educational activities, explain their ideas with scientific reasons, and support.

Purpose of the Study

The study investigated the effects of argumentation-based science teaching approach on senior secondary school students' learning outcomes in Chemistry. Specifically, this study examined:

i. determine the effects of argumentation-based science teaching approach on students' academic achievement in Chemistry.
ii. determine the influence of gender on the relative effectiveness of argumentation-based teaching approach and conventional teacher expository method on students' academic achievement in Chemistry.

Research Hypotheses

The following research hypotheses were formulated for the study:

i. There is no significant difference in the academic achievement of students exposed to Argumentation-Based Science Teaching Approach and those taught using conventional Teacher Expository method in Chemistry.
ii. There is no significant difference in the academic achievement of male and female students exposed to Argumentation Based Science Teaching approach and those taught using conventional Teacher expository method in Chemistry
iii. There is no significant difference in the academic achievement of male and female students exposed to Argumentation-Based Science Teaching Approach.

Method

The study adopted a quasi-experimental design. The population consisted of all senior secondary school three (SSIII) Chemistry students in Ondo State. Purposive sampling technique was used to select two (2) senior secondary schools from the State used for the study. The choice of the schools used for the study was based on the following criteria, schools with;

i. a standard and functional Chemistry laboratory and
ii. qualified and experienced Chemistry teachers.

In each school selected for the study, intact class of Chemistry students was involved. The schools were randomly

assigned to experimental and control groups. One instrument was developed by the researcher tagged "Chemistry Achievement Test (CAT)" was used to assess students' academic achievement in Chemistry. The face and content validity were done by experts in Chemistry department while the reliability was determined by using test-re-test method. The data obtained from trial testing was analysed using Cronbach Alpha and a coefficient of internal consistency of 0.87 for CAT. The research hypotheses were analyzed using t-test.

Results

Hypothesis One; There is no significant difference in the academic achievement of students exposed to Aargumentation-Based Science Teaching Approach (ABSTA) and those taught using Conventional Teacher Expository Method (CTEM) before treatment

The result of the analysis is shown in Table 2

Table 1: Results of t-test analysis of pre-test scores of experimental and control groups

Variables	N	X	SD	df	t	Sig	Decision
Experimental Group (pre-test)	40	32.90	12.61	78	.942	.349	NS
Control Group (Pre-test)	40	30.50	10.03				

NS= Not Significant at 0.05 alpha level

To test this hypothesis, t-test analysis was conducted. The result showed that, there was no statistically significant difference in the pre-test scores between the experimental and control group students in terms of dependent variables at the beginning of the implementation.

Hypothesis Two; There is no significant difference in the academic achievement of students exposed to Aargumentation-Based Science Teaching Approach (ABSTA) and those taught using Conventional Teacher Expository Method (CTEM) after treatment.

Table 2: t-test analysis of post -test scores of chemistry students taught with Argumentation-Based Science Teaching Approach (ABSTA) and Conventional Teacher Expository Method (CTEM)

Variables	N	X	SD	df	t	Sig	Decision
Experimental Group	40	57.75	18.39	78	2.380	0.02	*
Control Group	40	49.15	13.57				

* = Significant at 0.05 alpha level

The result in Table 3 showed that, the main effect of treatment (Argumentation Based Science Teaching Approach) on students' academic achievement was significant (t=2.380, P=0.02). Therefore, the null hypothesis stating a non-significant difference in the mean academic achievement of chemistry students taught using Argumentation-based science teaching approach was rejected. This indicates that, the Argumentation-Based Science Teaching Approach (ABSTA) was more effective when compared to the conventional approach in terms of enhancing academic achievement in chemistry and argumentativeness.

Hypothesis Three; There is no significant difference in the academic achievement of male and female students exposed to

Argumentation-Based Science Teaching Approach.

Table 3: t-test analysis of post-test scores of male and female chemistry students taught with Argumentation-Based Science Teaching Approach (ABSTA)

Variables	N	X	SD	Df	t	Sig	Decision
Male	22	57.22	16.92	38	0.19	.472	NS
Female	18	58.32	18.86				

NS= Not significant at 0.05 alpha level

The result in Table 3 showed that, the main effect of gender on students' academic achievement was not significant (t= 0.19, p = .472). Therefore, the null hypothesis stating a non-significant difference in the mean achievement scores of male and female chemistry students taught using argumentation-based teaching approach was retained. Hence, there is no difference in the achievement of male and female students in Chemistry when taught using Argumentation-Based Science Teaching Approach (ABSTA).

Discussion

The result showed that, there was no statistically significant difference in the pre-test scores between the experimental and control group students in terms of dependent variables at the beginning of the implementation. The comparison of the pre-test scores showed that the groups displayed similar characteristics. The level of prior knowledge of a subject is an important factor in student's ability to engage in effective argumentation. Therefore, when engaging students in argumentation, their prior knowledge should be considered.

The findings of this study also indicated that significant difference existed between the academic achievement of students exposed to Argumentation-Based Science Teaching Approach (ABSTA) and their counterparts that were taught with Conventional Teacher Expository Method (CTEM). Students exposed to Argumentation-Based Science Teaching Approach (ABSTA) performed significantly better than those taught with Conventional Teacher Expository Method (CTEM). This was supported by the findings of Farrokhlagha (2019), Yilmaz-Ozcan and Tabak (2019), Ural and Gencoglan (2020), Isiker and Emre (2021), which found that, argumentation-based instruction had a positive impact on students' academic achievements. The findings from these researchers also indicated that argumentation-based instruction had a positive impact on academic achievements and scientific process skills. The superior performance of students in the experimental group may be attributed to the input from the teacher who exposed them to activity-oriented method and also aroused their interest in the scientific argument. The activities the learners engaged in when exposed to argumentation-based teaching approach allowed them to participate in the teaching -learning process through discussions. In this process, students make claims about the given topic, justify their claims and try to refute the counter-claims (Asian, 2019). Besides, students are also provided to develop socially by creating effective scientific discussion environments with small group activities (Asian, 2019). This teaching approach facilitated students understanding which seems to translate into improvement in their academic achievement. The findings revealed that the academic achievement

of the students was significantly influenced by the activities related to Argumentation-Based Science Teaching Approach (ABSTA) was concluded that the application of argumentation-based science learning (ABSL) approach in the 'Structure and Properties of the Matter' unit contributed to the academic achievement of the students.

The results of this study also revealed that there was no significant difference in the academic achievement of male and female students exposed to Argumentation-Based Science Teaching Approach (ABSTA). This suggest that both male and female students benefitted from this teaching strategy. The results showed that argumentation-based science teaching approach had a similar effect on the academic achievement of both male and female students. This could be explained by the fact that each gender had equal opportunity to participate effectively during teaching and learning process. The implication of this is that the argumentation-based instruction is gender friendly. This finding is in line with the outcomes of the research conducted by Asian (2019) who found that there was no significant difference between the post-test scores of students in the experimental group 1, experimental group 2 and control group in terms of gender.

Conclusion

Based on the findings of this study, that sstudent's exposed to Argumentation-Based Science Teaching Approach (ABSTA) performed significantly better than those taught with Conventional Teacher Expository Method (CTEM), it could be concluded that argumentation-based instruction had a positive impact on students' academic achievements and it is thus a more effective method of teaching Chemistry than the didactic teaching.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Chemistry teachers should be exposed to Argumentation-Based Science Teaching Approach (ABSTA) in order to promote active students' participation, discovery learning, motivation, learning by doing and learning by experience among students.
2. Textbooks writers and publishers should shift emphasis from teachers to students' activities in line with constructivist epistemology which invariably incorporate argumentation-based teaching strategy. Teachers' guides and related activities should also be developed and produced along such strategies.
3. Federal and state ministries of education, relevant educational agencies and other stakeholders should organize workshops on the use of Argumentation-Based Science Teaching Approach (ABSTA) to enhance better performance of students in Chemistry. In addition, for wider application of this approach, some policy guidelines should be formulated to guide the implementation process. In particular, the teachers would require training and retraining on relevant curriculum materials and reference materials on how to implement Argumentation-Based Science Teaching Approach (ABSTA) which will make students effective problem solvers.

Suggestion for Further Studies

Since in this study, the effects of the method on academic achievements was investigated, it is therefore suggested that the effects of the argumentation-based teaching strategy on other areas (such as attitudes towards science, critical

thinking skills, scientific process skills and course social skills) could be investigated in future studies.

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TEACHERS' PERCEPTIONS, PRACTICES AND CHALLENGES OF INTEGRATING TECHNOLOGY AND INDIGENOUS KNOWLEDGE SYSTEMS IN SCIENCE PEDAGOGY IN NIGERIAN SECONDARY SCHOOLS

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Abstract

This study examined science teachers' perceptions, instructional practices, and challenges in integrating technology and Indigenous Knowledge Systems (IKS) in science pedagogy within Nigerian secondary schools. A mixed-method research design was adopted and a stratified sampling technique was used to select participants from riverine, rural upland and city centre schools in Rivers State. Two research instruments were employed: the Technology and Indigenous Knowledge Integration in Science Pedagogy Questionnaire (TIKISPQ), which yielded a reliability coefficient of 0.81 using Cronbach's alpha and Technology and Indigenous Knowledge Integration in Science Pedagogy Interview Template. Both instruments were validated by experts in science education and educational technology. Data were analyzed using frequency counts, mean, and standard deviation to answer the research questions, while Analysis of Variance (ANOVA) and Scheffй post hoc tests were used to test the null hypotheses. Findings revealed that science teachers held positive perceptions of integrating technology and IKS (M = 3.33, SD = 0.91), though their instructional practices were generally low (M = 2.18, SD = 0.92). Teachers also reported facing several challenges in implementation (M = 3.26, SD = 0.92). ANOVA results indicated no significant differences in perceptions [F(2,118) = 1.87, p = .158] or challenges [F(2,118) = 1.32, p = .271], but a significant difference in instructional practices across school locations [F(2,118) = 5.72, p = .004]. It was recommended that government and educational authorities provide adequate ICT facilities and that teacher training institutions offer continuous professional development to enhance teachers' capacity for effective technology and IKS integration in science pedagogy.

Keywords: Technology Integration, Indigenous Knowledge Systems, Science Pedagogy, Teachers' Perceptions, Nigerian Secondary Schools

Introduction

Technology integration in education refers to the deliberate and systematic application of digital tools and resources to enhance the process of teaching and learning across various educational settings. This approach includes the embedding of digital technologies, both hardware and software such as computers, tablets, Learning Management Systems, Educational Apps, digital laboratories, interactive whiteboards, simulations and multimedia presentations into instructional practices to enhance content delivery, learner engagement and knowledge construction (Hennessy et al., 2022). For technology integration to be effective, it must go beyond the simple use of digital devices. It also requires the alignment of technological tools with pedagogical goals and curriculum objectives to facilitate active, inquiry-based and collaborative learning experiences. Utilizing digital simulations and virtual experiments allows students to visualize complex scientific phenomena, while multimedia content addresses various learning styles and encourages deeper understanding. As a result, the integration of technology transforms classrooms into dynamic and student-centered environments where teachers take on the role of facilitators, guiding students in their exploration and application of knowledge through digital resources (UNESCO, 2023).

Amidst the ongoing digital transformation, the integration of Indigenous Knowledge Systems (IKS) into science teaching and learning has garnered increasing global recognition as a fundamental aspect of inclusive and culturally relevant pedagogy. Indigenous Knowledge Systems are bodies of knowledge that are locally grounded and community based, developed over generations through interactions with the natural environment (Aderonmu & Adolphus, 2021). They are inherently experiential, relying on observation, practice and oral transmission to interpret and manage natural phenomena such as weather patterns, agriculture, health, among others. This knowledge has been vital for traditional societies, guiding their survival strategies, resource management, and environmental stewardship, all of which are deeply rooted in cultural values and lived experiences (Ngubane & Mkhize, 2021). Indigenous knowledge provides deep, contextual understandings of natural phenomena based on centuries of lived experiences and interactions with the environment. When coupled with digital technologies, IKS can be preserved, recorded and shared more efficiently, creating opportunities for learners to relate scientific theories to local contexts (Aderonmu & Adolphus, 2021). This intersection affirms indigenous ways of knowing and promotes a comprehensive science pedagogy that connects contemporary scientific exploration with ancestral knowledge, harmonizing innovation with cultural preservation. In recent years, Indigenous Knowledge Systems (IKS) have garnered more recognition as important and culturally significant resources for contextualizing science teaching, especially in African educational contexts. IKS includes the shared knowledge, values and practices that indigenous groups have cultivated over time to understand and engage with their natural surroundings (Ngubane & Mkhize, 2021).

Technology and Indigenous Knowledge Systems (IKS) can complement one another to foster significant and culturally pertinent science teaching by

combining contemporary scientific tools with traditional methods of understanding the environment. Digital technologies like multimedia applications, simulations and virtual reality can serve to preserve, showcase and convey indigenous practices and environmental knowledge, rendering them accessible to learners in captivating and interactive formats. This integration enhances profound conceptual comprehension, affirms learners' cultural identities, and promotes valuing diverse ways of understanding. Thus, integrating technology with IKS enhances scientific teaching and promotes decolonized, inclusive and contextually relevant education that aligns with students' real-life experiences.

Integrating technology and indigenous knowledge into science teaching and learning activities aligns well with Nigeria's ongoing educational reforms, the National ICT-in-Education Policy, and the International Sustainable Development Goal 4 (SDG 4) concerning Quality Education. Nigeria's educational policy framework highlights leveraging ICT to enhance teaching quality, widen access and encourage innovative teaching methods that consider learners' cultural and social backgrounds (FME, 2021). Integrating technology with Indigenous Knowledge Systems (IKS) in science teaching offers numerous advantages as highlighted by (Eze & Mphahlele, 2023; UNESCO, 2023)

(i) *enhance cultural significance and inclusiveness*: Integrating technology with IKS guarantees that science pedagogy reflect learners' cultural histories and personal experiences, enhancing the meaning and inclusivity of the learning process.

(ii) *promotes better grasp of scientific ideas*: Applying digital resources to demonstrate indigenous methods like farming, medicine or ecological management enables students to link theoretical science with real world applications.

(iii) *preserves and revitalizes indigenous knowledge:* Technology facilitates capturing, storing, and sharing IKS via digital archives, videos and online platforms, preserving cultural heritage for future generations.

(iv) *promotes inquiry-driven and participatory learning*: The integration of IKS and digital tools fosters experiential, hands-on learning, allowing students to explore local phenomena through a combination of traditional knowledge and contemporary technology.

(v) *fosters critical thinking and innovation abilities*: The integration of traditional knowledge and digital inquiry cultivates creativity, problem-solving and innovative skills vital for tackling scientific challenges both locally and globally.

Science teachers serve as crucial players in integrating technology and Indigenous Knowledge Systems (IKS) in classroom practice. Their capacity to merge these domains relies on their perceptions, teaching skills, cultural understanding and technological expertise, which together affect how well they contextualize science learning (Aikenhead & Ogawa, 2021). Teachers not only design and implement lessons that incorporate digital tools such as multimedia presentations, simulations and online resources but also draw connections to indigenous practices and locally relevant examples that resonate with students' experiences. Investigating teachers' practices, perceptions and challenges is crucial for enhancing

culturally responsive science pedagogy in Nigeria since teachers act as the main facilitators of curriculum implementation. Examining their classroom practices and perceived obstacles offers understanding into the contextual factors that influence teaching and learning processes, encompassing infrastructural, pedagogical and cultural limitations.

Statement of Problem

Despite the increasing advocacy and support for merging technology with Indigenous Knowledge Systems (IKS) in science pedagogy, there is still a lack of empirical evidence regarding how teachers actually apply this dual approach in classroom environments, especially in developing regions such as Nigeria. Most existing studies in science pedagogy have examined either Information and Communication Technology (ICT) integration or Indigenous Knowledge Systems (IKS) in isolation, rather than exploring their intersection as complementary pedagogical frameworks. Research on ICT integration has largely emphasized digital literacy, infrastructure, and teacher competency, while studies on IKS have focused on cultural preservation, contextual learning and decolonizing the curriculum. This separation overlooks the potential synergy between technology and indigenous knowledge in creating more inclusive, culturally responsive and inquiry-based science teaching. Consequently, there is a growing need for empirical studies that investigate how teachers can harmonize technological tools with indigenous epistemologies to enrich science learning experiences, particularly within African educational contexts. It is on this premise that this study was carried out to investigate science teachers' perception, practices and challenges towards the integrating technology and indigenous knowledge systems in science pedagogy in Nigerian secondary schools.

Aim and objectives of the study

The aim of this study is to examine teachers' perceptions, practices and challenges of integrating technology and indigenous knowledge systems in science pedagogy. Specifically, the objectives of the study are to;

(i) investigate teachers' perceptions toward the integration of technology and Indigenous Knowledge Systems in science pedagogy.

(ii) **examine the instructional practices** of science teachers in integrating technology and Indigenous Knowledge Systems (IKS) within secondary school science classrooms in Nigeria.

(iii) **identify the major challenges** faced by science teachers in implementing the integration of technology and Indigenous Knowledge Systems in Nigerian secondary schools.

Research Questions

The following research questions were raised to guide the study.

1. What are the perceptions of science teachers toward the integration of technology and Indigenous Knowledge Systems in science pedagogy?
2. What instructional practices do science teachers employ in integrating technology and Indigenous Knowledge Systems (IKS) in science teaching and learning in Nigerian secondary schools?
3. What challenges do science teachers face in implementing the integration of technology and Indigenous Knowledge Systems in Nigerian secondary schools?

Hypotheses

The following hypotheses were tested at 0.005 level of significance.

Ho_1: There is no significant difference in the perceptions of science teachers toward the integration of technology and Indigenous Knowledge Systems (IKS) in science pedagogy across riverine areas, rural upland and city centres.

Ho_2: There is no significant difference in the instructional practices of science teachers in integrating technology and Indigenous Knowledge Systems (IKS) across riverine areas, rural upland and city centres.

Ho_3: There is no significant difference in the challenges faced by science teachers in implementing the integration of technology and Indigenous Knowledge Systems (IKS) across riverine areas, rural upland and city centres.

Methodology

This study adopted a mixed-method research design, which combines both quantitative and qualitative approaches to provide a comprehensive understanding of science teachers' practices, perceptions, and challenges in integrating technology and Indigenous Knowledge Systems (IKS) in science pedagogy. The quantitative aspect involved the use of a structured questionnaire to collect numerical data on teachers' practices perceptions, practices and challenges, while the qualitative component used semi-structured interviews to obtain in-depth insights into teachers' experiences and contextual realities. The mixed-method approach was chosen to enhance the validity of findings through triangulation and to provide a richer interpretation of the data collected from diverse educational settings.

The population of this study comprised all science teachers in public secondary schools located across riverine, rural upland, and city centre areas of Rivers State, Nigeria. People in riverine, rural upland, and city centers are classified by their unique geographic settings, which influence population density, building patterns and economic activities. Riverine communities are located along rivers with characteristics such as potential flooding and reliance on the water for transport, while rural upland settlements feature dispersed, low-density populations and significant agricultural activity. City centers are characterized by high population density, numerous amenities and dense infrastructure, distinguishing them from other settlement types. These regions were selected to reflect the geographical and infrastructural diversity of the state, which may influence teachers' access to technology and their use of Indigenous Knowledge Systems in science instruction.

A sample size of 121 Science teachers was selected for the study obtained by the stratified sampling technique from the three geographical strata; riverine (21), rural upland (43) and city centre (57). Two researchers' self-designed instruments were employed for data collection. A structured questionnaire titled "Technology and Indigenous Knowledge Integration in Science Pedagogy Questionnaire" (TIKISPQ) was developed by the researchers. The instrument consisted of 30 item statements distributed across the three research questions, 10 item statements each addressing teachers' perceptions, practices and challenges. The items were structured on a four-point Likert scale with a reliability coefficient index of 0.81 using Cronbach's Alpha.

The second instrument was titled, Technology and Indigenous Knowledge Integration in Science Pedagogy Interview Template (TIKISPIT) which

consist of a semi-structured interview guide was developed to complement the quantitative data. The interview focused on eliciting teachers' detailed views on how they integrate technology and IKS in their teaching, as well as the contextual challenges they face in their respective environments. The instrument was validated by two experts in Educational Research to ensure clarity, relevance, and alignment with the study objectives. Data analysis was conducted using mean and standard deviations to answer the research questions while Analysis of Variance (ANOVA) to test the hypotheses and a Post Hoc analysis using Scheffй test to identify the specific groups contributing to the difference.

Results

Research Question 1: What are the perceptions of science teachers toward the integration of technology and Indigenous Knowledge Systems in science pedagogy?

Table 2

Mean and Standard Deviation of Science Teachers' Perceptions toward the Integration of Technology and Indigenous Knowledge Systems in Science Pedagogy.

S/N	Item Statements	Mean	SD
1	Integrating technology with Indigenous Knowledge Systems enhances students' understanding of science concepts.	3.45	0.91
2	The use of Indigenous Knowledge makes science lessons more relatable and culturally meaningful to students.	3.38	0.87
3	I believe technology can help preserve and promote local Indigenous scientific practices.	3.42	0.94
4	Incorporating Indigenous Knowledge into science lessons improves students' critical and reflective thinking.	3.51	0.95
5	Combining technology and Indigenous Knowledge encourages student participation and engagement in science learning.	3.33	0.89
6	I perceive the integration of technology and Indigenous Knowledge as essential for achieving culturally responsive science education.	3.47	0.96
7	Digital tools such as videos and simulations can effectively present Indigenous scientific practices in the classroom.	3.29	0.82
8	Integrating Indigenous Knowledge and modern technology supports the goals of Nigeria's science education curriculum.	3.40	0.92
9	I believe students gain deeper appreciation of science when lessons include both technological and traditional knowledge perspectives.	3.36	0.97
10	I feel confident that integrating technology and Indigenous Knowledge can help bridge the gap	2.68	0.84

S/N	Item Statements	Mean	SD
	between modern science and local realities.		
	Aggregate Mean Value	3.33	0.91

Source: Researchers' field work, 2025.

As presented in Table 2, the aggregate mean score of 3.33 indicates that science teachers generally agreed with the item statements on the integration of technology and Indigenous Knowledge Systems in science pedagogy. This finding implies that teachers hold positive perceptions, acknowledging that such integration enhances students' understanding, engagement and appreciation of culturally relevant science learning.

Research Question 2: What instructional practices do science teachers employ in integrating technology and Indigenous Knowledge Systems (IKS) in science teaching and learning in Nigerian secondary schools?

Table 3

Mean and Standard Deviation of Science Teachers' Instructional Practices in Integrating Technology and Indigenous Knowledge Systems (IKS) in Science Teaching and Learning.

S/N	Item Statements	Mean	SD
1	I use multimedia tools (videos, animations, and slides) to demonstrate Indigenous scientific practices during science lessons.	2.52	0.94
2	I encourage students to share Indigenous explanations of natural phenomena before introducing scientific concepts.	2.47	0.92
3	I design science lessons that combine local examples with digital simulations for better conceptual understanding.	2.41	0.90
4	I use digital platforms (e.g., YouTube, educational apps) to showcase Indigenous innovations relevant to science topics.	2.38	0.95
5	I integrate community-based Indigenous practices (e.g., fishing, farming, or herbal medicine) when teaching related science topics.	2.33	0.97
6	I employ digital assessment tools (e.g., Google Forms, quizzes) to evaluate students' understanding of Indigenous and modern scientific ideas.	2.28	0.91
7	I collaborate with local artisans or elders to demonstrate traditional scientific methods using technological support (e.g., video documentation).	2.10	0.93
8	I use locally produced videos and photographs to connect Indigenous practices with modern science principles.	2.05	0.96

S/N	Item Statements	Mean	SD
9	I engage students in group projects where they investigate Indigenous technologies using digital research tools.	1.84	0.89
10	I adapt ICT tools to create culturally relevant instructional materials that integrate Indigenous and modern science knowledge.	1.38	0.78
	Aggregate Mean Value	**2.18**	**0.92**

Source: Researchers' field work, 2025.

As presented in Table 3, the aggregate mean score of 2.18 indicates that science teachers' instructional practices in integrating technology and Indigenous Knowledge Systems (IKS) are generally low on the four-point Likert scale. This suggests that while teachers acknowledge the value of integrating technology with Indigenous knowledge, their actual classroom implementation remains limited.

Research Question 3: What challenges do science teachers face in implementing the integration of technology and Indigenous Knowledge Systems in Nigerian secondary schools?

Table 4

Mean and Standard Deviation of Science Teachers' Perceived Challenges in Implementing the Integration of Technology and Indigenous Knowledge Systems (IKS) in Nigerian Secondary Schools.

S/N	Item Statements	Mean	SD
1	Inadequate access to ICT facilities makes it difficult to integrate technology and Indigenous Knowledge in science teaching.	3.81	0.91
2	Lack of proper training limits my ability to use digital tools to teach Indigenous Knowledge-based science concepts.	3.67	0.93
3	The school curriculum does not adequately support the inclusion of Indigenous Knowledge in science lessons.	3.59	0.87
4	Limited internet connectivity hinders the effective use of online platforms for integrating Indigenous Knowledge in science education.	3.46	0.95
5	There is insufficient time within the school timetable to include both technological and Indigenous-based science instruction.	3.33	0.99
6	Lack of institutional support discourages teachers from integrating technology with Indigenous Knowledge practices.	3.25	0.88
7	Some Indigenous Knowledge practices are difficult to align with modern scientific concepts using technology.	3.12	0.84
8	Students show low interest when Indigenous Knowledge is	2.97	0.80

S/N	Item Statements	Mean	SD
	taught using technology-based methods.		
9	I experience technical difficulties when using ICT tools to demonstrate Indigenous science-related activities.	2.84	0.92
10	There is a lack of collaboration between teachers and Indigenous community members in developing culturally relevant digital resources.	2.53	0.89
		3.26	**0.90**

Aggregate Mean Value

Source: Researchers' field work, 2025.

As presented in Table 4, the aggregate mean score of 3.26 (SD = 0.90) indicates that science teachers generally agree that they encounter various challenges in implementing the integration of technology and Indigenous Knowledge Systems in science pedagogy.

Ho$_1$: There is no significant difference in the perceptions of science teachers toward the integration of technology and Indigenous Knowledge Systems (IKS) in science pedagogy across riverine areas, rural upland and city centres.

Hypotheses

Table 5

One-Way ANOVA Summary of Science Teachers' Perceptions toward Integration of Technology and Indigenous Knowledge Systems across School Locations.

Source of Variation	Sum of Squares (SS)	Df	Mean Square (MS)	F	p-value
Between Groups	1.842	2	0.921	1.87	0.158
Within Groups	58.241	118	0.494		
Total	60.083	120			

Source: Researchers' field work, 2025.

As shown in Table 5 one-way analysis of variance (ANOVA) was conducted to determine whether there were significant differences in science teachers' perceptions of integrating technology and Indigenous Knowledge Systems across school locations. The result revealed no statistically significant difference among the three groups, F(2, 118) = 1.87, p = .158. This implies that teachers across riverine, rural upland, and city centre schools hold similar positive perceptions toward integrating technology and Indigenous Knowledge Systems in science pedagogy.

Ho$_2$: There is no significant difference in the instructional practices of science teachers in integrating technology and Indigenous Knowledge Systems (IKS) across riverine areas, rural upland and city centres.

Table 6

One-Way ANOVA Summary of Science Teachers' Instructional Practices in Integrating Technology and Indigenous Knowledge Systems across School Locations.

Source of Variation	Sum of Squares (SS)	Df	Mean Square (MS)	F	p-value
Between Groups	6.482	2	3.241	5.72	0.004*
Within Groups	66.859	118	0.567		
Total	73.341	120			

Source: Researchers' field work, 2025.

A one-way analysis of variance (ANOVA) as shown in Table 6 was conducted to examine whether science teachers' instructional practices in integrating technology and Indigenous Knowledge Systems differ across school locations. The result showed a statistically significant difference among the three groups, $F(2, 118) = 5.72$, $p = .004$. Therefore, the null hypothesis (Ho_2) is rejected, indicating that there is a significant difference in the instructional practices of science teachers in integrating technology and Indigenous Knowledge Systems (IKS) across riverine areas, rural upland, and city centres. Since the hypothesis revealed a statistically significant difference among the three groups a post hoc test was further employed to revealed that margin of significant differences

Table 7

Scheffй Post Hoc Test of Differences in Science Teachers' Instructional Practices Across School Locations

Groups Compared	Mean Difference (I–J)	Std. Error	p-value	Decision
Riverine Area – Rural Upland	−0.42	0.18	0.042*	Significant
Riverine Area – City Centre	−0.63	0.20	0.006*	Significant
Rural Upland – City Centre	−0.21	0.17	0.218	Not Significant

Source: Researchers' field work, 2025.

The Scheffй post hoc analysis in Table 7 revealed that significant differences exist between Riverine Area and Rural Upland teachers ($p = .042$) and between Riverine Area and City Centre teachers ($p = .006$), while the difference between Rural Upland and City Centre teachers was not statistically significant ($p = .218$). The Scheffй post hoc test indicated that teachers in city centre schools reported significantly higher levels of instructional practices integrating technology and Indigenous Knowledge Systems compared to those in riverine schools. Similarly, rural upland teachers demonstrated moderately higher integration practices than their riverine counterparts. This pattern suggests that geographical and infrastructural factors may influence the extent of technology and IKS integration, with urban teachers having greater access to digital tools and pedagogical support for innovative instructional practices.

Ho_3: There is no significant difference in the challenges faced by science teachers in implementing the integration of technology and Indigenous Knowledge Systems

(IKS) across riverine areas, rural upland and city centres.

Table 8

One-Way ANOVA Summary of Science Teachers' Challenges in Implementing the Integration of Technology and Indigenous Knowledge Systems Across School Locations.

Source of Variation	Sum of Squares (SS)	Df	Mean Square (MS)	F	p-value
Between Groups	1.926	2	0.963	1.32	0.271
Within Groups	86.187	118	0.730		
Total	88.113	120			

Source: Researchers' field work, 2025.

A one-way analysis of variance (ANOVA) was conducted to determine whether there were significant differences in the challenges faced by science teachers when integrating technology and Indigenous Knowledge Systems across different school locations. The results showed no statistically significant difference among the three groups, $F(2, 118) = 1.32$, $p = .271$. This finding implies that teachers across riverine, rural upland, and city centre schools experience similar levels of challenges.

Discussion of Findings

The findings of this study revealed that science teachers possess positive perceptions toward the integration of technology and Indigenous Knowledge Systems (IKS) in science pedagogy, as shown by the aggregate mean score of 3.33. The result implies that most teachers agree that technology and IKS integration makes science concepts more relatable, enhances cultural relevance, and promotes deeper understanding among students. This finding aligns with the assertion of Ogunlade and Fatoba (2022) that integrating culturally grounded knowledge with modern technologies can enhance students' conceptual comprehension and engagement in science classrooms. Experts from the interviewed participants revealed the following;

"In my view, technology plays an important role in preserving and promoting Indigenous scientific practices for future generations. So I feel that integrating technology with Indigenous Knowledge in science lessons increases students' engagement and participation." (C_6)

"I believe that combining Indigenous Knowledge with technology makes science learning more meaningful and culturally relevant to students." (C_{17})

Teachers' positive perception underscores their awareness of the pedagogical value of cultural inclusivity in teaching science. By combining Indigenous knowledge with technology, teachers believe they can bridge the gap between abstract scientific ideas and students' lived experiences. This supports the argument of Aikenhead and Ogawa (2021) that contextualizing science within students' cultural environments promotes meaningful learning and critical thinking. Despite the overall positive perception, the moderate standard deviation (SD = 0.91) indicates slight variations in teachers' views, possibly due to differences in school environments, access to resources, or professional

development opportunities. Teachers in urban areas may have more exposure to digital tools, while those in rural and riverine schools might rely more heavily on community based Indigenous knowledge due to infrastructural limitations. This variability supports Oluwaseun and Adeoye's (2023) observation that contextual factors such as location and access to ICT facilities significantly influence teachers' readiness and ability to integrate technology into science teaching.s

The findings of this study also revealed that science teachers' instructional practices in integrating technology and Indigenous Knowledge Systems (IKS) are generally low, as reflected by the aggregate mean score of 2.18. The limited use of ICT tools, digital simulations, and Indigenous examples in science teaching may be attributed to inadequate access to technological resources, insufficient training and lack of institutional encouragement. This finding aligns with Adebayo and Yusuf (2021), who observed that most Nigerian teachers still rely on conventional, teacher-centered methods due to infrastructural and skill-based constraints.

Experts from participants indicated that;

"Although I understand the importance of integrating Indigenous examples, I often rely on conventional teaching methods due to lack of digital resources."(C_{14})

"I find it difficult to combine local Indigenous practices with modern technology in my lessons because I have not received enough training on how to do so." (C_{11})

Similarly, Oluwaseun and Adeoye (2023) reported that even when teachers express positive attitudes toward ICT integration, their classroom practices often remain minimal because of limited digital literacy and contextual barriers. Excerpts from some participants noted that;

"I would like to design culturally relevant materials using ICT, but the absence of technical support and appropriate content limits my efforts."(C_9)

"I sometimes use local illustrations in my science lessons, but without technological support, it is hard to make the lessons engaging."(C_{21})

The low level of instructional practices highlights a disconnect between teachers' perceptions and classroom implementation, suggesting that awareness of innovation does not automatically translate into pedagogical transformation.

"Collaborating with community members to integrate Indigenous practices through technology is difficult because there is no formal structure for such partnerships." (C_3)

This supports the position of Ezeudu and Sampson (2022) that effective integration requires continuous teacher mentoring, context-sensitive training, and supportive school environments. Therefore, while teachers may conceptually value the integration of technology and IKS, systemic challenges such as poor infrastructure, insufficient pedagogical support and inadequate exposure to blended teaching models limit their ability to implement these practices effectively.

The findings of this study revealed that science teachers generally experience numerous challenges in integrating technology and Indigenous Knowledge Systems (IKS) into science teaching, as indicated by the aggregate mean value of 3.26. This suggests that despite teachers' positive perceptions about the relevance of technology and IKS integration, several contextual and systemic barriers hinder their effective classroom implementation. Excerpts

from some interviewed participants stated that;

"We have very few functioning computers and no reliable internet access, which makes it almost impossible to integrate technology with Indigenous Knowledge in our science lessons."(C_{18})

"Most of us were not trained to use ICT tools for teaching, especially in connecting them with Indigenous practices, so we often feel unprepared." (C_{25})

"We receive little or no support from school administrators to develop projects that merge technology with local Indigenous content."(C_1)

These findings are consistent with those of Ogunlade and Fatoba (2022) and Ezeudu and Sampson (2022), who reported that infrastructural deficits, low digital competence, and minimal administrative encouragement significantly constrain teachers' use of innovative pedagogies in Nigerian secondary schools.

"The school curriculum focuses mainly on Western science and leaves little room for including Indigenous Knowledge or technology-based innovations."(C_{24})

"Sometimes, Indigenous Knowledge cannot be easily linked to scientific explanations using technology, and that discourages teachers from trying."(C_{18})

Moreover, the lack of collaboration between teachers and Indigenous community experts further limits the development of culturally relevant digital materials as highlighted by Aderonmu and Adolphus (2021). Excerpts noted from a participant revealed that;

"There is no formal collaboration between teachers and Indigenous community members to create culturally relevant digital learning materials."(C_{10})

While teachers acknowledge the value of integrating technology and IKS in science pedagogy, addressing these persistent challenges through improved policy implementation, continuous professional development, and community partnerships is crucial for sustainable educational reform.

Conclusion

The study concludes that science teachers in public secondary schools generally hold positive perceptions toward the integration of technology and Indigenous Knowledge Systems (IKS) in science pedagogy. They acknowledge that such integration can enhance students' understanding, engagement and appreciation of culturally relevant science learning. However, despite these favorable perceptions, teachers' actual instructional practices in implementing this integration remain significantly low, as reflected in the aggregate mean value. This discrepancy highlights a gap between teachers' beliefs and classroom realities, suggesting that the potential of technology and IKS integration is yet to be fully harnessed within the Nigerian science instructional context.

Furthermore, the study established that numerous contextual and institutional challenges continue to hinder science teachers from effectively implementing this pedagogical approach. Key constraints include inadequate access to ICT resources, poor internet connectivity, limited training opportunities and insufficient institutional support. These challenges are particularly pronounced in rural and riverine schools compared to their urban counterparts, reflecting disparities in educational infrastructure and support systems. Therefore, the study concludes that achieving meaningful integration of technology and Indigenous Knowledge in science pedagogy requires a multifaceted approach involving policy reform, sustained teacher capacity development, curriculum review and collaborative partnerships with

Indigenous communities to promote culturally inclusive and technologically enriched science learning experiences.

Recommendations

The following recommendations were stated for the study.

1. Government and educational authorities should provide adequate ICT infrastructure and reliable internet connectivity across all school locations to support the effective integration of technology and Indigenous Knowledge Systems in science pedagogy.
2. Teacher training institutions and Ministries of Education should organize continuous professional development programs to enhance teachers' digital competence and pedagogical skills for blending Indigenous Knowledge with modern scientific concepts.
3. Curriculum developers and policymakers should incorporate Indigenous Knowledge components into science curricula and promote collaboration between schools and local communities to ensure culturally relevant and context-based science instruction.

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EFFECT OF ARTIFICIAL INTELLIGENCE ON STUDENTS' ACADEMIC PERFORMANCE IN COMPUTER SCIENCE

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Abstract
The purpose of this study was to investigate the effect of Artificial Intelligence (AI) on the academic performance of Senior Secondary School students in Computer Science. The objectives were to assess the influence of AI on students' performance and compare it with conventional teaching methods. A quasi-experimental design of pre-test, post-test, and control groups was employed. The population comprised 12,231 SS II students from 122 public secondary schools, with a sample of 160 students selected through multistage sampling procedure. Data were collected using a researcher-designed Computer Science Performance Test (CSPT). The instrument was validated by experts in Computer Science Education and Tests, Measurement and Evaluation, and found reliable with a coefficient of 0.83. The CSPT was administered at pre-test and post-test before and after a six-week instructional period. Data were analyzed using mean, standard deviation, and t-test at 0.05 significance. Findings revealed that students exposed to AI significantly outperformed those taught via conventional methods. It is recommended that schools adopt AI in teaching would provide technological resources, and train teachers in AI-based instruction to enhance student learning outcomes.

Keywords: Artificial Intelligence, Computer Science, Academic Performance, Secondary School Students, Instructional Strategies

Introduction
Education is widely recognized as a key driver of societal, moral, intellectual, cultural, and social development. It provides individuals with the knowledge, skills, and attitudes necessary to navigate and contribute meaningfully to society while fostering national development. The critical importance of education has prompted both individuals and governments to invest heavily in educational systems and infrastructure, ensuring that students are well-equipped to meet the challenges of modern life (Ekundayo, 2020). In Nigeria, education is prioritized at federal, state, and local government levels, reflecting a collective recognition of its transformative potential. Beyond personal advancement, education is seen as a cornerstone for national growth, promoting social cohesion, political engagement, technological innovation, and economic development. Secondary education, in particular, plays a pivotal role in equipping young people with skills for self-employment, vocational engagement, and advanced scientific knowledge, thereby enabling them to lead meaningful lives within their communities (Federal Government of Nigeria, 2014).

Science, as a discipline, is dedicated to explaining natural phenomena and establishing governing principles that regulate natural processes. Through

systematic observation, experimentation, and analysis, science enables predictable and accurate explanations of events in the natural world (Remi & Akujobi, 2019). In contemporary society, science remains profoundly relevant due to its applications in technological advancement and problem-solving. Its interactive and experiential approach relies on experimentation, validation, and critical analysis, which distinguishes it from other fields of knowledge and underscores the need for specialized teaching strategies (Sivakumar & Kirubanandhini, 2014). Nations, including Nigeria, have increasingly recognized that scientific progress is central to development, as breakthroughs in technology, medicine, and engineering directly shape the quality of life and the global competitiveness of a country.

Computers and digital technologies have become integral components of modern life, spanning industries, education, homes, offices, and business ventures. This widespread adoption underscores the importance of equipping individuals with foundational computer literacy and technical skills. Computer Science, as a field, encompasses computational thinking, programming, and the principles governing hardware and software systems (Ajayi & Ajayi, 2020). It involves a spectrum of topics, from coding and algorithm design to data structures, networking, cybersecurity, and software development. Teaching Computer Science in secondary schools, especially in Kwara State, requires embedding computational thinking, programming skills, and digital literacy into the curriculum. This aligns with the global focus on Science, Technology, Engineering, and Mathematics (STEM) education, aimed at preparing students for the demands of the 21st-century workforce.

The importance of Computer Science in national development cannot be overstated. It plays a crucial role in physical sciences, engineering, healthcare, governance, business, and security by providing technological solutions to societal challenges (Lim, Gottipati, & Cheong, 2024). Through interactive and experiential learning, students engage with both theoretical concepts and practical applications, developing the skills necessary to innovate and solve real-world problems. Computer Science education is therefore across all educational levels in Nigeria, starting from junior secondary school, and is compulsory due to its interdisciplinary applications. Despite these efforts, secondary school students' performance in Computer Science examinations remains a concern. Reports from the West African Examinations Council (WAEC) reveal a declining trend in student achievement over recent years, as illustrated in Table 1.

Table 1: WAEC Subject Performance Analysis of Candidates in Computer Studies, Kwara State (2019–2023)

Year	Candidates that Sat	% Pass (A1–C6)	% Fail (D7–F9)	% Absent
2019	1,542	82.03%	14.46%	2.83%
2020	1,764	59.80%	18.78%	2.86%
2021	1,433	63.85%	27.98%	5.47%
2022	1,740	78.90%	13.62%	2.84%
2023	1,750	78.40%	13.48%	3.47%

Source: The West African Examinations Council (WAEC), *Subject Performance Analysis of Candidates in Kwara State WASSCE (SC), 2019–2023.*

The data presented in Table 1 reveals that students' performance in Computer Studies in Kwara State between 2019 and 2023 fluctuated significantly. In 2019, students recorded the highest pass rate of 82.03%, reflecting a strong performance in the subject. However, there was a sharp decline in 2020, with the pass rate dropping to 59.80%, possibly due to disruptions in academic activities linked to the COVID-19 pandemic and the shift to remote learning, which may have affected students' preparedness. In 2021, performance slightly improved to 63.85%, indicating gradual recovery. By 2022 and 2023, the pass rates rose again to 78.90% and 78.40% respectively, showing a restoration of academic stability and improved instructional delivery. Throughout the five years, the failure rate ranged between 13.48% and 27.98%, while absenteeism remained relatively low, averaging around 3% to 5%, suggesting consistent participation but varying levels of academic achievement across the period.

Artificial Intelligence (AI) is being explored as a potential intervention to enhance teaching and learning outcomes. AI simulates human cognitive processes, including learning, adapting, problem-solving, and self-correction (Zhang & Lu, 2021; Fahimirad & Kotamjani, 2018). Machine learning, a subset of AI, enables systems to identify patterns, make predictions, and apply insights to new situations, thereby enhancing educational applications (Jordan & Mitchell, 2015). In education, AI facilitates personalized learning by analyzing students' strengths, weaknesses, and learning preferences, providing customized content, recommendations, and feedback (Gupta & Sakshi, 2021).

AI-powered educational platforms offer several advantages, including immediate feedback, real-time assessment, and interactive learning experiences. This approach encourages self-reflection and active participation, allowing students to correct errors and reinforce understanding promptly (Ahmadi, 2023). AI tools also enhance accessibility for learners with disabilities, support teachers in routine tasks, and allow educators to focus on mentoring and facilitating deeper engagement with students (Ikedinach et al., 2019). AI teaching and learning become more adaptive, interactive, and aligned with digital-native innovations, bridging gaps in traditional instruction.

Given the persistent poor performance in Computer Science in Kwara State, the use of AI presents a strategic approach to improving academic outcomes. By leveraging AI's capabilities for personalized learning, real-time feedback, and interactive engagement, education can transition from traditional analog methods to a digital knowledge-based framework. Such innovation has the potential to transform teaching and learning, enhance student achievement, and prepare Nigerian students for the technological demands of the 21st century. Hence, the need to investigate the effects of Artificial Intelligence (AI) on the academic performance of secondary schools students in Computer Science in Kwara State, Nigeria.

Purpose of the Study

The purpose of the study was to investigate the effects of Artificial Intelligence (AI) on the academic performance of secondary schools students in Computer Science.. It specifically:

i. assessed students' academic performance in Computer Science before and after being exposed to AI-based instructional strategies;
ii. compared the academic performance of students taught

using integrated AI strategies with those taught using conventional teaching methods;

Research Question

A research question was raised to guide the study:

1. Would Artificial Intelligence (AI) influence students' performance in Computer Science before and after exposure to Artificial Intelligence?

Research Hypotheses

The following null hypotheses were formulated for the study:

1. There is no significant difference in the academic performance of students in the experimental and control groups before the treatment in Computer Science.
2. There is no significant difference in the academic performance of students exposed to Artificial Intelligence (AI) and conventional teaching strategies in Computer Science.

Methodology

This study adopted a quasi-experimental design ofpre-test, post-test, and control groups to examine the effect of Artificial Intelligence (AI) on students' academic performance in Computer Science. The design was chosen to allow investigation of cause-and-effect relationships between the independent variable (AI) and the dependent variable (students' performance). The population consisted of 12,231 Senior Secondary School Two (SSS II) students from 122 public secondary schools across the sixteen Local Government Areas of Kwara State (Ministry of Education, 2024). A sample of 160 students was selected using a multistage sampling procedure, which involved random selection of two senatorial districts, one Local Government Area from each, and two public secondary schools from each LGA, ensuring representation of both urban and rural locations. The selected schools were assigned to experimental and control groups, and intact classes within these schools, comprising both male and female students, formed the study sample. Data were collected using a researcher-designed Computer Science Performance Test (CSPT), consisting of two sections: Section A elicited students' bio-data, while Section B contained 20 multiple-choice questions drawn from WAEC examinations conducted between 2021 and 2023. The instrument was validated for face and content validity by lecturers in Computer Science Education, Tests, Measurement and Evaluation experts, and experienced WAEC examiners. Reliability was established using the test-retest method on 20 students from schools outside the sample, yielding a coefficient of 0.83, indicating high reliability. AI instructional package for the experimental group included lesson plans, teaching materials, case studies, practical demonstrations, and assessment tools designed to guide teachers in integrating AI into classroom instruction. The control group was taught using conventional methods. The experimental procedure spanned eight weeks: the first week involved pre-test administration to determine group homogeneity and student baseline performance; six weeks were dedicated to treatment, during which the experimental group received AI-based instruction for forty minutes per period per week, while the control group continued with traditional teaching; and the final week involved administering the post-test using the CSPT, with items reshuffled to avoid test-wiseness. Data analysis employed descriptive statistics, including mean, standard deviation, and bar charts, to answer the research questions, while hypotheses were tested using t-tests at a 0.05 level of significance to determine the effect of AI on students' performance in Computer Science.

Results

Research Questions 1: Would Artificial Intelligence (AI) influence students' performance in Computer Science before and after exposure to Artificial Intelligence?

Table 1: Mean and Standard Deviation of students' performance in Computer Science before and after exposure to Artificial Intelligence

Group	N	Pre-test		Post-test		Mean Difference
		Mean	SD	Mean	SD	
Artificial Intelligence	77	55.20	10.30	70.50	8.70	15.30
Conventional Method	76	54.80	11.00	60.20	10.10	5.40

Table 1 shows the mean and standard deviation of students' performance in Computer Science before and after exposure to Artificial Intelligence (AI) compared with the conventional method. The results reveal that students in the AI group (N = 77) recorded a mean score of 55.20 before exposure, which increased significantly to 70.50 after exposure, with a mean difference of 15.30. In contrast, the conventional group (N = 76) had a mean score of 54.80 before exposure and 60.20 after exposure, with a smaller mean difference of 5.40. This indicates that while both groups improved, students exposed to AI experienced a greater enhancement in performance, implying that AI-based instruction had a stronger positive influence on learning outcomes than the conventional method.
This is also depicted in figure 1 below.

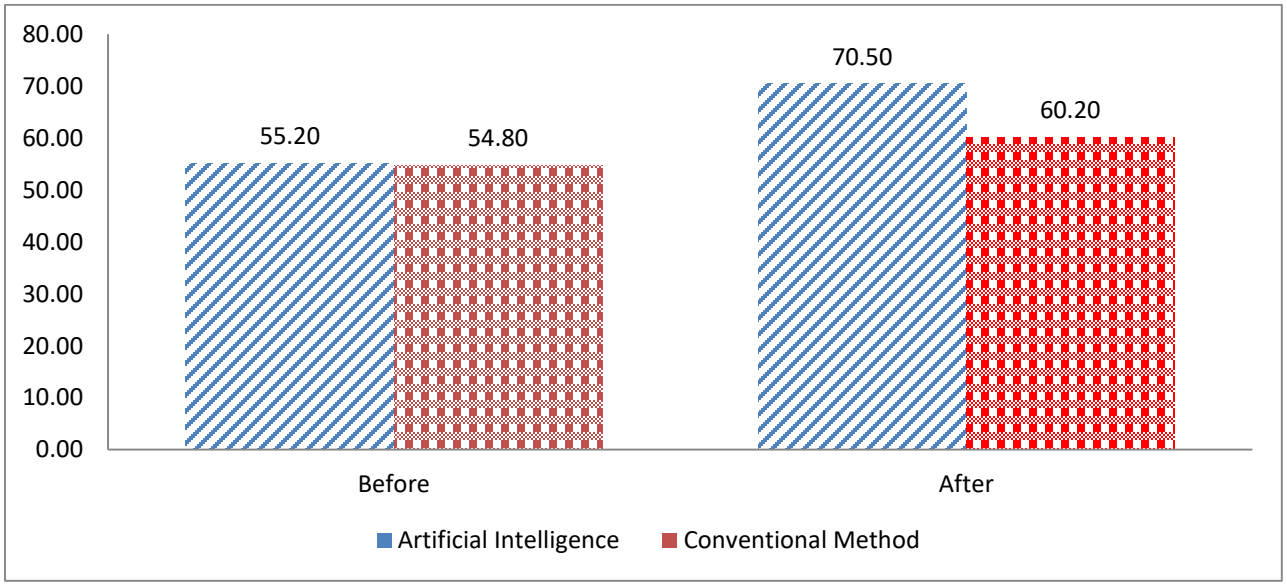

Figure 1: Bar Chart showing students' performance in Computer Science before and after exposure to Artificial Intelligence

Testing of Hypotheses

Hypothesis 1: There is no significant difference in the academic performance

of students in the experimental and control groups before the treatment in Computer Science

Table 2: t-test of the academic performance of students in the experimental and control groups before the treatment in Computer Science

Group	N	Mean	SD	df	t	p
AI Group	77	55.2	10.3	151	0.23	0.82
Conventional Group	76	54.8	11.0			

P<0.05

Table 2 presents the independent samples t-test comparing the academic performance of students in the AI group and the conventional group before treatment in Computer Science. The AI group (N = 77) had a mean score of 55.20 (SD = 10.30), while the conventional group (N = 76) recorded a mean of 54.80 (SD = 11.00). The analysis yielded a t-value of 0.23 with 151 degrees of freedom and a p-value of 0.82, which is greater than the 0.05 significance level. This result indicates that there was **no statistically significant difference** in the pre-treatment performance of the two groups, confirming the null hypothesis that both groups had comparable academic performance before the intervention.

Hypothesis 2: There is no significant difference in the academic performance of students exposed to Artificial Intelligence (AI) and conventional teaching strategies in Computer Science.

Table 3: t-test of the academic performance of students exposed to Artificial Intelligence (AI) and conventional teaching strategies in Computer Science.

Group	N	Mean	SD	df	t	p
AI Group	77	70.5	8.7	151	5.12	0.001
Conventional Method	76	60.2	10.1			

P<0.05

Table 3 presents the t-test analysis of students' academic performance in Computer Science after exposure to integrated Artificial Intelligence (AI) and conventional teaching strategies. The AI group (N = 77) obtained a higher mean score of 70.50 (SD = 8.70), compared to the conventional method group (N = 76), which had a mean score of 60.20 (SD = 10.10). The computed t-value was 5.12 with 151 degrees of freedom, and the associated p-value was 0.001, which is less than the 0.05 significance threshold. This result indicates a statistically significant difference in performance between the two groups, favoring students taught with AI. Therefore, the null hypothesis is rejected, confirming that the use of AI significantly enhanced students' academic performance in Computer Science compared to conventional teaching strategies.

Discussion

The finding of this study revealed that students exposed to Artificial Intelligence (AI) showed greater improvement in academic performance compared to those taught with the conventional method. This suggests that AI has the potential to transform teaching and learning by making instruction more interactive, personalized, and student-centered. Unlike conventional methods that often rely on teacher-led explanations and rote memorization, AI

provides adaptive feedback, tailors content to individual learning needs, and encourages active participation. These features make learning more engaging and effective, particularly in a practical and dynamic subject such as Computer Science. This result is in line with the finding of Sanusi, Adedoyin, and Olanrewaju (2024), who found that AI applications in Nigerian schools improve learning outcomes by supporting individualized learning and providing real-time feedback. It is also corroborated by Onuh and Charles (2023), who found that AI tools such as smart assessments and intelligent tutoring systems significantly enhance instructional effectiveness in secondary schools. Similarly, Okonkwo and Ade-Ibijola (2021) found that AI integration in Nigerian education has the potential to foster creativity, improve student motivation, and strengthen academic achievement by making learning more practical and accessible. The finding is further consistent with Eze and Nwosu (2022), who emphasized that AI-based learning platforms help students overcome barriers such as overcrowded classrooms and limited teaching resources, which are common challenges in Nigeria. This reveals that importance of adopting AI as a complementary instructional strategy to address gaps in the traditional classroom and to promote better performance in Computer Science and other subjects.

The finding of the study revealed that there was no significant difference in the academic performance of students in the AI and conventional groups before treatment, showing that both groups were academically comparable at baseline. This indicates that any observed differences in performance after the intervention can be attributed to the instructional strategies rather than pre-existing disparities in students' abilities. This finding is in line with the findings of Onu and Charles (2023), who reported that ensuring comparable groups before the introduction of new instructional approaches is essential for measuring the true effect of innovative teaching methods such as AI. It is also corroborated by Eze and Nwosu (2022), who found that baseline equivalence allows researchers to isolate the impact of emerging technologies on students' learning outcomes more accurately. Similarly, the finding is consistent with the work of Sanusi, Adedoyin, and Olanrewaju (2024), who found that pre-intervention equality between experimental and control groups strengthens the validity of educational experiments and enhances the credibility of their results. In the Nigerian, where differences in prior knowledge and access to resources can affect learning outcomes, establishing baseline comparability is particularly important. Thus, this result validates the reliability of the subsequent findings in this study by confirming that the groups were initially on equal footing before the AI intervention was introduced.

The finding of the study revealed that a significant difference was found between students exposed to AI and those taught with the conventional method, with the AI group performing better. This suggests that using AI in teaching enhances students' learning outcomes by making instruction more interactive, adaptive, and engaging. Unlike the conventional method, which often depends on rote learning and teacher-centered explanations, AI tailors content to individual learning needs, provides timely feedback, and supports active participation, which improves students' understanding and retention of knowledge. This finding is in line with the finding of Adeoye and Olanrewaju (2022), who reported that AI-based instruction significantly improved students' academic achievement in Computer

Science by fostering personalized and self-directed learning. It is also corroborated by Okonkwo and Nwafor (2023), who found that students exposed to AI-supported tools demonstrated higher performance and motivation compared to those taught with traditional approaches. Similarly, the finding is consistent with Adebayo and Yusuf (2021), who emphasized that AI integration enhances problem-solving skills and critical thinking, thereby improving academic outcomes. In Kwara State, where challenges such as large class sizes and limited teaching resources often hinder effective instruction, this result highlights the transformative potential of AI as a tool to bridge learning gaps and promote equitable access to quality education. Thus, the superiority of AI-based teaching over conventional methods underscores the need for its wider adoption in Computer Science and other subjects.

Conclusion

Based on the findings of this study, it is concluded that the use of Artificial Intelligence (AI) in teaching Computer Science significantly improves students' academic performance. The students exposed to AI demonstrated higher achievement compared to those taught using conventional methods, confirming the effectiveness of AI as an instructional strategy. The pre-test results established that the groups were initially comparable, indicating that the observed improvement was directly attributable to the AI intervention. Therefore, AI can be considered a valuable tool for enhancing teaching and learning in Computer Science, providing a more effective approach than traditional classroom methods.

Recommendations

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

1. Schools and educational authorities in Kwara State should integrate Artificial Intelligence (AI) into Computer Science instruction to enhance student engagement, understanding, and academic performance.
2. Teachers should be trained in the use of AI tools and platforms to effectively deliver personalized, interactive, and student-centered lessons. Professional development programs should include practical sessions on AI-assisted lesson planning, assessment, and classroom management.
3. Curriculum developers should incorporate AI-supported learning activities and resources into the Computer Science syllabus to ensure students are exposed to modern, technology-driven instructional approaches.
4. Schools should be equipped with the necessary technological infrastructure, including computers, internet access, and AI-enabled educational software, to facilitate effective AI-based teaching and learning.
5. Educational policymakers should create guidelines and incentives to encourage the adoption of AI in secondary schools, ensuring that both teachers and students benefit from technological innovations in education.

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IMPACT OF COMPUTER-RELATED STRESS ON LEARNING OUTCOMES OF UNDERGRADUATE STUDENTS IN TAI SOLARIN UNIVERSITY OF EDUCATION

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Abstract

The study examined the impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education. Two research questions guided the study. A descriptive research design of survey type was used. The population for this study comprised undergraduates in Tai Solarin University of Education, Ogun State, Nigeria for the academic session 2024/2025. A total of 200 undergraduate students from the selected university were selected as sample size using purposive sampling technique. The findings of the study revealed that there were high level responses of computer-related stress among undergraduate and that explanatory variable (computer-related stress) shown to be significantly impact learning outcomes of undergraduate students in Tai Solarin University of Education. It was recommended that the management of TASUED should provide more conducive learning environment, adequate IT infrastructural facilities, computer literacy should be encouraged to help lower anxiety and reduce stress in an IT environment.

Keywords: Computer-Related Stress, Learning Outcomes, Undergraduate Students

Introduction

One of the achievements of an institution is to improve the learning outcomes of students. Learning outcomes are statements of the knowledge, skills and abilities individual students should possess and they can demonstrate upon completion of a learning experience or sequence of

learning experiences. It is important to make sure that outcomes, which could be positive or negative are attainable. Outcomes need to be reviewed in light of students' ability, developmental levels, their initial skill sets, and the time available to attain these skill sets. They should also be in line with what is being taught. Learning outcomes should rely on active verbs in the future tense. It is important that outcomes be stated in the future tense in terms of what students should be able to do as a result of instructions earlier. For example, the learning outcome students have demonstrated proficiency in terms of students' actual performance instead of what they will be able to accomplish upon completion of the programme. Learning outcomes should also be active and observable so that they can be measured. Learning outcomes should be framed in terms of the program instead of specific classes that the it offers. However, Ebele and Nkiru (2024) stated that student learning outcomes are statements that specify what students will know, be able to do or be able to demonstrate when they have completed or participated in a course or program.

Osisanwo et al. (2019) were of the opinions that students learning outcomes comprised Intellectual skills. With this type of learning outcome, the learner will understand concepts, rules or procedures; and cognitive strategy. In this type of learning outcome, the learner uses personal strategies to think, organise, learn and behave, verbal information, and motor skills and attitude. The contemporary situation globally, requires` many sectors to directly work with computer and its tools including that of educational sector. The need for computer education in schools cannot be over emphasized. This is because computers make things easy in our society. Information Communication Technology has become an integral part of our society (Chiemeke, 2020). Exposure to this new medium gives one the opportunity to acquire unlimited amount of knowledge and a chance to communicate with others around the world. Information Communication Technology (ICT) is now a fast way to create, send and consume new information.

Computer Mediated Communication (CMC) extends mental capabilities and enhances our intellect (Lakos & Shelley, 2020). Computers have now been accepted "unconditionally" as an integral part of our entire educational system. The increase in computer usage is rapid and has also generated new challenges. In fact, one of the most dynamic and innovative areas of growth in education is the utilization of computer technology. Shinn (2019) asserted that for a school to remain competitive it also must adapt to changes and be innovative with its use of computers. She further stated that, despite income, school budgets and location, all students will have access to information through the internet (Shinn, 2019). Today, the internet is being used as a payment method; telecommunication traffic is also possible through the computer video and audio services (Jonah, 2017). Technology can play a vital role in helping students meet higher standard and perform at increased levels by promoting alternative, innovative approaches to teaching and learning. Email is taking the place of inter-office correspondence. Business is rapidly becoming computerized. Students and workers need to be comfortable with computers now more than ever. As the academic and business environment continues to move forward in computer technology, the gap is widening between development in computer technology and those people who experience computer anxiety.

Computer-Related Stress" or "Computer Anxiety" are used in the literature vocabulary due to teacher and student resistance to computer use (Ogunleye, 2022). Student computer-related stress, also known as computer stress or cyberphobia, refers to the fear, apprehension, and negative emotions a student experiences when interacting with or anticipating using computers, potentially impacting their academic performance and overall well-being. Computer stress or anxiety is a specific type of anxiety that manifests when an individual anticipates or experiences interaction with computers. It can include feelings of fear, apprehension, worry, and even physical symptoms like sweaty palms or rapid heartbeat. Computer anxiety can lead to avoidance of using computers, hindering students' ability to complete assignments, participate in online learning, and access educational resources. It can make it difficult for students to focus and concentrate on their studies, leading to decreased engagement and potentially lower grades. The stress and anxiety associated with computers can negatively impact a student's overall mental and emotional health (Ebele & Nkiru, 2024). According to Osisanwo et al. (2019), the factors contributing to computer related stress include lack of computer literacy or experience, fear of making mistakes or appearing incompetent, perceived lack of control over technology, negative past experiences with computers and rapid technological advancements and the pressure to keep up.

The causes of this resistance according to Nickerson (2021) are not unconnected with feelings of stupidity, fear of obsolescence, fear of the unfamiliar operations done with computers and the thought that computers have a dehumanizing effect. Psychological factors are important in educational research; they have been linked with improving student learning outcomes. Psychological factors are also important in correcting deviant behaviours of young people (Bolandifar & Noordin, 2018). Therefore, in considering computer utilization, it is important to consider psychological factors like computer stress. Studies have shown that computer related stress, lack of confidence, and lack of enjoyment influence both the acceptance of computers and their use as teaching and learning tools. Therefore, the need to disabuse the mind of both teachers and their students from such fears and replace these misconceptions with confidence building measures is more than ever paramount.

In this regard, computer ownership and computer experience are two very important and interrelated factors that can help in mitigating fear and computer related stress about computers from the minds of teachers and students (Lakos & Shelley, 2020). The teacher, if guarantee, may result in a reciprocal outcome of computer experience that provides the technical know-how and the intellectual ability to manipulate and discover the pedagogical power of the computer.

Most students are enthusiastic about gaining admission into the university without knowing that extent of intellectual challenges they will face, which will force and expose them to the use of smart technologies such as computer. Students must engage academically in order to acquire knowledge and skills that will equip them to face their academic challenges. In order to fully engage in their studies towards success, and to ensure timely submission of assignments, reading course contents and prepare for examinations, most students are forced by fast changing digital environment in

the 21st century where they have found themselves as digital natives, to rely on the use of smart solution applications. The benefits of innovations in the Information and Communication Technology are seen in students' everyday life but little or nothing is known about the effect of computer-related stress on learning outcomes.

However, the usage of Tai Solarin University of Education as case study for this paper was that, the university was special as it's based on education and education is learning. Both education and learning aim to acquire knowledge, skills, and new information, and both can happen at any age, often driven by use of technology, formal process often involving guidance from teachers/lecturer, learning is a broader, lifelong process that can happen through formal education or informal experiences. Hence, this study sought to examine the impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education.

The main objective of the study was to examine the impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education. Specifically, the study sought to:

1. Identify the level of computer-related stress among undergraduate students in Tai Solarin University of Education.
2. Investigate the impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education.

The following research questions guided this study:

1. What is the level of computer-related stress among undergraduate students in Tai Solarin University of Education?
2. What is the impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education?

Literature

Ebele and Nkiru (2024) investigated the prediction of students' academic achievements in Computer Studies by academic stress in Awka Education Zone of Anambra State, Nigeria. The findings of the study revealed, among others, that academic stress does not significantly predict students' achievement in Computer Studies and the moderating influence of gender in the prediction is insignificant. Igwe and Ejide (2024) investigated the relationship between technostress and academic engagement of undergraduate university students in Anambra State. The findings revealed that technostress had a very low positive relationship with students' academic engagement. This suggests that technostress had marginal or no relationship with academic engagement. Ishola et al. (2022) examined human-computer interaction and techno-stress among undergraduates. Findings showed that undergraduates have positive perceptions of technology-influenced stress, and based on gender and age, no significant difference exists in their perceptions. Osisanwo and Ehioghae (2022) investigate computer anxiety as a correlate of use of Information Technology tool by undergraduates of Library and Information Science in Tai Solarin University of Education (TASUED), Ijagun, Ogun State. Findings show that the level of computer anxiety among LIS undergraduates is high. The available IT tools among LIS undergraduates are mobile technology, laptops, CD-ROM, printers and internet search engines. The most frequency utilized IT tools among LIS

undergraduate are mobile technology and laptops. The impact of computer anxiety on students' utilization of IT tools is high. Fitzgerald (2021) explored how technology characteristics influence students' technostress, and in turn their perceived academic performance. The results showed some technology characteristics were associated with technostress, while some were not.

Research Method

The study uses a descriptive research design of survey type. This design is considered very appropriate because the researchers intend to collect data from the selected respondents to provide answer to the study objectives. The population for this study comprised undergraduates in Tai Solarin University of Education, Ogun State, Nigeria for the academic session 2024/2025. A total of 200 undergraduates from Tai Solarin University of Education, for the academic session 2024/2025 were selected as sample size. Purposive sampling technique was use for the selection of the sample size. However, only Educational Technology undergraduates were selected for the study. The study used researcher developed questionnaire; titled: Computer-Related Stress and Learning Outcomes of Undergraduates Questionnaire (CRSLOQ). The questionnaire (CRSLOQ) requested responses on a four (4) – point scale format. The responses rating scales are as follows: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The questionnaire divided into two sections A and B. Section A focuses on demographic characteristics of the respondents, while section B focuses on the related items on level of computer-related stress and learning outcomes. The initial draft of the instrument was subjected to face validity by the experts from Educational Technology. To ensure the reliability of the instrument, a reliability exercise was carried out. The instruments were administered to a sample of 25 Educational Management undergraduates. The purpose was determined the stability and consistency of the instruments. Cronbach's Alpha was used to determine the level of reliability coefficient which yielded 0.81. Data were collected using the validated instrument. The researchers administered the questionnaire with the help of 3 research assistants to the respondents. Mean and standard deviation were used for analyzing research question 1 and research question 2 was answered using regression analysis at 0.05 level of significance.

Results

Research Question 1: What is the level of computer-related stress among undergraduate students in Tai Solarin University of Education?

Table 1: Descriptive statistics on the level of computer-related stress among undergraduate students in Tai Solarin University of Education

Items	Mean	SD
I enjoy working with computers.	2.88	.997
I am confident in my ability to use computers.	3.14	.751
I feel tense whenever I am working on a computer.	3.15	.733
I feel anxious whenever I am using computer.	2.94	.903
I would like to continue working with computers in the future.	3.26	.746
Cluster Mean	3.07	

Source: Field Survey, 2025

Table 1 showed that cluster mean was 3.07 which greater than bench mark mean value 2.50. The implication of this result was that there were high level responses of computer-related stress among undergraduate students in Tai Solarin University of Education.

Research Question 2: What is the impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education?

Table 2: Impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.406	1.035		15.854	.000
	Computer-related stress	.696	.032	.593	21.624	.000

a. Dependent Variable: Leaning outcomes

Table 2 demonstrated that the coefficient of computer-related stress had a positive sign, suggesting that raising or improving in computer-related stress would enhance the learning outcomes of undergraduates. With a magnitude of computer-related stress (β =.593, t = 21.624, p <.05) and a p-value less than 0.05, the explanatory variable (computer-related stress) was shown to be significantly impact learning outcomes of undergraduate students in Tai Solarin University of Education.

Discussion

The findings of the study revealed that there were high level responses of computer-related stress among undergraduate students in Tai Solarin University of Education. These findings were in consonant with Fitzgerald (2021) showed some technology characteristics were associated with technostress, while some were not. The students' technostress could, however, not be determined to have an association with their perceived academic performance. The study discusses possible contributing factors to the results. Oladosu et al. (2020) findings of the study revealed that as undergraduate students use smart devices, they become techno-stressed, and this is negatively influencing their learning with the devices. Adenekan (2024) finding revealed that the respondents experienced cognitive, affective and behavioural forms of techno stress, which had negative effect on their personal and professional development.

The findings also revealed that the coefficient of computer-related stress had a positive sign, suggesting that raising or improving in computer-related stress would enhance the learning outcomes of undergraduates and that a p-value less than 0.05, the explanatory variable (computer-related stress) was shown to be significantly impact learning outcomes of undergraduate students in Tai Solarin University of Education. These findings correlate with Wang et al. (2021) showed that, in the past 20 years, the application of human–computer interaction not only made significant contributions to the development of hazard recognition, but also generated a series of new research

subjects, such as multimodal physiological data analysis in hazard recognition experiments, development of intuitive devices and sensors, and the human–computer interaction safety management platform based on big data. Future research modules include computer vision, computer simulation, virtual reality, and ergonomics. Ahmed et al. (2023) finds out school portal was the most common information system (IS) in all the institution, and these portals are not meant for e-learning but rather registration.

Conclusion

This study examined the impact of computer-related stress on learning outcomes of undergraduate students in Tai Solarin University of Education, the following conclusions were drawn based on the findings of the study that: there were high level responses of computer-related stress among undergraduate students and also that the explanatory variable (computer-related stress) was shown to be significantly impact learning outcomes of undergraduate students in Tai Solarin University of Education.

Recommendations

The following recommendations were raised in line with the findings of the study:

1. The university management should equip department with technological tools to aid the use of computer in instructional delivery for undergraduates.
2. The management of TASUED should provide more conducive learning environment, adequate IT infrastructural facilities, computer literacy should be encouraged to help lower anxiety and reduce stress in an IT environment and that head of Departments should make sure that computer-oriented courses are taught by lecturers who are trained in the use of ICT facilities in teaching and learning.

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PLAGIARISM DETECTION IN SUBMITTED ONLINE ASSIGNMENTS - A COMPARATIVE PERFORMANCE ANALYSIS OF THREE MACHINE LEARNING ALGORITHMS

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Abstract

Literature showed that plagiarism has globally become a malignant and destructive practice in tertiary institutions. Artificial Intelligence (AI) tools has facilitated high-tech plagiarism, and consequently undermined authenticity of academic works; bringing credibility of academic programs, value of degrees, and the skills of graduates under threat. This study developed an AI model for performance evaluation of machine learning algorithms in detecting plagiarism in online assignment submission. A dataset of 200 submissions obtained from A Corpus of Plagiarized Short Answers (ACOPSA)) and local student assignment submissions was trained with Random Forest, XGBoost, and K-Nearest Neighbors machine learning algorithms in the model. Precision, Recall, F1 score, Accuracy, and ROC-AUC were employed for comparative performance assessment of the algoritms,. Findings showed that Random Forest (Accuracy: 0.857, Precision: 0.858, and F1 Score: 0.854) achieved the best overall performance, followed by XGBoost (Accuracy: 0.800, Precision: 0.820, and F1 Score: 0.795) while KNN yielded the least performance (Accuracy: 0.579, Precision: 0.591, and F1 Score: 0.546). Random Forest demonstrated superior capability in detecting paraphrased and heavily disguised plagiarism. For academic integrity sustenance in all academic institutions, the researchers recommended development of hybrid models that concurrently detects lexical and semantic matches, and enforcement of ethical use of AI.

Keywords: Plagiarism Detection, Online Assignment, Academic Integrity, Machine Learning Algorithms, Hybrid Models.

Introduction

Increasing availability and accessibility to digital tools and platforms occasioned by the Internet, has made plagiarism a pervasive issue in academic environments, widespread, prevalent and difficult to detect. The fact that students admitting to cheating and copying academic works are on the increase is worrisome and this worrying trend is largely driven by the ease of copying and pasting from online sources (Oravec, 2023). In addition to traditional forms of plagiarism, such as directly copying text, students now have access to powerful AI-based tools that can paraphrase content and manipulate it to avoid detection by conventional plagiarism checkers (Kumar, 2021). With these advances, students can now produce academic work that appears original but is, in fact, generated by AI systems or heavily paraphrased from external sources.

Traditional plagiarism detection tools like Turnitin developed to catch instances of direct copying often struggle with more sophisticated forms of plagiarism, such as paraphrasing or using AI tools to alter the content to evade detection. This has created a significant gap in the effectiveness of these tools, as students increasingly use paraphrasing tools powered by AI to avoid detection (Kumar, 2021). As a result, educational institutions are facing significant challenges in upholding academic integrity.

Furthermore, the rapid development of generative AI technologies, such as OpenAI's ChatGPT, Deepseek, Google's Bard, and Amazon's Bedrock, has introduced new complexities to the issue of academic cheating. These tools are capable of producing high-quality content that can easily be submitted as assignments or exam answers without students contributing any original thought or effort. These tools have become so sophisticated that their outputs can be difficult to distinguish from student-generated work, further complicating the task of detecting academic dishonesty (Huang, 2023). This "AI plagiarism," poses a serious challenge to the integrity of academic assessments (Gillard & Rorabaugh, 2023). The misuse of these AI tools for academic cheating undermines the value of educational qualifications and can have long-term consequences for both institutions and students alike.

The limitations of existing plagiarism detection systems have become increasingly apparent in the face of these emerging technologies. While tools like Turnitin and Grammarly are widely used, they primarily focus on comparing text at a surface level, without truly understanding the underlying meaning of the content(Oravec, 2023). The inability to detect AI-generated text, paraphrased content, or subtle changes in language has made these systems inadequate for addressing modern plagiarism challenges (Dahmen Kayaalp, Ollivier, Pareek, Hirschmann, Karlsson, & Winkler, 2023). As AI technology continues to evolve, there is also a potential for more sophisticated forms of academic dishonesty, making it necessary for educational institutions to adopt more advanced solutions.

Literature Review

Several plagiarism checkers have been developed over the years to mitigate plagiarism, such as PlagAware, 2021; Check for plagiarism, 2021; KIT, 2021; Turnitin, 2021; Blackboard, 2021. Each, with its peculiar limitations. Moreover, plagiarizers are becoming negatively "smarter" and can outsmart these systems. Rearranging and paraphrasing content could successfully trick some of these plagiarism checkers. In addition, there are numerous free online paraphrasing tools powered by Artificial Intelligence (AI), that are able to evade many plagiarism detectors. These tools modify "stolen contents" to such a degree as to evade even the most advanced copy content scanning software (Kumar, 2021). As AI tools continue to evolve and provide more sophisticated capabilities for content generation, there is a pressing need for an advanced, AI-based system to effectively detect and prevent plagiarism and cheating in online assignments. Hence, this study sought to develop a machine-learning AI model for detecting plagiarism and cheating in online assignments and use it to compare the performance of three AI-based machine learning algorithms in detecting plagiarism and cheating in online assignments.

Plagiarism Detection

Plagiarism detection tools have advanced significantly over the years, particularly in detecting verbatim or near-verbatim copying (AmberBlog, 2025). These tools, largely based on word-level fingerprinting or string-matching algorithms, are highly effective for identifying direct plagiarism, but they often struggle with semantic plagiarism, where similar ideas are conveyed using different words or paraphrasing techniques.

Word-Based Versus Semantic Based Detections

Traditional detection systems primarily rely on surface-level lexical similarity. They identify overlaps in word sequences, phrases, or sentence structures (Singh & Kumar, 2022). However, when content is paraphrased—especially using different syntactic forms or vocabulary—the similarity score diminishes even though the semantic meaning remains intact. For example, the original sentence: *"The house belongs to him" could be p*araphrased as: *"That man owns the bungalow" or as "The building is Mr. Raphael's."*

While these sentences convey the same meaning, they have no common lexical tokens. It is therefore difficult for conventional plagiarism detection systems to detect their similarities.

However, integration of deep learning models, natural language processing (NLP) and semantic networks has promoted semantic detection, a new shift in plagiarism detection paradigm from traditional approach that focuses on word-level lexical comparisons, as found in Grammarly and Turnitin, to meaning-level comparisons that focuses on what the intent behind the text is (Chen & Raji, 2023).

However, semantic comparison however is costly computationally. Currently, it is not feasible to carry out deep semantic analysis of several billions of literary works, documents or online resources by brute-force approach. Consequently, assignment of vector or numerical values to documents had been proposed by researchers in order to allow for a more effective large-scale comparison for similarity. This does not require pair-wise comparisons directly. (Ahmad et al., 2024).

Recent works such as SemAntiDetect and ConceptMatch have used ontological graphs and contextual embedding for selected academic fields to advance Heinrich and Maurer's (2000) proposed framework that suggested employing domain-specific ontologies, to detect equivalence between conceptually similar texts (Zhao & Mensah, 2025).

Vector Space Models (VSMs) for Similarity Detection

Vector Space Model (VSM) that uses term frequencies and semantic embedding to convert texts into dimensional vector equivalence is gaining ground in recent times among researchers (Nakpih, 2024; Turney & Pantel, 2025). VSM uses cosine similarity to calculate document similarity by measuring angles between vectors in the space for the documents. The bigger the angle, the less similar are the documents and vice versa. With its focus on semantic rather than lexical similarities, context-conscious VSM plagiarism detection tools like BERT, WORD2Vec and SBERT proved to be more promising in identifying recycled idea, paraphrased content or cross-lingual academic dishonesty (Tariq et al., 2022).

Although computational costs and the need to be domain specific remain a challenge, it is apparent that focus in literature is shifting from traditional less effective lexis (word) based to semantics based plagiarism detection tools for academic integrity preservation in literary works.

Performance Limitations of Existing Plagiarism Detection Tools

The major challenges limiting performance of existing plagiarism detection tools are:

Use of synonyms and paraphrasing - many detection tools could not effectively detect these in literary works. Besides, there are several AI tools that can use word synonyms to restructure and automate document rewriting for splagiarists while retaining the original meaning. Traditional systems that rely on lexical or string-based comparison consequently fail to detect such skillful AI powered plagiarism. Especially worrisome is when the paraphrasing of a document is done on a large scale, even models like GPT and BERT that rely on semantic similarity detection could not measure up as they still require scalability and precision optimization (Zihang, Boqing & Liqiang, 2025).

Offline Contents - when documents whose sources are not available online (such as unpublished dissertations, old textbooks, or physical journals) are plagiarized, plagiarism detection tools like Copyscape and Turnitin who, rely soley on access to digitized and indexed databases become ineffective. Ditto to documents in restricted access domains (Zihang, Boqing & Liqiang, 2025).

Cross-Language Plagiarism – this is now a major concern in the academia. When intellectual contents are translated to another language only to be attributed to another author different from the original author is a worrisome case of cross-language plagiarism (Yilmaz & Fernбndez, 2024). Monolingual detection systems have often failed woefully in such cases as they failed to detect contents hat are semantically the same but presented in another languages.

Addressing the Challenges of Existing Plagiarism Detection Tools

Efforts of notable organisations like Google and Internet Archive in digitizing and indexing vast data bases and knowledge repositories had proved helpful in extending the reach of available intellectual works' similarity detection tools, and thus reducing this challenge to some extent. Intent and semantic based detection tools like SBERT and search engines like ConceptNet that employ the use of NLP (Natural Language Processing) and compare intent and concept in paraphrased documents rather than word similarity are equally promising in overcoming plagiarism (Chen & Raji, 2023). These systems, are however limited by being computationally intensive with respect to needed resources and are therefore not yet scalable enough for real time deployment and analysis, thus limiting applicability of these innovative efforts. Consequently, intuitive manual skill of human evaluators, editors, and reviewers are still indispensable in defending and upholding academic integrity. Besides, some levels of plagiarism such as idea theft definitely require manual human contextual comprehension and interpretation regardless of the supports from automated systems.

Nwohiri, Joda, and Ajayi (2023) confirmed the increasing challenge of plagiarism in academia and highlighted the limitations of existing plagiarism detection tools in their study titled "AI-powered plagiarism detection: leveraging forensic linguistics and natural language processing". Their study proposed development of AI-driven plagiarism detection system that could crawl the web to index articles, generate levels of similarities between documents among other things by applying NLP and forensic linguistics to assess plagiarism levels. They further suggested integration of AI and forensic linguistics into plagiarism detection to enhance detection efficiency.

Oravec (2023), in the article: "Artificial Intelligence - implications for academic cheating: expanding the dimensions of responsible human-ai collaboration with ChatGPT and Bard," explores the ethical concerns surrounding AI-generated content in higher education. The study examines the technological arms race between cheating detection systems and students utilizing AI tools for academic dishonesty. The research identifies how AI-powered methods, including facial recognition and watermarking, can be used to curb cheating while also promoting responsible AI usage. The study concludes that instead of solely focusing on punitive measures, educators should guide students in ethically integrating AI into their academic work, preparing them for a collaborative, AI-driven future.

The systematic review by Sozon, Alkharabsheh, Fong, and Chuan (2024) titled: "Cheating and plagiarism in higher education institutions: a literature review" systematically examines factors contributing to academic dishonesty. The study identifies key drivers of plagiarism, such as academic pressure, lack of integrity awareness, outdated honor codes, and the misuse of AI tools. The findings indicate that cheating and plagiarism are influenced by individual, social, cultural, institutional, and technological factors. The study recommends the establishment of ethical and moral development tutorials, revision of honor codes to incorporate AI tools, and the development of plagiarism detection software to improve students' academic writing and paraphrasing skills. The review concludes that a multi-faceted approach, involving policy changes and

technological advancements, is essential for combating academic dishonesty effectively.

Ibrahim (2023), in the article: "Using AI-based detectors to control AI-assisted plagiarism in essay writing: the terminator versus the machines," investigates the effectiveness of AI-driven classifiers in detecting AI-generated texts in ESL compositions. The study examines the reliability of RoBERT a-based classifiers in identifying machine-generated texts, analyzing a dataset of 240 human-written and AI-generated essays. The findings reveal that while these classifiers can detect AI-generated content, their accuracy is inconsistent. The study concludes that while AI-based detectors provide promising solutions for academic integrity in ESL writing, further refinements are needed to enhance their reliability in detecting AI-assisted plagiarism.

Vani and Gupta (2016) argue that intelligent techniques for detecting high obfuscations are still in their infancy, and most of the available online, standalone, and web-based tools are unable to detect complex manipulations.

Foltynek et al. (2020) evaluated the performance of 15 plagiarism checkers from both the coverage and usability perspectives. The study analyzed texts in eight different languages, including Czech, English, German, Italian, Latvian, Slovak, Spanish, and Turkish, with Wikipedia, online publications, and academic theses serving as the primary sources. It was concluded that better results were obtained for major languages compared to minor ones, that the source of the document significantly influenced the performance of these checkers, and that plagiarism from single sources was more difficult to detect than that from multiple sources.

Objectives

This study compared performance of three machine learning algorithms in detecting plagiarism and cheating in online assignments.

Methodology

This study adopted a design and development research methodology model. It involves system modeling, development, testing, and evaluation of its performance in detecting textual plagiarism.

Figure 1 shows the architectural design of the model..

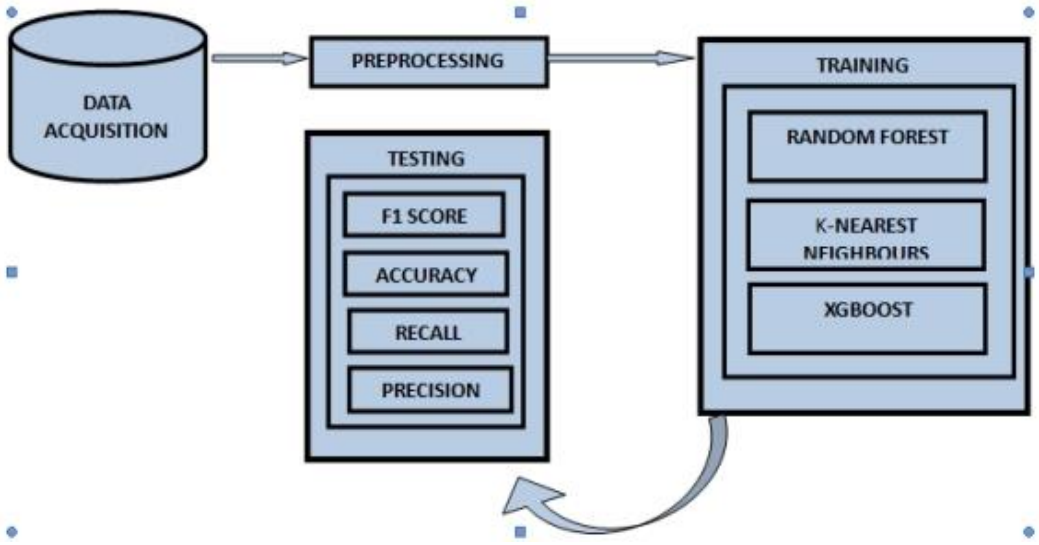

Figure 1 Plagiarism Detection Model's Architectural Design

Implementation

Data Collection

The primary dataset used for training and evaluating the AI-based plagiarism detection model was obtained from the A Corpus of Plagiarized Short Answers (ACOPSA). This dataset is publicly available and has been specifically designed for research in automatic plagiarism detection (see table 1).

Table 1: Snippet of input Dataset for ACOPSA

	File	Group	Person	Task	Category	Native Eng	Knowledge	Difficulty
2	g0pA_task	0	A	a	non	native	1	1
3	g0pA_task	0	A	b	cut	native	4	3
4	g0pA_task	0	A	c	light	native	5	3
5	g0pA_task	0	A	d	heavy	native	3	4
6	g0pA_task	0	A	e	non	native	4	3
7	g0pB_task	0	B	a	non	native	2	1
8	g0pB_task	0	B	b	non	native	3	3
9	g0pB_task	0	B	c	cut	native	5	3
10	g0pB_task	0	B	d	light	native	2	2
11	g0pB_task	0	B	e	heavy	native	4	3
12	g0pC_task	0	C	a	heavy	native	4	3
13	g0pC_task	0	C	b	non	native	3	3
14	g0pC_task	0	C	c	non	native	2	4
15	g0pC_task	0	C	d	cut	native	1	5
16	g0pC_task	0	C	e	light	native	2	2
17	g0pD_task	0	D	a	cut	non-native	1	1
18	g0pD_task	0	D	b	light	non-native	2	2
19	g0pD_task	0	D	c	heavy	non-native	3	3
20	g0pD_task	0	D	d	non	non-native	2	3
21	g0pD_task	0	D	e	non	non-native	3	3
22	g0pE_task	0	E	a	light	non-native	1	1
23	g0pE_task	0	E	b	heavy	non-native	2	2
24	g0pF_task	0	F	c	non	non-native	2	2

Source: www. Zenodo.org/

The ACOPSA dataset was developed by Barro, B., Tounkara, T., & Franɜois, T., and is accessible via academic repositories such as Zenodo or other relevant open research data platforms. It has been used in several NLP and educational integrity studies due to its carefully annotated plagiarism classes.

Data Quantity and Distribution:

The secondary dataset consists of 100 short answer documents,, evenly distributed across four distinct categories:

1. **Non-Plagiarized** – 25 documents containing original answers written independently by participants.
2. **Light Plagiarism** – 25 documents with minor word substitutions or slight paraphrasing.
3. **Heavy Plagiarism** – 25 documents that are heavily reworded but maintain the original meaning.
4. **Cut-Paste Plagiarism** – 25 documents that contain exact copies from source materials with no modification.

This balanced distribution enables the model to learn and distinguish among varying degrees of textual plagiarism.

Local Content Contribution:

In addition to the ACOPSA dataset, primary data was also sourced locally to improve contextual relevance. This includes 100 sample of real student assignments (e.g., essays, code submissions). These samples were collected from academic institutions under informed consent and anonymity to supplement the model's training dataset with local content, and for model evaluation.

Data Cleaning:

To ensure consistency, prior to training, the dataset was cleansed by removing special characters, unnecessary whitespace, and any HTML tags, standardizing punctuation and casing and by eliminating any duplicate records.

Preprocessing:

At this stage four NLP techniques were applied. Using methods such as TF-IDF or word embeddings, vectorisation was used to convert text into equivalent numerical representations; lemmatisation for word reduction to their basic dictionary form (e.g., "converting" → "convert"); tokenization for splitting each text into individual words or tokens and Stop-word Removal for removing determinants, auxiliary verbs (e.g., "are", "the") and other words that has no contribution to semantic meaning. After preprocessing, the dataset was divided into two sets for training and testing on ratio 80:20 respectively.

Data Analysis and Evaluation Metrics

Performance of machine learning algorithms (Random Forest, XGBoost, and K-Nearest Neighbours (KNN)) evaluated was measured using accuracy, precision, F1 score, confusion matrices, and Receiver Operating Characteristic (ROC) curves with Area Under the Curve (AUC) values. Since plagiarism detection does not have a definitive "correct" answer, evaluation was conducted using both qualitative and quantitative measures. These measures are:

1. **Plagiarism Index** – this was calculated as the degree of lexical and semantic matches or overlaps detected by the model for the documents being compared within the score range of 0 and 100.

2. **Precision and Recall**
Accuracy of the model in distinguishing between plagiarized and non-plagiarized contents of the submitted documents was measured with precision and recall metrics. These metrics revealed the quantity of document items flagged as plagiarized that are actually plagiarised in the true sense.

$$precision = \frac{TP}{TP+FP} \quad \text{..... Equ 1}$$

That is, of all flagged plagiarism, how much was actually plagiarized?

$$Recall = \frac{TP}{TP+FN} \quad \text{..... Equ 2}$$

That is, of all actual plagiarism, how much was detected?

These were computed using a confusion matrix, based on the binary classification.

Where:

TP - True Positive; FP - False Positive; FN – False Negative; TN – True Negative;
And in the context of this study:
TP - Plagiarized and correctly flagged; FP - Non-plagiarized but wrongly flagged FN - Plagiarized and not flagged; TN - Non-plagiarized and correctly not flagged

3. F1 Score

To balance precision and recall, the F1-score was used:

$$\text{F1 score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Equ\ 3$$

4. Accuracy

Accuracy gives an overall measure of how many predictions (both plagiarized and non-plagiarized) were correct.

5. Semantic Similarity Score

The model computed concept overlap between source and target text, especially for light or paraphrased plagiarism. The system was also tested using with primary data - real-world student assignments.

Results and Discussion

Performance of the model is discussed below.

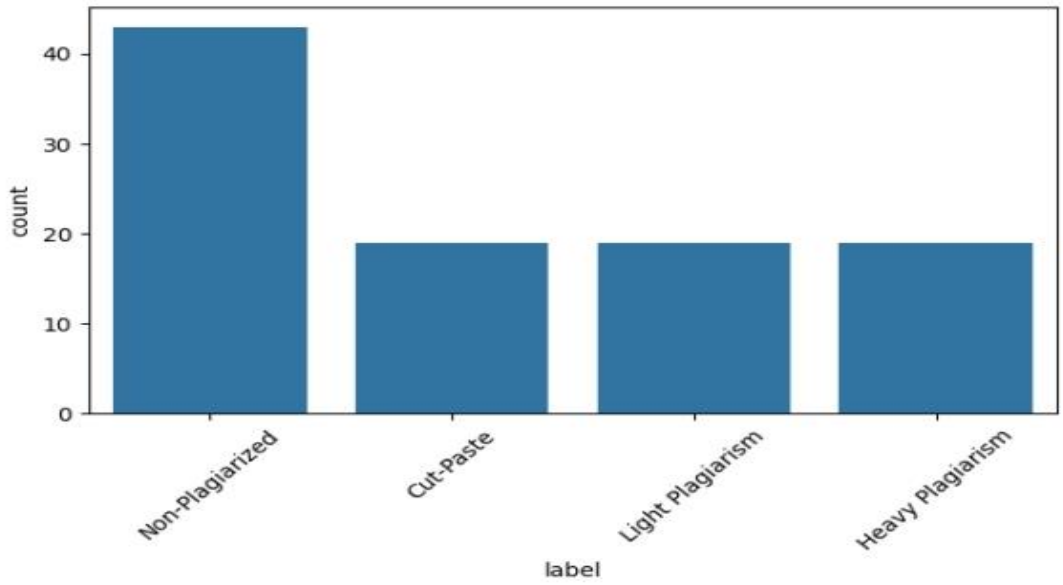

Figure 2: Bar chart showing plagiarism results for ACOPSA dataset

Model Performance Summary

The performances of the Random Forest, XGBoost, and KNN models were compared using accuracy, precision, and F1 score. The results are presented in Table 2. Random Forest (Accuracy: 0.86 , Precision: 0.86, and F1 Score: 0.85) achieved the best overall performance, followed

by XGBoost (Accuracy: 0.80, Precision: 0.82, and F1 Score: 0.80) while KNN yielded the lowest performance (Accuracy: 0.57, Precision: 0.59, and F1 Score: 0.55) and was therefore considered suboptimal.

Table 2 Comparison of Machine Learning Models for Plagiarism Detection

	Model	Accuracy	Precision	F1 Score
1	Random Forest	0.86	0.86	0.85
2	KNN	0.57	0.59	0.54
3	XGBoost	0.80	0.82	0.80

Confusion Matrix Analysis

To further evaluate the model's classification effectiveness across different types of plagiarism, confusion matrices were generated. These matrices help visualize the distribution of correct and incorrect predictions for each plagiarism category: Cut-Paste, Heavy Plagiarism, Light Plagiarism, and Non-Plagiarized content.

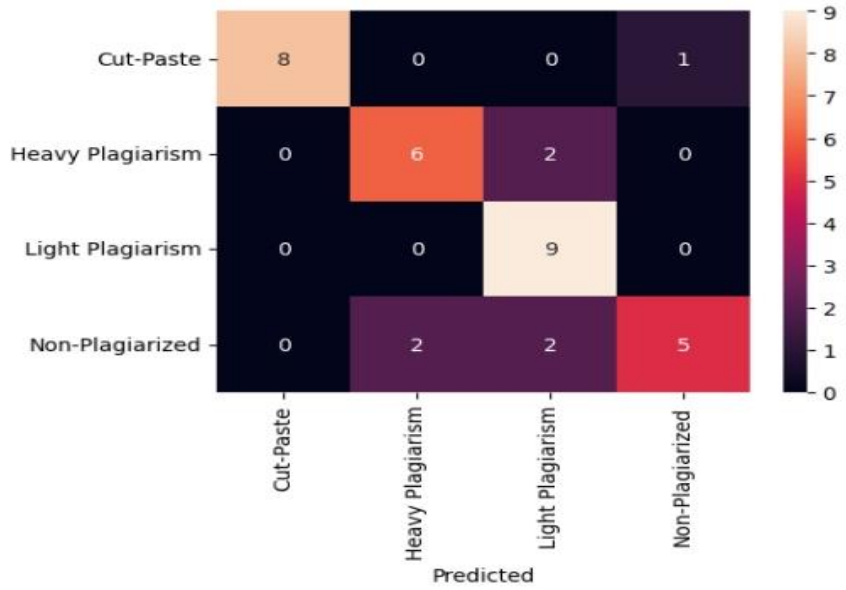

Figure 3: Confusion Matrix for XGBoost Classifier

The confusion matrix for XGBoost shows strong performance across most categories: Cut-Paste Plagiarism was correctly identified 8 out of 9 times, with only 1 misclassified as *Non-Plagiarized*. Heavy Plagiarism saw 6 correct predictions, but 2 were misclassified as *Light Plagiarism*. Light Plagiarism achieved perfect classification with 9 out of 9 correct predictions. Non-Plagiarized content had a moderate misclassification rate, with 2 cases wrongly predicted as *Heavy Plagiarism* and 2 as *Light Plagiarism*. XGBoost demonstrates high sensitivity to *Light Plagiarism* and *Cut-Paste* categories, but shows some difficulty distinguishing *Non-Plagiarized* from *semantically similar* plagiarized content, possibly due to paraphrasing.

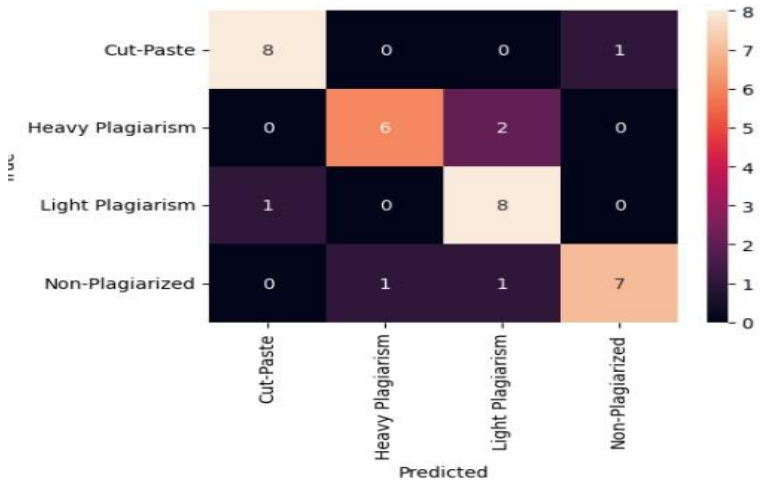

Figure 4: Confusion Matrix for Random Forest Classifier

Cut-Paste Plagiarism was correctly classified in 8 out of 9 cases. Heavy Plagiarism had 6 correct and 2 misclassified as *Light Plagiarism*. Light Plagiarism saw 8 correct predictions, with 1 false positive as *Cut-Paste*. Non-Plagiarized was mostly well identified (7 correct), with only 1 misclassified each as *Heavy* and *Light Plagiarism*. Random Forest shows a balanced performance across categories, particularly in handling *Non-Plagiarized* submissions. However, slight confusion between *Light* and *Cut-Paste* categories suggests limitations in lexical-level differentiation.

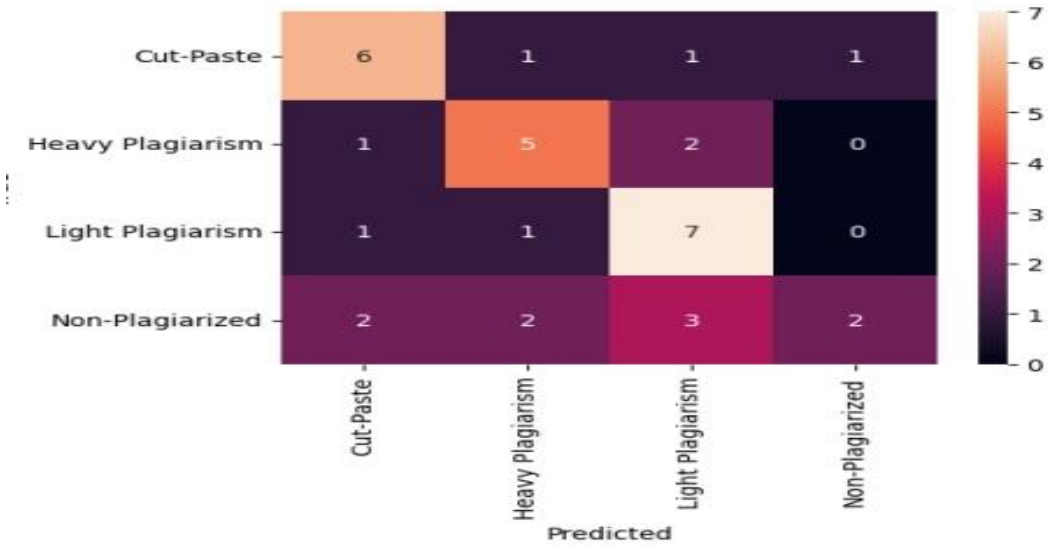

Figure 5: Confusion Matrix for K-Nearest Neighbors (KNN) Classifier

Cut-Paste Plagiarism was detected correctly in 6 cases; 3 were misclassified. Heavy Plagiarism had 5 correct classifications, with 1 predicted as *Cut-Paste* and 2 as *Light*. Light Plagiarism saw 7 correct predictions, with 2 misclassified. Non-Plagiarized content had the highest misclassification rate, with only 2 correct predictions. The remaining were misclassified into *Cut-Paste*, *Heavy*, or *Light* categories. KNN underperformed compared to the

other models. It had difficulty generalizing, especially for *Non-Plagiarized* content, likely due to its reliance on local similarity without deeper contextual understanding.

Table 3 Summary of Confusion Matrix

Model	Strengths	Weaknesses
XGBoost	Excellent at detecting *Light Plagiarism*	Misclassifies *Non-Plagiarized* as *Plagiarized*
Random Forest	Balanced detection, especially *Non-Plagiarized*	Occasional confusion between *Light* and *Cut-Paste*
KNN	Decent for *Light Plagiarism*	Poor differentiation for *Non-Plagiarized* cases

These findings align with the performance metrics in Table 3, further confirming the superiority of Random Forest and XGBoost in detecting various plagiarism categories, with XGBoost showing slightly better precision and F1 score, while Random Forest excelled in handling real non-plagiarized content.

Receiver Operating Characteristic (ROC) Curve

Performances of Random Forest, XGBoost, and K-Nearest Neighbours (KNN) machine learning classification models in detecting various forms of plagiarism using the ACOPSA dataset were also evaluated using ROC (Receiver Operating Characteristic) curve analysis (figure 6), to illustrate how well each model could distinguish among the four forms of plagiarism under consideration, namely: Non-Plagiarised, Light Plagiarism, Heavy Plagiarism, and Cut-and-Paste. The area under this curve enables us to determine the trade-off between the true positive rate and the false positive rate across different value levels. A higher Area Under the Curve (AUC) indicates better model performance.

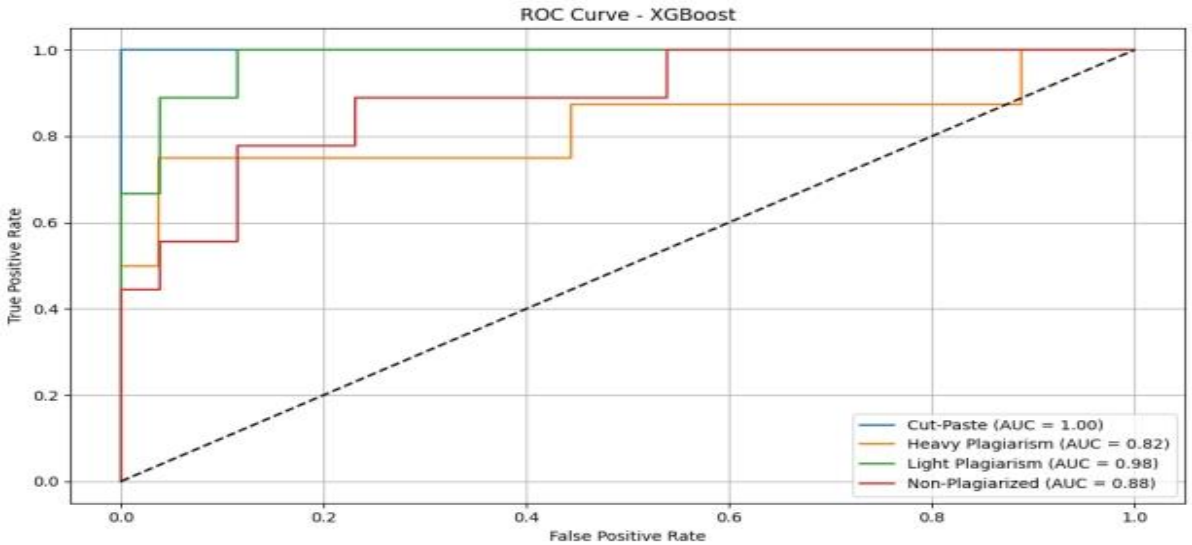

Figure 6: ROC Curve for XGBoost Model

XGBoost demonstrated exceptionally high detection accuracy for *Cut-and-Paste* plagiarism with an AUC of 1.00, indicating perfect classification. It also

performed very well in detecting *Light Plagiarism* (AUC = 0.98), and moderately well for *Non-Plagiarised* (AUC = 0.88) and *Heavy Plagiarism* (AUC = 0.82). See figure 6.

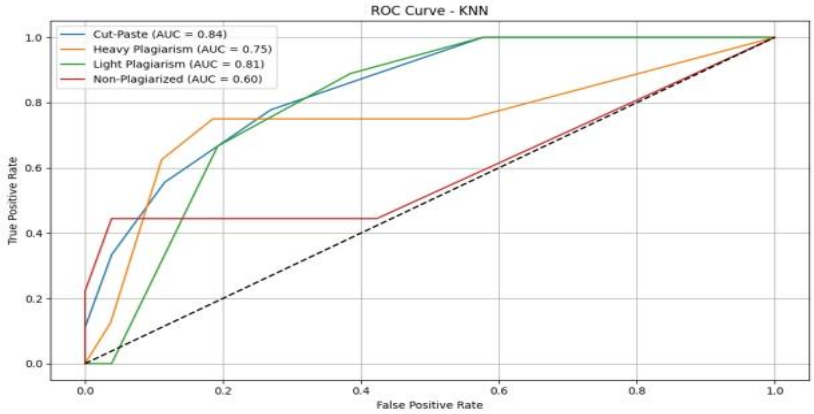

Figure 7: ROC Curve for K-Nearest Neighbour (KNN) Model

KNN underperformed in most categories, especially in identifying *Non-Plagiarised* content, with a low AUC of 0.60, indicating a tendency to falsely label original work as plagiarised. Its AUC values for *Cut-and-Paste* (0.84), *Light Plagiarism* (0.81), and *Heavy Plagiarism* (0.75) were moderate but not reliable enough for academic detection systems (see figure 7).

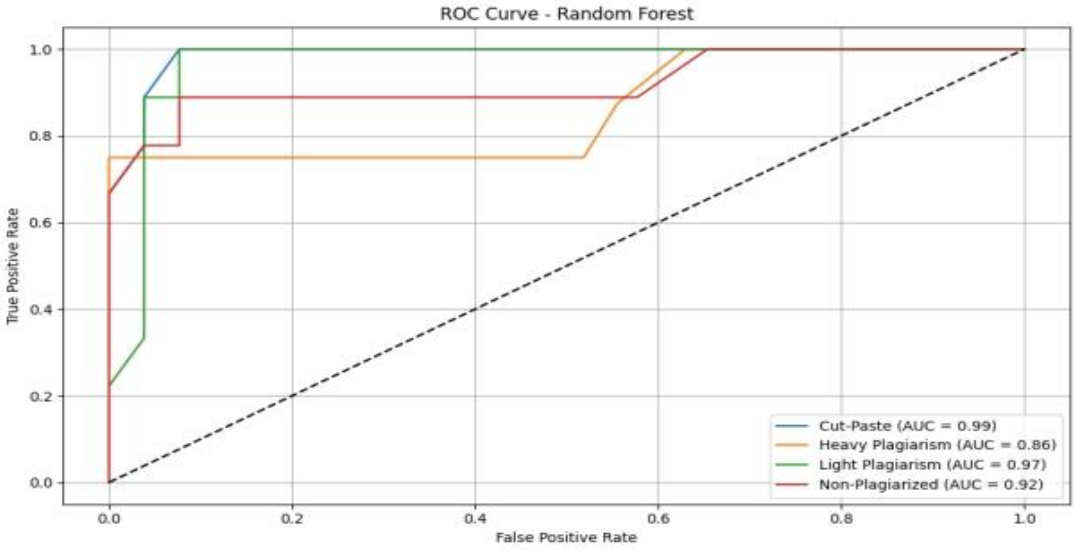

Figure 8: ROC Curve for Random Forest Model

Random Forest, by contrast, offered the most balanced and consistent performance across all categories. It achieved very high AUC values: *Cut-and-Paste* (0.99), *Light Plagiarism* (0.97), *Non-Plagiarised* (0.92), and *Heavy Plagiarism* (0.86). These results confirm the model's robustness and its superior capacity to discriminate accurately between original and

plagiarised text in all forms (see figure 8).

The confusion matrix analyses reveal that while Random Forest achieves balanced performance across all categories, challenges remain in differentiating closely related plagiarism types—especially Light versus Heavy or Cut-Paste plagiarism. Similarly, the need for further refinement to minimize false positives, which is crucial to avoid unfairly penalizing genuine student work is what the moderate misclassification rates for non-plagiarized content highlights.

As opined by Oravec (2023), this study advocates constitution and utilization of institutional policies and educational initiatives aimed at promoting ethical use of AI given the rising challenges of identifying AI generated contents. This requires that detection models are continuously updated and more sophisticated lexical, semantic and cross-language detection features incorporated to adequately combat dynamically emerging forms of plagiarism.

As highlighted in this study, it is imperative that each institution prioritises digitizing and indexing their local contents in their repositories to make them available online to facilitate performance of plagiarism detection tools and increase their detection reach.

Conclusion

This study developed a model that carried out performance analysis and comparison of three machine learning classification algorithms in detecting plagiarism in assignments for online submissions. Random Forest and XGBoost showed strong detection performance, as Random Forest provided the most balanced and reliable detection across different types of plagiarism. The system was particularly effective at identifying clear cases of cut-and-paste plagiarism as well as subtle paraphrasing.

While the AI models demonstrated promising accuracy and precision, some challenges remain, especially in distinguishing between closely related plagiarism categories and avoiding false positives on original work. These limitations highlight the need for continued improvements in model design and access to comprehensive datasets, including local academic content. Future work should consider working with larger datasets, incorporating cross-language semantic similarity detection and institutional advocacy for ethical use of AI in academics and research.

Recommendations

Institutions and researchers are encouraged to regularly review and benchmark existing plagiarism detection tools to identify their limitations and uncover opportunities for enhancement with AI models. Future development efforts should focus on designing hybrid AI models that integrate both lexical and semantic similarity techniques, which will improve plagiarism detection of paraphrased and cleverly disguised contents even those involving cross-language academic dishonesty Additionally, it is important for developers to simulate and validate the performance of these models using diverse and realistic datasets, including publicly available datasets such as ACOPSA as well as local student submissions.

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EFFECTIVENESS OF 5ES CONSTRUCTIVIST INSTRUCTIONAL MODEL ON STUDENTS' PERFORMANCE AND RETENTION IN CHEMISTRY IN SECONDARY SCHOOLS IN EKITI-STATE, NIGERIA.

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Abstract

This study investigated the effectiveness of 5Es Constructivist instructional Model on Senior Secondary School Students' Academic Performance and Retention in Chemistry in Ekiti State, Nigeria. Specifically, this study examined the effectiveness of 5Es constructivist instructional model on academic performance of students taught Chemistry before and after treatment as well as on their retention. The study adopted quasi experimental design. The population comprised 12690 Chemistry students in all year two of 202 public senior secondary schools in Ekiti State. The sample of 139 was selected through multi-stage sampling procedure. An instrument tagged "Chemistry Academic Performance Test (CAPT) was used for data collection. Inferential statistics of t-test was used to test hypotheses generated. All the hypotheses were tested at 0.05 level of significant. The findings revealed that the students taught using 5Es constructivist instructional model performed better ($p<0.05$) and retained more knowledge ($p<0.05$) than those taught using Conventional method. The study concluded that 5Es constructivist instructional model improved academic performance and aid better retention of students towards Chemistry when compared with conventional method. The study recommends the adoption of 5Es constructivist instructional model in teaching Chemistry.

Keywords: *5Es (Engagement, Exploration, Explanation, Elaboration, Evaluation) Constructivist Instructional Model, Academic performance, Retention, Chemistry*

Introduction

Education is the process of acquiring knowledge and skills which serves as light to the paths of global development, the best antidote to solve global challenges. Education is the field

of study that deals mainly with the methods of teaching and learning in school (Meriam, 2024).

Skills acquisition and activities from various scholars like Newton, Faraday, Avogadro and some others emanated various concepts that made up of the studies in science. To acquire the knowledge of science, one requires science education. Science education is a field of study concerned with producing scientific literate learners in a society. Science education is the subject thought as elementary science in primary school level, as basic science in junior secondary school level while at the senior secondary level, it is taught as Biology, Physics and Chemistry.

The relevance of Chemistry as a requirement for technological advancement of a nation cannot be underrated. It has contributed tremendously in health sector, agricultural sector and industry. Chemistry is one of the three main branches of science, it is the subject that is popularly called "the nucleus of science". It is so called because it bridges other natural sciences. Chemistry is the study of composition, structure (defined as elements and compounds); and properties of matter, the changes they undergo under various conditions of temperature and pressure, and the energy that is released or absorbed during the process (Mellyn and Alan, 2024). Faleye (2024) also described Chemistry as the branch of science that deals with the identification of substances of which matter is composed; the investigation of their properties and the ways in which they interact, combine and change, and the use of these processes to form new substances. All substances, either naturally occurring or artificially produced, consist of species of atoms or elements. Therefore, Chemistry can be defined as the study of matter, properties, how and why matter combined or separate to form new substances. Matter is the name given to everything that can be touched, seen, felt or smelled. Chemistry is essential in various fields and sectors as in agriculture, health, industries and others. It is a prerequisite for students that will be admitted into any course in science and technological fields in higher institutions of learning.

Despite the usefulness of Chemistry, there are various challenges that are facing the teaching and learning of the subject. Over the years experts have been working on the challenges in Chemistry. Many instructors and learners consider Chemistry as difficult to teach and to study (Okebukola, 2020). Some also beliefs that Chemistry has a reputation as a hard and difficult science to master (Anne, 2016). Chemistry is often regarded as a difficult subject; an observation which often repels learners from learning Chemistry (Soyibo and Okelola, 2020). Report from several researchers reveals that students' performance in senior secondary schools certificate examination (S.S.C.E) conducted by WAEC and NECO in Chemistry is persistently been poor (Ojukwu, 2016; Adeniyi, 2020). Poor academic performance of the students in internal and external examinations needs urgent attention, for it was reported that performance in internal examination in Chemistry is as bad as 25% pass (Adeyemi. 2020), so also 22% pass (Nnoli, 2022).

Poor performance of students in Chemistry has being a major concern in the field. Agoro (2018) opined that inefficient method of instruction brings poor performance as some students memorize and struggle to pass the examination while some may not able to make the required passmark meant

for admission. The country's level of educational system is not equipping the beneficiaries with the needed skills necessary for economic, scientific and technological development (Adebayo, 2020; Oyinloye, 2020; Nnoli, 2022). This is also supported by Adeniyi, (2020) who stated that poor academic performance of students in internal and external examinations is a reflection of the problems and challenges facing the economy of Nigeria today.

Hardly do students apply for Chemistry Education while seeking admission into higher education of learning due to lack of interest in the subject and because of the way it is taught. Majority of those studying Chemistry Education in the University are there not because it was their original plan but because they could not be admitted into the courses of their choice and are tired of sitting at home, this may be one of the reasons while some of Nigerian undergraduates students in Chemistry perceived higher percentage of Chemistry concepts (64.3%) as difficult. This is so because the problem is fundamental. Again some of those who graduated as Chemistry Educators had diverted to the industries and other sectors for employment. The consequence of this is that there are not sufficient qualified teachers to teach the subject thus making the school administrators to make use of teachers in other science-related disciplines to teach Chemistry in majority of the secondary schools. If science is poorly taught and badly learnt, it could burden the mind of the learner with dead information and even degenerate into a new superstition.

It is widely noted that one of the goals of science teaching is for science students to acquire knowledge as well as understanding, but some teachers often disseminate instructions as they were taught in one or two decades ago which make some learners regard scientific knowledge as alien to them, and just to absorb and memorize the scientific facts in order to pass examination. Evidence from several researchers suggested that oral presentation to large group of passive students contribute very little knowledge to real learning. Jegede (2023) opines that science needs to be activity laden. Aparna (2015) observed that cognitive theory on science has moved teaching and learning of science from telling story and dispensing of knowledge (or what one might term "absolute truth) to the problem solving phenomenon. Some of the methods of teaching science as stated by Oyedeji and Akinwumi (2019) include: teacher-centered methods (which include: traditional method, lecture method and demonstration method) and Heuristic method. Heuristic method is a method in which a student is being put in the position, to discover the principles of science. Heuristic method can be otherwise regarded as student–centered method which enriched with inquiry and discovery based methods, into which 5Es constructivist instructional model falls. It is a problem–solving technique that can be used for teaching science effectively. Since education is being regarded as a field of study that deals mainly with methods of teaching and learning in school (Meriam, 2024), there is a need to consider the methods of teaching that will make effective learning to take place.

In teaching towards understanding of major concepts in Chemistry and achieving conceptual change in the students learning, it is first necessary to understand students' prior knowledge, examine it, identify confusion and then provide opportunities for old and new ideas to come into contact in a meaningful way. In teaching towards conceptual change, it is counterproductive to cover more materials and present new ideas

without engaging students in their own meta-cognitive analysis (Oyedeji and Akinwumi, 2019). So, inquiry or discovery based method can be seen as the strategy for teaching towards conceptual change. Inquiry based method engages students in questioning of one's preconceptions and charistics of both conceptual change and scientific habits of mind (Jegede and Omotayo, 2016). Discovery method tends to focus more on the product of learning, where students discover a specific content of a concept. The 5Es constructivist instructional model is an inquiry-based approach that incorporates the elements of the discovery method as hybrid and utilizes the strengths of both approaches. It is 21st century instructional model.

The 5Es constructivist instructional model is about how learners' learn to construct ideas or knowledge in their own understanding by relating their prior knowledge with the new instruction presented. It is an interlinked progressive phases of learning to construct individual knowledge in group form through their experiences. It is a student–centered approach where students are involve in experiencing, questioning or investigating. Bybee (2019) asserted that 5Es constructivist based approach allows students and teachers to experience related activities to use and built on prior experiences and knowledge of the student, in order to access their understanding of the new concept. The 5Es constructivist instructional model motivates the engagement of the students in group by making them active participants in the classroom. This approach requires students to do beyond memorization of facts.

Several researchers have shown that using conventional methods in teaching Chemistry have limitations in promoting understanding and retention of concepts (Lawson, and Renner, 2015; Tara, Kishbaugh, and Stephen, 2018; Adeyemi, et al, 2022; Tamene, and Astrat, 2023). Constructivist learning theory suggests that learners build new knowledge based on prior experience and knowledge. The 5Es constructivist instructional model involves five interlinked phases. They are: engagement; exploration; explanation; elaboration and evaluation. These provide a carefully planned sequence of instruction that places students at the center of learning (Bybee, 2023).

1. Engagement phase is the first stage in this model whereby students will be introduced to new topic by asking question on the topic to be taught (in reference to Jeromes' Brunner 's theory who beliefs in knowledge moving from complex to simple) and observe their current understanding towards the concept. The teacher asks open-ended question that will subject the students to critical thinking that will emanate problem solving skill within their social group, this increase students' motivation to learning. The question may be on the topic to be presented or any related instructional material that is provided to enhance learning of the new topic. The question is meant to increase the students' curiosity towards the new lesson.
2. Exploration phase is the second stage that allows the students to interact and work together as a group to investigate the question; objects or situation, through their learning experience (otherwise known as prior knowledge), the students will be subjected to critical thinking through the question being asked from them to explore from their prior knowledge which leads to problem solving skill to make observations. Individual prior

knowledge will be directly related to others within their social group. This activity helps the students to acquire common experiences to give feedback to their teacher on the question being asked from them. They construct their own understanding through active learning.

3. Explanation phase is the third stage where the teacher will ask the students to give their response and observations in the exploration stage on the question being asked from them. The teacher will now present the new concept starting from the students' observations in the exploration stage and encourage the students to compare the new concept with their own observation constructed at the exploration stage through their prior knowledge. The teacher will correct their misconceptions and add other essential contents. This will aid accommodation and assimilation of the new concept in the learners. Various instructional materials can as well be used to aid the study.
4. Elaboration phase is the fourth stage whereby the teacher will encourage the students to apply what they have learnt to solve new problem. It will be in form of giving the students question to solve on the new concept. Students will apply the knowledge acquired from their teacher (more knowledgeable person as beliefs by Lev. Vygotsky's theory) through accommodation and assimilation of the knowledge into the learners' prior knowledge, to solve the given question. Knowledge acquired by individual students (students' prior knowledge with the new knowledge acquired) will be directly related to others within their social interaction to enhance common knowledge for making observations and respond to the question's given on the new concept.
5. Evaluation phase is the fifth and last stage of the 5Es constructivist instructional model. It is the stage of reflection of learning outcomes whereby students will be assessed individually. This is where the summative assessment of the students on the concept presented will be determined. It may be in form of classwork, assignment, test or examination.

For effective learning to take place, there must be active engagement and opportunity for practice and application. The learning process is facilitated by the skilled teacher who engages students in thinking, questioning, investigating, and experimentation and so on. The teacher should have good knowledge of the subject matter with suitable teaching methods for effective delivery of the concept. Constructivism beliefs in building knowledge and claims that learning remains subjective by the cognitive organ of the learner and is not transferred from teacher to learner. Also, it makes learners to think, be active and interact positively during the process of learning.

Academic performance is the result obtained from a specific learning task which can be measured by grade, score or accomplishment. It indicates student mastery of subject matter, ability to put knowledge into application and level of engagement or effort in a study (Candia, et. al, 2022). It develops knowledge, critical thinking abilities and skills. It identifies areas of improvement in the learners. The use of innovative teaching strategy is needed to enhance performance of students towards the learning of Chemistry. Academic performance can be measured in academic performance test, creativity or innovation and personal growth. Academic performance focus on what

learners will know, understand and be able to do at the completion of a learning experience. It gives direction towards specific information about what students has done after a specific task. Teacher needs to work on improvement of academic performance of students by be a facilitator of learning process. The teacher must focus on the idea that students should be actively involved in the process of teaching and learning. There are various learning styles in learners. Learning style is a reflection of inherited character or the one that developed through exposure, or influence of immediate environment to form personal character of the individual student in which knowledge is retained. Individual students have their own way to learn best likewise, they have ability to under stand and absorb knowledge at different pac es.

Some are fast learners, some are moderate l earners while some are slow learners, while some are very slow learners. Learners can also be grouped according to their various learning styles; visual learners, auditory learners, kinesthetic learners (hands–on-

experiment practices), reading or writing learners, logical learners (logic pattern and problem solving), solitary learners and social learners. Social learners learn through social interactions, collaborative activities and group discussions. Adegbite (2020) defined cognitive style as a psychological disposition which shows how individual is inclined to think, learn and process information. Individual students have their different ways of perceiving and analyzing information. 5Es constructivist instructional model utilize this individual ways of perceiving information from individual's prior knowledge to achieve effective learning. Cecilia, et, al. (2024) observed that students taught using 5Es instructional strategy outperformed those taught with conventional methods. Opeyemi, (2020) also in his submission observed that students taught with 5Es instructional strategy perform better than those taught using lecture method.

Retention is an important aspect of cognitive skills that allows learner to have access and retained information into memory, thereby helps learner to utilize the acquired information over time appropriately. It is the ability to store, recall and retain information, knowledge or skills over time (Adegoke, 2022). It connects information from short-term memory to long-term memory in order to access future recall. This means retention helps individuals to recall and build upon prior knowledge and skills, as well as to acquire more knowledge and skills into memory. Theory of constructivism based teaching and learning on individuals' prior knowledge, concepts and ideas that act as a starting point from which to comprehend, inculcate and display new knowledge (Lawson, 2018). Prior knowledge of a learner is retained in retention phase of learner's memory. 5Es constructivist instructional model enhance effective retention. Adeyemi, et al, (2022) observed that 5Es approach improved students' retention of Chemistry concepts.

Effective method of teaching may enhances retention by promoting active learning, curiosity, critical thinking, problem solving and some other skills in learners. These can be revealed in the academics performance of the learners. Some authors revealed that the low performance in Chemistry is attributed to ineffective instructional techniques and teaching aids (Soyibo and Okelola, 2020, Okebukola, 2020). So, it is important for a teacher to use appropriate instructional method in order to achieve the learning goals. Inculcating a teaching strategy that

encourages students to be active in the classroom may assist in achieving learning goals. So, the application of 5Es instructional model can as well improve the goals of learning in Chemistry.

Purpose of the Study

The main purpose of the study was to investigate the effectiveness of 5Es constructivist instructional model on senior secondary schools students' academic performance and retention in Chemistry in Ekiti State, Nigeria.

Specifically, this study purported to:

i. compare the academic performance of students taught using the 5Es constructivist instructional model with those taught using conventional method in Chemistry;
ii. determine the extent to which 5Es constructivist instructional model influences retention of the students in Chemistry;

Research Hypotheses

The following null hypotheses were generated for this study.

1. There is no significant difference in the academic performance of students taught Chemistry with 5Es constructivist instructional model and conventional method, before treatment.
2. There is no significant difference in the academic performance of students taught Chemistry with 5Es constructivist instructional model and conventional method after treatment.
3. There is no significant difference in the retention of students taught Chemistry using 5Es constructivist instructional model and conventional method.

METHODOLOGY

This study adopted a pretest, posttest, control group quasi-experimental design (one experimental group and one control group). The paradigm of the design is as shown below:

Experimental Group: O_1 X_1 O_2 , O_{R1}

Control Group: O_3 Xc O_4 , O_{R2}

Where

O_1 , O_3 = Pre-test observation (Academic Performance before treatment)
O_2 , O_4 = Post-test observation (Academic Performance after treatment)
O_{R1}, O_{R2} = Retention observation
X_1 - Treatment via 5Es constructivist instructional model
Xc – Treatment via Conventional method

The population for this study consisted of 12,690 Chemistry students in year two of all the 202 public senior secondary schools in all the16 Local Government Areas in Ekiti State, *(Source:* Department of Planning, Research and Statistics, Ekiti State Ministry of Education, 2024. The sample consisted of 139 Chemistry students in public secondary schools year two, Ekiti State, Nigeria. The sample was selected usin g multi-stage sampling procedure. Chemistr y Students' Academic Performance Test (CAPT) was the instrument used to collect data for academic performance of students' taught in this study. The CAPT consisted of two sections; A and B. Section A elicited information about the bio-data of the respondents such as the name of school and class. Section B was consisted of 20 multi-choice items of five options (A-E) from

which the respondents are expected to choose the options they deemed correct. The duration of CAPT was 20 minutes. The instrument was given to the respondents in both groups as pretest and post-test. Chemistry Academics Performance Te st (CAPT) was re-administered (as Retention Test) after two weeks of post-test to measure students' retention in Chemistry.

The face and contents validity of the instrument was ensured by two teachers who were Senior Secondary School Certificate Examinations' examiners in Chemistry, an expert in Science Education (Chemistry Option) as well as Test and Measurement expert in the Faculty of Education, Ekiti State University. The reliability of the instrument was established by finding the internal consistency of the instrument. CAPT was administered on 40 science students in S.S.II, outside the sample used for the study. The scores obtained from the Performance test was analyzed using Pearson's Product Moment Correlation Analysis, from which reliability coefficient of 0.86 was obtained for the CAPT which adjudged the instrument suitable for this study.

After selecting the subjects for the study, the researcher assigned the experimental and control groups using simple random sampling technique. The experimental procedures for this study were carried out in three stages: pre-treatment stage, treatment stage and post-treatment stage. Eight weeks were used for the study: pre-test: one week, treatment: four weeks, post-test: one week, conducted on both experimental and control groups. After two weeks of the post-test, there was retention test conducted on the respondents. Each of the questions in the CAPT was scored one mark and the total mark is twenty (20).

Results

Table 1 below shows the t-test analysis on the difference in the academic performance of Students' taught Chemistry with 5Es constructivist instructional model and conventional method before treatment.

Table 1: t-test analysis on the pretest scores of experimental and control groups. *p>0.05

Groups	N	Mean	SD	Df	t	P
5Es Constructivist Instructional Model	70	4.09	1.39	137	0.25	0.06
Conventional Model	69	3.98	1.37			

The result presented in table 1 showed that p (0.06) > (0.05), which means the p value is 0.06 which is greater than 0.05, the null hypothesis is thereby not rejected, implying that there was no significant difference in the academic performance of students taught Chemistry with 5Es constructivist instructional model and those taught with conventional method before treatment. This implies that the students in both groups were homogeneous at the commencement of this study.

Table 2 below shows the t-test analysis on the difference in the academic performance of students taught Chemistry with 5Es constructivist instructional model and conventional method after treatment.

Table 2: t-test analysis on the posttest scores of experimental and control groups.

Group	N	Mean	SD	df	t	P
5Es Constructivist Instructional model	70	13.17	1.65	137	13.79	0.00
Conventional method	69	9.52	1.46			

*p < 0.05

The result presented in table 2 showed that p (0.00) < (0.05), the p-value is 0.00 which is less than 0.05 level of significance, the null hypothesis is thereby rejected, implying that there was a significant difference in the academic performance of students taught Chemistry with 5Es constructivist instructional model and conventional method after treatment. This implies that the 5Es constructivist instructional model is more effective than the conventional method to teach Chemistry.

Table 3 below shows the t-test analysis of the difference in retention of students taught Chemistry using 5Es constructivist instructional model and conventional method.

Table3: t-test analysis on retention of students taught Chemistry with 5Es constructivist instructional model and conventional method.

Groups	N	Mean	SD	df	t	P
5Es Constructivist Instructional Model	70	12.21	1.78	137	15.17	0.00
Conventional Method	69	8.10	1.39			

*p<0.05

The result presented in Table 3 showed that p (0.00) < (0.05) the p-value (0.00) is less than 0.05 level of significance, the null hypothesis is thereby rejected implying that there was a significant difference in the retention of students taught Chemistry using 5Es constructivist instructional model and those taught with conventional method. Students taught Chemistry with 5Es constructivist instructional model had a better retention of the concepts taught than those taught with the conventional method. The implication of this is that, the 5Es constructivist instructional model is more effective in teaching Chemistry than the conventional method.

Discussion

The findings of the study revealed no significant difference in the academic performance of students taught Chemistry with 5Es constructivist instructional model and conventional method before treatment which implied the homogeneity of students in both groups at the commencement of the study. The finding further revealed a significant difference in the academic performance of students taught Chemistry with 5Es constructivist instructional model and those taught with conventional method, with the students taught with 5Es constructivist instructional model performing better than those taught with conventional method. This agreed with the study of Cecilia et al. (2024) that students

taught with 5Es constructivist instructional strategy performed significantly better than those taught with conventional method. It is also in line with the findings of Opeyemi (2020) who revealed that students taught with 5Es constructivist instructional strategy performed better than those taught using lecture method. The finding also aligns with that of Ednah, Olokoba and Borishade (2023) who revealed that the 5Es Constructivist teaching approach was found to be more effective in teaching Chemistry.

The findings also revealed a significant difference in the retention of students taught Chemistry using 5Es constructivist instructional model and those taught with conventional method after treatment with students taught with 5Es constructivist instructional model having a better retention of the Chemistry concepts taught than those taught with conventional method. This implied that 5Es constructivist instructional model aids retention of students taught Chemistry better than those taught with conventional method. This finding agreed with the finding of Adeyemi, et al. (2022) that 5Es constructivist instructional model showed a significant improvement in students' retention on Chemistry concepts. It also agreed with the findings from the study of Tamene and Asrat (2023) which confirmed a significant difference in students' retention between traditional method and 5Es constructivist instructional model in favour of 5Es constructivist instructional model.

Conclusion and Recommendation

From the findings of this study, it could be concluded that the two groups (5Es constructivist instructional model and conventional method) were homogeneous before the experiment. The use of 5Es constructivist instructional model improves academic performance and retention of students taught Chemistry better, when compared to conventional method. 5Es constructivist instructional model improved academic performance and aid better retention of students towards Chemistry when compared to conventional method.

Based on the findings of this study, it was recommended that the use of 5Es constructivist instructional model should be adopted in senior secondary schools for studying Chemistry concepts so as to improve academic performance, and retention of students to Chemistry.

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UNDERGRADUATES' DIGITAL LITERACY SKILLS AS FACTORS FOSTERING LEARNING SCIENCE IN OGUN STATE, NIGERIA

BY

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ABSTRACT

The study examined undergraduates' digital literacy skills as factors that fostering learning science in Ogun state, Nigeria. Two research questions and two null hypotheses were answered and tested. A descriptive survey research design was used. The population of this study comprised undergraduates of Educational Technology at Tai Solarin University of Education (TASUED). Eighty undergraduates were selected as sample size of the study using stratified sampling technique. A researchers' designed instrument tagged Undergraduates' Digital Literacy Skills and Learning Science Questionnaire (DLSLSQ) was used for data collection with reliability coefficient 0.92 Frequency counts and percentages were used for presenting demographic characteristics of the respondents. Descriptive statistics of mean and standard deviation were used for answering research questions. Hypotheses were tested using inferential statistics of regression analysis and correlation (PPMC). The findings of the study revealed that the level of undergraduates' digital literacy skills for learning science in Ogun state was moderate. Difficulty with abstract concepts, a heavy content load, inadequate digital skills by the teachers and students, poor practical applications, low level of digital infrastructure, inadequate resources, and lack of qualified teachers were among the issues confronting the effective learning science among undergraduates in Ogun state (3.12 > 2.50). There was significant influence of digital literacy skills on undergraduates' learning science in Ogun state. There was significant relationship between digital literacy skills and undergraduates' learning science in Ogun state (r = 0.429, p <.05). It was recommended that it is essential to provide enhanced digital tools, adequate access to technology, and effective digital literacy training for undergraduates in universities. Strengthening digital literacy initiatives, enhancing instructional strategies, improving infrastructure and access, providing comprehensive teacher training, and fostering collaboration among teachers are also recommended.

Keywords: *Undergraduates, digital literacy skills, learning science.*

Introduction

Learning science is an interdisciplinary field that studies how undergraduates learn and how to improve learning experiences. It draws on insights from

cognitive science, educational psychology, computer science, and other fields to understand the cognitive and social processes involved in learning. The goal is to use this knowledge to design more effective learning environments and practices. According to Okpa (2025), key aspects of learning science include integrating of knowledge from various fields like cognitive science, educational psychology, computer science, among others, investigating how undergraduates' cognitive processes (thinking, memory, problem-solving) and social interactions and the ultimate aim is to apply these to create more effective learning environments and practices in various settings, such as schools, workplaces, and online platforms. Learning science is possible in both formal settings like classrooms and informal settings like museums, homes, and online communities. Learning science applies is also informs the design of curriculum, instruction, and educational technologies to enhance learning outcomes both formal settings like classrooms and informal settings like museums, homes, and online communities. It also informs the design of curriculum, instruction, and educational technologies to enhance learning outcomes.

Ingale (2024) reiterated that learning science is useful through informing educational practices by understanding how undergraduates learn, help educators design more if undergraduates had acquired necessary digital literacy skills. Undergraduates' digital literacy skills extend beyond mere technological interaction to include problem-solving, analytical thinking, and the ability to evaluate digital content critically. In an increasingly interconnected world, digital literacy skills have become essential for personal, academic, and professional success. These skills enable undergraduate to navigate the digital landscape effectively, ensuring they can communicate, research, and engage with digital tools responsibly and informally. Afolabi and Afolabi (2025), stated that the ability to critically assess online information, adapt to evolving technologies, and collaborate through digital platforms is no longer optional but necessary for undergraduates. Digital literacy skills are a broad range of competencies that enable undergraduates to interact with digital technologies effectively and responsibly. These skills encompass more than just technical proficiency; they also involve critical thinking, ethical considerations, and the ability to communicate effectively in digital environments. Digital literacy consists of several key pillars: staying up to date with emerging technologies, communicating effectively online, managing digital content, and leveraging digital tools for collaboration. It extends beyond mere technological interaction to include problem-solving, analytical thinking, and the ability to evaluate digital content critically. Digital literacy skills empower students to fully engage with digital resources, ensuring they can make informed decisions, safeguard their privacy, and contribute positively to the digital world (Adenariwo, 2022).

Jatto and Diyaolu (2021) opined that understanding the impact of technology on education further emphasizes the role digital fluency plays in shaping how undergraduates learn, think, and collaborate. According to Jotangia (2020), there are four reasons why digital literacy skills are beneficial for undergraduates these includes; encourages individual learning, fosters independent problem-solving and adaptability, develops the ability to research and navigate new technologies, enhances memory and knowledge

retention, provides varied and dynamic ways of acquiring knowledge, reinforces understanding through multimedia formats such as videos, simulations, and interactive exercises, encourages communication and teamwork, enables students to collaborate effectively in virtual spaces, fostering teamwork and cross-cultural interactions, and acquisition of essential skills for lifelong learning. These skills allow undergraduates to engage in meaningful discussions and collaborate with diverse teams in professional and academic settings. Supports flexible teaching strategies; digital literacy allows adaptive teaching methods catering to diverse learning needs. Technology-enabled education ensures students can access personalised educational content suited to their unique learning styles and paces.

Kalsoom et al. (2021) reiterated that undergraduates need digital literacy skills for them to fully adopt learning of science in their field of endeavor and such skills includes technical, independent skills research, media literacy skills, digital citizenship skills as well as communication and collaboration skills. Technical skills include the ability to operate computers, use word processing software, manage digital files, create presentations, and navigate the internet effectively. Mastering these skills ensures students confidently engage with digital tools in academic and professional environments. In addition, technical skills encompass knowledge of operating systems, basic coding principles, and the ability to troubleshoot common technological issues. Independent research skill involves using search engines, online databases, and academic sources to gather credible information. It also includes evaluating the accuracy and relevance of digital content to make well-informed decisions. They empower undergraduates to become self-sufficient learners, enabling them to access and analyse digital materials for academic, professional, and personal growth. Media literacy skills, undergraduates with strong media literacy skills can discern credible sources, identify bias, and interpret digital messages effectively. In an era of digital media saturation, media literacy helps undergraduates navigate vast amounts of content, differentiating between factual information and misleading narratives. Additionally, media literacy promotes ethical engagement with digital content, encouraging responsible sharing and constructive online discussions.

Digital citizenship encompasses understanding digital rights, respecting intellectual property, practicing online safety, and maintaining a positive digital presence. By fostering digital citizenship, students contribute to a respectful and inclusive online community. Also, this skill includes understanding the impact of online actions, protecting personal data, recognising cyber threats, and promoting positive digital interactions. Digital citizens are aware of their online footprints and strive to create a safe and constructive digital environment for themselves and others. Effective communication involves using digital tools such as email, social media, and virtual meeting platforms to share information and engage in discussions. Strong communication skills allow students to engage in meaningful discussions, express ideas clearly, and collaborate efficiently in virtual settings, which is increasingly essential in remote work and online learning environments. Nyemezu (2022) collaborated that for undergraduates to be effective in learning science, there is need for them to have acquired sound digital literacy skills.

Despite its importance, learning science faces several challenges, these includes; understanding of complex

topics, heavy content load, difficulty in applying gained knowledge, lack of personalized learning, and examination preparation. Additionally, undergraduates may struggle with abstract concepts, unfamiliar terminology, and a lack of hands-on experience. Teachers also face challenges in creating engaging lessons, managing classrooms, and utilizing effective teaching methods. However, due to the significant benefits of learning science towards technology development, government and stakeholders in the sector have made many attempts towards smooth teaching and learning of the discipline. Despite these interventions, undergraduates still face some issues in learning science. Hence, this study examined undergraduates' digital literacy skills as factors fostering learning science in Ogun state, Nigeria.

Research Objectives

The main objective of the study was to examined undergraduates' digital literacy skills as factors fostering learning science in Ogun state, Nigeria. Specifically, the study sought to examine the:

1. level of undergraduates' digital literacy skills for learning science in Ogun state;
2. issues confronting the effective learning science among undergraduates in Ogun state;
3. influence of digital literacy skills on undergraduates' learning science in Ogun state;
4. relationship between digital literacy skills and undergraduates' learning science in Ogun state.

Research Questions

The following research questions were answered in this study.

1. What is the level of undergraduates' digital literacy skills for learning science in Ogun state?
2. What are the issues confronting the effective learning science among undergraduates in Ogun state?

Hypotheses

The following null hypotheses were tested at 0.05 significance level.

$H0_1$: There is no significant influence of digital literacy skills on undergraduates' learning science in Ogun state.

$H0_2$: There is no significant relationship between digital literacy skills and undergraduates' learning science in Ogun state.

Review of Literature

Okpa (2025) evaluates digital literacy skills among students in tertiary institutions in the southern geopolitical zone of Nigeria. The findings indicate that major emerging trends in digital literacy skill requirements among tertiary institution students include improved information retrieval, Artificial Intelligence (AI) and machine learning, data science and analytics, and cybersecurity. The study also revealed that these digital literacy skills significantly impact students' learning outcomes by enhancing information retrieval, expanding access to educational research, increasing collaboration and communication, and facilitating feedback and assessment. Additionally, inquiry-based learning, multimedia presentations, and flipped classroom approaches were identified as the most effective methods for integrating digital literacy skills in tertiary institutions. Debbarma and Shivam (2025) explored the Influence of digital literacy on science achievement among secondary school

students. The study findings reflect the impact of digital literacy on science achievement among secondary students, and it has particular importance these days as a tool in educational fields. Iftanti et al. (2025) examined the digital literacy development and factors affecting students' digital skills in the Language and Science Departments of a state Islamic university in Tulungagung, Indonesia. The results of this study demonstrated that good digital literacy skills are developed from internal factors like strong curiosity towards digital technology, individual desires, and educational needs for digital, students' preference for digitalization, and keeping up to date through using digital technology. Aremu and Udofia (2025) investigated the digital literacy skills of undergraduate Students Performing via Online Tests in Lagos State, Nigeria. Findings show that digital literacy plays a significant and positive role in the outcome of undergraduate performance. Ekine et al. (2024) examined digital literacy and learning as tools to quality education in Nigerian secondary schools in the post-Covid-19 era, with a specific focus on Rivers State. The findings revealed that there is confidence level of students in using digital tools, there is limited access to reliable internet connectivity, sufficient availability of digital devices. On the role of teacher training and support in facilitating digital literacy and learning, there is disagreement. That is there is insufficient training opportunities for teachers to develop their digital literacy skills, among others. Tamunoiyala and Williams (2022) investigated the Perceived Digital Information Literacy Level of Undergraduates at the University of Port Harcourt. The findings of the study revealed that undergraduate students are digitally knowledgeable. Finally, there is significant difference between undergraduate students' digital information literacy level among the various departments. Ibrahim (2024) assessed the knowledge and perception of lecturers regarding the integration of artificial intelligence for research and teaching in the faculty of arts in Nigeria. The findings revealed that the challenges militating against the use of artificial intelligence by lecturers include technical barriers, limited resources, and the need for AI systems to understand context and nuance, particularly in fields like literary translation, which complicates effective integration into teaching and research. Abdelaal and Sawy (2024) findings revealed that the drawbacks militating against the deployment of artificial intelligence include difficulties in understanding artificial intelligence algorithmic outcomes, the complex autonomy of AI systems, financial implications of implementation, and concerns regarding data privacy, alongside apprehensions about AI's impact on teaching and professors' roles.

Methodology

The descriptive survey research design was adopted for the study. The design was appropriate because it assisted the researchers to establish and collect needed data from the target audience towards answering and testing of research questions and hypotheses of the study. The population of this study comprised undergraduates of the Department of Educational Technology in Tai Solarin University of Education (TASUED), Ijagun. 80 undergraduates of the Department of Educational Technology in Tai Solarin University of Education (TASUED) were selected as sample size of the study. Stratified sampling technique was adopted to select sample size in order to ensure gender-balance. A self-researcher-designed instrument tagged Undergraduates' Digital Literacy Skills and Learning Science Questionnaire

(DLSLSQ) was used for this study. DLSLSQ was used for the collection of data from respondents on the level of undergraduates' digital literacy skills for learning science; issues confronting the effective learning science among undergraduates; and items on learning science. The questionnaire was structured on a four (4) – point Likert response scale format which is a modification of 5-point Likert scale. To ensure the face and content validity of the instrument, copies of the instrument were given to experts in the Department of Educational Technology, Tai Solarin University of Education (TASUED). Reliability test of the instrument (DLSLSQ) was done using a test-retest method. In this case, copies of the instrument (DLSLSQ) were administered twice on 10 undergraduates of the Department of Educational Technology, University of Ilorin, that are not part of the sample size within a week interval. The collected data from the dual administration of the instruments were compared using Pearson Product Moment Correlation (PPMC). It was reported that reliability coefficient yielded 0.92. Primary method of data collection was adopted in this study. Primary method includes the usage of questionnaire to collect data from the identified respondents. Descriptive statistics of mean and standard deviation were used for answering research questions 1 and 2. Hypotheses were tested using inferential statistics of regression analysis and correlation (PPMC).

Results and Discussion

Research Question 1: What is the level of undergraduates' digital literacy skills for learning science in Ogun state?

Table 1: Mean and standard deviation responses on the level of undergraduates' digital literacy skills for learning science in Ogun state

Items	Mean	SD
Information and data literacy skills	2.87	1.333
Communication skills	2.64	1.004
Collaboration skills	3.13	1.173
Content creation skills	2.93	1.003
Safety and problem-solving skills	3.15	.947
Skills to navigate and utilize various technologies.	3.22	.903
Cluster Mean	2.99	

Source: Field Survey, 2025

Table 1 indicated that cluster mean was 2.99 and the bench mark mean value was 2.50. This implied that the level of undergraduates' digital literacy skills for learning science in Ogun state was moderate.

Research Question 2: What are the issues confronting the effective learning science among undergraduates in Ogun state?

Table 2: Mean and standard deviation responses on the issues confronting the effective learning science among undergraduates in Ogun state

Items	Mean	SD
Difficulty with abstract concepts	2.89	.911
A heavy content load	2.92	.745
Inadequate digital skills by the teachers and students	3.00	.999

Poor practical applications	3.18	.934
Low level of digital infrastructure.	3.26	.833
Inadequate resources	3.29	.826
Lack of qualified teachers	3.33	.799
Cluster Mean	3.12	

Source: Field Survey, 2025

Table 2 showed that cluster mean was 3.12 and the bench mark mean was 2.50. Since, 3.12 >2.50, this implied that difficulty with abstract concepts, a heavy content load, inadequate digital skills by the teachers and students, poor practical applications, low level of digital infrastructure, inadequate resources, and lack of qualified teachers were among the issues confronting the effective learning science among undergraduates in Ogun state.

$H0_1$: There is no significant influence of digital literacy skills on undergraduates' learning science in Ogun state.

Table 3: Influence of digital literacy skills on undergraduates' learning science in Ogun state

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	17.979	1.381		13.020	.000
	Digital literacy skills	.163	.048	.161	3.356	.001

Dependent variable: Undergraduates' learning science

The first important thing to note in Table 3 was that the sign of the coefficient of digital literacy skills is positive. This implied that there was positive influence of digital literacy skills on undergraduates' learning science. Furthermore, the probability (p = 0.01) as reported in Table 4.5 for digital literacy skills implied that the slope (**β** = (0.16) is statistically significant. Hence, the researchers concluded that null hypothesis 1 was rejected and that there was a significant influence of digital literacy skills on undergraduates' learning science in Ogun state.

$H0_2$: There is no significant relationship between digital literacy skills and undergraduates' learning science in Ogun state.

Table 4: Relationship between digital literacy skills and undergraduates' learning science in Ogun state

Variables	Mean	SD	df	r-value	p-value
Undergraduates' learning science	15.8800	2.21692			
Digital literacy skills	16.1100	2.25583	78	.429	.003

Source: Field Survey, 2025

It was observed from Table 4 that there was significant relationship between the independent variable and the dependent variable (r = 0.43, p <.05). On this premise, the null hypothesis 2 was hereby rejected and the researcher concluded that there was a significant relationship between digital literacy skills and undergraduates' learning science in Ogun state.

The findings of the study showed that there was a moderate level of undergraduates' digital literacy skills for learning science in Ogun state. These findings were in agreement with Okpa (2025) indicated that there was low level of digital literacy skills among undergraduates and that major emerging trends in digital literacy skill requirements among tertiary institution students include improved information retrieval, Artificial Intelligence (AI) and machine learning, data science and analytics, and cybersecurity. The study also revealed that these digital literacy skills significantly impact students' learning outcomes by enhancing information retrieval, expanding access to educational research, increasing collaboration and communication, and facilitating feedback and assessment. Additionally, inquiry-based learning, multimedia presentations, and flipped classroom approaches were identified as the most effective methods for integrating digital literacy skills in tertiary institutions. Ogochukwu et al. (2024) indicated that while lecturers' digital literacy concerning AI is slightly above moderate, their actual use of AI tools remains low. Common applications include research and writing, plagiarism detection, data analysis, presentations, content creation, and idea generation. Key barriers comprise inadequate internet services, limited management support, difficulties integrating AI into traditional pedagogy, time constraints, and high software costs.

The findings further indicated that difficulty with abstract concepts, a heavy content load, inadequate digital skills by the teachers and students, poor practical applications, low level of digital infrastructure, inadequate resources, and lack of qualified teachers were among the issues confronting the effective learning science among undergraduates in Ogun state. These findings were in consonant with Okpa (2025) findings who also highlighted significant challenges, such as the digital divide, the complexity of digital tools, and limited access to technology.

There was a significant influence of digital literacy skills on undergraduates' learning science in Ogun state. These findings corroborated with Debbarma and Shivam (2025) findings reflect the impact of digital literacy on science achievement among secondary students, and it has particular importance these days as a tool in educational fields. The study highlights the importance of use and incorporation for science learning, performing, and assessing. Iftanti et al. (2025) results of this study demonstrated that good digital literacy skills are developed from internal factors like strong curiosity towards digital technology, individual desires, and educational needs for digital, students' preference for digitalization, and keeping up to date through using digital technology. External factors like the student's environment and lifestyle also contributed to good digital literacy development. This can be pedagogically implemented in teaching language and sciences such as building college OLABS, digital college system, digital-based learning, and digital-based competitions. These proposed instructional programs need further investigation to assess their effectiveness. Ekine, Olefolun and Achinwenwaru (2024) findings revealed that there is confidence level of students in using digital tools, there is limited access to reliable internet connectivity, sufficient availability of digital devices. On the role of teacher training and support in facilitating digital literacy and learning, there is disagreement. That is there is insufficient training opportunities for teachers to develop their digital literacy skills, among others.

There was a significant relationship between digital literacy skills and undergraduates' learning science in Ogun state ($r = 0.429$, $p < .05$). These findings corroborated the findings of Aremu and Udofia (2025) that digital literacy plays a significant and positive role in the outcome of undergraduate performance. The study concludes that the technology is less expensive, has less manpower demand, has lower anxiety levels, is stress-free in marking and scoring, and develops undergraduates' psychomotor and cognitive skills. Tamunoiyala and Williams (2022) revealed that undergraduate students are digitally knowledgeable. Finally, there is significant difference between undergraduate students' digital information literacy level among the various departments. The study concluded that there is universal recognition of the need to be digital information literate especially for undergraduate students who virtually would use digital gadgets and Web 2.0 packages in the course of their academic pursuit. Ibrahim (2024) assessed the knowledge and perception of lecturers regarding the integration of artificial intelligence for research and teaching in the faculty of arts in Nigeria. The findings revealed that the challenges militating against the use of artificial intelligence by lecturers include technical barriers, limited resources, and the need for AI systems to understand context and nuance, particularly in fields like literary translation, which complicates effective integration into teaching and research.

Conclusion

This study examined undergraduates' digital literacy skills as factors fostering learning science in Ogun state, Nigeria, the following conclusions were drawn based on the findings of the study that:

1. There was moderate level of undergraduates' digital literacy skills for learning science in Ogun state.
2. Difficulty with abstract concepts, a heavy content load, inadequate digital skills by the teachers and students, poor practical applications, low level of digital infrastructure, inadequate resources, and lack of qualified teachers were among the issues confronting the effective learning science among undergraduates in Ogun state.
3. There was a significant influence of digital literacy skills on undergraduates' learning science in Ogun state.
4. There was a significant relationship between digital literacy skills and undergraduates' learning science in Ogun state.

Recommendations

The following recommendations were raise in line with the findings of the study:

1. University management should provide enhanced digital tools, adequate access to technology, and effective digital literacy training for undergraduates.
2. There should be an effective mechanism to overcome the challenges associated with teaching and learning science among undergraduates in university.
3. Lecturer and students should deepen the use digital literacy skills for easier understanding and interpretation of learning science.
4. Nigerian public universities should ensure capacity building for lecturer to improve their knowledge and skills on ways to

impact digital literacy skills on undergraduates.

5. Students should engage in and explore more academic activities using digital technology.
6. Digital literacy initiatives, should be strengthening by enhancing instructional strategies, improving infrastructure and access, providing comprehensive teacher training, and fostering collaboration among teachers.

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EFFECTS OF GENERATIVE TEACHING STRATEGY ON SELF-EFFICACY AND SELF-REGULATION IN LEARNING GEOMETRY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN MAIDUGURI METROPOLIS, BORNO STATE, NIGERIA

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Abstract
This study investigated the effects of a generative teaching strategy (GTS) on self-efficacy and self-regulation in learning geometry among Senior Secondary School (SS II) students. Utilising a quasi-experimental, pre-test/post-test non-equivalent control group design, 106 SS II students were divided into an experimental group (N = 52) exposed to GTS and a control group (N = 54) taught using conventional methods. The Geometry Self-Efficacy and Self-Regulation Questionnaire (GSSQ) was administered before and after a six-week intervention. Data analysis using median, mean rank, and Mann-Whitney U-tests revealed statistically significant differences between the groups. The experimental group showed significantly higher post-intervention self-efficacy (median = 14, IQR = 3) compared to the control group (median = 9, IQR = 2) (U = 5, p = .001, r = 0.86). Similarly, self-regulation scores were significantly higher in the experimental group (median = 17, IQR = 3) than in the control group (median = 10, IQR = 2) (U = 3, p = .001, r = 0.86). Furthermore, within the experimental group, post-intervention self-regulation scores were significantly higher than self-efficacy scores (Z = 5.319, p < .001, r = 0.52). These findings suggest that generative teaching strategies significantly enhance both self-efficacy and self-regulation in geometry learning. The study recommends integrating GTS into the geometry aspect of the mathematics curriculum.

Keywords: Generative teaching strategy, self-efficacy, self-regulation, geometry, senior secondary school students.

Introduction
Geometry holds an important position within the secondary school Mathematics curriculum. It is crucial for developing spatial reasoning, logical deduction, and critical thinking skills (Jablonski & Ludwig, 2023). Its extensive applications across science,

technology, and engineering highlight its importance for national scientific and technological advancement, particularly in developing nations like Nigeria. A strong foundation in geometry is therefore not merely an academic requirement but a vital component of a student's intellectual and professional development.

However, despite its undeniable importance, a persistent and troubling chasm exists between the significance of geometry and the reality of student engagement and success. Senior secondary school students frequently approach geometry with pronounced apprehension and struggle to master its abstract concepts and rigorous, proof-based demands (Aboagye, Ke, & Mante, 2021; Machisi, 2021). This widespread difficulty indicates that traditional, transmission-based instructional models, which position students as passive recipients of information, are failing to equip learners with the essential psychological and metacognitive tools required for success.

A central facet of this failure is students' low self-efficacy. Self-efficacy is defined as an individual's conviction in their capacity to organise and execute the courses of action required to achieve specific goals, such as solving geometric problems (Bandura, 1997; Bradley, Browne, & Kelley, 2017). When students are plagued by doubts about their mathematical abilities, they are less likely to embrace challenging tasks, persist through difficulties, or invest sustained effort. This creates a self-fulfilling prophecy where low confidence leads to avoidance and poor performance, which in turn further erodes confidence (Juman et al., 2022; Mata, Monteiro, & Peixoto, 2012).

Compounding this crisis of confidence is a parallel deficit in self-regulation. self-regulation refers to the ability to oversee and direct one's own learning processes through goal-setting, strategic planning, self-monitoring, and self-reflection (Bradley et al., 2017; Mkenda, 2022; Santos, 2022). Geometry, with its multi-step proofs and need for strategic flexibility, demands high levels of these metacognitive skills. Yet, students often lack the capacity to plan their problem-solving approach, monitor their developing understanding, or evaluate the effectiveness of their strategies (Jelatu, Sariyasa, & Ardana, 2018; Santos, 2022). This lack of internal management is a primary reason why many students fail to achieve deep, transferable learning in geometry.

The interplay between these constructs is critical; students who believe in their capabilities are more likely to adopt self-regulatory behaviours, and successful self-regulation reinforces self-efficacy (Bradley et al., 2017). This synergy suggests that interventions targeting both constructs simultaneously could yield compounded benefits. In response to these challenges, generative teaching strategy (GTS) has emerged as a promising pedagogical approach. These strategies actively involve students in constructing their own knowledge through meaningful learning experiences, championing understanding over rote memorisation by encouraging connections between new and existing knowledge (Wang, 2017). Generative techniques, such as concept mapping, peer teaching, and reflective journaling, are theorised to create supportive learning environments that enhance self-efficacy by providing mastery experiences and foster self-regulation by

prompting active engagement and metacognitive awareness (Liu, 2023; Mkenda, 2022).

However, while the benefits of GTS for engagement and comprehension are established, and the individual importance of self-efficacy and self-regulation is well-documented, a critical gap exists in understanding whether GTS can *simultaneously* cultivate both of these foundational psychological constructs in the context of geometry. It remains unknown if GTS has a differential impact on self-efficacy versus self-regulation, and whether its influence is potent enough to counteract the documented challenges in a specific context like Nigerian senior secondary schools. Without this knowledge, educators lack evidence-based guidance on whether GTS is a comprehensive solution for fostering the autonomous, confident learners that geometry demands.

This study, therefore, aims to bridge this gap by examining the specific effects of a generative teaching strategy on both self-efficacy and self-regulation in learning geometry among senior secondary school students in Nigeria. The research seeks to provide empirical evidence to inform the development of more effective instructional practices that address not only content knowledge but also the crucial psychological drivers of learning.

Statement of the Problem

Geometry is a vital subject for developing logical reasoning, yet many senior secondary school students in Nigeria find its abstract nature challenging. This difficulty is primarily related to low self-efficacy and poor self-regulation, which are key internal factors for academic success. While these concepts are well-explored, there is a notable lack of research on how specific, innovative teaching methods like the Generative Teaching Strategy (GTS) can effectively improve both self-efficacy and self-regulation simultaneously in a geometry classroom. Traditional, teacher-centred approaches have proven inadequate in fostering these essential qualities, resulting in a cycle of underperformance and disengagement. Consequently, this study is necessary to assess the effects of GTS on these two variables, thereby providing evidence-based insights for instructional practices that can enhance student confidence and autonomous learning in geometry.

Research Objectives

The objectives of the study were to:

1. determine the effects of the generative teaching strategy on students' self-efficacy in geometry.
2. assess the effect of the generative teaching strategy on students' self-regulation in geometry.
3. examine the difference between students' geometry self-efficacy and self-regulation score when exposed to generative teaching strategy.

Research Questions

The following research questions were raised to guide the study:

1. What is the difference in geometry self-efficacy scores between students taught using the generative teaching strategy and those taught using conventional methods?
2. What is the difference in geometry self-regulation scores between students taught using the generative teaching strategy

and those taught using conventional methods?

3. What is the difference between students' geometry self-efficacy and self-regulation scores when exposed to generative teaching strategy?

Null Hypotheses

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

H_{01}: There is no significant difference in the post geometry self-efficacy scores between students taught using the generative teaching strategy and those taught using conventional methods.

H_{02}: There is no significant difference in the post geometry self-regulation scores between students taught using the generative teaching strategy and those taught using conventional methods.

H_{03}: There is no significant difference between students' geometry self-efficacy and self-regulation scores when exposed to generative teaching strategy.

Methodology

Research Design

A quasi-experimental research design was adopted for this study, specifically employing a pre-test/post-test non-equivalent control group design. Quasi-experimental designs are effective for establishing cause-and-effect relationships in real-world settings where randomisation may not be feasible Gopalan et al. (2020). This design enables researchers to compare outcomes from different groups without excessively manipulating environmental variables, thereby enhancing the external validity of the findings. In this study, two existing intact classes from selected schools were utilised as the experimental and control groups, with the experimental group receiving instruction through the GTS, while the control group followed conventional teaching methods. The detailed structure of the research design is represented in Figure 3.1, indicating the flow from pre-test to post-test and subsequent retention measurement through post-post-testing.

Population and Sample

The population of the study consisted of 3,468 Senior Secondary School Year Two (SS II) students across public coeducational schools in Maiduguri Metropolis. The demographic profile comprises approximately 1,902 males and 1,566 females, primarily from the Kanuri and Babur Bura tribes. The sampling technique employed was simple random sampling, aimed at ensuring an equitable selection process whereby every school had an equal opportunity of being chosen. From this population, a sample size of 106 students was determined, with 52 participants from the experimental group and 54 from the control group. This stratified approach aimed to capture the representativeness of the population while also focusing on the specific characteristics of the target demographic.

Research Instruments

The study employed a Geometry Self-Efficacy and Self-Regulation Questionnaire (GSSQ), adapted from the Mathematics Motivation Questionnaire (MMQ) by Fiorella et al. (Zetriuslita et al., 2020). The GSSQ consists of 8 items designed to measure students' self-efficacy and self-regulation in geometry learning. The instrument was administered prior to intervention (pre-test) and following the treatment phase (post-test) to both groups to assess changes in self-efficacy and self-regulation in learning geometry. The scoring system utilised a 5-point Likert scale for responses, allowing for a granular measurement of self-efficacy and self-regulation (Zetriuslita et al., 2020).

Validity and Reliability of the Instrument

The validity of the GSSQ was established through a rigorous validation process involving academic experts from pertinent fields. Their evaluations ensured that the instruments measured the intended constructs with clarity and relevance. The reliability of the GSSQ was determined via pilot testing, with a reliability coefficient of 0.79 obtained through Cronbach's Alpha, ensuring that the instrument maintains internal consistency over repeated measurements (Zetriuslita et al., 2020). This careful validation process was crucial in affirming the credibility of the research findings.

Procedure for Data Collection

Data collection involved a systematic approach to ensure a reliable and unbiased process. Initially, the researcher secured necessary permissions from the relevant educational authorities and introduced the study to principals and mathematics educators. The sample selection of schools and classes was achieved through random assignment, ensuring that each had an equal opportunity for involvement. During the first week, the GSSQ was administered as a pre-test to gauge initial self-efficacy and self-regulation levels in both groups. Subsequently, the experimental group received instruction under the GTS framework for six weeks, while the control group adhered to the conventional teaching method. After the treatment period, a post-test was administered to assess the immediate impact on student learning outcomes.

Method of Data Analysis

Due to violations of parametric test assumptions, non-parametric statistical methods were exclusively employed, using the median and Interquartile Range (IQR) for descriptive statistics to accurately represent the central tendency and spread of non-normally distributed data. The Mann-Whitney U-test was utilised to assess differences between independent experimental and control groups, while the Wilcoxon Signed-Rank Test evaluated changes within dependent groups over time, both at a 0.05 significance level, thus providing a framework for evaluating the generative teaching strategy's impact on geometry learning outcomes.

Results

Research Question 1: What is the difference in geometry self-efficacy scores between students taught using the generative teaching strategy and those taught using conventional methods?

Table 1: Median Self-Efficacy Scores Before and After Instruction by Teaching Strategy

Group	Pre_Self-efficacy			Post_Self-efficacy		Med. Diff.	Remark
	N	Mdn	IQR	Mdn	IQR		
Experimental	52	10	2	14	3	4	Substantial gain in self-efficacy post-intervention.
Control	54	11	2	9	2	2	Decrease in self-efficacy post-intervention.
Total	106						

Table 1 shows the median self-efficacy scores before and after the intervention for both the experimental and control groups. Before the intervention, the experimental group (N = 52) had a median self-efficacy score of 10 (IQR = 2), while the control group (N = 53) scored a median of 11 (IQR = 2). After the intervention, the experimental group's median self-efficacy increased to 14 (IQR = 3), with a median difference of 4 and a median gain of 3. Conversely, the control group's median self-efficacy dropped to 9 (IQR = 2), showing a median difference of 2.

H_{01}: There is no significant difference in the post geometry self-efficacy scores between students taught using the generative teaching strategy and those taught using conventional methods.

Table 2: Mann-Whitney U Test Results for Post-Instruction Self-Efficacy Scores by Teaching Strategy

Group	N	Mdn	IQR	U	p	Effect Size (r)	Decision
Experimental	52	14	3	5	0.001	0.86	Significant
Control	54	9	2				
Total	106						

Table 2 displays the results of the Mann-Whitney U test, which assessed the difference in post-instruction self-efficacy scores between the experimental and control groups. The results indicate a statistically significant difference in post-instruction self-efficacy scores between the two groups (U = 5, p = .001, r = 0.86). The experimental group (median = 14, IQR = 3) exhibited significantly higher self-efficacy scores compared to the control group (median = 9, IQR = 2). The large effect size (r = 0.86) suggests that the generative teaching strategy has a substantial practical significance for students' self-efficacy. Therefore, the null hypothesis (H_{01}) that there is no significant difference in post self-efficacy scores is rejected.

Research Question Two: What is the difference in geometry self-regulation scores between students taught using the generative teaching strategy and those taught using conventional methods?

Table 3: Median Self-Regulation Scores Before and After Instruction by Teaching Strategy

Group	Pre_Self-regulation			Post_Self-regulation		Med Diff.	Remark
	N	Mdn	IQR	Mdn	IQR		
Experimental	52	11	3	17	2	6	Substantial improvement in self-regulation post-intervention.
Control	54	11	2.5	10	2	1	Minimal change in self-regulation post-intervention.
Total	106						

Table 3 details the median self-regulation scores before and after the intervention for both groups. Initially, both the experimental (N = 52) and control (N = 53) groups had comparable median self-regulation scores, with the experimental group scoring 11 (IQR = 3) and the control group scoring 11 (IQR = 2.5). Post-intervention, the experimental group showed a notable increase in median self-regulation to 17 (IQR = 2), indicating a median difference of 6 and a median gain of 5. The control group's median self-regulation score, however, remained largely stable, shifting to 10 (IQR = 2) with a median difference of 1.

H_{02}: There is no significant difference in the post geometry self-regulation scores in geometry between students taught using the generative teaching strategy and those taught using conventional methods.

Table 4: Mann-Whitney U Test Results for Post-Instruction Self-Regulation Scores by Teaching Strategy

Group	N	Mdn	IQR	U	p	Effect Size (r)	Decision
Experimental	52	17	3	3	0.001	0.86	Significant
Control	54	10	2				
Total	106						

Table 4 presents the findings from the Mann-Whitney U test comparing post-instruction self-regulation scores between the generative teaching strategy group and the conventional methods group. A statistically significant difference was observed (U = 3, p = .001, r = 0.86). The experimental group (median = 17, IQR = 3) achieved considerably higher self-regulation scores post-intervention than the control group (median = 10, IQR = 2). The calculated effect size (r = 0.86) signifies a very large practical effect, suggesting that the generative teaching strategy had a substantial positive impact on students' self-regulation. Consequently, the null

hypothesis (H_{02}), asserting no significant difference in post self-regulation scores, is rejected.

Research Question Three: What is the difference between students' geometry self-efficacy and self-regulation scores when exposed to generative teaching strategy?

Table 5: Comparison of Median Self-Efficacy and Self-Regulation Scores Post-Instruction by Teaching Strategy

Group	Self-efficacy			Post_Self-regulation		Med. Diff.	Remark
	N	Mdn	IQR	Mdn	IQR		
Experimental	52	14	3	17	2	3	Self-regulation scores are notably higher than self-efficacy post-intervention.
Control	54	9	2	10	2	1	Both scores are low and closely aligned post-intervention.
Total	106						

Table 5 provides a comparison of median self-efficacy and self-regulation scores post-instruction for both teaching strategy groups. Within the experimental group (N = 52), post-intervention median self-efficacy was 14 (IQR = 3) and median self-regulation was 17 (IQR = 2). The median difference between these two constructs was 3, with a median gain of 2 for self-regulation over self-efficacy. For the control group (N = 53), post-intervention median self-efficacy was 9 (IQR = 2) and median self-regulation was 10 (IQR = 2), showing a median difference of 1.

H_{03}: There is no significant difference between students' self-efficacy and self-regulation scores when exposed to generative teaching strategy.

Table 6: Wilcoxon Signed-Rank Test Comparing Post-Intervention Self-efficacy and Self-regulation Scores in the Experimental Group.

Comparison	N	Z	p	Effect Size (r)	Decision
Self-efficacy vs. Self-regulation	106	5.319	< .001	0.52	Significant

Table 6 presents the results of the Wilcoxon Signed-Rank Test, which was conducted to determine if there was a significant difference between students' post-intervention self-efficacy and self-regulation scores within the experimental group. The analysis revealed a statistically significant difference between self-efficacy and self-regulation scores in the experimental group ($Z = 5.319$, $p < .001$, $r = 0.52$). The positive Z-value and medium effect size ($r = 0.52$) indicate that self-regulation scores were significantly higher than self-efficacy scores after exposure to the generative teaching strategy. This leads to the rejection of

the null hypothesis (H_{03}), suggesting a significant difference between these two constructs post-intervention in the experimental group.

Discussion

The Generative Teaching Strategy (GTS) significantly improved students' self-efficacy, shown by a notable rise within the GTS group, while the control group experienced a decline. This notable difference emphasises the strong positive effect of GTS, aligning closely with established self-efficacy theories (Bandura, 1997). This result resonates with past research, such as that by Fiorella and Kuhlmann (2020), which consistently highlights the beneficial impact of generative learning activities on student outcomes. Fiorella and Kuhlmann (2020) pointed out that involving students in retrieval practices and generative processes results in better long-term learning. Likewise, our findings suggest that GTS fosters greater student confidence in their geometry abilities, thereby boosting motivation in learning. Generative strategies, by encouraging students to actively build their understanding and engage in deeper cognitive processing (Fiorella and Mayer, 2015), offer more chances for mastery experiences and a stronger sense of achievement. In contrast, these outcomes differ markedly from some traditional methods, such as conventional lecture-based approaches, which have been shown to be less effective in fostering higher-order thinking and metacognitive skills. These methods often promote passive learning, which might hinder the development of self-efficacy and self-regulation, as indicated by research across various teaching and learning contexts. The differing results highlight the vital need for a shift towards more interactive instructional approaches that enable students to actively engage with the learning content.

Several potential reasons may account for the observed differences in self-efficacy and learning outcomes between the generative teaching and conventional methods. Firstly, the interactive nature of the GTS encourages more active engagement, allowing students to construct knowledge collaboratively and meaningfully. This contrasts sharply with traditional rote learning strategies, where students may feel less invested in their learning experiences.

The improvement in self-regulation within the Generative Teaching Strategy (GTS) group shows how well it helps students guide their own learning, especially when the control group's scores stayed flat. This fits with studies indicating that methods encouraging active thought and awareness are key to building these skills (Robson et al., 2020). GTS's structured problem-solving also really helps students remember and grasp tough subjects like geometry (Robson et al., 2020). Teachers play a vital role here; as Liu et al. (2019) found, when teachers actively lead generative strategies, it truly boosts student motivation and results. So, tailored GTS lesson plans likely made a supportive learning space that helped students thrive (Liu et al., 2019). It's also clear that motivation, teaching styles, and self-regulation are connected, with a teacher's inspiring strategies deeply affecting student achievement and inner drive (Messer et al., 2025). This suggests that well-planned GTS not only improves how students manage their learning but also makes them more engaged and understanding,

even in tricky areas like geometry. Ultimately, the positive shifts seen with GTS highlight its power in growing students' self-regulatory skills, supporting the idea that active learning and engaged teaching are fundamental for student success (Zulkifli & Kutty, 2022). The finding that self-regulation scores were notably higher than self-efficacy scores within the GTS group post-intervention is particularly interesting. This suggests that while GTS powerfully enhances both constructs, it may exert a slightly stronger immediate impact on self-regulation. This could be attributed to the inherent nature of generative activities, which often explicitly require students to plan, monitor, and evaluate their learning processes, thereby directly fostering self-regulatory behaviours. While improved self-regulation can subsequently lead to increased self-efficacy through successful task completion, the direct engagement with self-regulatory processes within GTS might explain this observed difference. The implications of these findings resonate with the theoretical frameworks underpinning self-efficacy and self-regulation models. By enhancing students' self-efficacy through the GTS, students are likely to adopt a more proactive approach to their studies, fostering a greater sense of autonomy in their academic journey. This connection is supported by Cheng et al. (2023), who emphasise that generative strategies advance not only learning outcomes but also metacognitive awareness, thereby enabling students to better manage their learning processes. The significant improvement in self-regulation scores among the experimental group further suggests that self-efficacy and self-regulation are intertwined, reinforcing the notion that self-efficacy is foundational for effective self-regulation in learning contexts.

Conclusion

Based on the objectives, research questions, and the tested hypotheses of this study, the following conclusions are drawn:

i. The generative teaching strategy (GTS) has a statistically significant and substantial positive effect on students' geometry self-efficacy. Students taught with GTS demonstrated significantly higher self-efficacy scores compared to those taught with conventional methods. Therefore, the null hypothesis (H_{01}) stating no significant difference is rejected.
ii. The generative teaching strategy (GTS) has a statistically significant and substantial positive effect on students' geometry self-regulation. Students in the GTS group exhibited significantly higher self-regulation scores than their counterparts in the conventional teaching group. Therefore, the null hypothesis (H_{02}) stating no significant difference is rejected.
iii. For students exposed to the generative teaching strategy, there is a statistically significant difference between their self-efficacy and self-regulation scores, with self-regulation being notably higher. This indicates that while GTS enhances both constructs, its immediate impact may be more pronounced on students' abilities to plan, monitor, and regulate their learning. Therefore, the null hypothesis (H_{03}) stating no significant difference is rejected.

Thus, the generative teaching strategy is a highly effective instructional model for simultaneously boosting both the confidence (self-efficacy) and the self-directed learning skills (self-regulation) of students in geometry, with a

particularly strong effect on the latter. The study strongly recommends the integration of generative teaching strategies into the geometry curriculum to foster these essential psychological attributes for academic success.

Recommendations

Based on the findings of the study, the following recommendations are put forth for various stakeholders in education:

i. Educators should adopt GTS in geometry curricula, supported by professional development, to boost student engagement, self-efficacy, and self-regulation.
ii. Curriculum developers should update content to be more interactive and application-based, encouraging GTS and promoting self-regulated learning.
iii. Policymakers must allocate funding and resources for ongoing teacher training in innovative strategies like GTS.
iv. Policy initiatives should ensure all students have access to quality mathematics education and benefit from effective teaching strategies.

Suggestions for further studies

To build upon the current research and deepen the understanding of generative teaching strategies, the following areas are suggested for future investigation:

i. Future research should examine the long-term impact of generative teaching strategies on students' self-efficacy and self-regulation through longitudinal studies.
ii. Studies could assess the effectiveness of these strategies across diverse educational settings, considering cultural influences on students' perceptions and behaviours.
iii. Research in mathematics beyond geometry could test the generalizability of these strategies in promoting self-efficacy and self-regulated learning.
iv. As education shifts online, exploring how generative strategies adapt to e-learning and affect student motivation and regulation is essential for digital curriculum development.

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EFFECTS OF DIGITAL INSTRUCTIONAL PACKAGE ON SECONDARY SCHOOL STUDENTS LEARNING OUTCOMES IN ECONOMICS IN LAGOS STATE, NIGERIA

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Abstract
The study investigated the effects of Economics Instructional Package (EcoIPac) on secondary school students' learning outcomes in Economics. The moderating effects of gender and students perception to Economics topics were taken into consideration. The study adopted quasi experimental, Pretest-posttest control research design. A multi-stage sampling procedure was used for the study. The research instruments for data collection were Treatment Package, Gender, Economics Achievement Test and Student Perception to Economics Topics Questionnaire, with reliability coefficients of 0.77 and 0.87 respectively. Sampled population comprised 398 public senior school respondents from six (6) schools randomly selected from the three (3) Educational Districts, Lagos State. Data were analysed using Analysis of Covariance at 0.05 level of significance. Results revealed a remarkable treatment effect on students learning achievement in Economics over control group ($F_{(2,386)} = 27.88$, $p < 0.05$). The finding also showed that treatment and gender interaction did not significantly affect students achievements $F_{(1,386)} = 0.006$, $p > 0.05$. And no interaction effect between treatment therapy and students perception to Economics topics ($F_{(2,386)} = 0.96$, $p < 0.05$). It was concluded that Economics Instructional Package (EcoIPac) is effective in improving students learning outcome in Economics. It is therefore recommended that, students should be encouraged to learn difficult topics with digital Instructional Package.

Keywords: Gender, Learning Package, Learning Outcomes, Students Perception

Introduction
Economics is a practical subject man perform on daily basis. It is a subject that deals with production, distribution, consumption, allocation of scarce resource to satisfy human desires and to make profit through rational decision making. It is a subject design for senior school students but not compulsory for all departments at senior school level.

Adeyemi-Adewoyin (2021) was of the view that, Economics is of great importance. It helps students to understand basic skills required to attain self-reliance and nation building. It equip students on how to proffer solution to economics challenges. At senior secondary school level, Economics is categorized as business subject in the senior secondary curriculum Federal Republic of Nigeria (FRN, 2014). Economics was widely offered and registered at West African Examination Council and National Examination Council. As a social science subject, it enables science students especially, to switch to other discipline of learning at tertiary institution. In recent times, academic achievement of Economics students has been inconsistent at the senior secondary school certificate examination (Mohammed and Jimoh

2022, Amao-Adeleke and Akorede, 2024).
Ede and Oleabhiele (2016) identified some reasons behind the inconsistent performance. These reasons are numerous in literature reviews over causes of poor performance. Arsaythamby and Julinamary (2015) reported that Economics involves use of some mathematical operations, tables and graphs interpretations using Economic theories and this makes some topics in Economics to be described to be difficult. Quite a lot of students demonstrated great deficiencies on Economics questions that has data response questions using graphs and tables to solve economic problems (WAEC, Chief Examiners Report 2021, 2022 and 2023). The cause of the inconsistent performance was attributed to some difficult topics in Economics (Mohammed and Jimoh, 2022).This makes students to find it challenging to expatiate their points to earn good marks.

Olamigoke and Ibode (2018) reported that learning has gone beyond classroom. It was suggested that schools should imbibed technological-based instruction for teaching and learning. This would make learning student centred. The use of technology for education has become part of human development. This has been proven in various sector of the economy and education is not left out. The introduction of technology to education is a global adventure. Today technology for education exist in Google meet, Zoom, Whatsapps, PowerPoint, Microsoft team, Youtube, among others.

Egbo et al; (2011) and Eiadat (2014) described instructional software as the use of computer to provide sequence of learning objectives to the students, it is organized and presented in images, sound and text and gives students the opportunity to interact positively with the software package. Olamigoke and Ibode (2018) defined software application as the use of ICT for teaching and learning in achieving students learning outcomes. Okorie and Agah (2014) reported that some teachers rely more on use of textbook for learning and develop negative disposition to the use of instructional materials. (Taiwo, 2009, Ohakamike, 2020 and Olamigoke, 2021) were of the view that, some teachers use technological based instructions for teaching and learning. It motivates and provides learning experiences to students through the use of different means of presentation. Ogunyomi (2021) developed Circle Geometry Software Package (CiGoSPac) for teaching and learning. It investigated the effect of CiGoSPac on students learning outcomes in Mathematics. The result revealed that, the therapy intervention significantly affect students learning outcome in Geometry. In another study, Ogunrinde (2023) developed and investigated the effect of learning package-Technology Enabled Assessment for Leaning Package with Feedback (TEALPF) and Technology Enabled Assessment for Leaning Package with Feedback and Remediation (TEALPFR) in Basic Science junior secondary school learning outcomes. The result showed that, the learning package (TEALPFR, TEALPF) significantly affect students learning outcome in Basic science.

The adoption of media or technology in education today can be seen as complimentary to teachers' activities during lesson delivery. Therefore, educational media are tools for teaching and learning either with the presence of the teachers or not. Babiker (2015) asserted that teachers should develop their instructional objectives (lesson) along technological-based instructions. Literature revealed that, software packages have been developed for teaching and learning Ogunyomi (2021). Quite a few had been developed for Economics while

some are on Google play store for learning of Economics.

The study of Amao-Adeleke (2025) developed a digital Instructional package for the learning of difficult topics in Economics and was adopted for the study. It was designed with ADDIE model. The learning package was developed into two modes, Economics Instructional Package (EcoIPac) was developed using text and diagrams on a web browser (goggle chrome) for learning Economics. It has no sound and animation. While Economics Instructional Package Sound and Animation (EcoIPacSA) was also built using text, diagrams, sound and animations, it was built on a web browser (goggle chrome) for learning Economics. The package was built with interactive learning feature such as loudness, text size, text colour, navigation of each slides (backward and forward pointers), topics in each lessons, quiz items for each lesson, feedback responses on wrong or correct option selected by the student. As well as percentage score of student. It has feature to retake the lesson or to select new lesson. The learning package contained eight (8) Economics topics identified as difficult to learn by the students.

Abubakar and Oguguo (2011) defined gender as the features that makes organisms to be identified with, on the basis of reproductive function as males or females. Adigun, Onihunwa, Irunokhai, Sada and Adesina (2015) referred gender as the biological and behavioural characteristics regarding being male or female. Differences in gender usually manifest, regardless of age, it was reported that boys tends to spend ample time on physical activities while girls demonstrate their skills on self-care activities (Hands et al., 2016). Osisanwo, Mabekoje, Shoaga and Iheanyichukwu (2024) regarded gender as a social trait attributed to being male or female a d relationship between them. Gender as a moderating variable is used to raise a question if digital package have same effect on students' academic performance in Economics irrespective of their gender. Gender differences in academic achievement have been examined in literature Abubakar and Oguguo (2011, Hand et al., (2016), and Afianty, Manogu and Marthaulina (2018).

Literature revealed that, there is significant differences in gender when it involves academic achievement in various disciplines, either males or females perform better while other researchers found no significant difference to academic achievement. For instance, the study of Baser (2013) revealed that, male students display good academic achievement than the females' students in computer programming. Ali, Goni, Yagana and Bularafa (2015) study revealed that no significant difference exist in gender and academic performance in college of education Bornu State. Ironically, the study of Osisanwo et al., (2024) result showed that there is significant effect of game-based treatment and gender on the executive functioning of children at pre-school on two way manner. This showed that game-based therapy performed better on the executive functioning of male in pre-school children than females. Thus, the females in pre-school can be encourage to adapt to it gradually.

Perception involves habitual tendencies that influences people's way of doing things Egbo et al., (2011). Rahmania (2020) defined perception as the use of sense organs in interpreting or presenting ideas and things. Arsaythamby and Julinamary (2015) posited that, due to students' disposition to learning, teachers usually adopt diverse teaching methodology to guide knowledge. This helps to retain students' knowledge and interest in learning. Chukwuemeka and Dorgu

(2019) were of the opinion that, methodology deploy in teaching is among factors that shapes perception of students to learning. It is believed that when the right method of teaching is employed, it provides positive disposition to learning.

Economics require encoding and decoding of certain principles and concept to be able to interprete economics issues appropriately. Encoding refers to skills involving mathematical functions to graphical illustrations in Economics while decoding is presenting economics issues in mathematical functions so as to give plausible solutions to economic problems. Hence, students' needs to understand basic concepts and principles of Economics of the subject matter. Some students perceives Economics as mathematical inclined subject and feels it is difficult to study very well during examination Adolphus and Agbesor (2008). This assertion makes students to have poor performance in examination. According to Arsaythamby and Julinamary (2015) some students finds it challenging to interprete Economics theories and concepts well enough in attempting questions on Economics during examination and this could be reasons students develop certain disposition towards Economics. Bichi, Ibrahim and Ibrahim (2018) reported that, academic achievement of students at senior school certificate examination in Mathematics continued to decline due to negative perception students crave toward Mathematics

In the study of Hagan, Amoaddai, Lawer and Atteh (2020) students perceived Mathematics to be difficult and this affect students' performance in the subject and other related subjects that has Mathematical inclination. The mastery of the subject matter as well as the methodology of presenting the lesson to the student may influence the understanding of the topic in a subject. Consequently, students perceived some topics in a subject to be difficult to comprehend especially when teachers do not have mastery of the lesson (Abd-El-Aziz, Nwokolo-Ojo, Hassan and Ann 2019)

Objectives of the study

- To examine how Economics Instructional Package (EcoIPac) have significant effect on students learning outcome.
- To investigate whether package intervention and gender interact to affect students' academic performance in Economics.
- To examine how package therapy and student perception to Economics topics interact to affect academic performance of students in Economics.

Hypotheses

H_{O1}: There is no significant main effect of treatment EcoIPac, EcoIPacSA on students' achievement in Economics.

H_{O2}: Economics Instructional Package (EcoIPac, EcoIPacSA) has no significant interaction effect on students' achievement and Gender in Economics

H_{O3}: The Economics Instructional Package (EcoIPac, EcoIPacSA) and Student Perception to Economics Topics (SPET) has no significant interaction effect on students' achievement in Economics.

Methodology

The study adopted a quasi experimental research design with 3x2x2 factorial matrix using non-randomised pretest, post-test and control groups. Treatment was considered at three levels - Economics Instructional Package with text and diagram. Economics Instructional Package having text, diagrams, sound and animation as well as control group. Gender was observed at two levels- male and female while, Student Perception to Economics topics was

considered at two levels- high and low. A multi-stage sampling procedure was used to select three (3) Educational District from six (6) Educational District in Lagos. Simple random was used to select two (2) schools each from the three (3) Educational District. A total of six (6) schools from the three (3) Educational Districts were randomly assigned to experimental and control groups. An intact class sampled of 398 SS 2 Economics students (148 males and 250 females) in public secondary schools in Lagos State, Nigeria were used for the study.

Four instrument were used in the study- Economics Instructional Package (EcoIPac): This was implemented to two groups. **Economics Instructional Package (EcoIPac)** was developed using text and diagrams on a web browser (Goggle chrome) for learning Economics. It has no sound and animation. While **Economics Instructional Package Sound and Animation (EcoIPacSA)** was also a package built using text, diagrams, sound and animations, it was built on a web browser (Goggle chrome) for learning Economics. Both packages contained quiz items for each lesson, feedback responses on wrong or correct option selected by the student. The launching of the package, loudness, text size, text colour, navigation of each slides (backward and forward pointers), topics in each lessons, were checked. All corrections, suggestions were used to improve the package. Both packages were validated by experts in software development, seasoned teachers teaching Economics. The researcher and the research assistant ensured the instruments was used for the treatment groups.

Conventional Method (CM): This was developed by the researcher for the teaching of control group. It empowered the teacher to be seen as the only source of knowledge and skills before the students. Students listened to their teacher's teachings and write on their note books when they are asked to do so. Also, the results were compared alongside the experimental groups.

Economics Achievement Test (EAT): The achievement test items were developed by the researcher to determine the learning outcome of students' in Economics before and after the treatment. The instrument was a multiple choice items with four option (A - D). The table of specification was used to establish the content validity. The study of Amao-Adeleke and Akorede (2024) identified eight (8) difficult topics and were used for the multiple choice items. The initial items contain one hundred and twenty (120) items. After a pilot study was carried out the final instrument contained fifty (50) items. The reliability of the instrument was 0.77 Kuder-Richardson (KR-20).

Student Perception to Economics Topics Questionnaire (SPETQ): The instrument was developed by the researcher. It contains 32 topic items extracted from the SSI – II Economics curriculum. The instrument was a 2- point response format (1) Easy to Learn, and (2) Difficult to Learn. It was validated and the reliability was determined using Cronbach alpha at 0.87. The instrument were administered to the students before and after the treatment.

Experiment procedure

The study was implemented in three stages

Stage One: Pre-Treatment: The experimental groups entails two groups - EcoIPac and EcoIPacSA as treatment and conventional method as control groups. The participants from each selected schools were randomly assigned as treatments and control group. The subject teachers in the sampled schools served as research

assistant and helped to administer the research instruments to the respondents as pretest.

Stage Two: Treatment: Within the duration of six weeks, the students in EcoIPac and EcoIPacSA groups used the packages for learning of difficult topics in Economics. Respondents in the control group were taught same topics using conventional method of teaching. They were not exposed to the treatment as a result of distance in the location of each schools.

Stage Three: Post Treatment: After the introduction of treatments for six weeks, the potency of the treatment package was to be assessed, the treatments and the control groups were administered same instruments again as post-test at the end of the eight week. The data were analysed using analysis of covariance (ANCOVA) to ascertain the main effects, pretest as covariate.

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Results

Hypothesis one:

There is no significant main effect of treatment EcoIPac, EcoIPacSA on students' achievement in Economics.

Table 1*: Summary Analysis of Covariance of Treatment on Students Achievement in Economics*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	27553.643	11	2504.877	67.889	.000	.659
Intercept	27044.300	1	27044.300	732.976	.000	.655
Pre Achievement	223.901	1	223.901	6.068	.014	.015
Treatment	2057.523	2	1028.762	27.882	.000	.126
Gender	.234	1	.234	.006	.937	.000
Post SPET	65.394	1	65.394	1.772	.184	.005
Treatment * Gender	28.428	2	14.214	.385	.681	.002
Treatment * Post SPET	70.963	2	35.482	.962	.383	.005
Gender * Post SPET	.927	1	.927	.025	.874	.000
Treatment * Gender * Post SPET	8.194	1	8.194	.222	.638	.001
Error	14242.075	386	36.897			
Total	554010.000	398				
Corrected Total	41795.719	397				

a. R Squared = .659 (Adjusted R Squared = .650)

Table 1 revealed the summary of analysis of covariance (ANCOVA) of Economics students' achievement by treatment (EcoIPac, EcoIPacSA and Control group). The result showed that students' academic performance is remarkably affected by the treatment ($F_{(2,386)} = 27.88$, $p < 0.05$). The therapy revealed that, there is great effect on students' performance in Economics. The table shows the partial eta square (η^2) was 0.126 effect size.

Table 2: *Estimated Marginal Means of Achievement in Economics by Treatment*

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
EcoIPac	38.029	1.349	35.377	40.681
EcoIPacSA	44.611	0.624	43.384	45.838
Control	28.086	2.062	24.031	32.141

a Covariates appearing in the model are evaluated at the following values: Pretest = 17.24.

Table 2 revealed the estimated marginal mean of students' achievement by treatment. It showed that participants in EcoIPacSA (Economics Instructional Package having text, diagrams, sound and animation) had a mean score of 44.61 with a standard error of .62 while participants in EcoIPac (Economics Instructional Package with text and diagram) and control groups had a lower mean score of 38.03 and 28.09 with standard error of 1.35 and 2.06 respectively.

Table 3: *Post-hoc Analysis of Treatment effect on Students Achievement in Economics*

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
EcoIPac	EcoIPacSA	-6.582	1.501	.000	-10.191	-2.972
	Control	9.943	2.472	.000	4.000	15.886
EcoIPacSA	EcoIPac	6.582	1.501	.000	2.972	10.191
	Control	16.525	2.139	.000	11.382	21.668
Control	EcoIPac	-9.943	2.472	.000	-15.886	-4.000
	EcoIPacSA	-16.525	2.139	.000	-21.668	-11.382

Table 3 indicates that participants in EcoIPacSA had significant effect over participants in EcoIPac and control groups. The mean difference of EcoIPacSA over the other groups were 6.58 and 16.53 with standard error of 1.50 and 2.14 respectively.

Hypothesis two:
Economics Instructional Package (EcoIPac, EcoIPacSA) has no significant interaction effect on

students' achievement and Gender in Economics.

Table 4: *Estimated Marginal Mean Economics Students Achievement and Gender by Treatment*

Treatment	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
EcoIPac	Male	37.716	2.195	33.399	42.032
	Female	38.343	1.561	35.273	41.412
EcoIPacSA	Male	44.466	1.001	42.499	46.434
	Female	44.755	.699	43.382	46.129
Control	Male	26.068	.827	24.442	27.693
	Female	29.095	3.067	23.065	35.125

Table 4 result showed that, male respondents in the control group recorded a mean score of 26.06 standard error of 0.82, males in EcoIPac recorded 37.71 standard error of 2.19 and male respondents in EcoIPacSA recorded a mean score of 44.46 standard error of 1.00. In comparison, the female respondents in the control group recorded a mean score of 29.09 standard error of 3.06, females in EcoIPac recorded 38.34 standard error of 1.56 and female respondents in EcoIPacSA recorded a mean score of 44.75 standard error of 0.69. Result in table 1 reveals that, there was no significant impact of gender on students achievements in Economics $F_{(1,386)} = 0.006$, $p>0.05$. Thus, the hypothesis which stated that, treatment and gender do not significantly affect students' performance in Economics was accepted.

Table 5: *Pairwise Comparison of Economics Achievement by Gender*

Gender		Mean Difference	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Male	Female	0.689	1.517	.650	-2.295	3.672
Female	Male	-0.689	1.517	.650	-3.672	2.295

Table 5 indicated that, male participants had significant Economics achievement over the female with a mean score of 0.68, standard error 1.51.

Hypothesis three:
The Economics Instructional Package (EcoIPac, EcoIPacSA) and Student Perception to Economics Topics (SPET) has no significant interaction effect on students' achievement in Economics.

Table 6: *Estimated Marginal Mean of Student Perception to Economics Topics (SPET) and Treatment by Students Achievement in Economics*

Treatment	Students Perception to Economics Topics	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
EcoIPac	Low	37.865	2.632	32.690	43.040
	High	38.193	.573	37.067	39.319
EcoIPacSA	Low	44.392	1.000	42.425	46.358
	High	44.83	.699	43.456	46.205
Control	Low	25.338	.535	24.286	26.390
	High	33.581	6.102	21.585	45.577

a. Covariates appearing in the model are evaluated at the following values: Pretest = 17.24.

Table 6 result show that, Economics performance of students did not significant affect the interaction of treatment and Student Perception to Economics Topics (SPET). It revealed that perception to Economics topics (SPET) and students' academic performance was not remarkably affected by the treatment ($F_{(2,386)}$ = 0.96, p <0.05). Low perception students in the control group recorded a mean score of 25.33 standard error of 0.53, low perception students in EcoIPac recorded 37.86 standard error of 2.63 and Low perception students in EcoIPacSA recorded a mean score of 44.39 standard error of 1.00. In contrast, the high perception of students in the control group recorded a mean score of 33.58 standard error of 6.10, high perception of students in EcoIPac recorded 38.19 standard error of 0.57 and high perception of students in EcoIPacSA recorded a mean score of 44.83 standard error of 0.69 respectively. Thus, students' perception to Economics topics and treatment did not significantly affect students' academic performance.

Discussion

The study investigated the effect of treatment (EcoIPac, EcoIPacSA) on students' achievement in Economics using gender and students' perception to Economics topics as moderators. The result revealed that, treatment has remarkable effect on Economics students' performance. Invariable, EcoIPac, EcoIPacSA as treatment impacted significantly on students learning outcomes. This finding supports the study of Ogunyomi (2021) developed a package on circle geometry for SS II students where the participants where shared into three groups- treatments and control groups. The treatments groups received Circle Geometry using CiGoSPac therapy while the control groups did not receive any intervention. The therapy was given to the groups over a duration of eight weeks. The result showed that participants in the treatment groups performed excellently due to the use of package developed than those who were not exposed to the therapy.

The result of this of this study also corroborated the study of Ogunrinde (2023) investigated effect of a treatment package technology enabled assessment for leaning package with feedback (TEALPF) and technology enabled assessment for leaning package with feedback and remediation (TEALPFR). The package was developed to improve students learning outcomes in Basic Science Junior secondary school within the period of eight weeks. The result show that the therapy (TEALPFR, TEALPF) significantly affect the academic achievements of students in Basic science. This was demonstrated using estimated marginal mean score of the groups.

The study showed that Economics Instructional Package (EcoIPac) and gender has no appreciable interaction effect on students' achievement in Economics. This affirms the result study of Osisanwo, Mabekoje, Shoaga and Iheanyichukwu (2024) investigated how game-based exercise and gender affect functioning of pre-school children in a two way manner. The result revealed that treatment-game-based and gender did not significant affect the executive functioning of pre-school children.

Also, this study showed that treatment intervention and gender did not appreciable effects on students' academic performance in Economics. Even though, male participants achieved higher mean score against the female participants. In other word, the treatment significantly worked better on the experiment group than the control group in terms of gender participants. By implication, efforts can be geared towards improving learning outcome with the use of EcoIPac package.

Furthermore, the study revealed that students' perception to Economics (SPET) and treatment therapy had no significant effect on students' achievement in Economics. High perception students in EcoIPacSA group had higher mean score than low students' perception. Also, the high perception participants in EcoIPac group also achieve higher mean score than low perception students to Economics topics. In the case of control group, the high perception students achieved higher mean score than the low perception student to Economics topics. The result agrees with Bichi, Ibrahim and Ibrahim (2018) asserted that, perception of students and academic achievement has no relationship thus some topics in Mathematics are still perceived to be difficult. In other word, treatment package and students' perception to Economics topics in terms of Economics did not remarkable impact on academic performance of students in Economics.

Conclusion

The study findings revealed that Economics Instructional Package (EcoIPac) have a remarkable impact on academic performance of students in Economics. It also indicated that treatment package and gender has no appreciable significant effect on students' academic performance in Economics.in addition, students' perception to Economics topics and treatment package did not significantly affect students learning outcomes. Furthermore, the result findings of this study revealed that (EcoIPac) have a significant effect on students learning outcome in Economics irrespective of their gender.

Recommendation

Based on the findings, Economics Instructional Package (EcoIPac) demonstrated significant effect on secondary school students learning outcome in Economics in Lagos State, Nigeria.

1. Use of ICT for learning should be encouraged by schools. It will aid their learning

developments and enable them to use Economics Instructional Package at their pace.

2. Schools with computers are encourage put them into use, install learning packages, get them updated when necessary. Learning with technological-based instructions will enrich students learning.
3. Curriculum planners should encourage schools to adopt indigenous learning package for learning. This will spur student's interest and improve academic performance.

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EFFECTS OF STUDENTS' INTEREST AND ATTITUDE ON ACADEMIC PERFORMANCE IN BASIC SCIENCE IN EKITI STATE

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Abstract
This study investigated students' attitude and interest as predictors of academic performance in Basic Science in Ekiti State. The study adopted descriptive survey and expo-facto research design. The targeted population for the study were 16,256 Junior Secondary Schools three students in all the 209 public secondary schools in Ekiti State. A sample of 240 students' were selected using multi-stage sampling procedure. Two instruments titled "Students Variables Questionnaire" and Inventory on Junior Secondary School Certificate Examination" were used for the study. Face and content validity of instrument were ensured and test re-test method was used to establish a reliability coefficient of 0.89 for SVQ. The data collected were analyzed using descriptive and inferential statistics. The results showed that the level of secondary school students' academic performance in Basic Science in Ekiti State was moderate and that there were significant relationships between students' attitude and interest and academic performance in Basic Science. Upon these findings, it was concluded that students' variables such as attitude and interest were important factors that influence academic performance in Basic Science, It was therefore recommended that stakeholders should build and maintain positive attitude and interest in students for better academic performance in Basic Science.

Keywords: Students interest, attitude, academic performance, Basic Science.

Introduction
In the world today, Science has become a dominant development indicator as countries like United State of America, Russia, Japan and China are referred to as developed countries based on their development in the areas of science (Agbaje & Alake, 2014). The world is scientific in thinking and behaviour, without the knowledge of science, people might find it difficult to adequately function. The development of any nation is a function of the level of her development in science and technology. Science has become an indispensable

tool as it plays vital roles in the lives of individuals and in the society at large. Science can be referred to as the study of phenomenon and event around us through systematic observation and experiment (Adodo & Oyeniyi, 2013). This means that, science is a step by step approach in making students curious about the world around them towards the development of scientific thinking.

For a country to thrive through science and technology, more emphasis must be laid on the level of teaching of science education-subjects such as Basic Science, Biology among others. Basic science is a science subject which embraces all core science subjects such as Physics, Chemistry, Biology, Mathematics and Technology. It is a subject that cuts across the school curriculum and needed in all branches of science. No student should therefore be denied the proper grasp of the knowledge of Basic Science at the elementary level of Primary and Junior Secondary classes. Perhaps, that is why Joseph and Okere (2018) defined Basic Science as the gate way science which helps to study Science Subjects holistically. The objectives of Basic Science are to enable students develop interest in Science and Technology as well as acquire basic knowledge and skills in Science and Technology; applying what science has taught them to meet human needs and take up further studies in science and technology (Joseph and Okere, 2018)

Despite the utilitarian value of Basic Science in science and technological advancement and teachers' position in the realization of these objectives. The researchers, observed that students run away from Basic Science because they perceive it as being abstract. This invariably has reduced the students' interest and hence attitude towards having the subject.

The report of the Ekiti State Ministry of Education, Science and Technology (2013) reveal that despite the enormous roles that science plays in national development and the efforts of the government in improving science education, observations show that the results of students in internal examination at the junior level seem not encouraging and the consequent results in most certificate awarding examination bodies such as WAEC, NECO, and NABTEB have not been satisfactory.

Table 1: Academic performance of students in Basic Science in public JSSCE in Ekiti State from 2019-2021.

Year	Total	Distinction		Credit		Pass		Failed		Absent	
	N	N	%	N	%	N	%	N	%	N	%
2019	11,429	1789	8.3%	7784	35.9 %	1139	52.6 %	516	2.4 %	201	0.8 %
2020	19,227	2065	10.7 %	6223	32.4 %	9658	50.2 %	1096	5.7 %	185	1.0 %
2021	18,623	1563	8.4%	7607	40.8 %	8768	47.1 %	480	2.6 %	205	1.1 %

Source: Research and statistic unit, Ekiti State Ministry of Education (2025).

It is observed that more than 50% of students in the year 2019 that sat for the examination had pass while only 8.35% had distinction. In the year 2020, among the total number of students that sat for the exam, only 43.1% could be considered to have made their result at minimum of credit level. In the year 2021, 8.4% of students registered had distinction and credit. This analysis shows that the performance of students in Basic Science has not been encouraging.

The researcher observed that a lot of teaching strategies have been experimented in teaching the students which seemed to have a little improvement on the academic performance of students in Basic Science. This could be as a result of the observed student's nonchalant attitude towards the subject.

Adedayo (2015) submitted that attitude is a very crucial variable when dealing with the way one responds to an issue, especially learning of Basic Science. The attitude could be considered as the outcome of one's impression about something or better still, one's perception of something. Ayodele (2016) observed that negative attitude of students towards science subjects affected the enrolment and performance of students in sciences. Festus and Ekpete (2012) also reported that students' positive attitudes to science correlate highly with their science achievement. It can then be adjudged that one's attitude to something manifests in the way he/she would respond to issues that pertain to the thing. This is applicable to learning, which involves full concentration of the learners' attention. Thus, the attitude of students contributes immensely to their academic progress (Adedayo, 2015).

Interest in science subjects can be described as a positive feeling or a feeling of curiosity or concern towards science. It can also be viewed as what turns one's attention towards the study of science. Hornby (2010) describes interest as concern or curiosity for individual preferences for a particular type of activity or event. He went further to define interest as the feeling of wanting to know or learn about something. To show interest in science is to be actively involved in science. Students tend to study science subjects better and decide to choose science as a course in Senior Secondary School when they are interested in science (Jari, Reijo, Kalle, Veijo & Anna, 2012). Interest-based motivation to learn has positive effects both on studying processes and on the quality and quantity of learning outcomes. Student's misconception of science subjects as difficult is liable to cause lack of interest in the subjects which is capable of affecting the performance of students in Sciences.

Statement of the Problem

The Ekiti State Ministry of Education, Science and Technology emphasize that, Basic Science is one of the compulsory subjects every student must attempt and pass at the JSS level before promotion to SSS class. However, the researchers observed that the academic performance of JSS students in Basic Science has overtime been experiencing a decline despite the compulsory need of this subject for promotion to the higher class and more generally, for the technological advancement of the nation.

The researchers opined that the poor performance of students in Basic Science at the Junior Secondary School level could be attributed to students' character such as attitude and interest and of which it appears that enough attention has not been given to these in connection with the academic performance of Junior Secondary School students in Basic Science. Therefore, the study sought to investigate the impact of these students' variables on the academic performance of Junior Secondary School Students in Basic Science in Ekiti State

Purpose of the Study

The study investigated the effects of interest and attitude on academic performance of secondary schools students in Basic Science in Ekiti State. Specifically, the study examined the:

(i) level of students' academic performance in Basic Science in Ekiti State.

(ii) relationship between students' attitude, interest, and academic performance in Basic Science.

Research Questions

One research question was raised for the study:

- What is the level of secondary school students' academic performance in Basic Science in Ekiti State?

Research Hypotheses

The following null hypotheses were formulated to pilot the study:

1. There is no significant relationship between students' attitude and academic performance in Basic Science in Ekiti State.
2. There is no significant relationship between students' interest and academic performance in Basic Science in Ekiti State.

Significance of the Study

The findings of the study would be of benefits to students, teacher, parents, and future researchers. The outcome of the study will assist students to know the importance of Basic Science subject thereby helping them to develop a positive attitude that will boost their interest towards Basic Science. The results will also provide information that would help Basic Science teachers to understand students' variables such as attitude, interest and towards the learning of Basic Science in order to use knowledge of these variables to improve academic performance of students in Basic Science. It will also be of benefits to parents

Delimitation of the Study

The study was conceptually delimited to students' attitude and interest and geographically delimited to all public secondary schools in Ekiti State.

Methodology

The study adopted descriptive survey and expo-facto research. The targeted population for the study consisted of all the 16,256 Junior Secondary Schools (JSS) three students in all the 209 public secondary schools across the 16 Local Government Areas of Ekiti State as at the time of the study (Ministry of Education, Science and Technology, Ekiti State, 2023). The sample for the study consisted of 240 JSS 3 students selected from the three Senatorial Districts of Ekiti State using multistage sampling procedure. Stage one involved the use of simple random sampling techniques to select 2 from the 3 senatorial districts in Ekiti state. Stage two involved the use

of random sampling technique to select two local government areas from each of the Senatorial Districts selected. The third stage involved the use of purposive sampling technique to select two secondary schools from each of the local government areas selected putting into consideration schools that were mixed school and schools with teacher who were University graduates of Integrated Science. The fourth stage involved of an intact class of an arm in each of the school selected.

Two instruments titled; "Students' Variables Questionnaire (SVQ)" and 'inventory on Junior Secondary School Certificate Examination (IJSSCE)' were used for collection of data for the study. The SVQ comprised two sections, A and B. Section A sought for information on the bio-data of the respondents such as name of school, class and gender while section B contained 5 items on students' interest and attitude as the influence of academic performance in Basic Science of Secondary School. The items in this section of the questionnaire were based on a 4-point Likert type scale ranging from Strongly Agree to Strongly Disagree and rated as: Strongly Agree - 4, Agree - 3, Disagree - 2 and Strongly Disagree - 1. The IJSSCE was used to request for students' score in Basic Science during the year 2021 to 2023 Junior Secondary School Certificate Examination.

The face and content validity of the instrument (SVQ) were ensured. The instrument was given to experts in Tests and Measurement and Science Education. They ensured the instrument contained the appropriate items that actually elicited the intending responses on the targeted students' variables in Basic Science. The reliability of SVQ was determined through test re-test method. The instruments was administered on 20 JSS 3 students of Basic Science outside the sampled Local government area. The same instrument was re-administered within an interval of two weeks to the same set of students. The two scores were then correlated and analyzed using Pearson's Product Moment Correlation statistic which yielded a reliability coefficient of 0.89 at 0.05 level of significant. These value was high enough to adjudge the instrument as being reliable.

During the administration of the instrument, the researchers discussed the importance and the focus of the study with the Integrated Science teachers as the research assistants in each of the schools selected. The research assistants helped in the administration and collection of the instrument. The JSSCE was used to collect students' results in Basic Science for the Ekiti State Ministry of Education. The data collected were analyzed using descriptive and inferential statistics. Descriptive statistics such as frequency and percentage were used to answer the research question while the hypotheses were tested using inferential statistics of Pearson's Product Moment Correlation at 0.05 level of significance.

Results

Descriptive Analysis

Question 1: What is the level of secondary school students' academic performance in Basic Science in Ekiti State?

In analyzing the question, JSSCE results of secondary schools in Ekiti State as

obtained from the Ekiti State Ministry of Education were used. Percentile distribution formula was used using low, moderate and high. Respondents who scored 33.3 % (26.64) of the total scores on students' variables in secondary schools and below were categories into 'low' level of students' variables and those who scored 66.6% (53.28) of total score and above were categorized into 'high' level while scores between the low and high students' variables were categorized into 'moderate' level.

Table 2: Level of secondary school students' academic performance in Basic Science in Ekiti State

Students' academic performance	N	%
Distinction	51	21.4
Credit	133	55.5
Pass	41	17.1
Fail	15	6.1
Total	240	100.0

Table 2 shows that, out of 240 students; 51 representing 21.4% obtained Distinction, 133 (55.5%) representing the majority had Credit, 1 (17.1%) had pass while 15 (6.1%) failed the subject. Therefore, the level of secondary school students' academic performance in Basic Science in Ekiti State is moderate.

Testing of Hypotheses.

Ho_1: There4 is no significant relationship between students' attitude and academic performance in Basic Science.

In order to test the hypothesis, scores relating to students' attitude were computed using items 1–5 in Section B of "Students' Variables Questionnaire (SVQ)" while academic performance in Basic Science were obtained from the record of school-based examination. These sets of scores were subsequently subjected to statistical analysis involving Pearson's Product Moment Correlation at 0.05 level of significance. The result is shown in Table 3.

Table 3: Correlation of students' attitude and academic performance in Basic Science in Ekiti State

Variable	N	Mean	SD	r	P
Students' attitude	240	16.70	2.79	0.437*	0.000
Academic performance	240	57.44	21.61		

*$p < 0.05$

Table 3 shows that the computed r-value (0.437) is significant at $p < 0.05$ level of significance. The null hypothesis is rejected. This implies that there is a significant relationship between students' attitude and academic performance in Basic Science in Ekiti State. The correlation between students' attitude and academic performance in Basic Science in Ekiti State is statistically significant in a positive direction.

Ho_2: There is no significant relationship between students' interest and academic performance in Basic Science.

In order to test the hypothesis, scores relating to students' interest were computed using items 6-10 in Section B of "Students' Variables Questionnaire (SVQ)" while academic performance in Basic Science were obtained from the record of school-based examination. These sets of scores were subsequently

subjected to statistical analysis involving Pearson's Product Moment Correlation at 0.05 level of significance. The result is shown in Table 4.

Table 4: Correlation of students' interest and academic performance in Basic Science in Ekiti State

Variable	N	Mean	SD	r	P
Students' interest	240	14.73	2.75	0.561*	0.000
Academic performance	240	57.44	21.61		

*p < 0.05.

Discussion

The study showed that the level of secondary school students' academic performance in Basic Science in Ekiti State was moderate. This implies that the students are doing well in Basic Science, hence the academic performance of the student is good. When teaching and learning activities in the schools are going on well, good academic performance of the students will be guaranteed.

The study showed that there was a significant relationship between students' interest and academic performance in Basic Science. It implies that the students' interest influences academic performance in Basic Science. When feeling of wanting to know or learn about Basic Science increases, studying processes, quality and quantity of learning outcomes is enhanced. The finding is consistent with the submission of Jari, Reijo, Kalle, Veijo & Anna,(2012) that unsatisfactory results of students in most certificate awarding examination bodies such as students tend to study science subjects better and decide to choose science as a course in Senior Secondary School when they are interested in science & Also, the finding supports the research work of Adodo and Oyeniyi (2013) that attributed unsatisfactory results of students in most certificate awarding examination bodies such as WAEC, NECO, and NABTEB to student's attitude to learning science, students' interest towards learning science. However, the finding negates the study of Lavin (2005) which found a reciprocal relationship between interest and learning achievements. Nevertheless, when students are interested in a subject, they are bond to perform better.

The study also revealed that there was a significant relationship between students' attitude and academic performance in Basic Science. This by implication means that students' attitude is given a needful attention. The finding is in agreement with the views of Festus and Ekpete (2012) that students' positive attitudes to science correlate highly with their science achievement. Also, the outcome of the research carried out by Adedayo (2015) reported that the attitude of students contributes immensely to their academic progress. Awang *et al.*, (2013) found that there is statistical significant relationship between students' attitudes towards their learning and academic performance. What can be responsible for this finding may be the fact that the management of secondary school has realized that students' positive

perception of Basic Science will trigger their performance in the subject

Conclusion

Based on the findings of this research, it was concluded that secondary school students' academic performance in Basic Science is moderate. It can be concluded also that students' variables such as attitude and interest were important factors that influenced academic performance in Basic Science.

Recommendations

The following recommendations were made based on the findings of this study.

1. Students are encouraged to develop positive attitude and have interest in the study of Basic Science.
2. Teachers of Basic Science should build and maintain positive attitude in students through the use of effective instructional strategies, teachers' classroom management and teachers' mastery of subject area for positive perception of the subject to enhance academic performance
3. Public enlightenment programme should be designed and organized by school counsellor in collaboration with the Ministry of Education to sensitize the public on the influencing consequences of attitude and interest on students' academic performance Basic Science.
4. Basic Science teachers and parents should adopt appropriate motivational strategies such as reinforcement and parental involvement in their wards' academic activities for better academic performance.

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AVAILABILITY AND UTILIZATION OF AUDIO VISUAL INSTRUCTIONAL MEDIA IN LEARNING OF MATHEMATICS IN SELECTED JUNIOR SECONDARY SCHOOLS IN IKERE LOCAL GOVERNMENT

BY

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Abstract

This study investigated the availability and utilization of audio-visual instructional media in learning of mathematics in Ikere Local Government. The population of the study consists of all junior secondary schools in Ikere Local Government Area of Ekiti State during 2023/2024 academic session.200 students were selected using multistage sampling technique from the targeted population. Four research questions were formulated to guide the study. A well-developed questionnaire was used to obtain information from the respondents. The reliability of the instrument was obtained with test-retest approach using Pearson Product moment correlation and the reliability coefficient was 0.87. The data collected were analysed using descriptive statistics (frequency count, percentage and mean).Findings revealed that some secondary schools have invested in the availability of audio visual resources for students in their Mathematics learning. Teachers responsible for operating audio visual equipment are available in some junior secondary schools. Among others, it was recommended that, continuous training for teachers and students such as organising of workshops and seminars for teachers to further enhance their skills. Regular evaluation and feedback could involve periodic assessment from both teachers and students such evaluation will help to identify the strength and area of improvement.

Keywords: Instructional media, visual resources Projectors, television, teaching Practice

Introduction

The problem of poor achievement of students in Mathematics is of great concern to Mathematics educators and stakeholders in education. The chief examiner's report of the West African Examinations Council (WAEC) examiner as reported by the Federal Ministry of Education (2010) observed the poor performance of students in Mathematics. The researcher's observation as WAEC examiner revealed that poor performance of students over the years is alarming. Among the reasons adduced for the poor performance of Mathematics in examinations include lack of instructional materials and teacher method of teaching. In the junior secondary school, the use of audio-visual instructional media has gained prominence as a tool to enhance the teaching of mathematics. This study focuses on the availability and utilization of audio-visual instructional media in selected junior secondary schools within Ikere Local Government. With the advent of technology and its potential to enrich classroom experiences, it is

crucial to assess the extent to which these resources are accessible and effectively employed to facilitate mathematics instruction. The integration of audio-visual instructional media into the teaching and learning process has emerged as a pivoted factor in enhancing educational outcomes.

The availability of audio-visual instructional media in junior secondary schools is multifaceted issue. In Nigeria, Junior Secondary schools is governed by policies and guidelines set by the federal ministry of education, which emphasize the importance of using modern teaching aids including audio-visual resources. Audio-visual instructional media encompass a wide range of resources, including videos, audio, interactive presentation and multimedia materials designed to supplement traditional teaching methods (Clark & Mayer, 2016). These tools have been shown to enhance engagement, comprehension, and retention of subject matter (UNESCO, 2017)

In the Nigerian educational contest understanding the availability and utilization of such media is pertinent due to their potential to bridge educational disparities and improve learning outcomes in mathematics which is abstract in nature.

Audio-visual instructional media encompass a wide range of educational tools, including video, audio, interactive software, and visual aids. These resources have the potential to enhance pedagogical by making learning more engaging, interactive, and effective (Clark & Moyer, 2016).

The incorporation of audio-visual instructional media, including videos, multimedia presentations, and educational software has gained prominence in educational settings worldwide (Clark and Mayer 2016). Such media have been found to stimulate students visual and auditory senses, making learning more interactive and memorable.

The availability and utilization of audiovisual instructional media in secondary schools are essential for enhancing the quality of education (Smith, 2019 Adeyemi et al, 2021). Nigeria being one of the most populous countries in Africa, faces unique challenges in providing educational resources including audiovisual media, to its junior secondary schools (Ajayi, 2018). The availability and utilization of audio visual instructional media in Nigerian junior secondary schools present both opportunities and challenges (Adesina 2014). While there has been progress in providing these resources, addressing the issues of training, infrastructure, and localize content is crucial to realizing their full potential with the right support and investment, audio visual material can significantly enhance the teaching and learning of mathematics in Nigerian junior secondary schools, contributing on brighter educational future for the nation. While there has been progress in making audio-visual instructional media available in Nigeria junior schools their effective utilization remain a challenge. One major issue is the lack of technical expertise among educators to integrate these tools seamlessly into their teaching methods. Additionally, there is shortage of training programs to equip teachers with the skills needed to use audio-visual resources effectively, moreover, schools often face infrastructure challenges including unreliable electricity and a lack of resources maintenance which hinder the consistent use of these materials.

Furthermore, there is need for localized content. Many of the available audio-visual materials are developed for international audiences and may not align with the specific curriculum and

cultural context of Nigerian junior secondary schools. The lack of context that tailored to the Nigerian educational system link the potential benefits of these resources.

Benefits of Audio visual instructional media in Teaching and Learning of mathematics in junior secondary schools.

Researchers such as Smith (2019) have highlighted that the utilization of projectors and visual aids serves as an effective means of illustration complex concepts. This visual reinforcement enhances the engagement of students making the numerical thinking process more accessible and enjoyable.

Moreover, educational software has emerged as a powerful tool for interaction learning. Babatunde (2017) reemphasize the educational software fosters active engagement with the mathematics.

Through these platforms, students have the opportunity to practice mathematics in an interactive and dynamic environment.

This approach not only aligns with the National policy on Education's recommendations (Federal Ministry of Education, 2013) but also empowers students to take an active role in their process of mathematics learning.

Educational television programs have been recognized for their role in providing students with authentic reasoning opportunities as seen in the research by Stinson et al (2020), television programs documentaries and visual aids

By exposing students to diverse accents, these audiovisual media contribute to more inclusive mathematics teaching (Ajayi, 2018). Visual aids, as identifies by Agbemu and Onyen emezu (2019) offer a visually appealing presentation of texts, making reasoning more engaging and effective.

In addition, supporting quantitative reasoning, projectors and visual aids reinforce mathematics laws and theorems (Oyebonyi & Akinsola, 2018). The visual elements of these tools facilitate a deeper understanding of mathematics, helping students internalize language rules and patterns more effectively. This alignment with curriculum objectives ensures that students not only learn the calculation but also develop a comprehensive understanding of its structural elements.

Furthermore, the utilization of audiovisual media, including projectors, television and educational software has been noted to boost motivation and engagement in the mathematics classroom. This finding corresponds with the research by Adelani and Adeyemi (2017) which underlines the pivotal role of motivation in mathematics learning. When lessons are designed to be interactive and visually appealing, students are more likely to active participate in their learning and remain enthusiastic about the study of mathematics

Statement of the Problem

The qualities of education in Nigerian secondary schools, particularly in rural and seminary born areas like Ikere Local Government Area has been a subject of concern. The mathematics being a fundamental component of the curriculum demands effective teaching strategies that facilitate quantitative reasoning and mathematical acquisition among students. However, there is a concern that the traditional pedagogical methods used seem to have resulted into lack of interest in mathematics. One of the potential solutions to address the issues is the integration of audio visual instructional media. This study seeks to address the issue of limited availability and under utilization of audio-visual resources in junior

secondary schools, which may hinder the achievement of mathematics teaching and learning.

Purpose of the study

The purpose of the study is to examine the availability and utilization of audio-visual instructional media in the teaching and learning of mathematics. Specifically, to assess the current availability of audio-visual instructional media resources, educational videos, multimedia presentations and interactive software within junior secondary schools in Ikere Local Government. To know the impact and influence of audio visual media on the teaching and learning of mathematics.

To analyse how teachers incorporate audio-visual instructional media into their pedagogical practices for mathematics instructions and to identify the strategies they employ to enhance students learning experiences

Research Questions

The following questions were raised the study.

i. To what extent are audio-visual instructional media resources available in junior secondary schools?
ii. How do teachers incorporate audio-visual instructional media into mathematics teaching practice?
iii. What are the impacts of audio visual media in mathematics?
iv. What are the influence of the use of audio-visual instructional materials on academic performance of students?

Methodology

The descriptive survey design was employed for the study to investigate the availability and utilization of audio-visual instructional media in teaching and learning of mathematics in selected junior secondary schools in Ikere Local Government Area .The population for the study consisted all junior secondary schools students of Ikere Local Government Area, Ekiti State. Nigeria. Multistage sampling technique was used for the study. Four co-educational schools were selected through simple random technique. Fifty (50) students each was chosen from four randomly selected secondary schools in Ikere Local Government Area of Ekiti State. The research instrument used for collection of data was a self - constructed questionnaire The questionnaire was divided into two sections; Section A and B. Section A consisted of information on bio-data of the respondents while section B was divided into parts with items from each part addressing the stated research questions . A. 4-point Likert type rating scale of Strongly Agreed SA= (4). Agreed (A) =3, Disagreed (D) = 2, Strongly Disagreed (SD) =1 was used. Each of the respondent picked the items as applicable. The research instrument was validated using face and content validity with the help of two (2) experts in the test, measurement and evaluation. The reliability of the instrument was obtained with test-retest approach using Pearson Product Moment Correlation Coefficient of 0.87.The researcher took permission from the principals and through them got in touch with the Mathematics teachers and students in the schools for the administration of the questionnaire .The data collected were analysed using frequency count, percentage and mean.

Research Analysis

ResearchQuestion1:

To what extent are audio-visual instructional media resources available in junior secondary schools?

Table 1: Descriptive analysis on the Extent of Availability of Audio-Visual instructional media resources in junior secondary schools

S/No	Item	SA %	A %	D %	SD %	Mean	Std
1	Audio visual resources such as TVs Projector or computers are accessible in our junior secondary school	56 (26)	102 (51)	33 (16.5)	9 (4.5)	3.02	0.79
2	Our Junior secondary school has dedicated classrooms or spaces equipped with audiovisual resources for teaching and learning	86 (43)	73 (36.5)	32 (16)	9 (4.5)	3.18	0.86
3	Our school has invested in the availability of audio visual resources for teachers to use in their mathematics teaching	58 (29)	122 (61)	18 (9)	2 (1)	3.18	.62
4	Trained personnel or teachers responsible for operating audiovisual equipment are available in our junior secondary school	98 (49)	62 (31)	38 (19)	2 (1)	3.28	.80
5	I play games on a computer or tablet to learn mathematics in school	54 (27)	90 (45)	41 (20.5)	15 (7.5)	2.91	.88

Weighted Average=3.15, Benchmark=2.50

Table 1 shows the extent to which audio-visual instructional media resources are available in junior secondary schools. The table show that the teacher agreed that the trained personnel or teachers responsible for operating audio visual equipment are available in our junior secondary school receiving the highest mean score (x=3.28). Meanwhile, ,since the weighted average as shown in table 1 is 3.15 which is greater than the benchmark of 2.50,it can be concluded that the extent to which audio-visual instructional media resources are available in junior secondary schools in Ikere Local Government Area of Ekiti State.

Research Question 2

How do teachers incorporate audio-visual instructional media into their mathematics teaching practices?

Table 2: Descriptive analysis on the Ways teachers incorporate audio-visual instructional media into teaching

S/No	Item	SA %	A %	D %	SD %	X	Std	Decision
1	Teachers in our school incorporate audio visual	83 (41.5)	88 (44)	17 (4.5)	12 (6)	2.75	0.81	Accepted

	instructional media into their mathematics teaching							
2	I have used videos or pictures to practice mathematics class as instructed by my teacher	90 (45)	42 (21)	30 (15)	3 (19)	2.91	.85	Accepted
3	Teachers receive feedback or assessment on their use of audiovisual media in mathematics instruction	77 (38.5)	62 (31)	61 (30.5)	0 (0)	3.08	0.83	Accepted
4	Teachers express a high level of satisfaction with the support and resources available for incorporating audiovisual media into their mathematics instruction	58 (29	92 (46	1 0.5)	49 (25.5)	2.80	0.84	Accepted
5	Teachers use a variety of audiovisual resources including educational software online platform and mathematics learning Apps	72 (36)	75 (37.5)	2 (1)	41 (26.5)	2.90	0.81	Accepted

Weighted Average=2.76
Benchmark mark=2.5

Table 2 shows how teachers in selected junior schools in Ikere Local Government Area incorporate audiovisual instructional media into their mathematics teaching practices. The table shows that only the "I have used videos and pictures to practice calculation in class as instructional by my teacher with a mean score of 2.75"Teachers receive feedback or assessment on their use of audio visual media in mathematics instruction with mean score of x=2.91) were accepted. Teachers express a high level of satisfaction with the support of resources available for incorporating audiovisual media into their Mathematics instruction (2.8). Teachers use a variety of audio visual resources including instructional software, online platform to teach Mathematics (3.39)Based on the result from this table and mean score acceptance by the decision rule, the teachers in selected junior secondary schools in Ikere Local Government Area incorporate audio-visual instructional media into their mathematics teaching practices.

Research Question 3:

What are the impact of Audio visual media in mathematic learning outcomes?

Table3: Descriptive analysis on the Perceived impact of Audio-visual media in mathematics learning outcomes

S/N	Item	SA %	A %	D %	SD %	X	Std	Remark
1	It is mere exciting to learn Mathematics with videos and pictures than with books and worksheets	65 (32.5)	109 (54.5)	17 (8.5)	9 (4.5)	3.15	0.75	Accepted
2	When I watch videos or listen to songs I feel like understand Mathematics more	90 (45)	78 (39)	12 (6)	0 (0)	3.29	0.73	Accepted
3	Watching fun videos and pictures helps to learn mathematics better than just mathematics	71 (35.5)	60 (30)	60 (30)	9 (4.5)	3.42	0.92	Accepted
4	It is easier to remember when I watch or listen to something	106 (43)	74 (37)	12 (6)	8 (4)	3.39	0.76	Accepted

Weighed Average=3.31, Benchmark=2.50

Table 3 shows that the perceived impact of audio-visual media on mathematics learning outcomes of junior secondary school students in Ikere Local Government Area compare to traditional teaching methods. All the items received has a mean score that is above the ave bench mean score of 2.50. based on the result from the table and mean score acceptance by the decision rule, the perceived impact of a audio visual media on the mathematics learning outcomes of junior secondary school students in Ikere Local Government Area compare to traditional teaching methods are better at their mathematics because of the video and pictures used in class. It is more exciting to learn mathematics with videos or listen to songs, they feel like they understand mathematics more, watching fun videos and pictures helps to learn mathematics better than just calculation (3.42). It is easier to remember mathematics contents that are abstract when they watch or listen to the contents (3.39)

Research Question 4

What are the influence of the use of audio-visual instructional materials on academic performance of students?

Table 4

Perceived Effects of Audio-Visual Instructional Media on Attention Span

S/N	Item	SA %	A %	D %	SD %	Mean	Std	Remark
1	Audio Visual Instructional media help me to stay focused during lessons	84 (42)	89 (45.5)	27 (13.5)	0 (0)	3.29	0.69	Accepted
2	Using videos and pictures in class makes learning more interesting for me.	39 (19.5)	110 (55)	42 (21)	9 (4.5)	2.89	0.76	Accepted
3	Audio Visual aids make it easier for me to understand	82 (41)	38 (19)	74 (37)	6 (3)	2.98	0.95	Accepted
4	Watching educational videos can improve my	90 (45)	74 (37)	36 (18)	0 (0)	3.27	0.75	Accepted

	attention span							
5	Visual aids like charts and diagrams engage me and keep my attention	81 (40.5)	75 (37.5)	26 (13)	18 (9)	3.09	0.94	Accepted

Weighted Average=3.17. Benchmark=3.17

Table 4 shows the perceived effects of the use of audio visual instructional media on the attention span of the pupils. The table shows that the respondents agreed to all the items .They perceived that effects of the use of audio visual instruction media help them to stay focused during lessons. Based on the result from this table and mean score acceptance by the decision rule, the perceived effects of the use of audio visual instructional media on the attention helps them to stay focused during lesson (3.29),Using videos and pictures in class makes learning more interesting for them(2.89), Audio-visual aids make it easier for them to understand complex concepts(2.98) Watching educational videos can improves their attention span(3.27) and visual aids like charts and diagram engage them and keep their attention (3.09).It can be concluded that the are effects of the use of audio-visual on the attention span of the students

Discussion of Findings.

Based on the investigation conducted on research question one, from table I, 79% of the respondents agreed that audio visual resources such as television, projector or computer are accessible in our junior secondary schools while 21% disagreed 79.5% agreed that their junior secondary schools has dedicated classrooms or spaces equipped with audio visual resources for teaching and learning while 20.5% disagreed. 90% agreed that their schools has invested in the availability of audio visual resources for teachers to use in their Mathematics teaching while 10% disagreed. 80% trained personnel or teachers responsible for operating audio visual equipment s are available in their junior secondary school while 20% disagreed. 72% agreed that they played games on a computer or tablet to learn Mathematics in school while 28% disagreed.

The findings reveal that availability and usage of audio visual instructional media resources, specifically, they indicated that resources such as TVS Projectors or computers are accessible in the junior secondary schools. The result is in the agreement with Anthony (2022) which submitted that blended instructional media approach is beneficial to the learning and comprehension of mathematics contents by the students at the lower class.

On research question two, from the table 2, 85.5% agreed that teachers use audio visual instructional in their Mathematics teaching while 14.5% disagreed.

28% of the respondents agreed that they have used video or pictures to practice Mathematics as instructed by their teachers while 72% disagreed. 69.5% teachers received feedback or assessment on their use of audio visual media in mathematics instruction while 30.5% disagreed, 24.5% agreed that teaching express a high level of satisfaction with the support and resources available for incorporating audiovisual media into their Mathematics instruction while 75% agreed that teachers use a variety of audio visual resources including educational software, online platform and mathematics learning Apps while 25% disagreed. According to Peter (2013) many teachers are active in using multimedia

in the classroom due to availability of experts among the teachers to handle it confidently

On research question three, from the table 3, 87% of the respondents agreed that it is more exciting to learn Mathematics with videos and pictures than with books and worksheets while 13% disagreed. 84% of respondents agreed that when they watch videos or listen to songs they feel like understand mathematics more while 16% disagreed. 65.5% of the response agreed that watching fun videos and pictures help to learn Mathematics better than just learning mathematics with rote learning while 34.5% disagreed. 80% of the respondents agreed that it is easier to remember contents when they watch or listen to videos while 20% disagreed.

Finally, on research question four, from table 4, 86.5% agreed that of the respondents agreed that audiovisual instructional media help them to stay focused during lessons while 13.5% disagreed 74.5% of the respondents agreed that using videos and pictures in class makes learning more interesting for them while 25.5% disagreed. 60% of the respondents agreed that audio visual aids make mathematics easier to understand while 40% disagreed.

82% of the respondents agreed that watching Educational videos can improve their attention span while 18% disagreed.

88% of the respondents agreed that visual aids like charts and diagram engage them and keep their attention while 12% disagreed. This work is in line with Babatunde (2017) that when students watch videos or listen to songs, they understand mathematics more.

Conclusion

This study describes the application of blended audio-visual instructional media resources into teaching and learning of mathematics in junior secondary schools in Ikere Local Government Area of Ekiti State. The application of these instructional media over face-to-face instruction exercises from textbooks and developed course materials which was used in the tutorial class and also made available on the e-learning. Moreover teachers are actively incorporating these resources into their mathematics teaching practices. The use of audio-visual media appears to enhance engagement, understanding and retention among students, thus positively affecting their attention span during lessons

Recommendations

Based on the findings, the following are recommended

1. Continuous training for teachers such as organizing of workshops or training sessions for teachers to further enhance their skills in effectively integrating audio-visual instructional media into mathematics
2. Regular evaluation and feedback could involve periodic assessment from both teachers and students such evaluation will help identify strengths and area for improvement allowing for adjustments to teaching practices.
3. Investment in infrastructure and resources to support the use of audio-visual instructional media in junior secondary schools.
4. Encourage collaboration among teachers within and across schools to share best practices, lesson

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STUDENTS' PERCEPTION OF THE UTILIZATION OF HUMOUR BY BIOLOGY TEACHERS AND THEIR ACADEMIC PERFORMANCE

BY

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Abstract

The purpose of this study was to investigate into students' perception of the utilization of humour by biology teachers and their academic performance. *The study uses both quantitative and qualitative experimental method to collect data from 100 senior secondary school II biology students; the quantitative data were used to measure students' perceptions of the use of humour by biology teachers. Biology performance test was the instrument used to collect data from students, and a total of 10 biology teachers were interviewed. The findings shows that the control group and the experimental group had a significant difference with a p value less than 0.05. The research revealed that many students support the teachers utilizing humour in class because it is pleasant. The result also shows that when humour is used as a teaching strategy in biology lessons, students find it to be enjoyable, enhance good learning environments, makes difficult topics easier to comprehend, build teacher-student relationship and reduce stress. It is therefore concluded that humour should be utilized by biology teachers wisely, and the type of humour employed should be depending on the lessons being taught.*

Keywords: Humor, Academic Achievement, Learning Environment, Biology

Introduction

Biology, with its terminology, complex processes and extensive memorization requirements poses a hurdle for many students which necessitate a more comprehensive and interactive learning approach. The following factors contributed to students' low biology achievement: a lack of teachers, an environment that is not favorable to learning, and inadequate teaching methods and educational resources (Ihekwoaba, Chinweuba-eze, and Nduji 2020). The teacher, the teaching strategies, and the methodologies employed are the most significant factors that generally affect students' progress in science, particularly biology. This is so because teachers may influence their occupational skills and direct them to improving student engagement, interest, and academic achievement in the subject (Cimer, 2015). Biology, as a core science subject often presents abstract and technical concepts that require a high level of cognitive engagement. Many students perceive biology as challenging

due to its scientific terminology and conceptual nature (Audu and Samuel, 2021). Consequently, innovative teaching methods sustain students' interest are essential. Instead of employing the teaching strategy that has been shown to be effective in raising student achievement, the majority of biology teachers still use traditional methods of instruction like the lecture method, where the teacher does the majority of the talking during the teaching and learning process. Although the traditional approach to teaching biology characterized by a one-way flow of information has long been an aspect of education providing a framework, for conveying essential biological principles (Ademola et al., 2022; Onowugbeda et al., 2023). This may fall short in effectively addressing the unique challenges posed by biology. While it is important to acknowledge the benefits of this approach in facilitating the acquisition of knowledge, it must also be recognized by its limitations when it comes to promoting active participation, cultivating critical thinking abilities, and adapting to the ever-changing landscape of the biological sciences (Adam et al., 2023; Agbanimu et al., 2021;2022; Ajayi et al., 2023). Teachers are continuously looking for new and creative ways to engage students in the classroom, such as through the use of the internet, other media, and entertainment tools including photos, animation, videos, projectors, and movies (Shabiralyani, Hasan, Hamad, Iqbal, 2015). It's interesting to note that one aspect of human development and neurology that has been predicted to academic excellence but teachers frequently ignore is the use of humor. According to Gbeleyi (2022) and Okebukola et al., (2021), implementing effective teaching strategies is crucial for engaging students and facilitating knowledge acquisition.

Humour, as a pedagogical approach, possesses the capacity to reconfigure the educational milieu through the infusion of amusement and light-heartedness within the instructional setting. The cultivation and incorporation of humour within the educational setting can be strategically employed to cultivate an environment that promotes a sense of inclusivity and mutual regard among both students and educators. Educators today often employ various forms of humour, including jokes, anecdotes, and interactive activities, to enhance the overall learning experience and promote a dynamic and engaging classroom environment. According to the research of de Guzman and Arceo (2022), incorporating humour in the educational setting can greatly contribute to creating a positive and inclusive space for learning. By using humour strategically and appropriately, educators can break down barriers and foster a relaxing and comfortable atmosphere between themselves and their students, ultimately leading to a conducive learning environment. Students who feel supported and welcomed are more likely to actively participate in the learning process. Humour plays a vital role in fostering social interaction and promoting a shared camaraderie. Allowing students and teachers to connect through light-hearted moments, and facilitates positive relationships.

The use of humour as a pedagogical tool is an effective way to ease tension in the classroom, as reported by Ogunyemi (2020), creating opportunities for emotional release in the classroom can have a positive impact on the overall learning environment. By providing a safe space for students to express and process their emotions, they can develop resilience. Creating a safe learning environment is crucial for students to fully engage in the learning process and form positive social relationships with their peers. The use of humour to approach difficult topics

demonstrates a high level of empathy and understanding, resulting in a nurturing atmosphere for students to thrive in.

When introducing humour approach into teaching, it's critical to consider both general and specific techniques to effectively engage students. In a general, understanding your target audience is crucial. Understand their backgrounds, interests, and cultural sensitivities to tailor your humour appropriately. Authenticity is vital; embrace a humour that aligns with your personality and teaching style to develop a true connection with your students. Timing plays a crucial role, so choose moments that enhance rather than disrupt the learning flow. Begin with icebreakers to set a positive tone and consider incorporating relatable examples from everyday life or popular culture. Encourage student participation by inviting them to share their own humorous experiences, fostering a collaborative and enjoyable learning environment. Lastly, self-deprecating humour can make you more approachable, breaking down barriers between you and your students. For specific humour approaches, consider incorporating wordplay, puns, or clever jokes related to the subject matter. Visual humour, such as memes or cartoons, can add a playful element to your teaching materials. Be cautious with sarcasm, using it sparingly and ensuring clarity to avoid potential misunderstandings.

Statement of the Problem

Biology is one of the core science subjects in the secondary school curriculum, serving as a foundation for careers in medicine, nursing, pharmacy and other health-related professions. However, over the years, students' performance in Biology has remained relatively poor. As one of the core subjects that all science secondary students must take in the senior class, the subject teachers frequently use his well-known strategy to cover the syllabus within the allotted time and this does not give room for proper understanding of the subject, which makes some students tag some topics in biology as being difficult. The student's attitude toward the subject and the teaching method utilized to disseminate the material are two of the most frequently noticed issues in the teaching and learning of biology. Biology topics that have been deemed challenging may have an impact on students' academic achievement. Given the foregoing, every Nigerian, including the researcher, should be concerned about this backwardness on a general level. The use of humour in the context of teaching has not received enough attention, according to earlier studies. This is a result of teachers' limited experience, training, and awareness of how to implement humorous teaching strategies, particularly while teaching biology. In addition, humour is still used sparingly and is regarded as being unimportant in the teaching process. In the earlier research, using humour in the classroom can benefit students' engagement, self-efficacy, motivation, concentration, and enthusiasm in learning as well as teachers' lesson plans. Teachers being funny or bringing in jokes to explain the concept of his teaching will be a good motivator for understanding and memory retention of the subject.

Aim and Objectives of the Study

This study aims to examine students' perception of the utilization of humour by biology teachers and their academic performance. Specifically, this study aimed to:

i. Determine the Biology Achievement Test mean score.
ii. Investigate student perceptions on the use of humour by biology teachers.
iii. Assess biology teachers' views and adoption of humour for an improved academic performance.

Research Hypothesis

Null Hypothesis: There is no significant difference between teachers use of humour on student academic performance.

Methodology

Research Design: This study utilizes quasi experimental design for data collection inculcating quantitative method involving an experimental group and a control group; and a qualitative method involving the Biology teachers.

Population of the Study: The study targeted population consisted of Senior Secondary School Students and Biology teachers in schools within Ijebu Ode and Odogbolu Local Government, Ogun State.

Sample and Sampling Techniques: The total samples of this research work comprised of 100 students from Senior Secondary School II involving an experimental and control group; and 10 Biology teachers in Ijebu Ode and Odogbolu Local Government area. Two secondary schools were randomly selected for this study. A purposive sampling technique was used to select 50 students to the experimental class and 50 students in the control.

Students in the control group did not participate in any humorous activities from the teacher while Students in the experimental group were taught humorously.

Research Instruments: The research instruments that were used for the quantitative method was a self-structured questionnaire on teachers' humor Usage in Biology and Biology Achievement Test (BAT) using a well-prepared lesson plan on a biology topic Hereditary Variation comprising of 20 multiple choice question base on lower level of Blooms taxonomy which was constructed by the researcher. The questionnaire's instrument was researcher-made using a Likert type scale with four ratings: 4-Strongly Agree (SA), 3-Agree (A), 2-Disagree (D), 1-Strongly Disagree (SD).

Method of Data Collection: The students were divided into experimental group and control group. A lesson plan was developed for the experimental group on Hereditary Variation reflecting the use of Humor while the lesson plan for the control group was without humor approach. Both groups were subjected to a posttest using the same achievement measures.

Method of Data Analysis: Data once collected is checked for errors and missing values. Tool for analysis included frequency analysis, Mean, Standard deviation and paired sample t-test performed using the SPSS version 22.

Result

Research Question 1: Biology Achievement Mean Score.

Table 1 shows the mean score of the respondents Biology Achievement Test (BAT). The study found out the mean scores between the two groups after calculating their Biology achievement test score. The experimental group exhibited a higher mean achievement score of 11.54 ± 2.38 than the control group with an achievement mean score of 8.24 ± 2.47.

Table 1: Biology Achievement Mean Score

	Mean	N	Std. Deviation	Std. Error Mean
Control	8.24	50	2.471	.349
Experimental	11.54	50	2.384	.337

Research Question 2: Student perceptions on the use of humour by biology teachers.

Table 2: The table shows the student perception on the use of humor by Biology teachers. To determine the level of agreement between each item, the mean score for each item was determined. It was noted that the student has a positive perception on the use of humor by the teachers. Humor in the classroom is important since it creates a learning-conducive environment and improves the retention of material. It enables a relaxed classroom atmosphere with less stress and less fear among the students.

Table 2: Student perceptions on the use of humour by biology teachers.

	No Items	Mean	S.D	Level of agreement
1	Humour in the classroom helps me connect with the teacher	3.17	.763	Agree
2	Teacher use of humour during lesson encourages class attendance	3.08	.938	Agree
3	Humour helps students to remember the gained knowledge	3.19	.841	Agree
4	If humour is well managed in the classroom, it is a good method of teaching	3.41	.734	Agree
5	Using humour in the classroom creates a positive learning environment	3.15	.857	Agree
6	Humour makes the relationship between teachers and students more open and flexible.	3.27	.766	Agree
7	Humour helps students overcome shyness and encourages them to interact with the teachers in the class	3.26	.901	Agree

Research Question 3: Biology teachers' views and utilization of humour for an improved academic performance.

Table 3: Every teacher surveyed agreed that using humour in the classroom is a smart move (F=10). Another argument made by educators in this subtheme is that humour keeps students from getting bored in class (F=6). Additionally, the interviews with teachers found that they believe humour makes difficult ideas simpler to learn (F=3). Humour strengthens the bond between students and teachers, according to four teachers (F=4). The teachers who were interviewed also mention some drawbacks to adopting humour in the classroom. Time management is one of the adverse

impacts mentioned; if poorly handled, humor takes up more time (F=4). According to the interview, another detrimental effect of employing humour in schools is poor class management (F=2). The teachers list other examples of how they employ humour in the classroom in the table above. The majority of the teachers use humour in their jokes and stories (F=6), whereas four teachers use imitation to bring humour into the classroom (F=4), drama (F=2), and cartoons (F=2).

Table 3: Biology Teachers views and utilization of humour for an improved academic performance.

Themes	Sub Themes	Frequency
Contributions	Humour is a good strategy for teaching	10
	It decreases boredom in class	6
	It makes complicated concepts easier to understand	3
	It helps develop Student-Teacher relationship	4
Negative effect	Time Management	4
	Classroom Management	2
Ways of using humor	Jokes/Funny stories	6
	Drama	2
	Imitation	4
	Cartoon	2

Null Hypothesis: There is no significant difference between teachers use of humour on student academic achievement.

Table 4: The control group received instruction using the conventional method whereas the experimental group received instruction with Humour. The result shows a statistically significant difference between the experimental and control group with a P-value of less than 0.05. In contrast to the students' in the control group, those in the experimental group engaged more effectively and are reportedly satisfied with the teacher use of Humour

Table 4: Teachers' use of humour on student academic performance.

Paired Samples Test

	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Control - Experimental	-3.300	3.803	.538	-4.381	-2.219	-6.137	49	.000
								.000

Discussion of Findings

The aforementioned findings back up Afghari and Allami's (2017) assertion that humour in teaching and learning processes fosters a fun environment that is conducive to learning and allows students to express themselves freely without feeling stressed out or embarrassed.

In the control group, students' motivation, anxiety, and involvement were impacted by the lack of humour stimuli, none of the things that thrived in the experimental group happened. Not many students in the control group appeared to like the lessons and the class as a whole than in the experimental group.

Kavandi (2016) claims that humour have been used in teaching to help promote learning environments and also lead to a better academic achievement. Often when teachers or other classmates make a humorous speech in class, students' thoughts will suddenly get engaged. Humour sense can raise students' mental abilities and foster critical thinking (Rindfleisch, 2018). A sort of entertainment meant to make people laugh is humour (Erdogdu, 2021). It can be used to establish a pleasant learning environment and enhance group cohesion, creativity, and student motivation by breaking the rigidity and stillness of a serious environment (Bolkan, 2015). Teachers can ease tension in the classroom and relieve students' stress, exhaustion, and boredom by using humour. According to Abdulmojeed and Hameed (2017), when a teacher employs humour, students learn complicated topics more easily and perform better. It has the primary function of building relationships; thus, it is unsurprising that the use of humour by teachers in the classroom can improve the relationship between teachers and students. Students have also been reported to prefer teachers who laugh and tell jokes because they perceive these teachers as being approachable and nice. However, if it is inappropriate, using humour as a teaching method could have the opposite effect of what the teacher intended.

The students' agreement with the notion that humour makes tough subjects easier to understand and aids in memory of learned information is another finding from the study. Humour inspires students to participate in class activities.

The majority of participants' comments on the influence of humour on teaching were favorable. The use of humor in the classroom, according to all participants, helped foster a positive learning environment, lower student tension, and stimulate more open dialogue. Participants shared their conviction that including appropriate humour in the classroom improved student motivation and engagement. Humour was also used to increase students' willingness to take chances in the classroom, encouraging them to speak up during discussions, participate in experimental activities, and ask questions. Participants agreed that humour in the classroom helped students learn the material better. Additionally, humor-based teaching can create a psychologically safe environment in the classroom that facilitates students learning (Friedman & Friedman, 2019; Kumar & Dhiman, 2019).

Time management and classroom management are the biggest drawbacks of employing humour in the classroom as stated by some teachers. It is believed that inappropriate humour use, which does not follow a predetermined plan, may result in these harmful effects. In the Control group, the students only pay attention to the teacher as she explains the material; however, it was noticed in the experimental group that, after the teacher uses humour to explain a concept, most of the students want to add their own jokes and engage in conversation with one another. This

makes it occasionally difficult for the teacher to call the class back to order and this takes up some of the time allotted for the lesson and disrupts the class.

An interviewed teacher stated that, "Humour is a good method of teaching but some teachers make jokes in the class to the extent that they run out of time making them unable to finish the lesson content which will also result in the student not understanding anything for that period, so humour should be well managed and teachers must also be able to maintain a serious tone."

Conclusion

The result from this study revealed that when humour is included in biology lessons, students find it enjoyable and stress free. This is because humour helps close the communication gap between teachers and students, it also helps enhance good learning environment and reduce stress.

Moreover, the humour used must be subject and topic related which will be able to bring out the course objectives. It was therefore observed that the inappropriate use of humour as an effect on time management and Classroom management but conclusion was made that if humour is used wisely and in an appropriate way it won't waste time and will as well hasten comprehension of what is being taught.

Students' anxiety levels can be lowered by an enjoyable learning experience made possible by the use of humour in the class. The result shows that when humour is included in biology lessons, students find it to be enjoyable. Despite this, it is true that biology teachers do not regularly use humour in the classroom. Teaching using humour supports and promotes the teaching and learning processes among biology students. This is because humour may be used to show emotion, communicate with students and teachers, and enhance learning environments and reduce stress. Humor in the classroom will make students feel more at ease and help close the communication gap between teachers and students. This is because a humorous lesson will increase students' levels of involvement. Therefore, incorporating humour into the classroom can help students feel more motivated, satisfied and interested in studying. This research, which indicates that the use of humour can make the class pleasant demonstrated by the students' laughter therefore generating an enjoyable learning environment, is supported by a number of prior studies. Students who engage in this activity report feeling happier and paying attention in class more. Additionally, prior research has demonstrated that the use of humour engages students and boosts their desire to learn. As a result, their anxiety will decrease as the issue of learning biology shifts from a negative to a positive one. Not only that, but humour can help students pay attention to the lesson and comprehend a challenging or complex concept. This is due to the fact that employing humorous analogies or explanations will help students understands the material, inspire them to seek solutions to problems, and elevate their moods.

However, depending on the target's emotion and the sort of humour used, the effect of humour on the target may change. As a result, it's crucial to intentionally use humour. Teachers can therefore use humour as an additional method to boost higher order cognitive abilities and material retention.

Recommendations

The following recommendations were made in light of findings from the study;

1. Teachers should have sense of humour and not be embarrassed to use it. Humour won't waste time if utilized wisely, infrequently, and controlled properly; instead, it will hasten comprehension of what is being taught.
2. The type of humor that should be used should be based on the lessons that the teacher is teaching. It should be topic and subject-related so that students may create connections quickly and effectively for good recall of what is taught.
3. Humour should be carefully planned with a few key goals in mind. In light of how it can help students learn, love studying, and provide students another reason to attend class.
4. When choosing the type of humour to include in the learning process, it is important to take into account both the course objectives and the students' developmental needs.
5. Teachers should be encouraged to pursue formal training on the use of humour in the classroom. Learning about how to use humour effectively exposes teachers to new methods of teaching and managing students.

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ASSESSMENT OF THE FACTORS AFFECTING TEACHING AND LEARNING OF ECONOMICS IN SECONDARY SCHOOLS IN EKITI STATE, NIGERIA

BY

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Abstract

This study assessed the factors affecting teaching and learning of Economics in secondary schools in Ekiti State, Nigeria. Specifically, it examined the influence of availability of instructional materials, teaching methods and students' attitude to teaching and learning of Economics. Descriptive design of survey type was adopted. The population comprised all Economics Teachers and Senior Secondary School Three students offering Economics in all 272 public secondary schools in Ekiti State. The sample comprised 50 Economics teachers and 100 students selected from four Local Government Areas. The instrument used was a self-designed questionnaire tagged "Factors Affecting Teaching and Learning of Economics" (FATLE). Reliability was ascertained through test-retest method, yielding a reliability coefficient of 0.79. Research questions were answered using descriptive statistics of mean and standard deviation. The hypothesis was tested using Pearson's Product Moment Correlation at 0.05 significance level. Findings revealed that availability of instructional materials influenced effective teaching and learning of Economics. Teachers' methods of teaching positively affected teaching and learning, and students' attitude towards learning Economics was influenced by teaching methods adopted. The study recommended merit-based employment of Economics teachers and regular organization of seminars, workshops and symposia on contemporary issues.

Keywords: Assessment, Instructional Materials, Methods of Teaching and Students' Attitude

Introduction

Economics, as a secondary school subject in Nigeria, occupies a central place in the curriculum because of its potential to equip students with the knowledge, skills, and attitudes necessary for understanding and managing the problems of scarcity, choice, and allocation of resources. Beyond its academic relevance, the subject prepares young people for meaningful participation in society by helping them appreciate issues such as production, distribution, consumption, and the dynamics of economic development. In line with the objectives of the national policy on education, Economics is designed to promote critical thinking, problem-solving, and sound decision-making that can contribute to both personal success and national growth. However, despite its importance, the teaching and learning of Economics in Nigerian secondary schools continue to face significant setbacks that affect students' performance in both school-based and external examinations.

Over the years, studies have shown that students' academic achievement in Economics has

remained unsatisfactory compared to other subjects (Adeyemi, 2018). This situation raises serious concerns about the effectiveness of instructional delivery and the conditions under which the subject is taught. One of the critical issues is the inadequacy of instructional resources. For instance, Olatunji and Ojo (2019) observed that the limited availability of textbooks, visual aids, and real-life economic models has made it difficult for learners to grasp abstract concepts. The over-reliance on verbal explanation without sufficient teaching aids often forces students into rote memorisation, thereby undermining their ability to apply economic principles in real-life contexts.

In addition to resource inadequacy, teaching methodology has been widely identified as a major constraint. Research evidence reveals that the majority of Economics teachers in Nigerian secondary schools rely heavily on the lecture method, which is largely teacher-centred and offers limited opportunities for student engagement. Olatunji and Ojo (2019) noted that such approaches stifle creativity, discourage critical inquiry, and fail to build the analytical skills necessary for mastery of the subject. Similarly, Akinbola (2020) found that innovative strategies such as group discussion, problem-solving, and project-based learning are either under-utilized or inconsistently applied. This pedagogical weakness explains why many students perceive Economics as abstract and difficult.

Another factor that influences students' achievement in Economics is the quality and professional competence of teachers. Akinbola (2020) established a strong link between teacher qualification and students' performance, noting that teachers with specialised training in Economics produced better learning outcomes compared to those with a general social science background. This finding underscores the importance of teacher training, professional development, and continuous capacity-building as prerequisites for quality instruction. Without such interventions, teachers may lack the pedagogical skills to present abstract concepts in a simplified and practical manner.

Furthermore, the school environment and classroom management have been shown to play a decisive role in shaping learning outcomes. Eze and Okonkwo (2021) reported that overcrowded classrooms, poor seating arrangements, and frequent distractions undermine teaching effectiveness. In poorly managed classrooms, students' concentration drops significantly, and the ability of teachers to use interactive methods is curtailed. This points to the fact that even when teachers are well-trained, unfavourable classroom conditions can still hinder effective teaching and learning.

The introduction of information and communication technology (ICT) into the educational system was expected to transform teaching and learning processes in Nigeria. However, recent evidence suggests that ICT integration in the teaching of Economics remains minimal. Yusuf and Bello (2022) found that secondary schools equipped with ICT tools such as projectors, internet access, and digital resources recorded better student engagement and improved achievement levels in Economics. Yet, many schools, particularly in rural areas, lack such facilities, thereby widening the gap in learning opportunities between students in urban and rural settings. This technological disparity reflects broader inequalities in the Nigerian education system.

Beyond institutional and instructional challenges, students' attitudes also play an important role in learning Economics. Mohammed and Ibrahim (2023) discovered that students' interest and attitude toward Economics are largely shaped by the teacher's disposition and the relevance of the teaching methods employed. Students who perceive the subject as abstract and irrelevant to their daily lives often

develop a negative attitude, which translates into poor performance. Conversely, when teachers contextualise lessons using practical, real-life examples, students are more likely to develop a positive attitude and achieve better results.

Taken together, the reviewed studies highlight that the challenges facing the teaching and learning of Economics in Nigerian secondary schools are multidimensional. They range from inadequate instructional resources, ineffective pedagogical strategies, and limited teacher competence to poor classroom management, insufficient ICT integration, and negative student attitudes. Although some progress has been made in addressing these issues, there remains a significant gap in ensuring that Economics is taught in ways that enhance students' understanding and practical application. This underscores the need for further research into how teachers' pedagogical skills can influence students' academic achievement in Economics, especially within the context of Ekiti State where similar challenges have been reported.

Statement of the Problem

Economics is a subject being taught in secondary schools in Ekiti State, and it has been observed that students performed below expectation in the Senior Secondary Certificate Examination as shown in the WAEC Chief Examiners' Reports (2021, 2022 and 2024). In that, it has been observed that there are lots of factors militating against the effective teaching and learning of Economics in secondary schools which include lack of qualified teachers, lack of instructional materials, poor methodology of teaching, attitudes and interest of teachers and students in teaching and learning of Economics, etc.

It appears that majority of teachers in secondary schools encounter challenges particularly in the area of inadequate teaching aids, irrelevant instructional materials, and methods of teaching adopted in teaching Economics. Observation reveals that majority of teachers use irrelevant methods of teaching and this seems to have contributed to poor academic performance of the students. This implies that the teachers used methods that fail to improve the learning of Economics by the students.

It appears that the learning of Economics by students are not encouraging and the reasons for this may not be far from the teachers' attributes and students' personal academic factors. To this end, this study assessed the factors that could be responsible for the low performance established in this study.

Purpose of the Study

The purpose of the study was to assess the factors affecting teaching and learning of Economics in secondary schools in Ekiti State. Specifically, the study:

i. assessed the influence of instructional materials on learning of Economics in secondary schools.
ii. examined the influence of teaching methods on teaching and learning of Economics in secondary schools
iii. investigated the influence of students' attitude towards learning of Economics in secondary schools.

Research Questions

The following research questions guided this research work:

1. To what extent do instructional materials influence the teaching and learning of Economics in secondary schools?
2. To what extent do methods of teaching affect the teaching and learning of Economics in secondary schools?
3. What is the attitude of students towards learning of Economics in secondary schools?

Research Hypothesis

The following research hypothesis was formulated and tested in the study:

1. There is no significant relationship between the availability of instructional materials and effective learning of Economics in secondary schools in Ekiti State.

Methodology

The research design used for this work was survey design. This is because only a part of the population was studied and the findings were generalized to the entire population. The population comprised of all Economics teachers and all Senior Secondary School Three (SS III) students offering Economics in all 272 public secondary schools in Ekiti State. The sample for the study comprised 50 Economics teachers and 100 students from four Local Government Areas (LGAs). The sample was selected using multistage sampling procedure. The first stage was the selection of one of the three Senatorial Districts in Ekiti State using simple random sampling technique and Ekiti South Senatorial District was selected. The second stage was the selection of four, out of the six LGAs in the Senatorial District using simple random sampling technique. The third stage was the selection of five secondary schools from each of the four LGAs using simple random sampling technique, making a total of 20 schools. The fourth stage was the selection of five SSS III students from each of the selected schools, making a total of 100 students. All the 50 Economics teachers found in the schools were purposively selected and used for the study. The instrument used for data collection was a self-designed questionnaire tagged Factors Affecting Teaching and Learning of Economics (FATLE). The instrument comprised two sections (A and B). Section A presented the demographic data of the respondents while section B contained 15 items related to the variables in the study. The questionnaire was patterned on the Four-Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The questionnaire was validated by the researchers' supervisor and three Tests and Measurement experts from the Institute of Education, Faculty of Education, Ekiti State University, Ado-Ekiti. A test-retest reliability method was used to ascertain the reliability of the instrument. The researcher administered the instrument to 20 respondents outside the sample twice in the interval of three weeks and their responses were analysed using Pearson's Product Moment Correlation (PPMC) statistics. This yielded a reliability coefficient of 0.79, which was considered high enough for the study.

The researcher, after explaining the purpose of the study to the respondents, administered the instrument to them with the help of two-trained research assistants. Their responses were collected as soon as they finished. Descriptive and inferential statistics were used to analyse the data collected in the study. Research questions were answered using mean and standard deviation. The only hypothesis formulated for the study was tested using Pearson's Product Moment Correlation at 0.05 level of significance.

Results

Research Question 1: To what extent do instructional materials influence the teaching and learning of Economics in secondary schools?

Table 1: Mean Responses of Teachers on the Influence of Instructional Materials

S/N	Item	Mean	SD	Decision
1	Lack of Economics textbooks affects students' learning	2.97	0.91	Agree
2	Some secondary schools lack libraries, leading to ineffective teaching	2.30	0.88	Disagree
3	Lack of classroom accommodation affects teaching of Economics	2.95	1.05	Agree
4	Teachers do not make use of appropriate teaching materials	2.75	0.97	Agree
5	The school library lacks current Economics textbooks	2.40	0.82	Disagree
Grand Mean		2.67		

Decision: $\bar{X}$ = or > 2.50 is Agreed while $\bar{X}$ < 2.50 is Disagree

Table 1 shows that the majority of teachers agreed that the availability of instructional materials has a positive influence on the teaching and learning of Economics. The grand mean score of 2.67, which is above the criterion mean of 2.50, indicates that instructional materials play a vital role in facilitating effective learning. Teachers observed that inadequate supply of textbooks and poor classroom conditions hindered students' understanding of Economics concepts.

Research Question 2: To what extent do methods of teaching affect the teaching and learning of Economics in secondary schools?

Table 2: Mean Responses of Teachers on Methods of Teaching

S/N	Item	Mean	SD	Decision
1	Time allotted to Economics affects teachers' preparation	2.10	0.76	Disagree
2	Deductive method of teaching is more effective	3.00	1.01	Agree
3	Lack of good teaching method affects students' performance	3.10	0.94	Agree
4	Variety of methods used improves students' performance	2.30	0.89	Disagree
5	Teaching method affects students' learning outcome	2.70	0.95	Agree
Grand Mean		2.64		

Decision: $\bar{X}$ = or > 2.50 is Agreed while $\bar{X}$ < 2.50 is Disagree

From the above Table 2 revealed that teachers generally agreed that teaching methods significantly affect the teaching and learning of Economics. A mean score of 2.64 suggests that ineffective methods such as one-way lectures reduce students' participation and comprehension, while student-centred methods enhance students' understanding.

Research Question 3: What is the attitude of students towards learning of Economics in secondary schools?

Table 3: Responses of students' attitude towards learning of Economics

S/N	Item	Mean	SD	Decision
1	Some students absent themselves from Economics class	2.75	1.04	Agree
2	Poor preparation by teachers makes learning uninteresting	2.63	0.92	Agree
3	Teachers' nonchalant attitude discourages students	2.58	0.85	Agree
4	Students dislike Economics because of its mathematical nature	2.48	0.80	Disagree
5	Embezzlement of funds affects availability of classrooms	2.30	0.84	Disagree
Grand Mean		2.55		

Decision: $\bar{X}$ = or > 2.50 is Agreed while $\bar{X}$ < 2.50 is Disagree

The results in Table 3 indicated that students' attitudes towards Economics are moderately positive. Although some students show disinterest due to perceived difficulty of the subject, the overall mean score of 2.55 suggests that with improved teaching approaches and teacher commitment, students' attitudes towards learning of Economics can become more favourable.

Hypothesis Testing

Hypothesis 1: There is no significant relationship between the availability of instructional materials and effective learning of Economics in secondary schools in Ekiti State.

Table 4: Relationship between availability of instructional materials and effective learning of Economics in secondary schools

Variable	N	Mean	SD	df	Sig. (p)
Availability of instructional materials	150	2.64	0.94	148	0.012
Effective learning of Economics	150	2.71	0.88		

p>0.05

Table 4 shows that the calculated significance value (0.012) is less than the 0.05 level of significance. Therefore, the null hypothesis is rejected. This implies that there is a significant relationship between the availability of instructional materials and the effective learning of Economics among secondary school students in Ekiti State. The result suggests that the more instructional materials are available and used appropriately, the more students' learning outcomes in Economics improve.

Discussion

The finding of the study revealed that availability of instructional materials lead to effective teaching and learning of Economics in secondary schools. The finding showed that the use of instructional materials for the teaching of Economics makes it easy for the teachers to deliver the instruction adequately while it helps the students in getting the contents in Economics very well. The finding is in agreement with the finding of William (2012) that the availability of instructional materials is essential for effective teaching and learning of Economics in secondary schools. It found that schools with the dearth or non-availability of the instructional materials may record poor students' attitude towards learning of Economics in classroom. The finding also agreed with the finding of Nwadum (2014) that provision of

instructional materials and teaching aids by schools lead to effective teaching and learning in the schools.

The finding of the study revealed that teachers' methods of teaching affect teaching and learning of Economics in the secondary schools. It revealed that students' attitude towards learning of Economics was influenced by the methods of teaching adopted by teachers. The finding was in conformity with the finding of Aneke (2010) natures or types of methods of teaching adopted in by teachers is important because it will enable the teachers to relate Economics issues to students well.

Students' attitude influenced teaching and learning of Economics in secondary schools. The attitude of the students motivated or demotivated the teachers to do more and it help to determine the extent of students' learning in Economics. The finding is in line with the finding of Olatoun (2010) that attitude of teachers towards teaching and attitude of students towards learning of Economics contributed majorly to the successful teaching and learning of Economics in secondary schools.

The findings of the study revealed that the availability of instructional materials has a significant relationship with the effective learning of Economics in secondary schools in Ekiti State. The result is in agreement with the findings of Adeyemi (2018) that schools with sufficient instructional resources recorded higher students' achievement in Economics compared to those with inadequate materials. Similarly, it agrees with the finding of Okafor and Ojo (2020) that instructional resources stimulate learners' interest and make abstract economic concepts more concrete and comprehensible.

Conclusion

The study concluded that the teaching and learning of Economics in secondary schools in Ekiti State are influenced by the availability of instructional materials, teaching methods, and students' attitudes. The findings revealed that adequate and proper use of instructional materials significantly enhances students' understanding of Economics. It also established that effective and interactive teaching methods promote better learning outcomes, while students' positive attitudes motivate teachers and improve classroom engagement. Therefore, improving the teaching and learning of Economics requires adequate provision of instructional materials, adoption of effective teaching strategies, and encouragement of positive students' attitudes towards the subject.

Recommendations

The following recommendations were made based on the findings and conclusion of the study:

1. Employment of Economics teachers by the government through the ministry of education should be strictly based on merit so as to make it possible for only those who studied the course to be appointed.
2. The government should try as much as possible to organize from time to time, seminars, workshops and symposium for Economics teachers on contemporary issues in the field.
3. The government should provide instructional materials to schools and teachers should also improve where necessary for Economics.
4. More emphasis should be laid on Economics as a core subject in senior secondary schools in order to boost students' morale towards the subject.

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JUNIOR SCHOOL CERTIFICATE RESULTS IN MATHEMATICS AND BASIC SCIENCE AS PREDICTORS OF STUDENTS' PERFORMANCE IN SENIOR SECONDARY SCHOOL PHYSICS EXAMINATIONS IN ONDO STATE

BY

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Abstract

The study investigated the junior school certificate results in Mathematics and Basic science as predictors of students' performance in senior secondary school Physics examination in Ondo State. Four research hypotheses were generated for the study. The hypotheses were tested at 0.05 level of significance. Thirty-six secondary schools were purposively selected from six local government areas of the three senatorial districts in Ondo state, namely, Ondo north, Ondo central and Ondo south. Two local government areas were selected from each of the senatorial districts using simple random sampling technique. A total of 1,826 from the entire 2020/2021 SSS3 Physics students who came in by JSCE and had complete record from SSS1 to SSS3 and also sat for Physics in SSS classes and 2020/2021 WAEC/NECO SSCE were involved in the selected secondary schools. Data collected were analyzed using correlation analysis and regression analysis. Result revealed that Mathematics and Basic science JSCE results significantly predict students' performance at the SSS2 unified examinations in Physics ($F = 91.639$, $P < 0.05$), WAEC SSC examinations in Physics ($F = 220.297$, $P < 0.05$), and NECO SSC examinations in Physics ($F = 66.478$, $P < 0.05$). It was concluded that JSC mathematics and Basic science examination results would significantly predict the academic performance of students at the SSS 2 unified, WAECSSC and NECOSSC Physics examinations. Based on the findings of this study, it was recommended among others, that JSCE results should remain a yardstick for admitting students into senior secondary schools as a way of achieving and maintaining quality Physics education.

Keywords: *Performance, Correlation, JSCE, Basic science, Physics.*

Introduction

The academic performance of students depends to a great extent on certain factors. These factors include type of school attended, sex and age (Ogunboyede, 2017; Olatunde 2017; Robert; 2019; Adelana, 2020; Ojuola, 2021). Researchers showed that previous knowledge affects academic performance (Ogunwole, 2016; James, 2018; Ololade, 2019; Obiano, 2020; Wilson and Thompson, 2020; Akinola, 2021 Ojuola, 2021). This is, one of the major reasons for the adoption of JSCE as a yardstick for admitting students to senior secondary schools in Nigeria (Wilson and Thompson, 2020). Hence, a student is admitted with the assumption that he or she possesses the ability and skills necessary to cope with the academic challenges at the Senior Secondary School level.

The Junior School Certificate Examination (JSCE) is a public examination in Nigeria, conducted by each State of the Federation through their respective Ministries of Education for students at the end of the third year of Junior Secondary Schooling.

The National Examination Council (NECO) is a national examination body responsible for the conduct of JSCE for all JSS3 students of the Federal Government Colleges and some Private Secondary Schools in Nigeria who are willing to register their students for NECO examinations. The JSCE is the system adopted in admitting students to senior secondary schools and the admission is controlled by the various States' Ministries of Education in Nigeria.

The unified examination is the examination conducted by the Ministries of Education for senior secondary school two (SSS2) at the end of third term in Ondo State. The results of this examination serve as a promotion examination to SSS3. While the Senior School Certificate Examination (SSCE) on the other hand is a national examination for all Senior Secondary School three (SSS3) students in all secondary schools in Nigeria. It is being conducted and administered by West African Examinations' Council (WAEC) and National Examinations' Council (NECO). The two examination boards conduct parallel or equivalent Senior School Certificate (SSC) Examinations in the country. The WASCE was first conducted in 1958 by WAEC and its validity has been ascertained by many researchers like Olatunde (2017) and Olagbade (2019).

According to Ojelade (2019), when scores on a test can be appreciably used to predict or estimate learners performance on another test, the test used for prediction, the predictor, is said to have predictive validity, while the second test that was predicted is referred to as criterion. Omodara (2020) said that predictive validity is the ability of an instrument to predict some future event (s). Predictive validity is the extent to which a test predicts success in future when candidates are selected into study programs in Nigeria schools on the basis of their JSCE. The belief behind this selection process is that students who meet the admission requirements will likely succeed in their studies. However, how accurate this belief actually is remains uncertain.

If an examination existed that could a accurately forecast a student's future performance with minimal mistakes, admission committees in schools would have dependable tools to choose candidates most likely to excel in their academic pursuits. But unfortunately, most current tests of performance do not possess such quality (Agenta, 2016). Predictive validity, within this context demands that for any test of performance to be used as an index of later performance in a school, it must be fully established that the test scores are capable of forecasting degree of success in the proposed area of study. In other words, for the test scores to be used as predictors of future academic performance, there must be a significant relationship between such score and later performance or some criterion.

Mathematics is as old as man. It has developed from the time when there was often little practical use of what was studied to its present position as the basis on which our scientific and technical knowledge built. The importance of mathematics cannot be overstressed as it is the base of all science. All students must learn and pass it at the secondary school level before they can be admitted into the university (Olofin and Kolawole, 2020).

Basic science is one of the subjects offered at the junior secondary level. The essence of teaching basic science at junior secondary level in Nigeria secondary education is to prepare students for the science subjects so that each of the major science subjects, that is, physics, chemistry and biology will not be totally new to the students at the senior secondary level. Basic science as a subject is therefore a perquisite to subject like physics, chemistry and biology. Sciences are very important in the development of a nation. The development of a country rest on

science and technology in the world of work (Nwakie, 2018). All students must learn and pass Mathematics and Basic science at the junior secondary school level before they can be admitted to learn Physics at the senior secondary schools (Nwaogozie, 2022).

Physics is one of the science subjects in the secondary school curriculum in Nigeria. The subject is offered at the senior secondary school level Oriola (2019) observed that Physics is needed to produce the necessary human resource and skilled labour force to manage our local industries and educational institutions. The study of Physics helps us to understand our natural world and also approach challenges we face in life and our work place in a more systematic and logical manner. Physics education is the conscious effort to raise the level of scientific of all students and equip them with relevant basic scientific knowledge needed for their own living and also contribute to the country development (Olusola, 2022).

Despite the unique position of examinations in educational system, there have been conflicting reports on the predictive strength of the JSCE at predicting performance in the senior secondary school examinations (Ondo State Ministry of Education, 2016, Gideon, 2016; Olusola, 2020; Daniel, 2020 and Ojuola, 2021). Based on that concern, some educational researchers have advocated for the review of the junior school certificate examinations on the ground that its predictive value is in doubt (e.g. Donald, 2017 Olagbade 2019 Zainab, 2022). For example Donald (2017) examined the predictive validity of Oyo State junior secondary certificate examination. The study was undertaken to find out whether there is significant relationship between the overall performance of students in the JSCE and their performance in the senior school certificate examination (SSCE). Scores of students in JSCE and scores of students in SSCE were correlated using correlation analysis procedure. Overall performance in JSCE across the six subjects of which Mathematics, Basic science and Physics were included showed no significant relationship between the subjects. It was recommended that JSCE must be reviewed. He therefore advocated for the review of JSCE on the ground that its predictive value is in doubt.

Adebayo (2018) examined the predictive validity of JSC examination scores in selected public and private secondary schools in Abeokuta, Ogun State. Scores of 40 students in Mathematics and Basic science at 2010 and 2011 were run against their scores in 2013 and 2014 Physics in Abeokuta. The JSCE results in Mathematics and Integrated science were run against SSC examination results in Physics using person product moment correlation to determine the relationship. Result revealed that JSCE Mathematics and Basic science examinations were not significant predictor of the performance of students in SSC physics examination. The result also showed no significant relationship between students' performance in the overall JSC examinations and SSC examinations. The researcher had correlated JSC Mathematics and Integrated science in the SSC Physics examinations. The above inconsistent reports and findings leave one with doubt as to whether JSCE may have reliable validity. It is therefore necessary to examine the predictive validity of the Junior School Certificate (JSC) Mathematics and Basic science examinations in Ondo state.

The study was designed to examine the junior school certificate results in Mathematics (JSCMTH) and junior school certificate Basic science (JSCS) as predictors of student's performance in senior secondary school Physics examinations in Ondo state. The study was specifically designed to:

a) examine the relationship among the academic performance of

students in JSC Mathematics, JSC Basic science, SSS2 unified Physics, WAECSSC Physics and NECOSSC Physics examination results.

b) determine the values of JSC Mathematics and Basic science examination results in predicting subsequent results in SSS2 Physics examinations.
c) determine the values of JSC Mathematics and Basic science examination results in predicting subsequent results in WAECSSC Physics examinations.
d) determine the values of JSC Mathematics and Basic science examination results in predicting subsequent results in NECOSSC Physics examinations.

Research Hypotheses

The following hypotheses were generated for the study:

H_{01}. There is no significant relationship among the academic performance of students in JSC Mathematics, JSC Basic science, SSS 2 unified Physics, WAECSSC Physics and NECO SSC Physics examination results.

H_{02}. JSC Mathematics and JSC Basic science examination results will not significantly predict the academic performance of students at the SSS2 unified Physics examinations.

H_{03}. JSC Mathematics and JSC Basic science examination results will not significantly predict the academic performance of students at the WAEC SSC Physics examinations.

H_{04}. JSC Mathematics and JSC Basic science examination results will not significantly predict academic performance of students at the NECO SSC Physics examinations.

Methodology

The study was a descriptive research of the expost-facto research design as the researcher did not have direct control on the independent variables, their manifestation has already occurred. (Ngokie (2020). They were inherently not manipulable. The data were collected from the examination result sheets sent to schools by the Ondo State Ministry of Education known as JSCE Computer sheet and master marks' sheet records in the schools

The target population consisted of the entire 2020/2021 SSS3 students who were admitted into senior secondary schools through JSCE results in Ondo State. The sample for the study comprised of 1,826 SSS3 Physics students selected through multistage sampling technique. The selected Physics students were the students who wrote Mathematics and Basic science in JSCE, offered as a subject at the senior secondary school level and wrote 2020/2021 WAEC/NECO SSCE. These constituted the subjects for the study. First the geographical areas of Ondo State were stratified into three Senatorial Districts, namely; Ondo North, Ondo Central and Ondo South, using stratified sampling technique. A simple random sampling technique was then used to select two Local Government Areas (LGAs) out of six from each of the Senatorial Districts. Six secondary schools from each of the selected Local Government Areas were then selected using purposive random sampling technique. These schools were purposively selected because they are the top six oldest secondary schools from each of the selected LGAs and have been presenting students for WASCE and NECO for over 20 years. Therefore, they were expected to have well-equipped laboratories and libraries for effective teaching and learning of Basic science, Mathematics and Physics.

An inventory titled "Students JSCE and senior secondary school examination (SSSE) Academic Performance Proforma'' was used to collect the relevant data for the study.

The Proforma consisted of items that captured information about the students such as name of school, Local Government Area, students' JSCE grades in Mathematics and Basic science for 2017/2018, the students' grades in Physics for 2019/2020 unified examinations and 2020/2021 SSC examinations. The pattern of grading students' scores in JSSCE are such that the distinction grade is represented by "A" (60 – 100). The credit grade is represented by "C" (50 – 59). The ordinary pass is represented by "P" (40 – 49) while the failure grade is represented by "F" (0 – 39). The pattern of grading students' scores in senior secondary school examinations (internal and external) are such that the distinction grade is represented by B3 to A1(65 – 100). The credit grade is represented by C6 to C4 (50 – 64). The ordinary pass grade is represented by E8 to D7 (40 – 49) and the failure grade is represented by F9 (0 – 39) Fadotun, (2020). For the purpose of scoring, therefore, JSCE grades of A, C, P and F were awarded 3, 2, 1 and 0 points respectively while SSSE grades of (B3 - A1), (C4 – C6), (D7 – E8) and F9 were also awarded 3, 2, 1 and 0 points respectively (see table 1).

The data collected were analyzed using correlation analysis and regression analysis. These analyses were chosen as focus was placed on association relationship indicating the strength, direction of relationship as well as prediction (Nwakie, 2018). All the null hypotheses postulated for the study were tested at 0.05 level of significance.

Table 1: Pattern of Grading Students in JSCE Mathematics and Basic science and SSS 3 Physics.

Examination	Grade	Scores Range	Scoring Point
JSCE Mathematics and Basic science	A	60 – 100	3
	C	50 – 59	2
	P	40 – 49	1
	F	0 – 39	0
SSSE Physics	A	65 – 100	3
	C	50 – 64	2
	P	40 – 49	1
	F	0 – 39	0

Results and Discussion

Testing of Hypotheses

$H0_1$: There is no significant relationship among the academic performance of students in JSC Mathematics, JSC Basic science, SSS2 unified Physics, WAECSSC Physics and NECO SSC Physics examination results.

Table 2: Correlation matrix showing relationship among the academic performance of students in JSC Mathematics, JSC Basic science, SSS2 unified Physics, WAECSSC Physics and NECOSSC Physics examination results.

Variables	JSCE Mathematics	JSCE Basic Science	SSS2 unified Examination Physics	WAECSSC Physics	NECOSSC Physics
JSCE Mathematics	1				
JSCE Basic Science	0.482 P = 0.000	1			
SSS2 Unified Examination Physics	0.648 P = 0.000	0.568 P = 0.000	1		
WAECSSC Physics	0.689 P = 0.000	0.743 P = 0.000	0.631 P = 0.000	1	
NECOSSC Physics	0.674 P = 0.000	0.685 P = 0.000	0.494 P = 0.000	0.812 P = 0.000	1

Table 2 presented the relationship among the academic performance of students in JSC Mathematics, JSC Basic science, SSS2 unified Physics, WAECSSC Physics and NECOSSC Physics examination results. The result showed that there was positive significant relationship between JSC Mathematics and SSS2 unified Physics examination results ($r = 0.648$, $P < 0.05$), JSC Basic science examination result had a positive significant relationship with SSS2 unified Physics examination results ($r = 0.568$, $P < 0.05$). The results revealed that JSC Mathematics examination results had positive significant relationship with WAECSSC Physics examination results ($r = 0.743$, $P < 0.05$), JSC Basic science examination result had a positive significant relationship with WAECSSC Physics examination result. ($r = 0.631$, $p < 0.05$). The table also revealed a positive significant relationship between JSC Mathematics and NECOSSC Physics examination results ($r = 0.674$, $P < 0.05$), a positive significant relationship was established between JSC Basic science and NECOSSC Physics examination results ($r = 0.685$, $P < 0.05$). By implication, the hypothesis was rejected since independent variables significant correlate with dependent variable at 0.05 level of significance in each case.

H_{02}: JSC Mathematics and JSC Basic science examination results will not significantly predict the academic performance of students at the SSS2 unified Physics examinations.

Table 3: Summary of regression analysis of the academic performance of students in JSC Mathematics and JSC Basic science examination results with the SSS 2 unified Physics examinations results

$R = 0.645$ $R^2 = 0.416$ Adjusted $R^2 = 0.414$	Sum of squares	df	Mean square	F	Sig.
Regression	296.651	2	148.326	99.481	0.000
Residual	2718.907	1823	1.491		
Total	3015.558	1825			

$P < 0.05$, significant results
Dependent variable: UNIPHY

Predictors (constant), JSCMTH, JSCS

The results in table 3 showed the academic performance of students in JSC Mathematics and JSC Basic science on SSS2 unified Physics examination results (F = 99.481, P < 0.05). Thus, the hypothesis 2 was rejected. The result revealed that there was positive correlation between the academic performance of students in JSC Mathematics, JSC Basic science and SSS2 unified Physics examination results. (R = 0.645, P < 0.05). The value of the coefficient of determination (R^2 = 0.416) indicated that the predictor variables jointly accounted for 41.6% of the variance in criterion

H_{03}: JSC Mathematics and JSC Basic science examination results will not significantly predict the academic performance of students at the WAECSSC Physics examinations.

Table 4: Summary of regression analysis of the academic performance of students in JSC Mathematics and JSC Basic science examination results with the WAECSSC Physics examination results

R = 0.718 R^2 = 0.516 Adjusted R^2 = 0.513	Sum of squares	df	Mean square	F	Sig.
Regression	739.914	2	369.957	170.017	0.000
Residual	4986.728	1823	2.176		
Total	5726.642	1825			

P < 0.05, significant results
Dependent variable: WAEC PHY
Predictors (constant), JSCMTH, JSCS

The result in table 4 showed the academic performance of students in JSC Mathematics and JSC Basic science on WAECSSC Physics examination results (F = 170.017, P < 0.05). Thus, the hypothesis 3 was rejected. The result showed that there was positive correlation between the academic performance of students in JSC Mathematics, JSC Basic science and WAECSSC Physics examinations results (R = 0.718, P < 0.05). The value of the coefficient of determination (R^2 = 0.516), indicated that the predictor variables jointly accounted for 51.6% of the variance in WAECSSC Physics examinations.

H04: JSC Mathematics and JSC I Basic science examination results will not significantly predict the academic performance of students at the NECO SSC Physics examinations.

Table 5: Summary of regression analysis of the academic performance of Students in JSC Mathematics and JSC Basic science examination results with the NECO SSC Physics examination results.

R = 0.684 R^2 = 0.468 Adjusted R^2 = 0.466	Sum of Squares	df	Mean square	F	Sig.
Regression	229.876	2	114.938	84.825	0.000
Residual	2471.328	1823	1.355		
Total	2701.204	1825			

P < 0.05, Significant results
Dependent variable: NECO PHY
Predictors (constant), JSCMTH, JSCS

The results in table 5 showed the academic performance of students in JSC Mathematics and JSC Basic science on NECO SSC Physics

examination results (F = 84.825, P< 0.05). Therefore, the hypothesis 4 was rejected. The result showed that there was positive correlation between the academic performance of students in JSC Mathematics JSC Basic Science and NECO SSC Physics examination results (R = 0.684, P < 0.05). The value of the coefficient of determination (R^2 = 0.468) indicated that the predictor variables jointly accounted for 46.8% of the variance in NECOSSC Physics examinations.

Discussion of the Findings

Finding from hypothesis 1 revealed that there was significant relationship among the academic performance of students in JSC Mathematics, JSC Basic science, SSS2 unified Physics, WAECSSC Physics and NECOSSC Physics examination results. The finding was not in consonance with the findings of Donald (2017) and Raymond (2018) who found no significant relationship between the JSC Mathematics, JSC Basic science and SSC Physics examination results.

Finding from hypothesis 2 revealed that the academic performances of students in the JSC Mathematics examinations and JSC Basic science examinations were significant predictors of the academic performance of students in the SSS2 unified Physics examinations. This was in contrary to the findings made by Gideon (2016) and Adebayo (2018) who reported that the JSC Mathematics and Basic science examinations could not predict the academic performance of students at the SSC Physics examinations.

Finding from hypotheses 3 and 4 revealed that academic performances of students in the JSC Mathematics examinations and JSC Basic science examinations were significant predictors of the academic performance of students at the WAEC and NECO SSC Physics examinations. This was in agreement with the finding of Ojuola (2021), who reported that the JSC Mathematics examinations and JSC Basic science examinations were significant predictors of the academic performance of students at the SSC Physics examinations. However, this was at variance with the findings of Akinola (2021), who claimed that JSC Mathematics examinations was not a significant predictor of students' performance at the SSC Physics examinations and found no significant relationship between the performance of students in the JSC Basic science and the SSC Physics examinations.

The JSCE is a yardstick for admitting students into the SSS in Ondo State. The student who is hereby selected must have possessed the abilities and skills necessary to cope effectively with the academic challenges/rigours in the SSS, since such a student would have acquired and completed the contents of the JSS curriculum. A student who performs brilliantly in the JSCE in Mathematics and Basic science should have the ability to cope and perform brilliantly in the SSS2 unified examinations and SSCE in Physics. All things been equal, a student with good results in Mathematics and Basic science JSCE should also obtain the same grades in SSS2 unified examinations and SSCE in Physics.

Conclusion

Based on the findings of the study, it was concluded that JSC Mathematics and Basic science examination results would significantly predict the academic performance of students at the SSS2 unified, WAECSSC and NECOSSC Physics examinations.

Recommendations

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

1. The JSCE results should remain as a yardstick for admitting Physics students into senior

secondary schools as a way of achieving and maintaining good quality Physics education.

2. Parents should divest themselves of illusion that the grades obtained by their words in Basic science is an authentic indicator of the grades they would have at senior secondary school Physics. They should rather get their wards properly equipped to face the greater task that lies ahead in Physics. This could take the form of procuring relevant textbooks in Physics.

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LECTURERS AND UNDERGRADUATES' ATTITUDES TOWARDS ONLINE TEACHING IN OYO STATE, NIGERIA: IMPLICATIONS FOR SCIENCE EDUCATION TEACHING IN THE POST COVID-19 PANDEMIC ERA

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Abstract

This article investigated the attitudes of some Science education lecturers and students towards online teaching strategy. The study was carried out in one of the public universities in the southwest, Nigeria. The undergraduates involved in the study were those pursuing Bachelor of Science Education degrees in Biology, Chemistry, Physics, Mathematics and Integrated Science and the science education lecturers that were teaching the students as at the time of the study. The study adopted a descriptive survey design of the ex-post facto type. The sample comprised 75 Science education lecturers and 75 science education students of the university selected through simple random sampling technique. A valid and reliable Online Teaching Attitudinal Scale (Criterion related validity = 0.78 and r = 0.86) was used to collect relevant data for the study. Data were analyzed by using frequency count and t-test statistics. Results of findings showed that a higher proportion of the lecturers exhibit positive attitude towards online teaching while a higher proportion of the students possess a negative attitude towards online teaching. It also revealed insignificant difference between the attitudes of science education lecturers and students in terms of their attitudes towards online teaching. In addition, there is no significant difference in the attitudes of male and female students towards online teaching. The study recommended that there was the need for both the university lecturers and their students to develop positive attitudes towards online teaching. It also recommended that university authorities should provide necessary digital tools and encourage digital training among university staff especially science education lecturers. . The university authorities should provide necessary digital tools and encourage digital training among university staff especially science education lecturers.

Key words: Online teaching, undergraduates, attitudes, science education lecturers, science education students, pandemic

Introduction

Online teaching has gained popularity due to its accessibility, flexibility, and cost-effectiveness. It involves asynchronous lectures and blended classes, with various strategies developed to teach online classes (Ally-Charles et al., 2024; Gustin & Vasquez, 2017; Kopczynski & Silvia, 2023). However, teachers often face challenges due to lack of student feedback and simplified approaches to promoting participative behaviour. Online teaching strategies can vary depending on the subject and assignment type, and some classroom practices are equally relevant in both online and face-to-face interactions. The shift to online teaching platforms during the COVID-19 pandemic highlighted the need for educators to adapt their teaching methods and effectively utilize online platforms.

The COVID – 19 has brought about tremendous changes around the world and this has given rise to the digitalization of education process through online teaching and learning as well as its introduction into the educational programmes of universities. In order to stem the spread of COVIC – 19 pandemic, many nations and indeed institutions have moved many of their operations online. Since the arrival of the pandemic, universities have been introducing digitalized strategies to teaching and learning. This step has resulted into adaptation problems for both students and teachers. Some of the problem areas according to Leontev (2023) include teachers' lack of digital skills with its attendant effects on lesson preparation as well as conduct of online classes. In contrast, Passey et al (2018), Raimi (2022), Raimi, Babayemi, Umanah and Akpan (2024) pointed out the consequences and benefits of the introduction of online teaching which is manifested in the fact that many of the lecturers were found to be competent in the use of digitalized techniques of teaching. This was made possible as a result of the current situation, although preparing for online teaching consumes more time than preparing for similar physical classes.

Ethical challenges have arisen due to the need for students to have online learning readiness (OLR), which is based on their preferences and technological confidence. The debate centered on whether teachers could demand students have their cameras on during lectures, leading to Zoom fatigue. Some educators used different approaches, while others argued that non - verbal cues are important for learning and rapport building. Traditional education has been transformed into online learning (OLE) in synchronization with the new technology era to improve education (Wang, 2023; Xie et al., 2018). The rapid development of information technology and emerging technologies like the Internet of Things has led to new technologies and methods to promote education equilibrium. Effective classroom interaction is essential for improving teaching effectiveness and quality.

The COVID-19 pandemic has prompted institutions to adopt online or blended learning, resulting in increased

interest in online teaching. This shift has prompted a study on stakeholders' attitudes towards online teaching, particularly in science education. These studies revealed positive attitudes among medical and engineering students, but challenges like technical support and lack of interaction persist (Al-Fraihat et al., 2020; Khechine et al. (2020). The spontaneous and widespread adoption of online technologies in educational process is somehow an ambitious task which is not unconnected with the goal to overcome resistance to organizational change, developing ideas of trust and cooperation in this sense, the views and attitudes of teachers and students become significant because the perception and attitude to online class are crucial for motivation and learning.

In the context of science education, several studies have investigated the effectiveness of online teaching in different science subjects. For example, a study by Gustin and Vasquez (2017) found that online teaching was as effective as traditional face-to-face teaching in a chemistry course. In other related studies, Raimi (2022) and Raimi et al (2024) also affirmed the efficacy of the use of online teaching in different aspects of Chemistry at the undergraduate levels. Another study by Xie et al. (2018) reported that online teaching was effective in improving students' understanding of biology concepts. However, there is a need to investigate the attitudes of science education lecturers and undergraduates towards online teaching in specific contexts.

Theoretically, the study used a phenomenological framework to understand the experiences of online teachers during the COVID-19 pandemic. Phenomenology, a philosophical tradition, focuses on understanding human experience by analysing how people perceive and make sense of the world. It emphasised the context and how it shapes individual experiences. The study uses phenomenology to understand educators' perceptions and interpretations of their new teaching environment, suspending preconceived notions and beliefs. This approach provides a useful framework for understanding and supporting educators in this new teaching environment like online teaching.

This study also adopted the Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), and Community of Inquiry (CoI) models to understand the attitudes of science education lecturers and undergraduates towards online teaching in Oyo town, Nigeria. Fred Davis introduced the Technology Acceptance Model (TAM) for his doctoral project in 1986. TAM, a modification of the Theory of Reasonable Action, is designed especially for simulating individuals' adoption of technology or information systems. TAM explains how individuals adopt and use technology based on perceived usefulness and ease of use which invariably influences their attitudes. In an effort to forecast behavior, Icek Ajzen created the Theory of Planned Behavior (TPB) (Ajzen, 1991). TPB explains attitudes towards technology based on attitude towards the behavior, subjective norm, and perceived behavioral control. Garrison, Anderson, and Archer's model (2000, 2001) identifies three presences: social presence, cognitive presence, teaching presence and cognitive presence, focusing on meaningful interactions and the ability to create and verify meaning. The COI model explains the process of online learning and the role of social, cognitive, and teaching presence in creating a meaningful learning experience. The study aims to explain the challenges and opportunities of

online teaching and learning, as well as the role of social, cognitive, and teaching presence in creating a positive learning experience that engender both the lecturers and students attitudinal disposition to science education.

Empirically, Kopczynski and Silvia (2023) emphasized the importance of reimagining online learning for academic performance in higher education. The pandemic has increased accessibility and scalability, making online learning crucial for economic development, experiential learning, critical thinking, and student success. Despite challenges, online learning is expected to remain. Wang (2023) study explores the impact of AI, cloud computing, and 5G on online education, revealing that these technologies enhance learning time, place, and interest, and suggest high-efficiency interaction modes can improve synchronous classroom teaching quality. Asroriyah et al. (2023) utilized Telegram Quiz Bot to teach English structure material to high school students, achieving 90% correct answers, highlighting the need for user-friendly learning resources during the pandemic.

Ally-Charles et al. (2024) posited that the University of Guyana has made progress in Online Learning Environments, but challenges like inadequate ICT infrastructure, lack of training, and examination integrity resistance persist, necessitating more professional development and face-to-face proctoring. Ye (2024) investigates the integration of mobile interaction technologies in entrepreneurial education, focusing on creating a collaborative learning team environment model for knowledge building and identifying strategies for improved learning outcomes. In the same vein, Svihus (2024) in his study on online teaching in higher education revealed that experienced teachers, despite facing challenges, promoted participation and adapting to the new normal through strategies like asynchronous resources, role play, and external tools.

Statement of the Problem

The COVID-19 pandemic has forced many institutions to shift to the use of online or blended learning. This has led to a growing interest in online teaching. Science education is one of the fields that has been affected by this shift, and there is a need to investigate the attitudes of science education lecturers and undergraduates towards online teaching. Despite the growing interest in online teaching, there appear to be limited researches on the attitudes of science education lecturers and undergraduates towards online teaching at the universities' level in Nigeria, particularly in Oyo state.

Research Questions

The study sought to answer the following research questions.

i. What are the attitudes of science education lecturers and undergraduates towards online teaching?
ii. Is there any difference between the attitude of science education lecturers and science education undergraduates?

Research Hypotheses

i. There is no significant difference in the attitudes of science education students and lecturers towards online teaching.
ii. There is no significant difference in the attitudes of male and female science education teachers towards online teaching.
iii. There is no significant difference in the attitude of male and female science education undergraduates towards online teaching

Delimitation of the study

The study was delimited to science education teachers who taught science undergraduate students in one of the

public universities located within Oyo state, in the southwest Nigeria. . Only 400L undergraduate science education students took part in the study. Specifically, only undergraduate who were running courses in Biology, Chemistry, mathematics, Physics and Integrated science education were involved in the study.

Methodology

The study employed a descriptive survey design of the expo -facto type. This design was deemed appropriate because the study did not involve manipulation of variables or data collected. It only involved gathering and analysis of data. The sample for the study comprised 150 subjects made up of 75 lecturers and 75 science undergraduates. The science education lecturers were drawn from among the most senior and middle hierarchies of academic staff in the university while the students were drawn from among the 400 level undergraduates who were already preparing for their final semester examinations in the university at the time of carrying out this study. Simple random sampling technique was used to select 15 students across the five main programmes that make up science education in the university. The student participants were those pursuing their career in science education, Physics, Biology, Chemistry Integrated science and Mathematics. It is expected that this category of students will be able to provide adequate responses to the items of the research instrument Online Teaching Attitudinal Scale (OTAS). Both male and female Science education teachers participated in the study. Only one valid, reliable and relevant instrument was used to collect relevant data for the study. The instrument used is the Online Teaching Attitudinal Scale (OTAS). The OTAS is a 30 - item Ato-Wikinson's (1979) modified by Raimi (2002) Science Attitude Inventory. The instrument was made up of statements which are relevant to online teaching. Each OTAS item was rated a 4 – point likert scale ranging from strongly agreed (SA) to strongly disagreed (SD). Items which indicate positive attitude were rated on points ranging from 4, 3, 2, 1 i. e. 4 for strongly agreed and I for strongly disagree while the scoring pattern for each item which indicates a negative attitude were oppositely graded (i.e, 4 for strongly disagree to 1 for strongly agree). The instrument was subjected to further reliability test by administering items on a group of 100 science education lecturers and students in a private university within Oyo state. A test re-test reliability coefficient for the instrument was found to be 0.91. Criterion related validity of the OTAS obtained gave 0.75. The instrument was administered on the 12th week of the semester just before the commencement of second semester examination. The responses were collected from the respondents within twenty hours for the purpose of collation and analysis. The data collected were analysed using descriptive statistics and t -test.

Results

Table 1: Demographic Analysis of the study

Table 1a: Gender of the Respondents

Group	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Lecturers	21	28	54	72	75	100.00
Undergraduates	25	33.3%	50	66.7	75	100.00

Table 1a shows the classification of respondents based on gender. It shows that 21 (28%) of the participating lecturers are males while 54 (72%) are females. In the same vein 25 (33.3%) and 50 (66.7%) students participated in the study.

Research question 1: What are the attitudes of science education lecturers and undergraduates towards online teaching?

Table 1b: Altitude of Respondents towards online Teaching

Group	Attitude				Total	
	Positive		Negative			
	N	%	N	%	N	%
Lecturers	39	52.00	36	48.0	75	100.00
Students	34	45.33	41	54.7	75	100.00

Table 1b shows the analysis of the collected data based on attitude towards online teaching. It shows the demographic classification of science education lecturers and students towards online teaching. Analysis of the data collected revealed that out of the seventy-five (75) science education lecturers who participated in the study, thirty-nine 39 (52%) are adjudged as having positive attitude towards online teaching while 36 (48%) have negative attitude towards online teaching. Similarly, out of 75 science education students that took part in the study, 34 (46.57%) have positive attitude while 41 (53.42%) have negative attitude towards online teaching. The result were obtained by finding the mean attitude values for both the teachers and students after pooling all the attitude scores together and finding the mean attitude score for science teachers and students in each of the cases, attitude scores that fall within the mean and above were considered as having positive while all scores below the mean value were adjudged as negative attitude towards online teaching.

Test of Hypotheses

Ho 1: There is no significant difference in the attitudes of science education students and lecturers towards online teaching.

Table 2 Comparison of Science Teachers and Science Students Attitudes towards Online Teaching

Attitude Towards Online Teaching	N	$\bar{X}$	S. D	Df	t	Sig.	Decision
Lecturers	75	.67	3.46	148	1.09	0.276	NS
Students	75	.65	2.97				

Result of data analysis in the Table 2 compares the attitude of science teachers and science education students towards online teaching. Results of data analysis using statistics t-test revealed that there is no statistic significant difference between the attitude of science education teachers and science education students towards online teaching. This observation was arrived at because the calculated t-value (1. 09) was found to non-significant at 0.05 level of significance. ($t = 1.09$; $df = 148$; $p > 0.05$). Therefore, H_O1 is accepted.

Ho 2: There is no significant difference in the attitudes of male and female science education students towards online teaching.

Table 3. Attitude of Science Education Staff towards Online Teaching Based on Gender

Attitude Towards Online Teaching	N	$\bar{X}$	S. D	Df	t	Sig	Decision
Male Staffs	21	52.9	4.15	73	1.11	0.05	NS
Female Staffs	54	59.89	3.15				

Table 3 shows the result of data collection of the attitude of science education staff based on gender. The result reveals that there is no statistic significant difference between male and female students in terms of their attitudes towards online teaching. This is because the t-value (1.11) is not significant at 0.05 level of significance ($t = 1.11$; $df = 73$; $p > 0.05$). Therefore, H_O2 is accepted.

Ho 3: There is no significant difference in the attitude of male and female science education undergraduates towards online teaching.

Table 4. Comparison of Science Education Students' Attitude Based on Gender

Attitude Towards Online Teaching	N	$\bar{X}$	S. D	Df	t	Sig.	Decision
Male Students	25	63.95	2.85	73	1.25	0.214	NS
Female Students	50	65.7	2.8				

In Table 4. The result of the comparison of the attitudes of male and female science education students towards online teaching. The result shows that there is no statistic significant difference between male and female science students relative to their attitudes towards online teaching. This observation was arrived at because the observed t-value (2.02) is higher than the calculated t-value (1.25) is not significant at 0.05 level of significance ($t = 1.25$; $df = 73$; $p > 0.05$). Therefore, H_O3 is accepted.

Discussion of Findings and Implications

One major finding of the study is that substantial number of science education students exhibit negative attitude towards online teaching. Moreover, the number of science education teachers that were adjudged as having negative attitude towards online teaching also appear to be on the high side. This finding corroborates an earlier finding in a related study by Wang 2023, Xe et al., 2018 where they observed that teachers and students alike still prefer the conventional physical classroom interaction to the use of online or ICT based classroom mode. It is also in line with the findings of Hilary, Kabir and Obowu (2023) when they observed in their study that a higher proportion of senior secondary school teachers in Port Harcourt metropolis possess positive attitudes towards e - learning. This implies that, to an extent, the teachers showed some level of readiness in adapt to the use of e – learning in their classroom interaction. The implication is that about average number of lecturers that possess negative attitudes is that students will find it difficult to adapt to the changing world of technology and digitalization of science teaching and learning. This problem of adaptation was observed in an earlier study carried out by Leontev (2023) in his study on teachers and students' attitudes towards

online classes at a technical university where he observed that university teachers have problem adapting to online teaching because of low level digitalized knowledge. He also found that lack of digital tools and suitable infrastructures in the university impacted negatively on the attitudes of teachers and students towards online teaching. Similar findings were reported by Masalimova et al (2024), Veenstra Cott (2025), Raj et al (2025) higher online instruction was linked to lower performance and negative attitudes to learning. Contrary to this finding, Ojo (2000), Ojo and Olakulehin (2006) and John (2021) in their different studies found that students have positive attitudes to e – learning. In particular, Ojo and Olakulehin (2006) observed that students have positive attitudes toward Online Distance Learning (ODL) compared to traditional form of higher education. This implies the readiness of the students to continue to use online learning strategy against the conventional strategy. In the same vein. Ogunbodede and Ukpebor (2021) in their study on students' attitude towards online learning during the Covid - 19 pandemic observed that majority of the respondents who participated in the study have positive attitude towards online teaching. Further to this, Abaze and Odikpo (2024) also obtained a similar result among nursing students regarding their attitudes and perception towards online learning during covid - 19 lockdown. They also found a positive relationship between attitudes and perception among the sampled nursing students. The finding however negates those of Okolo (2022) and Jurakovic et al 2022 when they observed in their studies that university teachers and students have positive attitudes towards online teaching. The implication of these observations is for the management of universities and other tertiary institutions to provide necessary tools and gadgets to improve acquisition of digitalized knowledge and skills by teachers and students. The university authorities should as a matter of fact initiate and encourage in – service training as well as refresher courses on digitalization of education. These and other related actions by the university authorities can go a long way to improve the acquisition of basic digital skills with the consequential effects of improving the attitudes of both the university teachers and students alike.

The study also revealed an insignificant difference between the attitude of science education lecturers and students towards the use of online teaching strategy, this is highly related to finding earlier obtained in the study which indicated that substantial number of teachers and students possess negative attitude towards online teaching. The result is in line with the findings of Raimi (2022), when he observed similar results at certain level of educational attainment between university lecturers and science education undergraduates. It however negates the findings of Okolo (2022) who observed a significant difference in the attitude of university lecturers and undergraduates. The insignificant difference in the attitude of university lecturers and students has serious implication for science teaching and learning. This is because nowadays, there is an upsurge in students' enrolment, inadequate infrastructures, overloaded timetable, Ebola pandemic, the unpleasant experience of the COVID-19 pandemic, as well as other unforeseen natural disasters which impede physical classroom interaction. It has also become clearly evident that the conventional physical contact alone cannot suffice to promote effective teaching and learning in the face of desirous educational advancement. A blend of both physical and virtual teaching strategies could go a long way

in promoting science education (Raimi, 2002 and 2023, 2024). This is in line with Amuda and Muhammad (2022), who found that frequent use of ICT tools in teaching of Physics improved the competency and enhance students' achievement in the subject. As a result, it was recommended that there should be a paradigm shift in the attitudes of university teachers in terms of change of attitude towards the use of modern technology and other forms of digital tools to promote learning especially the sciences. This also has the potential effect of enhancing the attitude of Science Education students and hence, the overall achievement in the Sciences. The study further revealed that, there is insignificant difference between male and female science education lecturers in terms of their attitudes towards online teaching. This finding corroborates the results of studies carried out by (Raimi, 2002 and 2022) when he obtained similar findings at certain levels of educational attainment between male and female science teachers. However, it is desired that science education lecturers should develop the right type of attitude not only towards online teaching but towards digitalisation of education especially at the university level considering the advantage inherent in doing so. The implication of this to science teaching and learning is that being positive about digitalization on the part of university's teachers has the potential of infecting and influencing the students 'attitudes for the advancement of scientific knowledge.

That there exist no significant difference in the attitude of male and female undergraduates towards the use of online teaching strategy is not surprising after all. This is because of the conflicting nature of researches that are gender based. For instance, this finding is in line with the findings of Rhaman and Tiwan (2015); Raimi (2022) who in their various studies on attitude towards teaching profession obtained a similar result. In other studies, significant difference has been found between male and female at different levels of educational attainment. For instance, Hilary, Kabir and Obowu (2023) found a statistically significant difference between male and female students towards e – learning. Nwangwu (2020) also obtained a similar result in a related study. The implication of these conflicting findings on gender based studies is that at the undergraduate level, lecturers should as a matter of fact use strategies that would provide level plane ground and learning environment that would enable both male and female students continue on their educational attainment and in their chosen career. There shouldn't be any preferential treatment based on gender and both gender should be given equal opportunities to learn under the same condition and at individual's pace.

Conclusion

In this study, attitude of Science Education undergraduate students and lecturers towards online teaching strategies was investigated. Results of findings shows that sizeable number of Science Education lecturers and students have negative attitudes towards online teaching. It also revealed that gender has no significant influence on attitude towards online teaching, both for science education undergraduate students and their lecturers. These findings have implications for science teaching and learning in Nigeria, especially for educational institutions, policy makers, school administrators and science educators as well as their students.

Recommendations

Based on the findings of this study, it was recommended that, university lecturers should embrace digitalisation of teaching and learning and in particular,

the use of online teaching strategy due to the advantages inherent in doing so and at the same time develop positive attitude towards the use of online teaching and learning. It is also recommended that science education lecturers should employ strategies that will give both male and female undergraduates equal opportunities during science classroom instruction especially that which would enable them develop enhanced and positive disposition towards the use of ICT especially online teaching and learning strategies. Necessary digital tools and platforms should be provided by the relevant institutional authorities for the realisation of these objectives in the face of unpredictable global world and to key in to the contemporary and technologically driven world. This should be accompanied by regular training of staff on digitalisation of science teaching and learning. In – house as well as in – service training programmes that are focused on the use of modern technology in the teaching and learning of science should be put in place especially at the university level.

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ASSESSING THE ACADEMIC READINESS AND PERFORMANCE OF THE INAUGURAL 100-LEVEL SCIENCE EDUCATION STUDENTS AT ABDULKADIR KURE UNIVERSITY, MINNA: CHALLENGES AND FUTURE OPPORTUNITIES

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Abstract

This study was conducted to assess the Academic Readiness and Performance of the Inaugural 100-Level Science Education Students at Abdulkadir Kure University, Minna: Challenges and Future Opportunities. Twenty-six (26) Inaugural 100-Level Science Education Students were purposively selected from Abdulkadir Kure University in Niger State, Nigeria. The instrument used for the study was Researcher's designed questionnaire which was divided into two sections to elicit information on Academic readiness and challenges for future opportunities. The questionnaire was validated by experts, and its internal consistency was assessed using Cronbach's Alpha, which yielded a reliability coefficient of 0.77. Data analysis was done using Mean and Standard deviation. A criterion means of 2.5 was set as the basis for judgment. The findings suggest that while students are somewhat prepared for Chemistry and Physics, their Mathematics readiness is a concern. It was therefore recommended that emphasis should be tailored towards academic support by the university management to address varied students' academic challenges.

Keywords: Assessment, Academic-Readiness, Challenges, Science-Education, Students', Performance

Introduction

The transition from secondary school to university is a defining stage in a student's educational journey. In Nigeria, this process requires students to meet specific academic benchmarks, including passing the Senior Secondary School Examination (SSSE) with at least five credits in key subjects such as Mathematics and English (Aliyu and Ali, 2021; Owoeye, Faleye and Jimoh, 2022). Additionally, students must excel in the Unified Tertiary Matriculation Examination (UTME), conducted by the Joint Admissions and Matriculation Board (JAMB). This exam assesses students' knowledge in their chosen fields, with Mathematics being mandatory for all science students (Leyva, Walkington, Perera, & Bernacki, M. 2022; Azid, Ali, El Khuluqo, Purwanto, & Susanti, 2022). Achieving these milestones, along with meeting the cutoff scores set by their preferred universities, paves the way for admission into tertiary education (Onyeme, & Liyanage, 2024; Onebunne, & Igwe, 2021).

The tertiary level of education in Nigeria represents the final phase of the nation's 1-6-3-3-4 educational system, typically lasting a minimum of four years (Saadu, 2023; Ukpong, Alabekee, Ugwumba, & 2023; Fadokun, 2024). This level is offered through universities, polytechnics, and colleges of education, with Abdulkadir Kure University, one of the tertiary institutions in Niger State, admitting its first cohort of 100-level students into the Faculty of Education with a minimum UTME cutoff score of 160. Marking a historic moment, the students became pioneers of the newly established institution. Beyond academics, Abdulkadir Kure University seeks to align with global educational trends while promoting technical and vocational skills, much like other sister institutions worldwide. Her mission is to cultivate a community of learners who exemplify critical thinking and practical expertise, preparing them to contribute meaningfully to society and to meet the demands of a rapidly evolving global landscape. As Mohammed (2023) asserted, the university is dedicated to bridging the gap between theoretical knowledge and practical application, aims to cultivate critical thinkers rather than rote learners. This guiding principle reflects a commitment to foster well-rounded individuals capable of thriving in both academic and real-world environments.

In light of the above, the integration of theoretical knowledge with practical application at Abdulkadir Kure University is grounded in a robust pedagogical framework informed by Experiential Learning Theory, Constructivist Theory, Problem-Based Learning, Pragmatism, and Social Constructivism. These theoretical paradigms underscore the importance of experiential engagement, collaborative problem-solving, and the application of knowledge to real-world contexts, thereby fostering critical thinking and equipping learners to address complex challenges (Kolb, 1984; Barrows & Tamblyn, 1980; Vygotsky, 1978; Dewey, 1938). Within this framework, the university has established an academic environment that prioritizes independent thought, active engagement, and deep intellectual inquiry. This approach according to Ahsan, (2025) and Dighliya, (2025) not only enhances the educational experience but also cultivates the skills and mindset necessary for lifelong learning and adaptability in an evolving global landscape.

Empirical studies by Morris, Perry, and Wardle (2021), Wrigley-Asante, Ackah and Frimpong, (2023). Assem, Nartey, Appiah and Aidoo, (2023), Liou, (2021), Hardiansyah, Armadi and Wardi, (2024) and Wrigley-Asante, Ackah, and Frimpong (2023) support the above approach. Their findings revealed that students with strong foundational knowledge, particularly in science subjects, tend to achieve better outcomes in tertiary education. In Nigeria, those exposed to curricula emphasizing critical thinking and practical application transit more effectively into university life, while students from rote-learning backgrounds often struggle to adapt. (Hamzah, Oko-Joseph, & Mary 2025; Ibrahim & Ojo, 2022). These studies also highlight the need for tailored interventions, such as bridging programs, mentorship opportunities, and improved access to learning resources, to enhance academic readiness and performance (Lane, Morgan & Lopez, 2020). However, limited research exists on how these dynamics unfold in newly established institutions like Abdulkadir Kure University, which serves students from diverse and often under-resourced educational backgrounds. This study sought to address this gap by examining both the academic preparedness of its inaugural cohort and the institutional strategies required to support them effectively.

Academic readiness, academic performance, the challenges faced by students, and the influence of diverse educational backgrounds are

interconnected factors that significantly shape the educational journey. Academic readiness encompasses the foundational skills, knowledge, and attitudes students bring into their learning environment, which are critical for success (Musa, 2021). Academic performance reflects the measurable outcomes of their efforts and their ability to meet educational standards. Students may encounter various challenges, including adapting to new learning environments, managing workloads, and overcoming personal or academic barriers (Yusuf & Bello, 2020). Additionally, differences in educational backgrounds, shaped by varying curricula, teaching methods, and cultural contexts, can profoundly impact learning experiences and outcomes (Adamu, 2022). Understanding these factors is essential for educators and institutions seeking to design inclusive and effective strategies that support student success and close learning gaps.

It is against this backdrop that the researcher set out to address the challenges faced by the inaugural class of Abdulkadir Kure University. By identifying and tackling these barriers to success, the university can create a supportive environment that enhances students' educational experience while laying a solid foundation for future cohorts (Ogunleye, 2023). With thoughtful planning and targeted support, Abdulkadir Kure University can achieve her vision of becoming a center of excellence that produces critical thinkers, problem-solvers, and leaders equipped to make meaningful contributions to society.

Research Objectives

The objectives of this research are as follows:

1. To assess the academic readiness of the inaugural 100-level science education students at Abdulkadir Kure University, Minna, focusing on their preparedness in fundamental science subjects such as Mathematics, Chemistry, and Physics.
2. To evaluate the academic performance of these students during their first year of study, identifying key areas where they excel or struggle.
3. To identify the challenges faced by the students in adapting to the university's academic environment, particularly in relation to critical thinking, problem-solving, and independent study skills.

Research Questions

1. What is the level of academic readiness of the inaugural 100-level science education students at Abdulkadir Kure University, particularly in key science subjects like Mathematics, Chemistry, and Physics?
2. How do the students perform academically during their first year, and what trends emerge in their academic achievements and challenges?
3. What specific academic challenges do these students face as they transition from secondary to tertiary education, particularly in the areas of critical thinking, problem-solving, and independent learning?

Methodology

This study employed a descriptive survey research design to assess the academic readiness and performance of the inaugural 100-level Science Education students with a focus on identifying academic challenges and exploring future opportunities for improvement. The sample consisted of 26 purposively selected students who were part of the first cohort in the Science Education program.

Data were collected using a researcher-designed questionnaire, divided into two sections: one assessing academic readiness in Chemistry, Physics, and Mathematics, and the other addressing students' challenges and perceptions of future opportunities. The questionnaire

was validated by science education experts, and its reliability was confirmed with a Cronbach's Alpha coefficient of 0.77.

The data were collected using the researcher-made questionnaire which was administered to the students by the researcher in the classrooms. Informed consent was obtained, and participants' responses were treated with confidentiality. Data analysis was performed using descriptive statistics, specifically the mean and standard deviation, with a criterion mean of 2.5 established to assess academic readiness.

Results

In this section, Table 1-3 are presented with their interpretations tailored towards providing answers to the research questions raised

Research Question 1

What is the level of academic readiness of the inaugural 100-level science education students at Abdulkadir Kure University, particularly in key science subjects like Mathematics, Chemistry, and Physics?

Table 1: Mean and standard deviation of level of academic readiness of the inaugural 100-level science education students in key science subjects like Mathematics, Chemistry, and Physics?

S/no	Items	N	Mean	SD
1	I have a strong foundation in mathematics necessary for university-level coursework	26	2.35	1.02
2	I feel confident in my knowledge of chemistry to tackle university-level courses.	26	3.08	.69
3	I am well-prepared for the demands of university-level physics.	26	2.92	.75
4	I can solve problems in mathematics without significant difficulty.	26	2.19	.85
5	I can conduct basic chemistry experiments and understand lab safety protocols.	26	2.46	.99
6	I can apply physics principles to solve practical problems in coursework.	26	2.50	.91
7	I'm sure of my self-assessed skill level in science subjects.	26	2.27	1.08
8	I often often did practice these subjects during my secondary school days	26	2.65	.94
	Grand mean		**2.55**	

Decision mean = 2.50

Table 1 shows the mean and standard deviations of respondents on level of academic readiness of the inaugural 100-level science education students in key science subjects like Mathematics, Chemistry, and Physics. The survey results indicate that the inaugural 100-level science education students feel moderately prepared for university-level coursework in Mathematics, Chemistry, and Physics. The students showed moderate confidence in Chemistry (M = 3.08) and Physics (M = 2.92), suggesting they felt somewhat ready for these subjects. However, their preparedness in Mathematics was lower, with mean scores of 2.35 for foundational knowledge and 2.19 for problem-solving ability. Students also reported moderate confidence in their lab skills and self-assessed science abilities, with mean scores of 2.46 for chemistry experiments and 2.27 for self-assessment. Prior practice in these subjects during secondary school was also limited (M = 2.65). The findings

suggest that while students are somewhat prepared for Chemistry and Physics, their Mathematics readiness is a concern, and tailored academic support is needed to strengthen their mathematical foundations before they engage fully with university-level science coursework.

The grand mean of 2.55 shows that the inaugural 100-level science education students at Abdulkadir Kure University are moderately prepared for university coursework. While students feel reasonably confident in Chemistry and Physics, their Mathematics readiness is a concern, with lower preparedness scores. This indicates the need for targeted academic support, especially in Mathematics, to improve their foundational skills for success in science coursework.

Research Question 2:

How do the students perform academically during their first year, and what trends emerge in their academic achievements and challenges?

Table 2: Mean and standard deviation of academic performance during the first year of study.

Variable	M	SD
GPA (First Semester)	2.09	1.47
GPA (Second Semester)	2.36	1.66
Study Hours (per week)	8.8	2.68
Class Attendance (%)	81%	12%
Engagement (1-5)	3.3	1.06

Table 2 shows the mean and standard deviations of academic performance during the first year of study. The descriptive statistics for key academic variables showed notable variability among students. The average GPA increased slightly from M = 2.09 (SD = 1.47) in the first semester to M = 2.36 (SD = 1.66) in the second semester, indicating modest improvement but considerable variation in performance. Students reported an average of M = 8.8 hours (SD = 2.68) spent on academic work per week, with significant differences in study habits. Class attendance averaged M = 81% (SD = 12%), reflecting varied levels of attendance, likely influenced by factors such as motivation and external commitments. The average student engagement score was M = 3.3 (SD = 1.06), indicating moderate involvement in class but also significant individual differences. Overall, these findings highlight the diverse academic experiences of first-year students and emphasize the need for tailored academic support to address their varied challenges.

Research Question 3:

What specific academic challenges do students face as they transition from secondary to tertiary education, particularly in critical thinking, problem-solving, and independent learning?

The findings reveal several interrelated challenges that hinder students' smooth transition into university-level science education.

Theme 1: Weak Foundational Knowledge (Especially in Mathematics)

Students consistently reported inadequate preparation in Mathematics during secondary school. Many struggled with understanding core concepts, relying instead on memorization. As one student noted, *"In Physics and Chemistry I can try, but Mathematics is where I'm always lost. We were only taught to memorize formulas, not to understand why they work"* (P3).

This weak foundation affected their confidence and limited their ability to engage in higher-order problem-solving required at the tertiary level.

Theme 2: Difficulty with Critical Thinking and Analytical Learning

Participants highlighted that secondary school learning was heavily exam-oriented, with little emphasis on inquiry or reasoning. At university, they encountered demands for justification, evaluation, and deeper analysis of scientific ideas. One student stated,

"In secondary school, if you cram past questions, you will pass. But here, lecturers ask us to explain 'why' or defend our answer. That thinking part is hard" (P7).

Consequently, students struggled to critique arguments, interpret scientific evidence, and synthesize information from multiple sources.

Theme 3: Challenges in Independent Learning and Self-Regulation

The shift from teacher-directed learning to independent study posed a major difficulty. Students reported issues with time management, self-discipline, and seeking academic resources without guidance. As described by one participant,

"Nobody is forcing you to read here. If you don't plan yourself, you will fail. I'm still learning how to read on my own without waiting for the lecturer" (P2).

Many lacked experiences in setting study schedules or conducting self-driven research.

Theme 4: Impact of Secondary School Environment and Teaching Quality

Several students attributed their challenges to poor teaching methods and inadequate resources during secondary education. Practical exposure, especially in science laboratories, was limited.

"We rarely did practical in my school. Just chalk and talk. Coming here where practical is compulsory makes everything seem new" (P5).

While location (rural or urban) was not seen as a major factor, the quality of instruction strongly influenced their preparedness.

In view of aforementioned, the transition from secondary to tertiary education is marked by gaps in foundational knowledge, underdeveloped critical thinking, and weak independent learning skills. These issues stem largely from the limitations of secondary school preparation. To support student success, universities should implement academic bridging programs, mentorship initiatives, and strategies that build problem-solving and analytical competencies from the first year.

Discussion of the study

The study's findings shed light on the academic preparedness and challenges faced by the inaugural 100-level science education students at Abdulkadir Kure University, providing valuable insights into the students' readiness for university coursework and the obstacles they encountered due to their secondary school backgrounds.

The results from Table 1 revealed that the students felt moderately prepared for university-level coursework, particularly in Chemistry and Physics, where they reported higher levels of confidence (M = 3.08 for Chemistry and M = 2.92 for Physics). However, the students showed notable weaknesses in Mathematics, with foundational knowledge scoring a low mean of 2.35, and problem-solving ability rated at 2.19. This suggests that, while the students felt relatively confident in Chemistry and Physics, their mathematical readiness was a significant concern, requiring targeted academic support to build stronger foundations in these critical subjects. The students also reported limited practice in these subjects during their secondary school years (M = 2.65), which further highlighted the need for additional preparation, especially in Mathematics, to ensure they were fully

equipped to tackle the academic challenges of university-level science courses. The grand mean of 2.55 indicates a moderate level of preparedness, underscoring the importance of academic interventions, particularly in Mathematics, to improve students' readiness for their university education.

When examining academic performance, Table 2 shows a slight improvement in the students' GPA from the first semester (M = 2.09) to the second semester (M = 2.36), reflecting some progress in adapting to the demands of higher education. However, the considerable variability in performance, as shown by the high standard deviations, points to diverse academic experiences among the students. The average study hours of 8.8 hours per week and class attendance of 81% suggest that students had varied levels of commitment to their academic work, with some students struggling to engage fully. The moderate student engagement score (M = 3.3) further reflects the differences in how actively students participated in class, highlighting the need for more personalized engagement strategies and mentorship programs. These findings indicate that additional support during the first year could help students better manage their academic workload and boost overall performance. The study also explored the impact of secondary school backgrounds on academic preparedness. The qualitative findings reinforce the quantitative evidence indicating moderate to low preparedness among first-year science education students. Weak foundations in Mathematics particularly hinder the development of higher-order cognitive skills, including critical thinking and scientific problem-solving. The shift from guided instruction in secondary school to autonomous learning at university presents additional adaptation challenges. These findings align with existing literature Adeyemi and Adekunle, (2020), which highlights the inadequacy of Nigerian secondary schools in preparing students for tertiary academic rigor.

Conclusion

The study indicates that first-year science education students demonstrate moderate preparedness for university, yet they face considerable challenges in Mathematics and independent learning. While they display confidence in subjects like Chemistry and Physics, their weak foundational skills continue to affect overall academic performance. These findings highlight the need for targeted support to improve their readiness for tertiary education. Looking ahead, there are valuable opportunities to implement remedial programs and mentorship initiatives aimed at strengthening core competencies and easing the transition into university life. Additionally, curriculum reforms that promote critical thinking and problem-solving can significantly enhance students' long-term academic success.

Recommendations

To address these challenges, several recommendations are proposed:

1. Strengthen Mathematics teaching at the secondary level and provide remedial support at university.
2. Enhance collaboration between secondary schools and universities to align expectations.
3. Enhance Secondary School education by partnering with local schools to improve resources and teaching quality.
4. Implement Personalized Academic Support in the first year, including mentorship and tutoring programs.
5. Improve engagement strategies by incorporating active learning and encouraging extracurricular academic activities.
6. Provide tailored resources for Science Education, such as updated textbooks and laboratory facilities.
7. Introduce transition programs to help students adapt to autonomous learning.

8. Monitor academic progress with regular assessments and feedback.
9. Facilitate the transition from secondary to tertiary education with orientation programs.
10. Strengthen Mathematics foundations through bridging programs and additional tutorials.

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EFFECT OF SOCIAL MEDIA LEARNING PLATFORMS ON STUDENTS' PERFORMANCE IN COMPUTER STUDIES IN SECONDARY SCHOOLS

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Abstract

The purpose of this study was to examine the effect of Social Media Learning Platforms on students' performance in Computer Studies in selected secondary schools in Ekiti State, Nigeria. Specifically, the study aimed to identify the types of social media devices used by students for social networking and determine the factors affecting the use of Social Media Learning Platforms in teaching and learning. A quasi-experimental research design involving pre-test, post-test, and control groups was adopted. The population comprised all Senior Secondary School Two (SSS II) students in Ekiti State, totaling 16,585 across 205 public secondary schools. A multistage sampling technique was used to select 83 students from two mixed secondary schools from two Local Government Areas, randomly assigned to experimental and control groups. The instrument for data collection was the Computer Studies Performance Test (CSPT), consisting of 40 multiple-choice questions adapted from WAEC and NECO examinations. The instrument was validated by experts in Computer Education and Tests and Measurement, with a reliability coefficient of 0.83 obtained using the test-retest method. Data were collected over eight weeks in three stages: pre-test, treatment, and post-test, and analyzed using mean, standard deviation, and t-test at a 0.05 level of significance. Findings revealed that smartphones were the most commonly used devices, while poor internet connectivity and limited device access hindered effective use. The results also showed no significant difference in pre-test mean scores but a significant improvement in post-test scores among students taught using the Social Media Learning Platform compared to those taught conventionally. The study recommended that teachers integrate social media tools into teaching, while the government provides adequate internet facilities, digital devices, and training to enhance technology-based instruction.

Keywords: Computer Studies, Digital Devices, Social Media, Learning Platforms, Students' Performance, Technology-Based Instruction,

Introduction

In the 21st century, technology has become an indispensable component of education, transforming how teaching and learning take place across the world. The integration of digital tools and internet-based applications has created opportunities for interactive, flexible, and learner-centered instruction (Anderson & Dron, 2017). Education is no longer confined to the traditional classroom setting; instead, it extends to virtual and online spaces where students can

collaborate, access information, and share ideas in real time. Digital technologies, such as computers, smartphones, and internet-enabled devices, have enhanced communication and access to educational materials, thereby improving students' engagement and academic outcomes (Alalwan et al., 2019). Among these technologies, social media platforms—including WhatsApp, Facebook, YouTube, Telegram, and Google Classroom have evolved from mere social interaction tools to powerful learning environments that support collaboration, participation, and knowledge sharing.

The increasing adoption of social media for educational purposes demonstrates a shift toward digital learning ecosystems, where students and teachers can engage in continuous learning beyond the physical classroom. This shift aligns with global educational goals that emphasize the use of Information and Communication Technology (ICT) to promote innovation, inclusivity, and lifelong learning (UNESCO, 2022). Consequently, understanding the role of social media in modern education is crucial for improving teaching effectiveness and student performance, particularly in subjects like Computer Studies, where technology is both the medium and the content of instruction.

Computer Studies plays a critical role in preparing students for the demands of the digital age. It equips learners with essential digital literacy and ICT competencies required to function effectively in a technology-driven society. Through the study of computer systems, software applications, programming, and data management, students gain practical skills that enhance their ability to solve problems, think critically, and adapt to new technological innovations (Nwosu & Ogbuanya, 2020). In today's world, where almost every aspect of human activity—from education and commerce to healthcare and governance—is influenced by technology, Computer Studies has become a foundational subject for secondary school students. It fosters an understanding of how digital tools operate and encourages creativity in using technology for productive purposes (Adeoye & Olatoye, 2019). Moreover, the subject supports the development of 21st-century learning skills, including communication, collaboration, critical thinking, and digital citizenship. These competencies are vital for students to participate meaningfully in a globalized knowledge economy. Integrating social media learning platforms into Computer Studies instruction further enhances these outcomes by creating opportunities for interactive learning, peer collaboration, and real-world application of ICT skills. Thus, the inclusion and effective teaching of Computer Studies in the school curriculum not only promote technological proficiency but also prepare students for future academic and career pursuits in an increasingly digital environment.

Social media learning platforms have revolutionized the teaching and learning process by creating interactive and collaborative digital environments that foster deeper student engagement. In the context of Computer Studies, these platforms provide teachers and students with dynamic tools for communication, content delivery, and real-time interaction. Platforms such as Google Classroom, WhatsApp, YouTube, Telegram, and Facebook groups allow teachers to share instructional materials, video tutorials, and multimedia resources that make abstract computer concepts more tangible and relatable (Amin et al., 2021). Through these digital spaces, learning becomes more student-centered, as learners can ask questions, participate in discussions, and exchange ideas

beyond the physical classroom. This kind of interaction not only supports constructivist learning, where students actively construct knowledge through collaboration, but also enhances problem-solving and critical thinking skills essential in Computer Studies (Vygotsky, 1978; Rahman & Ahmed, 2020).

Additionally, social media learning platforms support real-time feedback and assessment, allowing teachers to monitor students' progress and provide immediate clarification on difficult topics. For example, instructors can post quizzes, share coding exercises, or upload practical demonstrations, while students can respond, comment, or collaborate on group tasks instantly. This two-way communication helps bridge the traditional gap between teachers and learners and fosters a sense of community and motivation to learn. The use of social media learning platforms in teaching Computer Studies enriches the learning experience by promoting interactivity, collaboration, accessibility, and continuity of learning, all of which are crucial for mastering ICT skills in the 21st century.

Despite the widespread availability and accessibility of social media tools, many teachers in secondary schools continue to depend heavily on traditional (conventional) teaching methods, such as lecture-based instruction and note dictation. These approaches, while useful for information delivery, often limit student participation, engagement, and creativity, particularly in a practical-oriented subject like Computer Studies (Okoye & Adigwe, 2021). The inability to integrate modern digital tools into the classroom has resulted in a persistent gap between technological advancement and instructional practice, thereby reducing the effectiveness of teaching and learning outcomes. Furthermore, several studies have shown that students tend to perform poorly in Computer Studies because the subject is often taught theoretically rather than through interactive or hands-on approaches that encourage exploration and collaboration (Ogunleye & Akinbola, 2019). Teachers who are unfamiliar with or untrained in the use of social media learning platforms may also feel reluctant to adopt them, leading to missed opportunities for enhancing digital literacy and problem-solving skills among students. In addition, institutional challenges such as inadequate internet connectivity, lack of digital infrastructure, limited access to smartphones or computers, and poor awareness of the educational potential of social media further hinder its effective use in classrooms (Eze, 2020). Consequently, while students are actively engaged with social media in their personal lives, its integration into academic learning especially in Computer Studies remains underutilized, contributing to low interest and suboptimal performance in the subject.

Over the years, numerous studies have explored the integration of Information and Communication Technology (ICT) into education, emphasizing its potential to improve teaching effectiveness and student learning outcomes (Adu & Galloway, 2019; Yusuf & Afolabi, 2020). These studies have highlighted the benefits of ICT in promoting digital literacy, enhancing communication, and fostering learner-centered approaches in various subjects. However, most of the existing research has focused broadly on ICT use in education or on other subjects such as Mathematics, Science, and English Language, with limited attention given to Computer Studies as a distinct field of investigation. Furthermore, while several scholars have examined the role of e-learning platforms and virtual classrooms, relatively few have

investigated the specific impact of social media learning platforms such as WhatsApp, Telegram, YouTube, and Google Classroom on students' performance in Computer Studies at the secondary school level in Nigeria. This gap is significant because Computer Studies inherently relies on digital engagement and practical applications, making it an ideal context for studying the influence of social media-assisted instruction.

Existing literature has not sufficiently addressed how factors such as students' access to digital devices, teachers' digital competence, and institutional support shape the effectiveness of social media learning platforms in enhancing student outcomes. Hence, there is a pressing need for empirical research that focuses on how the use of social media learning platforms influences students' engagement, participation, and academic performance in Computer Studies within Nigerian secondary schools. This study, therefore, seeks to fill this gap by providing evidence-based research into the educational value of social media platforms in Computer Studies instruction.

Statement of the Problem

In today's technology-driven world, the role of digital tools in education continues to expand, offering new possibilities for improving teaching and learning processes. Social media learning platforms such as WhatsApp, YouTube, Telegram, and Google Classroom are increasingly recognized for their potential to support collaboration, communication, and resource sharing among teachers and students. However, in many secondary schools, particularly in Nigerian, the extent to which these platforms are used in the teaching and learning of Computer Studies appears limited. Instruction in Computer Studies is often conducted through conventional methods that emphasize lectures and note-taking rather than interaction and exploration. This approach may not fully support students in developing the practical and problem-solving skills required for digital literacy and ICT competence. Consequently, students' interest and performance in Computer Studies may be influenced by the teaching method and the level of exposure to interactive learning environments. Certain factors may contribute to this situation, including insufficient awareness of the educational value of social media tools, limited teacher training in technology-enhanced instruction, inadequate infrastructure, and the diversion of social media use toward non-academic activities. While research has been conducted on ICT integration in education, fewer studies have explored the specific use of social media learning platforms in enhancing learning outcomes in Computer Studies at the secondary school level. It is within this context that the present study is situated, focusing on how the use of social media learning platforms may influence students' performance in Computer Studies compared with conventional instructional approaches.

Purpose of the Study

The main purpose of this study is to examine how the use of social media learning platforms influences students' performance in Computer Studies at the secondary school level. Specifically, the study aims to:

i. Identify the types of social media devices commonly used by students for social networking and learning purposes.
ii. Examine the factors that affect the use of social media learning platforms in the teaching and learning of Computer Studies.

iii. Compare the performance of students taught Computer Studies using social media learning platforms with those taught through conventional instructional methods.
iv. Determine whether there are significant differences in students' pre-test and post-test performance when exposed to social media learning platforms and traditional teaching methods.

Research Questions

The following research questions guided this study:

1. What are the types of social media devices used by students for social networking?
2. What are the factors affecting the use of Social Media Learning Platforms in the teaching and learning of Computer Studies?

Research Hypotheses

The following null hypotheses were formulated and tested in this study:

1. There is no significant difference in the pre-test mean scores of students exposed to the Social Media Learning Platform and those taught using the conventional method.
2. There is no significant difference in the post-test mean scores of students exposed to the Social Media Learning Platform and those taught using the conventional method.

Methodology

The study adopted a quasi-experimental design involving pre-test, post-test, and control groups to determine the effect of social media learning platforms on students' performance in Computer Studies. The design allowed for comparing students' learning outcomes before and after exposure to different teaching methods. The population consisted of all Senior Secondary School Two (SSS II) students in Ekiti State, totaling 16,585 across 205 public schools (Ministry of Education, Ekiti State, 2022). A multistage sampling procedure was used to select two Local Government Areas (LGAs) from two senatorial districts, from which two mixed secondary schools were purposively chosen and randomly assigned to experimental and control groups. The research instrument used for data collection was the Computer Studies Performance Test (CSPT), which consisted of 40 multiple-choice questions adapted from WAEC/NECO examinations. The instrument was validated by experts in Computer Education and Tests and Measurement, and a reliability coefficient of 0.83 was obtained using the test-retest method. The experiment lasted eight weeks: one week for pre-test, six weeks for treatment, and one week for post-test. The experimental group was taught using social media platforms, while the control group was taught using conventional classroom methods. Data collected were analyzed using descriptive statistics such as mean and standard deviation to answer research questions, and inferential statistics, specifically the t-test, to test the hypotheses at a 0.05 level of significance.

Results

Research Question 1: What are the types of social media devices used by students for social networking?

Table 1: Frequency Counts and Percentages of the social media devices used by Computer Studies students for Social networking

Devices	Frequency (N = 83)	Percentages (%)
Smartphone	83	100.00
Tablet	54	65.06
Laptop	42	50.60
Desktop Computer	41	49.40
Smart watch	23	27.71
Other:	15	18.07

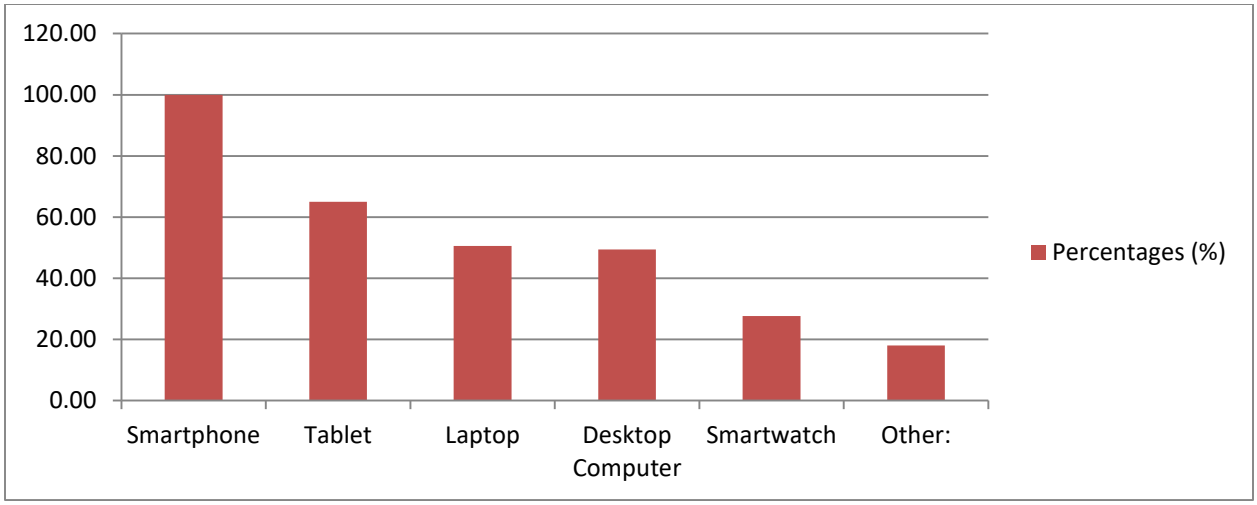

Figure 1: Bar Chart showing Social Media device used by Computer Studies students for social networking

The data from table 1 and figure 1 reveals that all Computer Studies students use smartphones for social networking, making it the most prevalent device among them. Tablets and laptops are also commonly used, with 65.06% and 50.60% of students, respectively, utilizing these devices. Desktop computers are used by nearly half of the students, while smart watches and other devices are less common, with 27.71% and 18.07% of students using them, respectively. This further depicted by figure 1 below;

Research Question 2: What are the factors affecting the use of Social Media Learning Platforms in the teaching and learning of Computer Studies?

Table 2: Frequency counts and Percentages of the factors affecting the use of Social Media Learning Platform in the teaching and learning of Computer Studies

Factors	Frequency (N=83)	Percentages (%)
Ease of access	73	87.95
Quality of content	56	67.47
Engagement with instructors	31	37.35
Interaction with peers	67	80.72
Availability of resources	78	93.98

Platform features (e.g., video, forums)	65	78.31
Technical issues (e.g., slow internet, device limitations)	83	100.00
Privacy and security concerns	67	80.72
Other	47	56.63

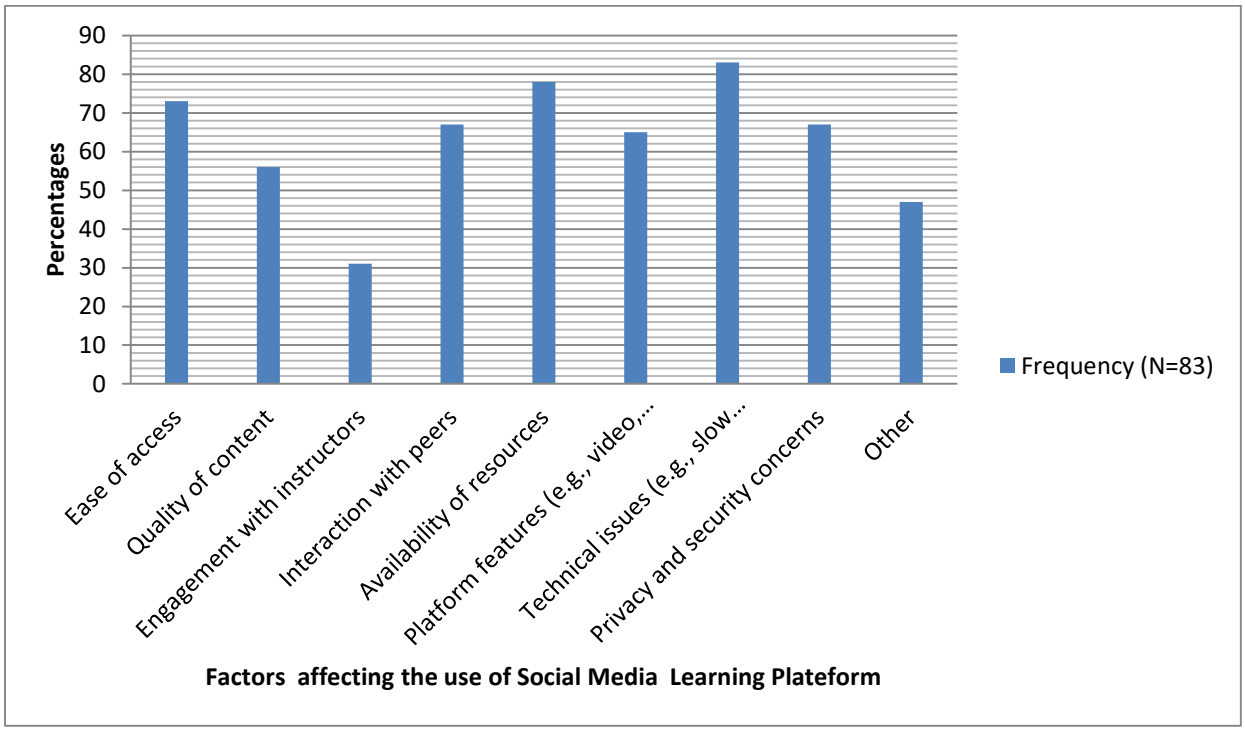

Figure 2: Bar Chart showing factors affecting the use of Social Media Learning Platform in the teaching and learning of Computer Studies

Table 2 and figure 2 highlights several key factors affecting the use of Social Media Learning Platforms in Computer Studies. Technical issues, such as slow internet and device limitations, are the most significant factor, affecting all students. Availability of resources is also highly influential, with 93.98% of students acknowledging its importance. Ease of access and interaction with peers are crucial factors, with 87.95% and 80.72% of students respectively, considering them significant. Platform features, such as videos and forums, contribute to 78.31% of students' experience. Qualities of content and privacy/security concerns are relevant factors for 67.47% and 80.72% of students, respectively. Engagement with instructors, while important, is the least mentioned factor, affecting 37.35% of students. This is also shown on figure 2 below.

Hypothesis 1: There is no significant difference in the pre-test mean scores of students exposed to the Social Media Learning Platform and those taught using the conventional method.

Table 3: T-test Analysis of the pre-test means scores of students exposed to Social Media Learning Platform and the conventional group

Variables	*N*	*Mean*	*S.D*	*df*	*t-cal*	*p-value*
Social Media Platform	44	49.71	6.66	81	0.871	0.387
Conventional Group	39	51.33	10.20			

Table 3 reveals that since the p-value exceeds 0.05, the hypothesis is therefore not rejected indicating that there is no significant difference in the pre-test mean scores between students exposed to the Social Media Learning Platform and those in the conventional group. This suggests that both groups had similar performance levels before the intervention.

Hypothesis 2: There is no significant difference in the post-test mean scores of students exposed to the Social Media Learning Platform and those taught using the conventional method.

Table 4: t-test Analysis of the post-test means scores of students exposed to Social Media Learning Platform and the conventional group

Variables	*N*	*Mean*	*S.D*	*df*	*t-cal*	*p-vale*
Social Media Platform	44	82.77	8.37	81	18.409	0.000
Conventional Group	39	54.94	4.62			

P<0.05

The result on table 4 reveals that since the p-value is well below 0.05, the hypothesis is therefore rejected indicating that there is a statistically significant difference in the post-test mean scores between students exposed to the Social Media Learning Platform and those in the conventional group. This significant difference suggests that the Social Media Learning Platform had a substantial positive impact on the students' performance compared to the conventional learning approach.

Discussion

The findings of the study revealed that smartphones were universally used by all Computer Studies students for social networking, highlighting their dominance as the most accessible and multifunctional digital tool among learners. This outcome reflects the growing penetration of mobile technology among Nigerian students, who often rely on smartphones for both academic and social engagement. Tablets and laptops were also commonly used, suggesting that some students have access to additional devices that enhance online learning and research activities. Desktop computers, however, were only moderately used, likely because they are stationary and primarily found in school laboratories rather than for personal use. Smartwatches were less common, as their educational functionality remains limited, while other unspecified devices were the least used. This finding supports the observation of Adebayo (2020) and Owolabi & Ajayi (2019), who reported that mobile phones, particularly smartphones, are the most widely used ICT tools among Nigerian secondary school students due to their affordability, portability, and internet connectivity. Similarly, Ogunlade and Adeyemi (2019) emphasized that the increasing use of smartphones for educational purposes in Nigeria demonstrates students' adaptation to digital learning environments despite

infrastructural and economic challenges. Overall, the result underscores the central role of mobile technology in shaping students' learning experiences and interactions in Computer Studies classrooms across Nigeria.

The study identified technical issues, such as slow internet connectivity and device limitations, as the most significant factors affecting the effective use of Social Media Learning Platforms in the teaching and learning of Computer Studies. These challenges hindered students' ability to fully engage with online learning resources and participate in interactive activities. This finding aligns with Ogunlade and Adeyemi (2019), who observed that unreliable internet access and inadequate digital infrastructure remain major barriers to e-learning adoption in Nigerian secondary schools. Similarly, Adu and Galloway (2015) reported that many schools in Nigeria face challenges such as poor bandwidth, frequent power outages, and outdated devices, which negatively impact the integration of ICT tools into classroom instruction. Furthermore, Ajayi and Ekundayo (2018) noted that while teachers and students recognize the potential of social media for learning, technical and infrastructural constraints often limit its pedagogical effectiveness. Thus, the findings of this study reinforce the need for improved internet facilities, provision of reliable digital devices, and better technical support systems to enhance the successful use of Social Media Learning Platforms in Nigerian schools.

The finding of the study revealed that there was no significant difference in the pre-test mean scores between students exposed to the Social Media Learning Platform and those in the conventional group, indicating that both groups had similar performance levels before the treatment. This suggests that the students were relatively homogeneous in their prior knowledge of Computer Studies at the beginning of the study. The result implies that any subsequent difference observed in the post-test performance could be attributed to the effect of the instructional strategies rather than pre-existing differences in ability. This finding supports the position of Olatoye and Adekoya (2019), who emphasized the importance of establishing group equivalence in experimental studies to ensure that variations in post-test outcomes can be confidently linked to the intervention applied. Similarly, Ogunniyi and Adegoke (2020) noted that comparable pre-test results between experimental and control groups strengthen the internal validity of quasi-experimental studies in educational research.

The finding of the study showed that the Social Media Learning Platform had a substantial positive impact on students' performance in Computer Studies compared to the conventional learning approach. Students who were taught using the Social Media Learning Platform demonstrated improved understanding, engagement, and retention of concepts, as reflected in their higher post-test scores. This improvement can be attributed to the interactive and collaborative nature of social media platforms, which promote active participation, real-time feedback, and peer learning. The finding aligns with Adebayo and Olatunji (2021), who reported that integrating social media tools into classroom instruction enhances students' motivation and academic achievement. Similarly, Ajayi and Ekundayo (2018) observed that technology-based learning environments foster better comprehension and creativity among secondary school students compared to traditional teacher-centered methods. Furthermore, Ogunlade and Adeyemi (2019) emphasized that social

media-based instruction encourages learner autonomy and collaboration, which are essential for developing digital competence and higher-order thinking skills. Hence, the study underscores the effectiveness of Social Media Learning Platforms as a valuable pedagogical tool for improving students' academic performance in Computer Studies.

Conclusion

Based on the findings, the study concluded that the use of Social Media Learning Platforms improved students' performance in Computer Studies more than the conventional method. It also concluded that smartphones were the main devices used for learning, while poor internet connectivity and limited access to devices hindered effective use. The study affirmed that when properly utilized, Social Media Learning Platforms can enhance students' engagement and achievement in Computer Studies.

Recommendations

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

1. Teachers should integrate Social Media Learning Platforms into the teaching of Computer Studies to enhance students' engagement and academic performance.
2. Schools should provide reliable internet access and adequate digital devices to support effective online learning.
3. Government and educational authorities should organize regular training programs for teachers on the use of social media tools for instructional purposes.
4. Students should be encouraged to use social media responsibly for academic purposes rather than for non-educational activities.
5. School administrators should develop policies that promote the safe and productive use of social media in teaching and learning environments.

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INFLUENCE OF DIGITAL LITERACY SKILLS ON RESEARCH PRODUCTIVITY AMONG LIBRARIANS IN PUBLIC COLLEGES OF EDUCATION IN SOUTHWESTERN NIGERIA

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Abstract

This study investigated the influence of digital literacy skills on research productivity among librarians in public colleges of education in Southwestern Nigeria. It evolved around determining the level of digital literacy skills possessed by the librarians and its influence on research productivity among librarians in public colleges of education in Southwestern Nigeria. Descriptive survey design was adopted for the study using professionals in public colleges of education in Southwestern Nigeria. Questionnaire was used for data collection purposes. Data collected were analysed using descriptive statistics such as frequency counts, percentages, means and standard deviation for research questions, while Pearson's Product Moment Correlation (PPMC) was adopted to analyse the only hypothesis stated at a 0.05 level of significance. The study concluded that the level of digital literacy skills of librarians in public colleges of education was high. Findings also revealed that the digital literacy skills possessed by the librarians greatly contribute to their level of productivity. The study concluded that digital literacy skills positively affect the productivity of librarians in public colleges of education.

Keywords: Digital Literacy Skills, Productivity, Librarians

Introduction

Research productivity could generally be interpreted to be the quantity and quality of a researcher's output in terms of publications, patents, citations relative to time and resources invested. It is an important factor in both personal and professional settings, measuring the relationship between what is put in and what is brought out. Productivity focuses on maximization of efficiency and effectiveness at work, to achieve good results with the same or reduced effort. It goes beyond hard work, but ability to work smarter and manage time, energy and reduce overhead cost. Librarians' productivity comes to bear on the successful realization of educational processes in colleges of education in Nigeria. Libraries in educational institutions are expected to facilitate the transference, storage and preservation of knowledge. Despite new technologies, including the advent of

the internet, the college of education libraries are still beneficial for researchers, educators and students.

The research productivity levels of the librarians define the level of impact the librarians research output will have on the community of users. The librarians plan the physical and material resources needed to encompass the goals of library, they are expected to do their task with integrity and ensure that they are more productive over an extended period of time. Innocent (2022) explained that research productivity can include research publication in professional journals and in conference proceedings, writing a book or chapter, gathering and analyzing original evidence, working with post-graduate students on dissertations and class projects, obtaining research grants, carrying out editorial duties, obtaining patents and licenses, writing monographs, developing experimental designs, producing works of an artistic or creative nature, engaging in public debates and commentaries. Innocent's explanation implies that the knowledge, skills and attitude possessed by the librarian will be expressed in the quality and quantity of the research output and made available to the community of users.

Improved research productivity among librarians in public colleges of education could depend on digital literacy skills, self-efficacy, and level of job satisfaction of the librarians. Digital literacy skills, most often referred to as information and communication technology (ICT) skills by researchers such as Adamu and Babalola (2022) denoted the capacity, abilities and proficiencies required to use digital technology to facilitate education and training, advance employability, and accomplish personal goals. It is important because digital information resources have taken over from the former traditional library practice and as such without digital literacy skills 'synonymously called ICT' skills, librarians would find it difficult to function efficiently. Digital literacy skills involve the use of varieties of digital facilities to search for information, navigate through volumes of information resources, generate and communicate information and cooperate. It also involves the skills for critical thinking and information analysis. To engage in today's society, librarians need to possess certain digital literacy skills abilities. Osinulu (2022) described digital literacy skills by library professionals and information workers as having required competence and being familiar with the use of the Internet and digital devices to create, retrieve and communicate information. The competencies needed to apply digital literacy skills vary depending on the setting (workplace and employment, personal and community, education and training), and there is a continuum of these skills.

Components of digital literacy skills include the ability to use devices efficiently, create and edit documents, communicate information to end users, transact information with ease. Digital literacy includes ability to use digital devices for creating, editing and disseminating content, working effectively with end users, conducting transactions, maintaining safe online behaviour, and adapting to technology changes. Librarians' ability to effectively operate the digital devices is likely to influence their productivity in cataloguing and classification. In addition, if librarians are able to create and edit documents and have technology literacy to transfer information to end users, it will indicate an improved productivity in carrying out acquisition and circulation functions. Apart from these, possession of skills for transacting information with ease and being safe and responsible online speak a lot about the productivity of librarians' schedule of performing selective dissemination of information in colleges of education. Most importantly,

skills to use emerging technologies, which describes ability to keep in touch and abreast of new technologies as they are emerging is an indispensable component of digital literacy skills of librarians.

Digital literacy skills among librarians in colleges of education are about the ability of the librarians to effectively and efficiently make use of digital tools and internet resources, which is different qualitatively and quantitatively from evaluative skills required of them to printed materials. Digital literacy skills are also the quality possessed by librarians in colleges of education to understand and demonstrate day-in and day-out, the use of information from a variety of digital sources. However, being digitally literate may be different from being skillful in the utilization of digital instruments. The capacity for effective and efficient utilization of potentials developed through training for the execution of specific activities may be looked at as skill. It may also be regarded as 'dexterity or coordination especially in the execution of learned physical tasks, while it is by extension regarded as a learned power of doing something competently.

Possession of adequate digital literacy skills by librarians will enable them to execute activities and services such as online database utilization, e-mail service, web-based interactive tutorials and online referencing service (Akintola, 2021). Organisations are rapidly shifting from the printed mode of utilizing information to the digital mode. For librarians to perform efficiently and productively in this technological information age, digital literacy skills are required. Skills in basic computer software will enhance their abilities in connection with using technology to help people to locate, access, arrange, produce, and share information and foster effective digital relationship and responsible use of digital technology. Therefore, digitally literate skilled librarians should be able to handle and manipulate digital information gadgets to suit the purpose and meet the delivery of the learning objectives of the college. Possession of the ability to make and share meaningful information in different modes and formats is also a required determinant of the digital literacy skills of librarians. Digital literacy skills will enable librarians to create information needed in the college, collaborate and communicate effectively with other college functionaries. They would understand how and when digital information technologies can be used to support the provision of effective teaching and learning processes and encourage the students in cultivating individualized learning.

Digital literacy skills of librarians also include the possession of specific digital skills not only for library activities but also for research purposes. It involves having the knowledge, coordination and capability to use available digital information processing tools and applications to meet the needs of the research requirements of the librarians in colleges of education. Librarians' acquisition of digital literacy skills has been shown to significantly improve their service delivery to clients and also enable them to effectively execute their primary duties and core responsibilities, thereby meeting the aims and objectives of the library and the institutions. Possession of digital literacy skills by librarians is the gateway to the realization of adequate research output of librarians in present-day digitalized tertiary institution libraries.

Nowadays, information is communicated around the world through the internet, mobile devices, laptops, applications, and numerous databases. What information is available in college libraries and how it is transmitted depends on its nature, purpose, implications, and advantages. Emerging technology utilization skills of librarians come to play in this perspective. Knowledge can sometimes

be freely shared or subject to restrictions, and it can be viewed as goods and or services. However, the trend in information terrain nowadays is emerging technologies which requires adequate skills and dynamics of the librarian for effective adoption and utilization. Ability to communicate and collaborate means a lot in possession of digital literacy skills. For the librarians to carry out their duties to the best of their abilities, information must be transmitted between staff members working in different units or sections. Librarians' possession of high digital literacy skills will help to maximise research productivity and contribute positively to research output through the assistance of artificial intelligence. When librarians in the colleges of education demonstrate sufficient digital literacy skills, with continuous learning and adaptability, they can feel more confident in responding to readers' needs, which will raise their sense of confidence and facilitate increased research productivity.

The submission above may be applicable in academic library especially colleges of education and this may lead to increased research productivity among librarians as a facilitator of collaborative research activities. Invariably, digital literacy skills might have become crucial for librarians in public colleges of education in other to empower them and improve their research productivity. This connotes that, librarians with adequate digital literacy skills may possess a considerable level of research skills, and attain a convenient degree of high research productivity. Therefore, the study investigated the influence of digital literacy skills on research productivity among librarians in public colleges of education in Nigeria.

Statement of the problem

Librarians in colleges of education are expected to provide services that facilitate teaching and learning and research. Librarians are mandatorily expected to publish quality scholarly articles as part of the indices of their productivity. Although employee productivity is increasingly being studied by organisations, there still remains a scarcity of literature on the productivity of librarians in public colleges of education in Nigeria. The existing studies on it have taken a general human resource management (HRM) focus, which had created a wide gap on issues such as influence of digital literacy skills on research productivity among librarians in public colleges of education. There is less research carried out on tertiary institutions library especially in Southwestern Nigeria. Therefore, this study aims to investigate how digital literacy skills affect research productivity among librarians in public colleges of education in Southwestern Nigeria to fill the existing gap in the literature.

Objectives of the study

The main objective of this study is to investigate the influence of digital literacy skills on research productivity of librarians in public colleges of education in Southwestern Nigeria.

The specific objectives are to:

i. find out the level of research productivity of librarians in public colleges of education in Southwestern Nigeria;

ii. examine the level of digital literacy skills possessed by librarians in public colleges of education in Southwestern Nigeria;

iii. investigate the influence of digital literacy skills on research productivity of librarians in public colleges of education in Southwestern Nigeria.

Research questions

The following research questions were answered in the study

1. What is the level of research productivity of librarians in public colleges of education in Southwestern Nigeria?

2. What is the level of digital literacy skills possessed by librarians in

public colleges of education in Southwestern Nigeria?

3. What are the influences of digital literacy skills on research productivity of librarians in public colleges of education in Southwestern Nigeria?

Literature Review

Conceptual review

Productivity studies that have been published in the literature are varied and complex. They include research on both individual personnel productivity and organizational productivity. Kabir and Rabby (2023) explained that higher productivity is the outcome of happier, more motivated employees who are more likely to put their all into their work. According to them, the ability of human beings to accomplish the desired goals is productivity in the real sense. Adebayo (2021) described productivity as the outcome of several interrelated factors which are related to the input and output components of a production process. The author added that productivity is synonymously used to determine progress and profitability in an organization and all human endeavours. Eniekebi (2023) also defined productivity as a measure of how well-specified resources and services are offered and rendered to meet stated goals promptly. Turner (2020) stated that an engaged employee achieves above-average levels of productivity and contributes significantly to team effectiveness. Productivity of the librarians thrives when their engagement flourishes in a rapidly developing modern library.

Numerous studies have also examined library productivity at the organisational level with the aim of enhancing service delivery and fulfilling institutional aims and objectives. Chowdhury and Khan (2024) asserted that the character and quality of an institution of higher learning are shaped in large measure by the nature and accessibility of its library resources as well as the expertise and availability of its librarians. Several roles performed by librarians within the institutions include not only teaching credit courses but also provides access to information, whether by individual and group instruction, selecting and purchasing resources, digitizing collections, or organizing information.

According to Chowdhury and Khan (2024), library services and project offered in the library are many and are segregated into different sections. Selection of materials, ordering and preparation of payment vouchers to purchase materials or library resources is carried out in the acquisition section. Once the order is received, the books, accessioning and general processing will take place and sent to the Technical Section.

According to Cadiog (2024) research has a great impact on librarians' role in the society nowadays. This role has integrally evolved in assisting in the provision of research services and other informational service to faculty, students, and staff in both public and private sectors. Iwu-James, Egbuchuwa, Ugwuanyi et al, (2023) also defined research as a systematic analysis to uncover new facts or to gain further information needed to explain or resolve a specific problem. It is investigation undertaken for the creation and advancement of knowledge using verifiable facts, it is the engine that fuels development. Librarians are involved in research and in descriptions of this work, practicing librarians have a high potential impact on library and information science. Their productivity as scholars varies greatly, depending on things like institutional support, resources, and professional norms.

Digital literacy skills

Digital literacy according to Okeji, Nwankwo, Anene and Olorunfemi (2020) empowers professionals of all works of life (including librarians) to possess the

necessary skills that improve their economic and social status and improve the quality and output of their overall job performance and living standard. The authors further emphasized that digital literacy encompasses the skills, knowledge, and behaviours required for the effective and efficient use of digital devices, such as smartphones, tablets, iPhones, laptops, iPads, and desktop computers, to facilitate collaboration, communication, expression, advocacy and decision-making. According to Drew (2022), in a world where new information is constantly being published and consumed, having this capability is vital. Workers with digital literacy skills can also connect and collaborate more effectively. These can also prevent generation gaps in a diverse workforce with up to five generations working together.

Empirical review

Research Productivity of Librarians

Ossai-Ugbah and Akporhonor (2023) empirically analyzed librarians' productivity in generic perspective. They explained that one of the significant factors of transformation under any working condition in an academic environment is a dedicated, industrious, positively driven, and inventive human workforce. With the rise in technological innovations and changes in the library profession, there is a need for the organization (library) to consider employee productivity. This is because the achievement, existence, and power of any organization to compete with others depend on the productivity of their workforce.

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Digital literacy skills of librarians

Information and communication technology resources are being used by the library more than in the past. This necessitates that its staff have sufficient levels of digital literacy skills. Chukwueke and Idris (2023) looked into how the digital literacy skills of librarians affect their ability to provide services in academic libraries in Taraba State, Nigeria. They used a correlational approach and studied 112 librarians from 11 academic libraries in the state. Their results showed that having good digital literacy skills and delivering services are closely linked to the productivity and use of library resources in academic settings. This according to them, can help create a more organized and effective environment for getting and sharing information. The study found that the librarians had low levels of digital literacy, especially in using the internet for searching, communication, evaluating websites, and applying Boolean logic.

Research Productivity and Digital literacy of librarian

Several studies have been reported in the area of digital literacy skills and their relationship with research productivity. It had been discovered that possession of digital literacy skills by librarians is possibly a means to an end, but not an end itself. The goal must be geared towards improved research productivity of

librarians in academic libraries. Justifying the relationship between productivity and job satisfaction of librarians, the role of digital literacy came into mentioning by Rodarte and Moore (2022) that as point of need services have transitioned into online forums, chat and text reference, online consultations, and virtual instruction, academic librarians are more available, and savvy, online than ever before. This can be translated to mean that possession of digital literacy skills by librarians is a necessity for high level of research productivity to be derived.

Methodology

Research design

The study adopted a survey design of mixed method of convergent parallel type to collect both quantitative and qualitative data. A structured questionnaire was used to collect quantitative data while focus group discussion was used to collect qualitative data. This design helped to find out the influence of digital literacy on productivity of librarians in public colleges of education. Mixed method of both quantitative and qualitative (focus group discussion) approach was used to corroborate the findings of the study and ensure that the findings accurately reflect the responses of the respondents.

Population of the Study

The population for the study comprised all librarians in all the public colleges of education in Southwestern Nigeria. As at the time of carrying out this study, four, out of the thirteen colleges of education namely: Adeyemi College of Education, Ondo; College of Education, Ikere; Michael Otedola College of Primary Education, Epe; Osun State College of Education, Ilesa, were still running NCE programmes. The total population for the study was 224.

Sampling Techniques and Sample Size

Total enumeration was adopted to cover all the 224 librarians in the 13 public colleges of education in Southwestern Nigeria.

Research instruments

The research instrument for this study was a structured questionnaire titled *Questionnaire on Digital Literacy Skills and Productivity (QDLSPLP)*. It is divided into five sections A-E.

Section A dealt with the Demographic Information of the respondents such as Name of institution, gender, age, years of working experience, highest academic qualification. This is used to ensure that the responses represent a diverse, cross-section of respondents or the responses are somewhat representative of already-established, baseline data (if any exists).

Section B was tagged Digital Literacy Skills Scale (DLSS) consisted of 20 items, covering parameters such as: basic computer skills, library specific digital skills, Emerging technology utilization skills, communication and collaboration skills, and continuous learning and adaptability skills. The measurement was determined using Likert scaling techniques. Testing with 4 modules respectively based on the standardised scale of Strongly Agree, Agree, Strongly Disagree, Disagree. The authors used the scale in the development of digital literacy indicators for Thai undergraduate students using mixed-method research.

Method of data analysis

The data collected were analysed using descriptive statistics such as frequency counts, percentages, means and standard deviation for research questions one and two, and multiple regression analysis for research question three. Pearson's Product Moment Correlation (PPMC) was adopted to analyse the only hypothesis at a 0.05 level of significance.

Research question 1: What is the level of digital literacy skills possessed by librarian in public colleges of education in Southwestern Nigeria?

Table 1. Level of Digital literacy skills of the librarians in public colleges of education in Southwestern Nigeria

S/n	Statements	SD (%)	D (%)	A (%)	SA (%)	Mean	S.D.
Basic Computer skills							
1	I easily utilise basic computer software such as word processors and spreadsheet programmes.	44 (19.6)	27 (12)	60 (26.8)	93 (41.5)	2.90	1.14
2	I perform basic file management tasks, such as creating folders, renaming files, and moving files between folders.	48 (21.4)	31 (13.8)	69 (30.8)	76 (33.9)	2.77	1.13
3	I have confidence in troubleshooting common issues on computer software.	21 (9.4)	82 (36.6)	91 (40.6)	29 (13.4)	2.58	.837
	I use keyboard shortcuts and other efficiency tools in computer software.	68 (39.8)	14 (6.3)	130 (58)	11 (4.9)	2.38	.977
Weighted mean= 2.66							
Library Specific Digital Skills							
5	I use library management software for cataloguing, circulation, and inventory management.	123 (54.9)	74 (33)	14 (6.3)	13 (5.8)	1.63	.852
6	I am familiar with electronic databases and online library resources.	13 (5.8)	77 (34.4)	108 (48.2)	26 (11.7)	2.65	.75
7	I am skilled in troubleshooting library-specific software and systems issues.	91 (40.6)	82 (36.6)	33 (14.8)	18 (8)	1.90	.932
8	I efficiently operate new digital tools and technologies to enhance library services.	119 (63.1)	69 (30.8)	25 (11.2)	11 (4.9)	1.67	.86
Weighted mean= 1.96							
Emerging Technology Utilization Skills							
9	I subscribe to use of emerging technologies in my library	12 (5.4)	73 (32.6)	18 (8.1)	121 (54)	1.48	.642
10	Emerging technology is a challenge to my job productivity	24 (10.7)	55 (24.5)	69 (30.8)	76 (33.9)	2.87	1.00
11	I prefer old technology to emerging trend	21 (9.4)	18 (8)	91 (40.60)	94 (41.9)	3.19	.94

12	Advent of emerging technologies in library enhances my job performance	22 (9.8)	69 (30.80)	14 (6.3)	119 (53.1)	3.02	1.11
Weighted mean= 2.64							
Communication and Collaboration Skills							
13	I have skill in using email for professional communication and collaboration with colleagues	22 (9.8)	20 (9)	103 (46)	79 (35.3)	3.06	.913
14	I use digital communication channels such as blogs or social media for library activities.	24 (10.7)	76 (33.9)	55 (24.5)	69 (30.8)	2.75	1.01
15	I am proficient in using collaborative tools, such as shared documents or project management platforms.	18 (8)	82 (36.6)	33 (14.9)	91 (40.6)	2.87	1.04
16	I do participate in online collaborative projects and discussions related to library services and research activities	14 (6.3)	22 (9.8)	119 (53.1)	69 (30.8)	3.08	.80
Weighted mean= 2.94							
Continuous Learning and Adaptability Skills							
17	I engage in professional development activities related to digital literacy and emerging technologies.	33 (14.7)	62 (27.7)	112 (50)	17 (7.6)	2.50	.836
18	I always search for information about emerging technologies that could benefit library services.	13 (5.8)	114 (50.9)	39 (13)	68 (30.4)	2.63	.93
19	I have ability to adapt to new technologies for library services.	22 (9.8)	87 (38.8)	104 (46.5)	11 (4.9)	2.49	.75
20	I do encourage and support my colleagues in adopting new digital tools.	29 (12.9)	76 (33.9)	98 (43.8)	21 (9.4)	2.49	.83
Weighted mean= 2.53							
Grand weighted mean=2.55							

Table 1 showed the responses of the respondents on the level of digital literacy skills of librarians in public colleges of education in Southwestern Nigeria. The responses of the respondents were rated as follows: Communication and collaboration skills (2.94) being the highest. This revealed that the librarians utilized communication and collaboration skills to increase their research productivity through peer review and co-authorship. This is followed by basic computer skills (2.66), which provide the librarians the opportunity to make use of computers not only for

research and publication activities but also for other library functions. Emerging technology utilisation skills that ranked third with (2.64) showcased the advancement of the respondents on the use of new research technology tools such as artificial intelligence for research and publication purpose. Continuous learning and adaptability skills that ranked (2.53) indicated the readiness of the respondents to continue learning and adapting to the new trends in information processing and assessment, while library specific digital skills (1.96) that ranked lowest made it possible for the respondents to apply their skills to daily library activities for increased research productivity to take place. Table 1 further reveals the grand weighted mean of 2.55. Out of the maximum 3.00 obtainable score which is higher than the standard mean of 1.50, this connotes that librarians in public colleges of education in Southwestern, Nigeria possessed high level of digital literacy skills. It could be inferred from the findings that communication and collaboration skills (2.94), basic computer skills (2.66), emerging technology utilization skills (2.64) and continuous learning and adaptability skills (2.53) were the major skills that are contributing to digital literacy skills application to increased research productivity of librarians in public colleges of education in Southwestern Nigeria.

Testing of Hypothesis

The study postulated one null hypothesis tested at 0.05 level of significance. The results are presented in the following tables:

Ho1: There is no significant relationship between digital literacy skills and research productivity among librarians in public colleges of education in Southwestern Nigeria.

The table shows the influence of digital literacy skills on research productivity of librarians in public colleges of education in Southwestern Nigeria. The Pearson Product Moment Correlation (PPMC) analysis was used.

Table 2. Correlation analysis of digital literacy skills and research productivity among librarians in public colleges of education

		Research productivity	Digital literacy skills
Personnel Productivity	Pearson Correlation Sig. (2-tailed) N	1 224	.969 .000 224
Digital Literacy Skills	Pearson Correlation Sig. (2-tailed) N	.969 .000 224	1 224

Table 2 showed that there is a significant positive relationship between digital literacy skills and research productivity among librarians in public colleges of education in Southwestern Nigeria. (Correlation=0.01). Hence the hypothesis of no positive relationship was rejected. This implies that as digital literacy skill of librarians increases, their level of research productivity also increase.

Discussion of Findings

The findings revealed that the level of digital literacy skills of librarians in public colleges of education in Southwestern Nigeria was high. It was indicated that communication and

collaboration skills and basic computer skills played the most prominent role in the digital literacy skills of the librarians. This finding is in tandem with that of Abu and Okarfor (2023) who claimed that, since the inception of this century, library and Information Science scholars are believed to have, through publications acquainted library and information science practitioners of the need to be ICT compliant, having acknowledged ICTs' sustained advances and its incontestable influence on library practices and operations. The study examined skills in the use of different application programmes as well as web technology relevant to library and information services in the technology age. The research showed that there are improvements in computer skills of librarians in Nigeria. The study however contradicted the findings of Adegbite-Badmus and Alabi (2022) who claimed that librarians in polytechnics in South-West Nigeria possess weak skills in automated cataloguing and classification/use of Online Public Access Catalogue (OPAC), and averagely skilled in presentation using Microsoft Power Point, and database creation and management. However, they still need to improve on their weak or average ICT level to make them compete favourably with their counterparts in academics and to assist in solving ICT challenges of their users to improve and increase their research productivity.

Some of the digital literacy skills that librarians need to possess as a result of the findings in this investigation is skills in using emerging technologies, such as the confidence to assess the relevance and dependability of online information sources for research purpose and library patrons, the ability to handle copyright and intellectual property rights concerns when using digital resources in the library, and the desire to take part in training sessions to enhance their information assessment abilities. Communication and collaboration to use email for professional communication and collaboration with colleagues and also participate in online collaborative projects or discussions related to research and library services. This was supported by the findings of Chukwueke and Idris (2023) that believe that digital literacy, the skill to effectively use and manage digital technologies, combined with the consistent integration of these technologies into library services and would improve the quality of library service delivery significantly.

It is evident that digital literacy skills significantly influence librarians' research productivity. This explains why the digital literacy skills of librarians and the quality and quantity of their research output in Nigerian academic libraries are of great concerns. As custodians of information, librarians must adeptly navigate various digital platforms to deliver services effectively and contribute to scholarly publication of research findings.

Conclusion

The study investigated the influence of digital literacy skills on research productivity among librarians in public colleges of education in Southwestern Nigeria. Digital literacy skills significantly affect research productivity of librarians in public colleges of education. Based on the findings, it could be concluded that, possession of adequate digital literacy skills by librarians in public colleges of education would lead to enhanced research productivity among librarians in public colleges of education in Southwestern Nigeria.

Recommendations

Based on the findings of this study, the following recommendations were proposed:

1. Management of public colleges of education should implement properly tailored training and development programme to equip librarians with digital literacy skills

necessary for their roles as custodians of knowledge and researchers.

2. Library administrators should prioritise maintaining and enhancing librarians' advanced digital literacy skills through regular in-house seminars and workshops. As new technologies are continuously emerging, regular updates are equally essential to boost librarians' research productivity.

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COMPARATIVE ANALYSIS OF TEACHERS' PERCEPTIONS ON GENERAL AND ADDITIONAL MATHEMATICS CURRICULA IN SENIOR SECONDARY SCHOOLS IN EKITI STATE, NIGERIA

BY

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Abstract

This study examined a comparative analysis of teachers' perceptions on General and Additional Mathematics curricula in senior secondary schools in Ekiti State, Nigeria. The study investigated teachers' perceptions of curriculum content, assessed the influence of teacher qualifications on curriculum implementation, and explored the role of gender in shaping curriculum delivery. A descriptive research design was adopted, sample of 120 mathematics teachers drawn from six local government areas using a multistage sampling procedure. Data were collected using a validated questionnaire, Teachers' Perceptions on General and Additional Mathematics Curriculum (TPGAMC), with a reliability coefficient of 0.80. Findings revealed that teachers generally held positive perceptions of both curricula, but they regarded General Mathematics as more relevant to real-life situations, better aligned with student needs, and strongly influenced by teachers' perceptions in assessing learner performance. Conversely, Additional Mathematics curriculum was seen as more abstract and less focused on problem-solving, though beneficial for preparing students for advanced studies. Results further showed that teacher qualifications significantly influenced effective teaching in both curricula, with higher qualifications and professional development linked to better student outcomes. However, gender differences were found to play minimal role. The study recommended curriculum reforms to strengthen problem-solving in Additional Mathematics.

Keywords: Teachers' perception, General Mathematics, Additional Mathematics, Curriculum implementation, Teacher qualification, Gender influence

Introduction

Mathematics education believes to be old as humanity itself. It was believed to be a vital tool that is inevitable to human existence. It is a subject that is widely used by man to manage his daily activities. Throughout history, Mathematics believes to have served man in various forms such as in agriculture, trade, financial transactions and communication of quantitative information; its application seems to continue in shaping and supporting human development in countless ways. Mathematics believes to be a subject centered to the development of any science based discipline. It is a subject that provides foundation language to all experimental inquiries and analysis carried out by scientists and technologists. According to, Ibaan, Nduka and Daso (2024), Mathematics is a crucial discipline that impulse the nation development. It was perceived to be a subject through which science, technology and engineering ideas are formulated, tested and communicated. It was believed that its inferences induce the necessary outcome which served as veritable yield stick to measure every nation development.

Also, Mathematics believed to aids the learning of other subjects like Economics, Financial Accounting, Banking and Finance and Marketing among others. No wonder its study made compulsory at all level of education, mostly at primary and secondary school in Nigeria. It was believed that without brilliant performance in Mathematics to have access to worthwhile careers will be at risk since competence gained in the study of Mathematics has been an advantage to learners in the quantitative subjects to gain opportunity to contribute to the economic and technology development of a nation. Adeleye, (2021). Realizing the significance of Mathematics as a tool for improving other discipline as well enhancing nation growth and development in science and technology, countries of the world are expected to intensify efforts to reform their Mathematics Education Curriculum and respond in a positive way to global educational trend and the national developmental needs (NERDC,2013; Ajagun, 2019). It was believed that curriculum is the only vehicle on which teaching and learning activities ensued. It was perceived to be bedrock of all the classroom instructional proceedings, it outlines what students are expected to know and be able to do at various stage of schooling. FRN, (2014), asserted that curriculum is the basic means through which stated educational goals can be attained to gear individuals to an inspired citizens; designed by the education expertise to prepare individuals' to contribute drastically to nation economic and technological development (Ajagun,2019).

Sharon, (2020) reiterated the challenges to include the lack of interaction between teachers and students; placing too much emphasis on observable behaviours, lack problem-solving ability, prioritise rote procedures at the expense of deeper conceptual reasoning and placed more focus on societal needs instead of individual needs. Olorundare and Akinyemi (2014) said that inadequate teacher's involvement in the design and review of the Mathematics curriculum allows the disconnection between policy and practices. The noticeable and indisputable deficiency in the implemented curriculum were appeal for reform since it has been identified, aims to make curriculum contents to be clearly stated so that it satisfied the needs of students, which enable the education planners in Nigerian to develop initiatives, to improving skills needed in science and technology. It was believed that the latter attempt to reform implemented curriculum opening up into two sets of curriculum in Mathematics in Nigeria which are now running side by side at the senior secondary level of education. The two curriculums are General Mathematics and Additional Mathematics.

General Mathematics curriculum in Nigeria believed to be designed with specific aims. It was perceived to be a

foundational subject articulated in the National Policy on Education to impulse nation growth and development. According to FRN (2014) and Odogwu (2015), General Mathematics was made a core subject at both Primary and Secondary education levels in Nigeria due to its central role in the nation scientific, technology and economic development. Notwithstanding the aims attached to the curriculum, teachers' perception of General Mathematics perceived to significantly impart its effective implementation. The researcher observed that many of the teachers that handle the subject complain of the curriculum as abstract and overloaded.

According to Uka (2021), many Mathematics teachers believed that the curriculum is easy to understand by both teachers and the students but it focused on too many topics. And that the overloading of curriculum and its' abstraction in nature has been the reasons why it is impossible for the teachers to have enough time and the resources to present the content contains effectively. It was believed that complex nature of the curriculum affected teacher presentation of its contents effectively during Mathematics discourse in the classroom. Adedigba and Olanrewaju (2020) are of the opinion that the highly abstract and complex nature of General Mathematics curriculum poses serious challenges for teachers, makes some certain contents too abstract to teach. It seems that teachers inability to present the content knowledge effectively has made students see General Mathematics as abstract and also made the students memorize procedures without proper understanding of the underlying concept. Odogwu (2015) and WAEC Chief Examiner (2020), reiterated that the curriculum contents do not take care of daily student's experiences but rather serve the purpose of preparing the students for public examination such as WASSCE, NECO and NABTEB. This believes have made it impossible for the students to see the relevance of the content to their growth and in many situation has led to the students poor performance in the subject.

General Mathematics is a broad based curriculum which focused much on the completion of topics rather than to make students grasp and understand these topics. According to Amoo and Kasali (2016), the General Mathematics curriculum contains too many topics which have made it difficult for the teachers to effectively, engage the students during teaching and learning activities. They were of the opinion that the broad contents of the General Mathematics make the teacher to rush over the contents in the curriculum just to be able to finish in time without consider what the students were able to grasp and understand. Olagunju and Adediran (2018), opined that the arrangement or sequencing of the various topics in the General Mathematics curriculum make it difficult for the students to understand and also to relate the Mathematics contents to their daily life. Ezeugwe and Onyebuchi (2018) said that relating the Mathematics contents to the real life situation were made impossible due to inadequate materials to aids the teaching of the General Mathematics curriculum.

According to Adeniyi and Akanmu (2020), Teachers were of view that nature and content of Additional Mathematics curriculum are too rigorous to understand. It was designed to develop and prepare students for further study in the fields of Science and Technology. It was believed that proper understanding of Additional Mathematics content will help the student to develop higher logical reasoning and analytical problem solving skills, and also with constant practice on various content in Additional Mathematics will improve the conceptual understanding of the students who have strong interest in future careers in Science, Technology and Mathematics related fields. (WAEC, 2020).

Although, the two curriculums seems to be complementary to each other but they differ in term of scope, depth and instructional requirements. It was

observed that many teachers find the school curriculum content lacking in real-life relevance for learners, (Olabode, 2018). According to him, when instructional content falls to connect with students' everyday experiences, it becomes difficult for them to understand, and retain the subject matter. It seems that Additional Mathematics delves deeper into concepts areas such as calculus, trigonometry and advance algebra that perceived higher demand level of abstraction and problem solving skills (Adeniji & Owoeye, 2020). Agwagah and Ezeugo, (2018), revealed that teaching of Additional Mathematics has been seen as a great task, considering the limited time allocated to the teaching of the subject on the school timetable. This situation seems to have denied enough instruction time for teacher and students to interact well with adequate examples to support the curriculum content matter.

Adegoke and Mefun, (2016) was of the opinion that teachers' educational qualification is another vital variable that is crucial to the implementation of Mathematics curriculum at all level of education in Nigeria. It was believed that certain certificate possessed by any teachers determine their confidence, dedication, efficiency and effectiveness in implementing the contents contain in the curriculum. According to Akuta (2021), teacher's qualification described the level of education attainment and certificate obtained by the teachers after the completion of a stipulated program that will qualify them to teach at a given level of education. In view of Omaliko and Okpala (2021), teacher's qualifications include academic training such as HND, B.Sc, B.A. and M.A. among others while professionally qualification such as teachers certificates include TCII, NCE and degrees like B.Ed., B.Sc. Ed, B.A. Ed, and M.Ed, among others. It was perceived that variations in the teachers' qualifications significantly influence their ability and effectiveness in Mathematics curriculum implementation. It was observed by the researcher, that both teachers who are professionally qualified and those that are not professionally qualified are employed to teach General Mathematics at the primary and post primary school level of education, in agreement with, Omaliko and Okpala (2021), viewed that teachers who obtained formal qualifications like B.SC, in Mathematics plus a postgraduate Diploma in education are usually seen as better at teaching and understanding the General Mathematics curriculum. Conversely, Oyelekan and Bello (2017), reiterated that teachers in Kwara and Lagos states exhibited strong background in Mathematics, should be allowed to teach Additional Mathematics. Adedayo and Ojo (2020) were of opinion that Additional Mathematics curriculum covers more abstract and complex topics that need to be handled by only trained, experienced Mathematics teachers who possess a strong background in advance Mathematics concepts and pedagogy.

Gender was believed to be an imperative factor to be considered in effective implementation of Mathematics (i.e General and Additional Mathematics) curriculum at Secondary School level in Nigerian Education. According to Adeniji and Lawal (2018), maintain that teachers' gender, whether consciously or unconsciously, would affect how they present content, engage students, build their confidence and evaluate their performance. It was believed that gender dynamics in the classroom often affect teachers' communication styles and expectations, which in turn influence students' performance. It was believed that the variation in teacher's gender has significantly impact teacher's confidence, instructional methodology, instructional presentation and student's participation during Mathematics discourse in the classroom (Zakkamaris & Balash, 2017). In consonant, Eze and Ezeugwe (2018), reiterated that social cultural belief and expectation, professional access and teaching self-efficacy are the factors influencing teachers' capabilities and competence in implementing Mathematics curriculum. At present, there is a sparse research study

that examines the factors behind the difference in gender ability in implementing the curriculum of General and Additional Mathematics in Nigeria. Meanwhile, some finding reveled that female teachers' are effective in the presentation of General Mathematics contents than their male counterparts, Ogunniyi and Fakomogbon (2015) reiterated that female teachers show greater patience and emotional support to the students in presenting General Mathematics contents through the use of more interactive teaching styles such as group work, collaborative tasks and guided discovery approach than their male counterparts. They further restated the impact of conducive classroom situation to students learning abilities by emphasizing that female teacher often encourage inclusive classroom climates that encourage participation from all students regardless of ability and gender. Usman (2021) viewed that male teacher are of greater confidence, technical mastery in presenting complex contents and pose pedagogical confidence in teaching the contents in the higher order topics in Additional Mathematics.

Statement of the Problem

Teachers are the most essential component in the dispensation of knowledge in any classroom situation. It was believed that various qualities possessed by the teachers significantly impact their role during the instructional time. It was believed that the perception of teachers on the curriculum greatly affects how they direct the teaching, what they emphasize and how students learn. It was noticed that some teachers found Mathematics curriculum too difficult, overloaded or complex for their students. This may lead to students' poor understanding and low performance in Mathematics. Despite the curriculum reform, many Mathematics teachers still face challenges with its content, structure, and delivery. It was perceived that many teachers feel that the curriculum is not compressive or practical enough. The perception of teachers on the curriculum appears to make many teachers struggle on how well to present the content to the students and this has reduced students' motivation and participation in various classroom activities that concern with teaching and learning of Mathematics. Hence, this study is aimed at examining the comparative analysis of teachers' perceptions on General and Additional Mathematics Curriculum in Senior Secondary School in Ekiti State.

Purpose of the Study;

The purpose was to:
examine teachers' perceptions on the content of the Mathematics curriculum.
investigate teachers qualification on Mathematics curriculum implementation.
find out whether teachers' gender influence Mathematics curriculum implementation.

Research Hypotheses

Ho1: There is no significant difference between teachers' perception on General Mathematics and Addition Mathematics curriculum in Senior Secondary Schools.
Ho2: There is no significant difference between the teachers' perception on General Mathematics and Additional Mathematics on the basis of qualification.
Ho3: There is no significant difference between teachers' perception on General Mathematics and Additional Mathematics on the basis of gender.

Research Method

The design used for this study was a descriptive research of the survey type. The multistage sampling procedure was adopted to select the sample. The samples of 120 teachers were selected randomly from six out of the sixteen Local Government Areas (LGAs) in the State. Two LGAs were randomly selected from each of the three senatorial districts in the State. All Mathematics teachers in the six LGAs formed the sample for the study. The instrument for the study was a questionnaire titled Teachers' Perceptions of General and Additional Mathematics Curriculum (TPGAMC). Focusing on these three areas; curriculum content, gender and teachers qualification, the

face and content validity of the instrument was carried out by the Mathematics teachers and two experts in Test, Measurement and Evaluation. The reliability of the instrument was ascertained using test re-test method in which the instrument was administered twice on 30 teachers outside the sample. Pearson's Product Moment Correlation was used to ascertain the reliability co-efficient and the reliability coefficient of 0.80 was obtained and this was adjudge high enough to make the instrument reliable to be used for the study. One research's question was generating for the study also one research's hypothesis was raised. The research questions generated were answered using frequencies tools while hypothesis formulated for the study was tested using t-test at 0.05 level of significance.

Results

Table 1: Descriptive Analysis of teachers' perception of General Mathematics curriculum in Senior Secondary Schools N = 126

Items	Mean	Std. Deviation
The general mathematics curriculum is relevant to real-life situations.	3.32	0.88
The general mathematics curriculum is adequately aligned with students' needs and interests	3.52	0.82
Teachers' perceptions of the curriculum can influence student motivation and engagement	3.30	0.93
The general mathematics curriculum focuses more on procedural fluency than conceptual understanding	3.38	0.92
My perception of the general mathematics curriculum influences how I assess students' performance	3.57	0.73
Total	17.10	2.20

Mean Cut-off: 2.50

The results in Table 1 indicated that teachers generally hold a positive perception of the General Mathematics curriculum in Senior Secondary Schools, as all the mean scores are above the cut-off point of 2.50. The highest-rated item was the influence of teachers' perception on student assessment (M = 3.57, SD = 0.73), suggesting that teachers' views strongly shape how they evaluate learners. Similarly, the curriculum was perceived as being adequately aligned with students' needs and interests (M = 3.52, SD = 0.82), while its relevance to real-life situations (M = 3.32, SD = 0.88) and impact on student motivation and engagement (M = 3.30, SD = 0.93) were also positively acknowledged. However, teachers agreed that the curriculum tends to emphasize procedural fluency more than conceptual understanding (M = 3.38, SD = 0.92), pointing to a potential gap in fostering deeper comprehension. Overall, the total mean of 17.10 reflects a favourable perception of the curriculum, though with recognition of areas needing balance between procedures and concepts.

Table 2: Descriptive Analysis of teachers' perception of Additional Mathematics curriculum in Senior Secondary Schools N = 126

Items	Mean	Std. Deviation
The additional mathematics curriculum presents an appropriate level of challenge to students	3.14	0.77
The additional mathematics curriculum prepares students well for advanced mathematics courses	3.18	0.90
Teachers' perceptions of the additional mathematics curriculum influence student engagement	3.17	0.90

I prioritize certain topics in additional mathematics based on perceived importance	2.90	1.04
The additional mathematics curriculum focuses more on abstract concepts than problem-solving	3.42	0.69
Total	15.82	2.22

Mean Cut-off: 2.50

The descriptive analysis in Table 2 showed that teachers generally have a positive perception of the Additional Mathematics curriculum in senior secondary schools, as all the mean scores are above the cut-off point of 2.50. Teachers agreed that the curriculum presents an appropriate level of challenge to students (M = 3.14) and adequately prepares them for advanced mathematics courses (M = 3.18). Similarly, they acknowledged that their perceptions of the curriculum influence student engagement (M = 3.17). However, while teachers indicated that they sometimes prioritize certain topics based on perceived importance (M = 2.90), they strongly agreed that the curriculum places more emphasis on abstract concepts than on problem-solving (M = 3.42). With an overall mean score of 15.82 (SD = 2.22), the results suggest that although teachers view the curriculum as beneficial in preparing students, they perceive an imbalance in its focus, favouring abstract concepts over practical problem-solving approaches

Table 3: Descriptive Analysis of teachers' perception of General Mathematics on the basis of qualification N = 126

Items	Mean	Std. Deviation
Teachers with mathematics-specific qualifications teach general mathematics more effectively	3.48	0.76
Professional development programs improve my qualifications and enhance my instruction I general mathematics	3.33	0.86
Teachers with higher qualifications tend to achieve better student outcome in general mathematics	3.30	0.87
My qualification help me meet the diverse learning needs in general mathematics classes	3.29	0.77
My qualification support me in integrating real-world applications into general mathematics instruction	3.33	0.87
Total	16.71	1.99

Mean Cut-off: 2.50

The results in Table 3 showed that teachers generally hold a positive perception of the influence of qualifications on their effectiveness in teaching general mathematics, as all the mean scores were above the cut-off point of 2.50. The highest-rated perception was that teachers with mathematics-specific qualifications teach general mathematics more effectively (M = 3.48, SD = 0.76), suggesting that subject-specific training strongly enhances teaching quality. Similarly, professional development (M = 3.33, SD = 0.86) and higher qualifications (M = 3.30, SD = 0.87) were perceived as vital in improving instruction and achieving better student outcomes. Teachers also agreed that their qualifications help them address diverse learning needs (M = 3.29, SD = 0.77) and integrate real-world applications into instruction (M = 3.33, SD = 0.87). The overall mean of 16.71 indicates a strong consensus that qualifications positively impact teaching effectiveness and student learning in general mathematics.

Table 4: Descriptive Analysis of teachers' perception of Additional Mathematics on the basis of qualification N = 126

Items	Mean	Std. Deviation
Teachers with advanced mathematics qualifications teach additional mathematics more effectively	3.14	.77
My qualifications help me teach complex mathematical concepts in additional mathematics	3.18	.90
Professional development enhances my qualifications and improves additional mathematics instruction	3.17	.90
My qualifications influence how I use different strategies in teaching additional mathematics	2.90	1.04
Teachers with higher qualifications tend to produce better student learning outcomes	3.42	.69
Total	15.81	2.22

Mean Cut-off: 2.50

The results in Table 4 indicated that teachers generally hold positive perceptions of the influence of qualifications on the teaching of Additional Mathematics, as all the mean scores exceeded the cut-off point of 2.50. Among the items, the highest mean score (M = 3.42, SD = 0.69) shows that teachers strongly believe higher qualifications contribute to better student learning outcomes. Similarly, teachers agreed that their qualifications help them teach complex concepts (M = 3.18, SD = 0.90) and that professional development further enhances their instructional capacity (M = 3.17, SD = 0.90). The lowest mean score was recorded for the influence of qualifications on the use of different strategies in teaching Additional Mathematics (M = 2.90, SD = 1.04), although still above the cut-off, suggesting moderate agreement. Overall, the total mean of 15.81 reflected a favourable perception that qualifications play an important role in teaching effectiveness and student outcomes in Additional Mathematics

Table 5: Descriptive Analysis of teachers' perception of General Mathematics on the basis of gender N = 126

Items	Mean	Std. Deviation
Male and female teachers use different teaching approaches in general mathematics	3.06	1.08
Gender stereotypes influence how teachers interact with students in general mathematics	2.97	1.09
Societal expectations about gender roles affect students' attitudes towards general mathematics	2.75	1.11
Boys and girls respond differently to various teaching methods in general mathematics	2.84	0.98
Teachers' perception of student ability are influenced by gender in general mathematics	3.18	0.89
Total	14.79	2.98

Mean Cut-off: 2.50

The results in Table 5 showed that teachers generally perceive gender as having a moderate influence on the teaching and learning of General Mathematics, as all the mean scores are above the cut-off point of 2.50. Among

the items, the highest mean score was recorded for the perception that teachers' views of student ability are influenced by gender (M = 3.18, SD = 0.89), suggesting that teachers acknowledge some level of bias or differentiation in how they assess male and female students. Similarly, the belief that male and female teachers use different teaching approaches (M = 3.06, SD = 1.08) and that gender stereotypes influence teacher-student interactions (M = 2.97, SD = 1.09) also received relatively high ratings, indicating recognition of gendered influences in instructional practice. However, societal expectations about gender roles (M = 2.75, SD = 1.11) and differences in student responses to teaching methods (M = 2.84, SD = 0.98) were perceived to have a lower but still notable influence. Overall, the total mean score of 14.79 suggested that teachers perceive gender as a significant factor shaping both teaching practices and students' engagement with General Mathematics.

Table 6: Descriptive Analysis of teachers' perception of Additional Mathematics on the basis of gender N = 126

Items	Mean	Std. Deviation
Male and female teachers use different teaching approaches in additional mathematics	3.35	0.97
Societal expectations about gender roles shapen students' attitudes toward additional mathematics	3.07	1.17
Boys and girls respond differently to various teaching methods in additional mathematics	3.05	1.11
Teachers' perception of students' abilities are affected by gender in additional mathematics	2.98	1.08
I use strategies to promote gender equity in additional mathematics education.	2.80	1.15
Total	15.25	2.94

Mean Cut-off: 2.50

The results in Table 6 indicated that teachers generally perceive gender to play a role in shaping teaching and learning in Additional Mathematics, as all the mean scores are above the cut-off mean of 2.50. The highest mean score (M = 3.35, SD = 0.97) suggests that teachers believe male and female teachers use different teaching approaches, while societal expectations about gender roles (M = 3.07, SD = 1.17) and students' differing responses to teaching methods (M = 3.05, SD = 1.11) were also viewed as moderately influential. Teachers were less likely to agree that their own perceptions of students' abilities are affected by gender (M = 2.98, SD = 1.08), and the lowest mean (M = 2.80, SD = 1.15) indicates relatively limited emphasis on actively using strategies to promote gender equity in Additional Mathematics education. Overall, the total mean (M = 15.25, SD = 2.94) reinforces that teachers acknowledge gender differences, but their efforts towards fostering gender equity appear less prioritised

Test of Hypotheses

Ho1: There is no significant difference between teachers' perception on General Mathematics and Additional Mathematics curriculum in Senior Secondary Schools.

Table 7: t-test on teachers' perception of General Mathematics and Additional Mathematics curriculum

Variations	N	Mean	SD	Df	tcal	P
Mathematics	126	17.10	2.20	250	4.596	0.000*
Additional Mathematics	126	15.82	2.22			

*P<0.05

Table 7 showed that the t-cal value of 4.596 is significant because the P value (0.000) <0.05. This implies that null hypothesis is rejected. Hence, there is significant difference between teachers' perception on General Mathematics and Additional Mathematics curriculum in Senior Secondary Schools.

Ho2: There is no significant difference between the teachers' perception on General Mathematics and Additional Mathematics on the basis of qualification.

Table 8: t-test on teachers' perception of General Mathematics and Additional Mathematics on the basis of qualification.

Variations	N	Mean	SD	Df	tcal	P
Mathematics	126	16.71	1.99	250	3.380	0.001*
Additional Mathematics	126	15.82	2.22			

*P<0.05

Table 8 showed that the t-cal value of 3.380 was significant because the P value (0.000) <0.05. This implies that null hypothesis was rejected. Hence, there was significant difference between the teachers 'perception on General Mathematics and Additional Mathematics on the basis of qualification.

Ho3: There is no significant difference between teachers' perception on General Mathematics and Additional Mathematics on the basis of gender.

Table 9: t-test analysis for difference between the teachers' perception on General Mathematics and Additional Mathematics on the basis of gender.

Variations	N	Mean	SD	Df	tcal	P
Mathematics	126	14.79	2.98	250	1.212	0.227
Additional Mathematics	126	15.25	2.94			

P>0.05

Table 9 shows that the t-cal value of 1.212 is not significant because the P value (0.227) > 0.05. This implies that null hypothesis is not rejected. Hence, there is no significant difference between teachers' perception on General Mathematics and Additional Mathematics on the basis of gender.

Discussion

The findings revealed that teachers' perception of the General Mathematics curriculum was positively, particularly regarding its alignment with students' needs and interests and its relevance to real-life applications. The highest-rated perception was that teachers' views of the curriculum significantly influence how they assess student performance. This supports research by Uka (2021), who argued that teachers' perceptions shape classroom practices, assessment strategies, and ultimately students' achievement. Similarly, the perception that the curriculum is aligned with students' needs resonates with the assertion of Odogwu (2015) that relevance and student-centered content are critical for motivation and engagement in mathematics learning. However, the study also found that the General Mathematics curriculum

emphasizes procedural fluency more than conceptual understanding. This aligns with Sharon, (2020), critique that many mathematics curricula globally prioritize rote procedures at the expense of deeper conceptual reasoning, which may affect students' problem-solving competence. Thus, while teachers recognize the curriculum's strengths, they also acknowledge areas requiring improvement for balanced learning outcomes.

Teachers' perceptions of the Additional Mathematics curriculum, however, highlight a different set of concerns. Although the curriculum was seen as adequately preparing students for advanced mathematics and presenting an appropriate level of challenge, it was also perceived to overemphasize abstract concepts at the expense of problem-solving. This finding aligns with Adeniyi and Akanmu (2020), who found that senior secondary students often struggle with Additional Mathematics because of its abstract orientation, which reduces its perceived relevance. Teachers' tendency to prioritize certain topics based on perceived importance suggests attempts to make the subject more accessible to learners. Research by Agwagah and Ezeugo, (2018) affirms that selective teaching practices are common among mathematics teachers who attempt to balance curriculum demands with classroom realities. Overall, while the Additional Mathematics curriculum is perceived as academically rigorous and beneficial for further studies, teachers' concerns point to the need for a stronger emphasis on problem-solving and applied contexts to support student engagement and achievement.

Another key finding is the influence of teachers' qualifications on their effectiveness in teaching both General and Additional Mathematics. Teachers with mathematics-specific or higher qualifications were perceived to teach more effectively, producing better student outcomes in both subjects. This finding is consistent with Akuta (2021), who demonstrated that teacher qualifications and professional development are strongly correlated with instructional quality and student learning. Similarly, professional development was rated highly as a means of improving instructional practices, reflecting the findings of Rosli and Aliwee (2021), who emphasized continuous training for mathematics teachers to address curriculum reforms and diverse student needs. Notably, while qualifications were positively viewed across both subjects, the relatively lower mean score for the influence of qualifications on the use of different strategies in Additional Mathematics indicates that higher qualifications do not automatically translate into pedagogical flexibility. This suggests that teacher training should not only focus on content mastery but also on diverse instructional strategies.

The study also explored teachers' perceptions based on gender, and the results revealed that General Mathematics teachers believed that perceptions of student ability are sometimes influenced by gender and that male and female teachers may use different teaching approaches. These perceptions echo findings by MAN (2022), who reported that implicit gender biases often shape mathematics instruction and teacher expectations of students' performance. However, societal expectations about gender roles and student responses to teaching methods were rated lower; suggesting teachers believe external gender influences are less pronounced in General Mathematics. In contrast, perceptions in Additional Mathematics revealed stronger acknowledgment of gender-based differences in teaching approaches and societal expectations, though fewer teachers reported actively promoting gender equity in their practice. This finding is in line with UNESCO (2022), which highlighted persistent gender gaps in advanced mathematics and STEM education, often reinforced by teacher perceptions and practices.

The hypothesis testing provides further insight into the distinctions between teachers' perceptions of the two curricula. The results revealed a

significant difference between teachers' perceptions of General and Additional Mathematics curricula ($t = 4.596$, $p < 0.05$), suggesting that teachers value General Mathematics more positively, likely due to its relevance and alignment with student needs. This supports research by FRN (2014), who reported that students and teachers generally find General Mathematics more relatable than Additional Mathematics. Similarly, teachers' qualifications significantly influenced their perceptions of both subjects ($t = 3.380$, $p < 0.05$), reaffirming the critical role of professional training in shaping teaching practices and curriculum engagement. However, there was no significant difference in teachers' perceptions on the basis of gender ($t = 1.212$, $p > 0.05$), suggesting that while gender perceptions exist in classroom interactions, they do not significantly alter how teachers view the curriculum itself. This finding resonates with Adeniji and Lawal (2018), who concluded that teacher gender had minimal impact on perceptions of curriculum design, though it could affect interactional practices.

Conclusion

The study concluded that teachers generally hold positive perceptions of both the General Mathematics and Additional Mathematics curricula in senior secondary schools, though their views highlighted some important distinctions. Teachers perceived the General Mathematics curriculum as being more relevant to real-life situations and better aligned with students' needs, while also acknowledging that their own perceptions significantly influenced how they assessed learners. On the other hand, while the Additional Mathematics curriculum was viewed as beneficial in preparing students for advanced studies, it was seen as more abstract in focus, with less emphasis on practical problem-solving. These differences in perception suggest that although both curricula are valued, teachers see General Mathematics as more practical and student-centered compared to Additional Mathematics.

The study further concluded that teacher qualifications play an important role in shaping perceptions of effectiveness in teaching both subjects. Teachers with subject-specific and higher qualifications believed they could deliver instruction more effectively, meet diverse learning needs, and integrate real-world applications, especially in General Mathematics. Professional development was also recognized as an important factor in improving teaching capacity. In terms of gender, teachers perceived that male and female instructors may use different teaching approaches and that societal expectation and stereotypes influence student engagement. However, there was no significant difference in overall perceptions of the two curricula based on gender, implying that qualifications and the nature of the curriculum itself had stronger impacts on perceptions than gender.

Recommendations

The Additional Mathematics curriculum should be revised to include more practical and real-life applications, similar to General Mathematics, so that students can better appreciate its relevance and applicability beyond the classroom.

Continuous training and professional development programmed should be organized for mathematics teachers, with a focus on innovative pedagogical strategies, curriculum integration, and bridging the gap between abstract mathematical concepts and practical problem-solving.

Policies should encourage teachers to pursue higher subject-specific qualifications in mathematics. Institutions and governments should provide incentives such as scholarships or study leave to enhance teacher competence and confidence in teaching both General and Additional Mathematics.

Teachers should be equipped with strategies to counteract societal stereotypes and to promote gender equity in mathematics classrooms, ensuring both boys and girls are equally motivated and supported in learning General and Additional Mathematics.

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IMPACT OF FLIPPED CLASSROOM INSTRUCTIONAL STRATEGY ON STUDENTS' ACADEMIC PERFORMANCE IN BIOLOGY IN EKITI STATE, NIGERIA

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Abstract

This paper examined impact of flipped classroom strategy as a method in the teaching, learning process, characteristics, benefits and drawbacks of flipped classroom on senior secondary school students. Also examined gender issues and students' academic performance in biology and future directions. The study adapted a quasi-experimental pre-test, post-test and control group design three null hypotheses were generated and tested at 0.05 level of significance. The targeted population for the study consisted of all the 12,690 SS2 students offering Biology in 205 public secondary schools in Ekiti State. The sample consisted of 81 SS2 students found in the intact classes of the schools selected for the study. Selected through multistage random sampling technique. The instrument used to collect data for the study was the "Biology Performance Test" (BPT) which consist information on the bio-data of the respondents and as well 30 objective items. The data obtained were analyzed using descriptive statistics of mean and standard deviation (to answer the research question) and inferential statistics of t-test (to test the stated hypotheses). Findings of the study revealed that the flipped classroom method is more effective in teaching Biology than the conventional method and that the flipped classroom method is not gender sensitive. Based on these finding it was recommended that teachers should be encouraged to use the flipped classroom method over the conventional so as to concretize some of the concepts in Biology. It was also recommended that the government should regularly organize seminar and in -service training for teachers on how to make use of computer systems in their teaching processes.

Keyword: Flipped classroom, Instructional strategy, Academic performance, Students

Introduction

Nigeria today is undergoing major transformations which are multidimensional, affecting the technological, economic, social, cultural and political development of human communities. Education in the generic and global context is a strategic instrument for technological and economic transformation. The focus of education system all over the world is the development of the human capital required to meet present and future challenges of globalization (Dike, 2014). The enviable position of science education system of most countries of the world. Including Nigeria is perhaps justifiable. The reason is that science can exert a dominant influence on individual as well as on the developmental effort of a nation. The Universal recognition of the above submission is responsible for the prime position that has accorded science and in particular Basic Science which serve as a pivot upon which other sciences rotate.

The importance of Basic Science cannot be over stressed. All students must learn and pass it as the Junior Secondary School level before they can advance to the senior level. Despite the importance of Basic Science to mankind and the efforts of researchers to improve on its teaching and learning

the performance of students in the subject is still not encouraging. The rate and degree of failure could not be specifically determined but may be as a result of factors like teacher's qualification and School environment teaching strategies among others (Adu & Adeyanju, 2013). Research evidences have proved that Science contributes to the quality of life and nation building in all aspects of human endeavour (Abimbola, 2013). Therefore, for any meaningful development to take place every nation must embark on knowledge and skills of science and technology for rapid sustainable social, economic, political and technological advancement. Teacher's teaching strategies play a significant role towards improve teaching and learning process. Students -centred approach supported in educational media could enhance effective teaching and learning. Among the new educational media for teaching and learning is flipped classroom instructional strategy. A flipped classroom is an instructional strategy and a type of blended learning that reverses the traditional learning environment by delivering instructional content, when online, outside of the classroom. It is one such learning strategy that creates learning through technology, especially online video media, which help reduce lecture time and increase the time for in-class activities where learners can learn cooperatively through practice (DeLozier, S. J. & Rhodes, M. G. 2017). Technology can support flipped classroom by letting students gain first by exposure to new material outside of class usually via reading or lecture videos and then using class time to do the harden work of assimilating that knowledge perhaps through problem solving, discussion, or debates. The growing accessibility and sophistication of educational technologies open up increasing possibilities for students to explore, share, and create content. In addition, a flipped classroom has also been shown to promote not only students' sense of responsibility for their own work and self -regulation in assignment submission, but also their responsibility toward group assignments and classroom activities Yilmaz, R. (2017).

Flipped classroom instructional practice is a new model for effective teaching. Leo and Puzio (2016) referred to it as a form of blended learning in which learners learn content online by audio lectures or watching the video lectures, mostly at their various home and assignment is done together in the class with teachers and students discussing and solving questions. Students can work together on a task, exchange their opinion, experiences, views, discuss and negotiate strategies, actions and results through flipped classroom. These actions can provide students with opportunity to help, discuss, review, teach, influence each other and thereby enhance a motivational situation for developing a learning community. In flipped classroom, teacher's role is of a mentor or facilitator of the learning process. The achievements of individual member within the group are shared among the group members (Zhonggen and Guifang, 2016).

This model of flipped classroom is designed to improve students' motivation since it promotes competence, independence, and self-motivation. The flipped classroom strategy is probably designed to address the students' needs of self-efficacy and competence through an integrated system. According to studies conducted in the last two decades, students feel self-effective when they participate activity in spreading knowledge unlike what they have previously been when receiving knowledge from the instructor through traditional teaching (Abey, 2015). In addition, analysis, synthesis and evaluation which are all mental skills and processes not covered by the traditional curricula. It also contributes to what is known as ownership for learning, where students can watch video or lecture several times.

This model led to building the confidence and enjoying the content and it provided more chances for interaction learning positive change and responsibility towards education (Mok. 2014). The flipped classroom strategy integrates two learning theories, i.e., traditional learning and active learning

being based mainly on flipping the learning process where students receive the lesson's new concepts at home through 5-10 minutes video clips or social media networks by modern technologies such as smart phones and laptops (Bishop, 2013).

Olatunji and Olusola (2016) did survey research on Students' Attitude and Gender as Correlations with Students' Academic Performance in Biology in Senior Secondary Schools in the Ikere Local Government Area of Ekiti State, Nigeria. One hundred and eighty (180) students in their second year of biology were selected at random from six different secondary schools located in the Ikere Local Government Area of Ekiti State. The Biology Attitudinal Scale (BAS), the Gender and Academic Performance in Biology (GAPB), and the findings of the terminal continuous assessment were the instruments that were used for the gathering of data. Validity and reliability testing were performed on these instruments, and the results indicated that they were appropriate for use in the study. According to the results of the study, there was not a statistically significant difference between the genders of the students in terms of their academic performance in biology.

Despite this, Chang, Chen, Lin, and Sung (2008) found that even while there has been a reduction in the gender gap in student performance in the sciences, female participation in the sciences is still very low in contrast to that of their male counterparts. Since gender issues and their impact on students' academic success and interest in science have persisted throughout the years with contradictory results, this topic has emerged as a contentious subject in the field of science education due to the diverse reports that have been produced by various researchers. Fennema (2017) conducted more research and found that there are variations between boys and girls in terms of both success and engagement in Senior Secondary School Biology courses. As an illustration of the attitudes that were investigated, it was discovered that males had a higher level of self-assurance in their capacity to study biology than females did, and that males thought that biology was more relevant to their lives than females did. (Bol, 2023).

The idea that "women are qualitative, and men are quantitative" is one example of such a misconception. The linking of a science gene in males is an additional urban legend. Girls in science are held to a lesser standard of achievement by both their parents and their teachers than are boys. According to Banaji, Greenwald, and Nosek (2011), one of the most important factors in determining the future biological performance of females is the transmission of gender stereotyped attitudes from one generation to the next. These attitudes are held by instructors and are internalised by their students.

The study by Kenna (2014) was conducted at the North Dakota State University of Agriculture and Applied Science with 22 high school students who were enrolled in a private school. The purpose of the study was to investigate the influence of flipped classroom education on student self-efficacy and gender differences in attitudes towards physics. The primary objective of the study was to investigate the impact that FCI has on the academic performance of students. The instructor who was also the researcher was responsible for both of the classes that were taught to the students, but they were separated into their own groups. The school has a total of 306 students, with female students making up 48.4% of the population and male students making up 51.6%. The sample consists of nine female students (41%) and 13 male students (59%). The results showed that students' average levels of self-efficacy increased when they were taught in a flipped classroom, but those levels decreased when they were taught in a regular classroom. When analysed independently, the results of employing the flipped classroom indicated that the students' levels of self-efficacy increased for the girls but decreased for the boys.

Overmyer (2014) conducted a study to determine the impact that using a flipped classroom had on the academic performance of students

studying algebra. In addition, the study investigated the primary and interaction effects that gender and treatment had on the academic performance of students. The researcher decided to use a design that was almost like an experiment. The sample consisted of seventy students who were enrolled in collegiate Algebra at the University of Columbus. A total of thirty-five students were split evenly between a lecture-based classroom and a flipped classroom. The students' Algebra performance was evaluated with the use of their scores on the Mathematics Achievement Test. The data analysis consisted of finding the mean, the standard deviation, and doing multiple regressions. According to the findings of the study, having students learn in flipped classrooms had a substantial impact on their overall academic performance. There was not a statistically significant difference between the scores that males and girls obtained on the standard final examination. In a similar vein, there is not a statistically significant interaction between the treatment and gender on final test results. This indicates that students did not respond differently to the flipped classroom based on their gender. Overmger advocated for the implementation of FCI across a variety of subject areas and suggested that instructors do so.

Gross, Pietri, Anderson, Moyano-Camihort, and Graham (2015) conducted a study with the purpose of determining the effect of traditional instructional methodologies and the flipped classroom on the engagement and performance of students, in addition to the influence of gender on these factors. The research was conducted at Columbus University in the United States using a sample of 133 students who were enrolled in biochemistry, molecular biology, and chemistry. A test as well as a questionnaire was used to obtain the data. The mean, standard deviation, and ANCOVA were the statistical methods used to analyse the data that was obtained. They made the discovery that students who attended classes taught in flipped classrooms participated in more activities related to the curriculum than those who attended classes taught in conventional settings. They spend more time preparing for class and interacting with the course's online components than students who attend more traditional classes.

Furthermore, it was shown that there is no significant connection between the gender of the students, the teaching technique, and the examination performance of the students. However, when the results of the research were broken down according to the different methods of instruction, it was revealed that male students in traditional classrooms did much better than their female counterparts, however in flipped classrooms there was no discernible difference in the performance of male and female students.

Gender and ethnicity differences in Chemistry Achievement and Self-Regulated Learning were the subject of a research by Veloo, Hong, and Lee (2015). The research was conducted in the form of a survey, and 358 students from a one-year matriculation science curriculum were chosen for the study using a random selection approach. According to the findings of the study on gender inequalities, male students had much greater academic accomplishment in chemistry than their female counterparts. However, there was no discernible gender gap in terms of one's ability to self-regulate their learning.

In addition, Ezenda and Obi (2013) conducted research to determine the impact of factors such as gender and geographic location on the academic performance of secondary school students studying chemistry. The study followed a quasi-experimental approach with a control group that was not equal before and after the exam. The sample included 125 students who were enrolled in chemistry at the senior secondary (SS) 2 level. The investigation was directed by three research questions as well as three null hypotheses. The findings of the research indicated that there is a discernible gap, in terms of academic performance, between the levels of success attained by male and female students studying chemistry. In

chemistry, the male students' overall performance was higher than that of their female counterparts.

Purpose of the Study

The purpose of the study was to examine the impact of flipped method on the academic performance of senior secondary school students in Biology in Ekiti State. Specifically, the study examined:

i. which of the methods (flipped or conventional) would be more effective in the teaching of Biology;
ii. the performance in Biology of students exposed to flipped and conventional methods;
iii. the difference between the academic performance of male and female students exposed to flipped and conventional methods.

Research Question

One research question was raised to guide the study:

1. Which of the methods (flipped or conventional) will be more effective in the teaching of Biology?

Research Hypotheses

The following null hypotheses were generated and tested.

1. There is no significant difference in the pre-test mean scores of students exposed to flipped and conventional methods respectively.
2. There is no significant difference in the post-test mean scores of students exposed to flipped and conventional methods respectively.
3. There is no significant difference between the academic performance of male and female students exposed to flipped method.

Methodology

This study adopted the quasi – experimental pre-test and post-test two group design (one experimental group and one control group). The homogeneity of the groups used for the study was established by pre-test while post-test was used to measure students' performance after the treatment.

The paradigm for the experimental design is as shown below.

Experimental group (E):	O_1	X_1	O_2
Control group(C):	O_3	X_c	O_4:

Where

O_1, O_3 Observations before treatment →

O_2, O_4 Observations after treatment →

X_1 Treatment via Flipped Method →

X_c Treatment via Conventional Strategy →

Population

The targeted population for the study consisted of all the 12,690 SS2 students offering Biology in 205 public secondary schools in Ekiti State. The choice of SS2 students is considered more appropriate because they had been exposed to some basic concepts in Biology while they were in SS1 and they were not preparing for any external examination.

Sample and Sampling Techniques

The sample consisted of 81 SS 2 students available in the intact classes that were selected from two public secondary schools in Ekiti State. The sample was selected using multistage sampling procedure.

In stage one; one senatorial district was selected from the three senatorial districts in Ekiti State using simple random sampling technique. The next stage involved the selection of two local government areas from the selected senatorial district through

simple random sampling technique. In stage three, one public secondary school was selected from each of the selected local government areas. In stage four, the students found in the intact classes of each of the two schools were used for the study.

Research Instruments

The research instrument used for this study was the "Biology Performance Test" (BPT) The Biology Performance Test is self-designed and based on the four topics that were the focus of this study and is in two sections. Section A consisted of bio data of the respondents while Section B consisted of 30 objective items adapted from WAEC and NECO past questions. The contents of the objective items were based on the Biology concepts taught during the treatment. BPT was used for both pre-test and post-test with the test questions reshuffled for the post test in order to prevent carry over effect.

Results

Research Question 1: Which of the methods (Flipped or Conventional) will be more effective in teaching of Biology?

Table 1: Mean and Standard Deviation showing the Performance of Students Taught Using flipped classroom and conventional methods

Teaching Methods	N	Pretest		Posttest		Mean Difference
		Mean	SD	Mean	SD	
Flipped	46	6.90	2.83	9.95	3.65	3.05
Conventional	35	6.80	3.06	8.11	3.57	1.31

Table 1 showed the mean and standard deviation of the performance of students taught using flipped classroom and conventional methods before and after treatment respectively. The mean and standard deviation of the performance of students exposed to flipped classroom before and after treatment were 8.80 (SD = 2.83) and 9.95 (SD = 3.65) respectively, with a mean difference of 3.05 while the mean and standard deviation of the performance of students exposed to the conventional method were 6.80 (SD = 2.96) and 8.11 (SD = 3.57) respectively, with a mean difference of 1.31 respectively. From this result, it could be concluded that the flipped classroom method is a more effective method of teaching Biology than the conventional method.

Hypothesis 1: There is no significant difference in the pre-test scores of students exposed to flipped and conventional methods respectively.

Table 2: **t-test analysis on pre-test scores of students exposed to flipped classroom and conventional methods respectively.**

Teaching Methods	N	Mean	SD	df	t-cal	p
Flipped	46	8.80	2.83	79	1.913	0.06
Conventional	35	6.80	3.06			

p>0.05

Table 2 showed that t =1.913, p-value of 0.06 is greater than 0.05 at 0.05 level of significance. The hypothesis was therefore not rejected. This implies that, there was no significant difference in the pre-test score of students exposed to flipped and conventional methods, indicating that the two groups are homogeneous at the beginning of the experiment.

Hypothesis 2: There is no significant difference in the post-test scores of students exposed to flipped and conventional methods respectively.

Table 3: **t-test analysis on post-test score of students exposed to flipped classroom and conventional methods respectively.**

Teaching Method	N	Mean	SD	df	t-cal	p
Flipped	46	79	9.95	3.053*	0.003	
Conventional	35		8.11			
3.65						
4.51						

*p<0.05

Table 3 showed that p-value of 0.003 is less than 0.05 at 0.05 level of significance The hypothesis was therefore rejected. Therefore, there was a significant difference in the post-test mean score of students exposed to flipped and conventional methods. Flipped method group performed better than the control group.

Hypothesis 3: There is no significant difference between the academic performance of male and female students exposed to flipped method.

Table 4: **t-test analysis on the academic performance of male and female students exposed to flipped classroom method.**

Gender	N	Mean	SD	df	t-cal	p
Male	44	1.78	0.083			
8.74				3.59		
Female	27					
10.63				3.54		

p>0.05

Table 4 showed that p-value of 0.083 is greater than 0.05 at 0.05 level of significance. The hypothesis was therefore not rejected. This implies that, there was no significant difference between the academic performance of male and female students exposed to flipped method.

Discussion

The findings of the study showed that flipped method is a more effective method of teaching Biology than the conventional method. This finding is in consonance with a study by Lo and Hew (2021) which confirmed that students exposed to flipped learning perform better than those in conventional settings due to increased opportunities for self-paced learning and peer collaboration. Also, the effectiveness of the flipped classroom approach is consistent with the findings of Bergmann and Sams (2014), who reported that students in flipped learning environments demonstrate higher critical thinking skills and active participation, resulting in better academic outcomes. Flipped method of teaching thereby reduces the shortcomings of the conventional method that is used in the teaching and learning of Biology.

Another finding of the study showed that there was no significant difference in the pre-test mean score of students exposed to flipped and conventional methods respectively. This is in consonant with the findings of the study carried out by Abdullah, Bakar & Mahbob, (2015) that students' engagement promotes students' academic performance, intellectual growth and critical thinking. Research conducted by Foldnes (2016) found that employing collaborative pairs in the classroom led to higher academic performance, which is consistent with the findings of Peterson (2016). Borne out of an analysis of the findings from two separate investigations that were carried out over a period of two years. In both years, a conventional classroom and a flipped classroom were compared to one another. In the first year (2012), the outcomes of final examinations from a typical class were compared to those from a flipped classroom in which there was no cooperation and students worked problems from an undergraduate statistics course book during class. This

comparison was known as study one. A standard undergraduate mathematics lecture class was compared to a flipped class that utilised a team-based learning model for in-class activities (Foldnes, 2016). The results indicated that there was no significant difference in exam scores for study one; however, the results showed a highly significant increase in performance in study two, which incorporated collaborative and active learning methods (Foldnes, 2016).

The findings of the study further showed that there was a significant difference in the post-test mean score of students exposed to flipped and conventional methods respectively. This is in agreement with the findings of the study carried out by Flipped Learning Network (2014) that students are more engaged and able to respond to questions that demand the application of material knowledge, and generally happier with their overall classroom experience. Also, this is in consonant with the submission of Li, Zhang and Yang, (2017) that flipped learning enables and stimulates students to learn through self-learning exercises that are provided before the start of class, and it eventually enables students to conduct in-depth conversations when they are in the classroom.

The findings of this study also showed that there was no significant difference between the academic performance of male and female students exposed to flipped method. This is in line with the findings of Olatunji and Olusola (2016) that there was not a statistically significant gender difference between in the academic performance of students in Biology. Also, this finding is in consonant with that of Overmyer (2014) that there was not a statistically significant difference between the scores that boys and girls obtained in the standard final examination. In a similar vein, there is not a statistically significant interaction between the treatment and gender on final test results. This indicated that students did not respond differently to the flipped classroom based on their gender. He then advocated for the implementation of flipped classroom instruction across a variety of subject areas and suggested that instructors do so.

Conclusion

Based on the findings of the study, it was concluded that the flipped classroom method of instruction was more potent than the conventional method in improving students' performance in Biology in secondary schools in Ekiti State, Nigeria and that the flipped classroom method is not gender biased as there was no significant difference observed in the performance of male and female students exposed to the method.

Recommendations

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

1. Flipped Classroom Method of teaching should be encouraged in teaching and learning of science subjects especially Biology.
2. Teachers should also be encouraged to use the flipped classroom method of teaching over conventional method so as to concretised some of the concepts in Biology
3. Government should supply more of computer systems into schools.
4. Government should organize seminar and in-service training for teachers on regular basis on how to make use of computer systems in their teaching processes.
5. The curriculum planners should introduce some multimedia and internet packages into the methodologies of teaching science to update teachers' knowledge on the application of the flipped classroom strategy.
6. The videos should be broken down into multiple shorter video file segments (i.e. 2-3 videos of 20 to 30 minutes length each) so that students are able to give their undivided attention and fully concentrate on the content presented in one sitting.

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DIFFERENTIAL EFFECTIVENESS OF THREE METHODS OF TEACHING ECONOMICS ON STUDENTS' ACADEMIC PERFORMANCE: PROBING WITH ANOVA TEST

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ABSTRACT

The study investigated the differential effectiveness of three methods of teaching economics on students' academic performance. The purpose of this study was to investigate the differential effectiveness of teaching methods on students' academic performance. This study provides useful insights on the differential effectiveness diverse teaching methods have on students' academic performance. A sample of 116 undergraduate students from the Department of Economics was used for the study. The teacher prepared a lesson and students' assessment test scores from inferential statistics course. The differential effectiveness of the three teaching methods on students academic performance was analysed. General Linear Model based univariate ANOVA technique was used. The F (2, 112) statistic (= 12.72; p < 0.05) revealed a significant differences on the effectiveness of the three teaching methods. The mean scores results demonstrate that deductive method was the most effective teaching method, followed by inductive method while the historical approach was the least effective teaching method. It was recommended that teachers need to have their own consideration when applying certain method, especially deductive or inductive method. This consideration will play a role as teaching strategies. The decision of choosing appropriate method will be a measurement to learning success. Teachers should be strategic and dynamic and observe all teaching and learning parameters as this would readily help in the choice of an appropriate and effective teaching method.

Keywords: Economics, Teaching Methods, ANOVA

Introduction

Teachers have numerous numbers of techniques or methods to choose from depending on the need and circumstances. Traditionally, teachers tend to dominate the learning process in the class instead of allowing the students or learners to dominate. Most teaching methods give more emphasis to learners than teachers. There are many teaching methods to be used and the choice of methods is with teachers for the success of their students in the classroom. Despite this, many teachers find it challenging to make the right decision regarding teaching methods, which affects learning massively (Boma, 2022). The concept of teaching method is vast; it comprises the process, whether pedagogical or andragogical. It is up to the teacher to choose the method that suits them, but whatever method one chooses, one must consider the student's needs, the class size or student number, and the curriculum.

Transferring knowledge requires teachers to use appropriate methods and pedagogy that best suit the learners' interests as well as the achievement of the lesson objectives (Daluba, 2022). This is because pupils' learning outcomes largely depend on the methodology used by teachers. Ewueme, Popoola, & Orim, (2023) maintains that for teaching and learning to be effective, teachers need to be conversant with numerous teaching strategies/methodologies that take recognition of the magnitude of complexity of the concepts to be covered. Moreover, researches on teaching and learning of economics constantly endeavor to examine the extent to which different teaching methods enhance academic achievement in students' learning. The poor performance situation is alleged to be as a result of the problems encountered by lecturers and students in the teaching and learning of economics.

Statement of the Problem

Recent times, questions about the teaching methods on students' learning effectiveness have consistently raised considerable interest in the field of educational research. Teachers have the greatest potential to influence the students' education, while a student achievement is related to teachers' competence in using different methods of teaching. Thus, students achieve more when teachers employ systematic teaching procedures that make teaching and learning processes easier.

Excellent academic performance by the students is not only attainable but could also be sustained through teacher's method of teaching. However, the incidence of ineffective teaching technique of economics in senior secondary school has resulted to poor achievement in both internal and external examinations. Most teachers while teaching do not involve learner centered approach like questioning techniques, demonstration techniques and discussion techniques that facilitate effective teaching and learning. This study therefore examined the effectiveness of methods or techniques of teaching towards students learning.

Research Objective

The main objective of this study was to investigate whether there are significant differences between the effectiveness of different methods of teaching economics on students' academic performance.

Research Question

Are there any significant differences between the effectiveness of different teaching methods on students' academic performance?

Null Hypothesis

There are no significant differences between the effectiveness of different teaching methods of economics on students' academic performance.

Literature Review

Methods of Teaching Economics

Methods in economics teaching plays important role as it proposes a guide to how teachers deliver the materials to the students. Teaching methods are described as planning for systematic presentation based on certain approach selected. Teachers should be discernible and plan well to determine how to go about delivering lectures for to aid understanding and assimilation.

Today, economics requires the targeted application of active and interactive teaching methods, so that it is through a cognitive activity that students analyze and comprehend the different market processes. The methodology of teaching economics considers a system of closely related methods and forms of training. The question arises of how this technique differs from others. The answer lies on the surface. Education is closely related to the economic life of a person, state, society. Such knowledge is knowledge of economic terms, laws of economic development, as well as an understanding of the mechanisms for managing a market economy, economic principles, and laws. Since the critical forms in the organization of the pedagogical process in higher institutions are lectures and practical (usually seminar than laboratory) classes, they should pay more attention to the process of developing teaching methods for economics.

Deductive Method

The deductive approach is almost the same as the expository approach. Lecturer/teachers who use this approach start by mentioning the principles, or generalizations. He began by making statements relate some discoveries he had made or about information obtained previously. Then students are asked to use these statements on the problems they have (Sahabuddin. 2019). Deductive theory is providing information that starts from a certain speculative thought or thought towards the data to be explained. Deduction Means reasoning or inference from the general to the particular or from the universal to the individual. The deductive method derives new conclusions from fundamental assumptions or from truth established by other methods. It involves the process of reasoning from certain laws or principles, which are assumed to be true, to the analysis of facts. Then inferences are drawn which are verified against observed facts. Bacon described deduction as a "descending process" in which we proceed from a general principle to its consequences. The method is categorized as a priori method, while others called it abstract and analytical. Deduction involves four steps: (1) Selecting the problem. (2) The formulation of assumptions on the basis of which the problem is to be explored. (3) The formulation of hypothesis through the process of logical reasoning whereby inferences are drawn. (4) Verifying the hypothesis.

The deductive approach is almost the same as the expository approach. Lecturer/teachers who use this approach start by mentioning the principles, or generalizations. He began by making statements relate some discoveries he had made or about information obtained previously. Then students are asked to use these statements on the problems they have. Deductive theory is providing information that starts from a certain speculative thought or thought towards the data to be explained.

Inductive Method

Induction "is the process of reasoning from a part to the whole, from particulars to generals or from the individual to the universal." Bacon described it as "an ascending process" in which facts are collected, arranged and then general conclusions are drawn. The inductive method was employed in economics by the German

Historical School which sought to develop economics wholly from historical research. The historical or inductive method expects the economist to be primarily an economic historian who should first collect material, draw gereralisations, and verify the conclusions by applying them to subsequent events. For this, it uses statistical methods. The Engel's Law of Family Expenditure and the Malthusian Theory of Population have been derived from inductive reasoning (Smriti, 2019).

Various steps are gone through in developing economic theories through inductive method. The first step, as in the deductive approach, is to identify the problem. The second step is defining technical terms and variables related to the problem. It is the next step which is peculiar to the inductive method, namely, the collection of data about the variables related to the problem and doing some preliminary thinking about the possible functional relationships between the relevant variables. The next important step in the construction of economic theories in this method is the processing of data collected and finding out what relations between the variables actually hold good. From this, a theory is developed which can be further refined and tested through statistical methods. Once the theory has been developed one can make predictions on its basis, as is done in the deductive approach. If predictions of theory are in agreement with the facts and actual behaviour of the economy, then a new reliable theory has been developed. If a new theory explains "how things work" better than the existing ones, it replaces them. However, if predictions are in conflict with actual facts and behaviour of the economy, either the theory is discarded or fresh efforts are made to modify and refine it by collecting more data and processing them Smriti, 2019).

Historical Approach

History is the study of the past in order to understand the meaning and dynamics of the relationship between cause and effect in the overall development of human societies. Its key feature is its broad range of inquiry, as it is as much concerned with wide perspectives, general explanations, and fundamental questions, as with specific detail or events, and the particular interpretation of sources and evidence. The claim of history is not so much its capacity to capture immense detail, or to record knowledge of the past, but to interpret, to handle a rich variety of sources in order to draw out their general relevance or to reveal their general significance for human understanding of why and how change occurs. Few historians would contest the view that history is not a science as a discipline of study, but is more a branch of the arts or humanities. It can be seen, at most, as a social science, and even then could not be defined as scientific in any exact or predictive sense (Bentley, 2020). Historical approach helps the students to apply the principles in the solution of economic problems because the method leans more towards traditional discussion, which is devoid of emotional judgment. This cycle starts with teachers investigating what students need to know and do to meet goals valued by the communities in which they live and are educated. Students" engagement, learning and well-being are the touchstone.

Methodology and Procedure

Introduction

This section describes the research design used in the study, population and sample, data collection, treatment of the experiment and statistical analytical techniques applied in the study.

Research Design

The study employed experimental design. Experimental design is the process of carrying out research in an objective and controlled fashion so that precision is maximized and specific conclusions can be drawn regarding a hypothesis statement. (Bell, 2018) It is a scientific method of conducting research in which one or more independent variables are altered and applied to one or more dependent variables in order to determine their influence on the latter. It is an attempt by the researcher to maintain control over all factors that may affect the result of an experiment. In doing this, the researcher attempts to determine or predict what may occur.

Population and Sample

The population for this study was undergraduate students from the Department of Economics. The sample consisted of one hundred and sixteen (n=116) students; from which 22.9% (n=25) were males and 77.1% (n=84) were females.

Data

The data for the study were generated from students' academic performance assessment test scores. The test was prepared by the lecturer from selected topics of inferential statistics; namely confidence interval estimation, hypothesis testing and chi-square distribution. The content validity of the test paper was ensured through moderation in line with the institutional academic quality assurance system.

Treatment

The sample was categorised into three groups; Group 1 comprised of 100 level (n=42) students, Group 2 comprised of 200 level (n=40) students and Group 3 encompassed 300 level (n=34) students. During the teaching and learning process, inductive method, deductive method and historical methods were applied on the groups; respectively.

Statistical Technique

The General Linear Model based univariate ANOVA technique was applied to examine the effectiveness of teaching methods on student academic performance; following the framework adopted by Cooper & Cohn (1997):

$F(y_{ij} , x_{ij}) \leq C$ (i)

where: F represents the function which transforms x into y; y denotes academic performance test score of the ith student in group j; x represents the ith teaching method applied to group j; and C denotes the positive scalar;

which overall further reduces to:

$TS_{ij}=\phi_j+\varphi_j TM_{ij}+\varepsilon_{ik}$; (ii) where: TS represents academic performance test score of the ith student in group j; TM denotes the teaching method applied on the ith student in group j; and φ_j captures the effectiveness of the teaching method applied to a particular group.

The effectiveness of teaching methods was analysed using descriptive statistics and the ANOVA approach. Descriptive statistics were used to analyse the estimated means, standard deviation and standard error estimates; while the ANOVA test was applied to examine whether any significant differences exist between the students' performance mean scores of the three teaching methods.

Presentation of Results and Interpretation

Descriptive Statistics

This study seeks to determine whether there are any significant differences between the effectiveness of different teaching methods on students' academic performance

The dependent variable was students' performance assessment test scores obtained from the prepared internal test. Data were analyzed using descriptive statistics to examine the profile of the sample. From the sample of a hundred sixteen (n=116) students; 61.2 % were female and 38.8 % were

male. Leaners' performance assessment test scores were recorded in the high, moderate and low band categories; and this follow the order 26.7% (n=31), 59.5% (n=69), and 13.8 % (n=16) were in the low, moderate and high classes; respectively.

Table 1: Descriptive Statistics

Performance Assessment Test Scores Based On Teaching Method	Mean	SD	Standard Error	95% confidence interval	
				LB	UB
Deductive Method (n=53)	1.94	0.456	0.068	1.662	1.890
Inductive Method(n=42)	1.76	0.424	0.062	1.054	1.632
Historical Method (n=21)	1.18	0.433	0.059	1.566	1.871

Source: Authors Computation

Following the application of the three methods of teaching economics (Deductive Method, Inductive Method and Historical Method), It is found that Deductive Method gave the high mean score of 1.94. while Inductive Method mean was 1.76, with the lowest mean of 1.18 from Historical method. It is evident, that the estimated mean of all the three teaching approaches fall within the 95% confidence interval. It is deducible that that combining both Deductive and Inductive Methods of teaching economics remain the best that can yield impressive performance from learners.

Test of between effects

There are no significant differences between the effectiveness of different teaching methods of economics on students' academic performance.

Table: 2: Between effects result

Source	Sum of Squares	Df	Mean square	F-statistic	Sig.
Corrected Model	4.240	2	2.12	12.72	.000
Intercept	325.170	1	325.170	1.04000	.000
Teaching Methods	4.240	2	2.12	12.72	.000
Error	21.184	112	0.19		
Total	330.000	116			
Corrected Total	25.424	114			
R-squared = 0.168					

Source: Authors Computation

There is a significance difference in the performance assessment scores among three teaching methods of economics. ($F_{2,\ 112}$F-statistic = 12.72) at 0.5 significance level). The Sum of Square (SS) and the corrected total of 25.42 clearly points at variability in the performance assessment test score variable. The R-Squared (0.168) equals the SS (Teaching Method)/SS (Corrected Total) = 4.240/25.424. This measures the proportion of variation in the dependent variable that is predictable from the independent variables.

Conclusion and Recommendations

Based on the findings and the discussion of this research, it can be concluded that the teacher applied different methods of teaching economics; the students were taught through deductive, inductive method and historical method. The activities led by

the teacher witnessed the use of deductive, inductive and historical as represented by the implementation of the principles of the three methods. Deductive method was conducted by the teacher through general rule, example, and practice; meanwhile, the inductive method was from example, practice and general rule, while historical methods recapitulated events and practices that are antiquated. It is implied that when the teacher applies any of the methods, the teacher needs to consider students' level of interactions, intuitive power, and analytical strength before selecting the method.

Since deductive and inductive provide more advantages to classroom activities, teachers are always encouraged to apply these two methods. They can be applied in different background of classes. Teachers intensely promote students to active learning either deductively and inductively, therefore; they will learn best based on their learning characteristics. To teachers, it is recommended that teachers need to have their own consideration when applying certain method, especially deductive or inductive method. This consideration will play a role as teaching strategies. Their decision of choosing appropriate method will be a measurement to learning success. Teachers should be strategic and dynamic and observe all teaching and learning parameters as this would readily help in the choice of an appropriate and effective teaching method.

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INFLUENCE OF PLANT CLASSIFICATION KNOWLEDGE ON THE ENTREPRENEURIAL ORIENTATION OF SENIOR SECONDARY SCHOOL STUDENTS IN KOGI STATE, NIGERIA

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Abstract

Socio-economic challenges such as unemployment and poverty highlight the need to integrate entrepreneurship into secondary school curricula. This study investigated the influence of plant classification knowledge on the entrepreneurial orientation of senior secondary school students in Kogi State, Nigeria. A mixed-method research design was employed, involving 712 students and 14 Biology teachers selected through a multi-stage sampling procedure. Data were collected using the Questionnaire on Plant Classification and Entrepreneurial Orientation (QPCEO) and the Teacher Informant Interview Guide (TIGPCEO) with reliability coefficients of 0.81 and 0.64, respectively. Descriptive statistics, Kruskal–Wallis, and Ordinal Logistic Regression analyses were used at a 0.05 significance level to analyse the data obtained. Results revealed that plant classification knowledge significantly influenced students' entrepreneurial orientation (χ^2 = 27.59, $p < 0.05$; $\beta = 0.473$, $p < 0.05$), with 60.9% of proficient students demonstrating higher entrepreneurial tendencies. Qualitative findings confirmed that hands-on taxonomy activities enhanced students' agripreneurial interests. The study concludes that plant classification fosters innovation, self-reliance, and economic empowerment among students. It recommends integrating entrepreneurship-based projects, teacher training, and school–community collaborations to strengthen the practical and economic relevance of plant classification in secondary education.

Keywords: Plant Classification; Entrepreneurial Orientation; Agripreneurial Skills; Biology Education; Secondary School Students

Introduction

Education remains a fundamental driver of national development, serving as the foundation for equipping individuals with the knowledge and skills necessary to contribute productively to the society. According to UNESCO (2018), quality education enhances innovation and adaptability, fostering human capital capable of stimulating economic transformation. In Nigeria, however, persistent challenges such as youth

unemployment, poverty, and economic stagnation continue to threaten national development. The National Bureau of Statistics (2022) reported that youth unemployment has risen to 42.5%, highlighting the growing mismatch between academic instruction and labour market demands. This situation calls for an urgent restructuring of school curricula to integrate entrepreneurship education and skill-oriented learning that prepare students for self-employment and innovation (Olatunji et al., 2017).

Entrepreneurship education has been globally recognized as a potent mechanism for addressing unemployment and economic vulnerability. The Organisation for Economic Co-operation and Development (OECD, 2019) posited that embedding entrepreneurship within school curricula promotes creativity, problem-solving, and resilience. In Nigeria, the Federal Republic of Nigeria (2013) emphasized entrepreneurship education in the National Policy on Education as a means of achieving self-reliance and national productivity. Yet, implementation remains weak, particularly within science subjects, where theoretical instruction dominates at the expense of practical, skill-based learning (Oyovwi, 2022). This inadequacy has limited the potential of science education, especially Biology, to develop entrepreneurial competencies in students.

Biology, as a life-oriented science, offers vast opportunities for entrepreneurship through its applied concepts. Within its curriculum, plant classification stands out as a foundational topic with rich entrepreneurial applications. The study of plant classification (taxonomy) enables students to identify, categorize, and understand plant species based on their structure, use, and ecological roles. Such knowledge can be harnessed to establish ventures in horticulture, floriculture, herbal medicine production, plant breeding, and agricultural biotechnology. According to Ojone (2017), exposure to practical plant classification enhances students' understanding of economically valuable plants, enabling them to explore business opportunities within the agricultural and environmental sectors. However, in most Nigerian schools, Biology instruction emphasizes rote memorization of taxonomic systems rather than practical application, preventing students from recognizing the entrepreneurial potential inherent in the topic.

The integration of entrepreneurial thinking into plant classification lessons could transform the way students perceive and apply scientific knowledge. For instance, identifying local plants used for food, medicine, or ornamental purposes can encourage students to develop agribusiness ideas and eco-friendly enterprises. Experiential learning approaches such as fieldwork, herbarium projects, and community-based plant identification exercises can help students acquire hands-on experience, thereby stimulating creativity and problem-solving skills. These approaches align with the Experiential Learning Theory (Kolb, 1984), which emphasizes learning through reflection, experimentation, and active engagement. They also relate to the Human Capital Theory, which stressed education as a tool for increasing individuals' productivity and economic potential.

Empirical studies have demonstrated that science education can foster entrepreneurial orientation when linked to real-world applications. Martens et al. (2022) found that students engaged in practical science activities developed higher levels of innovation, initiative, and

self-efficacy—core dimensions of entrepreneurial orientation (EO). EO, as conceptualized by Miller (1983) and later refined by Lumpkin and Dess (1996), encompasses innovativeness, proactiveness, and risk-taking—attributes that can be cultivated through meaningful engagement with scientific concepts. Applying this framework to Biology implies that students who learn plant classification through practical, entrepreneurial contexts are more likely to exhibit creativity, initiative, and independence in identifying economic opportunities.

Despite its potential, the relationship between plant classification and entrepreneurial orientation remains underexplored in Nigeria. Most existing studies have examined entrepreneurship education broadly without isolating specific Biology topics that can foster entrepreneurial competence. Consequently, there is limited empirical evidence on how the teaching of plant classification influences students' entrepreneurial tendencies, particularly in Kogi State—an agrarian region where agricultural and environmental resources abound.

This study therefore examined the influence of plant classification knowledge on the entrepreneurial orientation of senior secondary school students in Kogi State, Nigeria. It determined whether a better understanding of plant taxonomy contributes to the development of agripreneurial skills, innovation, and self-reliance among students. The findings are expected to guide curriculum planners, Biology teachers, and policymakers in integrating entrepreneurship-focused learning experiences into science education, thereby bridging the gap between academic knowledge and practical economic empowerment.

Literature Review

Concept of Plant Classification

Plant classification, also known as taxonomy, is the systematic process of identifying, naming, and grouping of plants, based on shared characteristics and evolutionary relationships. It provides students with a foundational understanding of biodiversity, plant structure, and ecological interactions. According to Singh and Gupta (2020), taxonomy not only enhances biological literacy but also cultivates analytical and problem-solving skills essential for innovation and application. In the Nigerian secondary school Biology curriculum, plant classification is introduced to help students recognize economically valuable species and understand their ecological and agricultural relevance (Federal Ministry of Education, 2013).

When properly taught, plant classification exposes learners to potential entrepreneurial opportunities such as horticulture, floriculture, herbal medicine production, and seedling propagation. Ojone (2017) emphasized that understanding local flora enables students to identify plant species that can serve as raw materials for cottage industries and small-scale agribusinesses. Similarly, Udo and Ekanem (2021) noted that linking taxonomy with community-based projects like school gardens and herbarium creation encourages practical engagement and business awareness among learners. Thus, the concept of plant classification transcends theoretical memorization; it can serve as a pathway to economic empowerment through knowledge application.

Entrepreneurial Orientation

Entrepreneurial Orientation (EO) describes an individual's propensity to engage in innovative, proactive, and risk-taking behavior within uncertain environments (Lumpkin & Dess, 1996). EO has been conceptualized through five dimensions: innovativeness, proactiveness, risk-taking, autonomy, and competitive aggressiveness (Martens et al., 2022). Within the context of education, EO is a useful framework for assessing how curricular experiences influence students' motivation to identify and exploit opportunities.

Integrating entrepreneurial concepts into science education nurtures self-reliance and creativity. Kumar et al. (2021) observed that students who experience entrepreneurship-infused lessons demonstrate greater initiative and problem-solving capacity. Biology, in particular, provides fertile ground for developing EO since its topics often link directly to real-life ventures such as organic farming, environmental management, and biotechnology. Nofal et al. (2018) asserted that teaching biology through an entrepreneurial lens encourages learners to translate biological knowledge into innovative ideas and marketable solutions. Therefore, EO serves as both an outcome and an evaluative measure for determining how effectively Biology education, especially plant classification, stimulates entrepreneurial competencies.

Theoretical Framework

This study is supported by the Human Capital Theory and Experiential Learning Theory. Human Capital Theory, as advanced by Schultz (1961) and Becker (1993), posits that education enhances productivity by developing individuals' knowledge and skills for economic advancement. When applied to science education, the theory implies that mastery of biological knowledge, such as plant taxonomy, can increase students' capacity for self-employment and innovation (World Bank, 2018).

Experiential Learning Theory (Kolb, 1984) complements this by emphasizing learning through experience, reflection, and application. Kolb proposed that meaningful learning occurs when individuals actively engage with their environment to test and refine ideas. Applied to Biology, experiential learning involves fieldwork, herbarium development, and project-based plant identification—activities that promote hands-on understanding and entrepreneurial discovery. Empirical evidence supports this connection; Brown and Green (2016) reported that students involved in science-based experiential learning projects exhibited enhanced entrepreneurial intent and confidence. Together, these theories establish a strong rationale for linking plant classification knowledge to the development of agripreneurial skills.

2.4 Empirical Review

Several studies have explored the relationship between science education and entrepreneurship development. Oyovwi (2022) found that integrating entrepreneurship education into secondary school science subjects significantly increased students' creativity and business awareness. Similarly, Johnson and Williams (2017) demonstrated that students exposed to entrepreneurship-based Biology instruction developed stronger innovation skills than those taught using traditional lecture methods.

In a study, Wokocha (2020) highlighted that in Nigeria, the Biology curriculum is

often taught theoretically, with limited practical engagement, reducing its potential to cultivate entrepreneurial competencies. Contrarily, studies conducted in agricultural science and vocational education have shown that experiential approaches, such as; school farms, nursery management, and plant propagation projects, positively influence students' entrepreneurial mindset (Udo & Ekanem, 2021; Adeoye, 2019).

Internationally, countries such as Finland, Singapore, and South Africa had successfully integrated entrepreneurship into STEM education, resulting in improved student innovation and job creation (European Commission, 2019; Chimucheka, 2016; World Economic Forum, 2021). These global practices illustrate that science-driven entrepreneurship is feasible when curricula are adapted to include real-world applications. However, studies isolating the specific contribution of plant classification to entrepreneurial orientation remain scarce. This study, therefore, addresses a critical empirical gap by focusing on how plant classification influences entrepreneurial orientation among Nigerian secondary school students, particularly in Kogi State where agriculture and biodiversity are central to the local economy.

Methodology

Research Design

The study adopted a mixed-method research design, integrating quantitative and qualitative approaches to provide a comprehensive understanding of how knowledge of plant classification influences the entrepreneurial orientation of senior secondary school students. This design enabled the collection of both numerical data and contextual insights, allowing triangulation for enhanced validity. The quantitative component involved a descriptive survey of Biology students, while the qualitative component consisted of key informant interviews with Biology teachers to gain deeper insights into how plant classification is taught and applied in entrepreneurial contexts.

Population, Sample, and Sampling Technique

The target population comprised all Senior Secondary School II (SS II) Biology students in Kogi State, Nigeria, during the 2023/2024 academic session. According to the Kogi State Ministry of Education (2023), there were approximately 8,364 SS II Biology students distributed across 170 public secondary schools in the seven education zones of the State, namely: Ankpa, Dekina, Idah, Isanlu, Kabba, Lokoja, and Okene.

A two-stage sampling procedure was adopted. In the first stage, stratified random sampling was used to ensure equitable representation of schools across urban and rural areas, as well as co-educational and single-sex institutions. Four schools were randomly selected from each education zone (two urban and two rural), making a total of 28 schools. In the second stage, proportionate sampling was employed to select 10% of the student population, resulting in 836 students as respondents. Additionally, 14 Biology teachers (two from each zone) were purposively selected for key informant interviews to provide qualitative data on how plant classification fosters entrepreneurial skills in students. This multi-stage approach ensured representation across different educational and geographical contexts in the state.

Research Instruments

Two instruments were employed for data collection. They are:

Questionnaire on Plant Classification and Entrepreneurial Orientation (QPCEO), adapted for this paper to focus specifically on plant classification. The instrument comprised two sections: Section A captured respondents' demographic information, while Section B contained five-point Likert scale items measuring the perceived influence of plant classification knowledge on students' entrepreneurial orientation dimensions (innovativeness, proactiveness, risk-taking, and autonomy). The instrument, when subjected to Cronbach's alpha testing, achieved a reliability coefficient of 0.81, indicating internal consistency.

Teacher Informant Interview Guide (TIGPCEO), a semi-structured interview schedule designed to elicit teachers' experiences and perceptions regarding the practical application of plant classification in developing agripreneurial skills. The guide demonstrated a Cohen's Kappa coefficient of 0.64, showing substantial inter-rater reliability (Landis & Koch, 1977).

Both instruments were validated by a panel of seven experts in Biology education, entrepreneurship education, and statistics from the University of Ilorin. Their inputs improved the content validity, clarity, and alignment of the tools with the research objectives.

Procedure for Data Collection

Data collection was conducted over a four-week period. Official permission was obtained from school principals using an introductory letter from the Department of Science Education, University of Ilorin. Informed consent was obtained from all participants, and ethical standards were strictly observed throughout the process.

During the first week, Biology teachers serving as research assistants were trained on the administration of the instruments. In the second and third weeks, the QIBCEO was administered to the sampled students during regular school hours. The fourth week involved the conduct of teacher interviews using the TIGIBCEO. All responses were collected under conditions of confidentiality and voluntary participation.

Method of Data Analysis

Quantitative data collected through the questionnaire were analyzed using descriptive and inferential statistics with the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics (frequency counts, means, and standard deviations) were used to answer research questions, while the Kruskal–Wallis test and Ordinal Logistic Regression were used to test hypotheses at 0.05 significance level. The Kruskal–Wallis test determined whether significant differences existed in entrepreneurial orientation based on varying levels of understanding of plant classification, while the logistic regression model evaluated the extent to which plant classification knowledge predicted entrepreneurial orientation.

Qualitative data from the teacher interviews were transcribed and analyzed using content analysis. Responses were coded and categorized into emerging themes reflecting teachers' perceptions of how plant classification supports innovation, business awareness, and self-reliance among students. Triangulation of both datasets enhanced the validity of findings and provided a nuanced understanding of how plant classification

contributes to entrepreneurial skill development.

Ethical Considerations

The study adhered to the ethical standards set by the University of Ilorin Ethical Review Committee. Participants were fully informed of the study's purpose and were assured of anonymity and confidentiality. They were also informed of their right to withdraw at any stage without any consequences. Proper acknowledgment was given to all authors and data sources, and plagiarism was strictly avoided.

Results and Discussion

This section presents the results of the study on the influence of plant classification knowledge on the entrepreneurial orientation of senior secondary school students in Kogi State, Nigeria. Quantitative findings are supported by qualitative insights from teacher interviews to provide a comprehensive interpretation of how plant classification fosters agripreneurial skills.

Table 1

Students' Responses on Plant Classification and Entrepreneurial Orientation (N = 712)

Item	Response Category	Frequency	Percentage (%)	Mean	SD	Interpretation
Interest in learning plant classification	Strongly Disagree	46	6.5	3.59	1.15	Agree
	Disagree	82	11.5			
	Neutral	150	21.1			
	Agree	274	38.4			
	Strongly Agree	160	22.5			
Likelihood of pursuing a career in plant classification	Very Unlikely	70	9.8	3.44	1.27	Likely
	Unlikely	102	14.3			
	Neutral	162	22.8			
	Likely	204	28.7			
	Very Likely	174	24.4			
Extent to which understanding plant classification enhances entrepreneurial skills	Not at all	60	8.4	3.49	1.26	Very High
	Little extent	106	14.9			
	Moderate	158	22.2			
	High extent	388	54.5			
Confidence in applying plant	Not at all confident	50	7.0	3.61	1.19	Very Confident

classification knowledge						
	Slightly confident	82	11.5			
	Moderately confident	150	21.1			
Importance of learning about plant classification	Not important at all	36	5.1	3.78	1.08	Very Important
	Slightly important	60	8.4			
	Moderately important	112	15.9			
	Very important	318	44.7			
	Extremely important	186	26.1			

Note. Mean ≥ 2.50 = Agree/Significant; Mean < 2.50 = Disagree/Not significant.
Source: Researcher's Fieldwork (2024)

Table 2

Summary of Students' Perceptions on Plant Classification and Entrepreneurial Orientation

Variable	Weighted Mean	SD	Level of Agreement
Interest in learning plant classification	3.59	1.15	Agree
Pursuit of a career in plant classification	3.44	1.27	Likely
Perceived enhancement of entrepreneurial skills	3.49	1.26	Very High
Confidence in applying plant classification	3.61	1.19	Very Confident
Importance of learning plant classification	3.78	1.08	Very Important
Overall Weighted Mean Score	3.58	—	High

Note. Mean ≥ 2.50 = Positive perception; Mean < 2.50 = Negative perception.
Source: Researcher's Fieldwork (2024).

The results in Tables 1 and 2 show that respondents displayed high levels of agreement across all items. Students expressed strong interest in learning plant classification ($\bar{x}$ = 3.59), high confidence in applying related knowledge ($\bar{x}$ = 3.61), and recognition of its importance ($\bar{x}$ = 3.78). These findings revealed that plant classification concepts meaningfully contribute to entrepreneurial readiness, consistent with Adeyemi et al. (2019), who reported similar outcomes among Nigerian secondary students.

Table 3

Kruskal–Wallis Test of the Influence of Plant Classification Knowledge on Entrepreneurial Orientation

Test Statistic	χ^2	df	p-value	Decision
Plant Classification → Entrepreneurial Orientation	27.59	2	0.000	Significant

Note. Significant at 0.05 level. Source: Researcher's Fieldwork (2024).

The Kruskal–Wallis result ($\chi^2 = 27.59$, $p < 0.05$) indicates a statistically significant influence of plant classification knowledge on students' entrepreneurial orientation. Students with higher proficiency in plant classification demonstrated stronger tendencies toward innovation, initiative, and risk-taking.

Table 4

Ordinal Logistic Regression of Plant Classification Knowledge Predicting Entrepreneurial Orientation

Predictor	Estimate (β)	SE	Wald χ^2	p-value	Odds Ratio (Exp β)
Plant Classification Knowledge	0.473	0.112	17.849	0.000	1.61

Note. Dependent variable = Entrepreneurial Orientation. Source: Researcher's Fieldwork (2024).

The regression result further confirms that plant classification significantly predicts entrepreneurial orientation ($\beta = 0.473$, $p < 0.05$). The odds ratio (Exp $\beta = 1.61$) explains that students proficient in plant classification are 1.6 times more likely to exhibit high entrepreneurial orientation than those with weaker understanding.

The findings affirm that knowledge of plant classification significantly influences the entrepreneurial orientation of secondary school students in Kogi State. Quantitatively, 60.9 percent of students with higher competence in plant classification, displayed greater entrepreneurial orientation. This confirms that plant classification is not purely theoretical but possesses practical economic value, capable of inspiring interest in agribusiness, horticulture, and botanical enterprises hence, these results aligned with the submission of Husni and Nasution (2024), who demonstrated that integrating entrepreneurship into biology lessons enhanced students' motivation toward agricultural ventures. The results are also in tandem with those of Adeyemi et al. (2019) and Osunleti et al. (2021) who emphasized that students skilled in plant taxonomy are better positioned to explore floriculture, herbal medicine, and plant-breeding businesses.

Qualitative insights from the interviews of teacher, supported the quantitative results. Teachers reported that hands-on taxonomy activities—such as plant collection, herbarium creation, and school garden projects, heighten students' awareness of economic opportunities. The view of one of the participants is that; Students begin to see that the plants they classify every day can be

grown, sold, or processed. They start linking biology to business.

This perspective aligns with Kolb's (1984) Experiential Learning Theory, which emphasizes that learning becomes meaningful when students actively apply concepts in real contexts. Similarly, Becker's (1993) Human Capital Theory supports the notion that educational investment—in this case, plant classification—enhances productivity and self-reliance. Comparative studies also provide further validation. Kumar et al. (2021) found that entrepreneurship-integrated science curricula improve students' initiative and opportunity-recognition skills. Udo and Ekanem (2021) observed that school-garden projects develop learners' business orientation and practical competencies. Collectively, these findings reinforce that connecting biology content to entrepreneurship strengthens innovation and employability.

Conclusion

Grounded in Human Capital and Experiential Learning theories, the study concluded that effective teaching of plant classification can serve as a catalyst for producing scientifically literate and economically active citizens capable of contributing to sustainable development.

Recommendations

Based on the findings, the following recommendations are made:

Curriculum Integration: The Biology curriculum should explicitly integrate entrepreneurship-oriented activities within plant classification topics. These could include identifying economically valuable plant species, developing mini-herbaria, and organizing school-based botanical exhibitions.

Experiential Learning Strategies: Teachers should adopt project-based and hands-on learning approaches, such as; school gardens, nursery management, and field excursions, to reinforce the practical applications of plant taxonomy.

Teacher Training and Resources: The Ministry of Education and educational agencies should provide regular training for Biology teachers on entrepreneurship pedagogy and supply instructional resources (plant samples, herbarium tools, garden plots) to support experiential learning.

Community and Industry Collaboration: Schools should partner with local agricultural agencies, herbal product companies, and floriculture businesses to expose students to real-world entrepreneurial opportunities derived from plant classification knowledge.

Policy Implementation: Education policymakers should strengthen the entrepreneurship component of science subjects, ensuring that students acquire both scientific literacy and business acumen before graduation.

By implementing these recommendations, secondary schools can transform plant classification instruction into a powerful vehicle for promoting agripreneurial competence, innovation, and sustainable livelihood among Nigerian youths.

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