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Beyond traditional teaching: impact of web-based instructional application on Lagos State secondary school students' academic achievement and attitude in commerce

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Abstract

This study examined the difference in the achievement and attitude of the commerce-taught students using WBIA and those traditionally taught at Lagos State Secondary School. Researchers have often focused on problems related to the field of science, neglecting the other arms at this level. A research question and a hypothesis were formulated to guide this study. This research uses a mixed method (quantitative and qualitative). A convenience sampling technique was used to select two intact classes of 100-80 students drawn from the population of students who offer commerce in Lagos State Secondary Schools. A WBIA was developed to teach five different topics in commerce, a standardised commerce achievement test, and a web-based instructional application interview guide were used to collect data and validated. The reliability of the commerce achievement test was r = 0.83. The hypothesis formulated was analysed using MANCOVA. The result of the hypothesis signifies a statistically significant difference in achievement and shows a positive attitude towards commerce at [F (1,104) = 266.08; $p < .05$, attitude F (1,104) = 9.96; $p < .05$. The use of WBIA features that link commerce concepts with real-world scenarios is highly recommended.

Keywords: Web-based instructional application (WBIA), Commerce, Academic Achievement, Student attitude, Senior secondary school, MANCOVA, Connectivism.

Introduction

The onset of the unexpected coronavirus disease (COVID-19) in 2019 reiterated the growing impact of technology on education. Many educational institutions around the world have relied on the use of technology to ensure continued education during the shutdown caused by the coronavirus. Hodges, Moore, Lockee, Trust and Bond (2020) reported that many institutions cancelled all their face-to-face classes, including labs and migrated to e-learning. Educational institutions were on a functional cessation because they had to protect their students from viral exposures, likely in a highly mingling student community.

The result of school closures related to COVID-19 was alleviated by educational institutions that had supportive Web-based learning platforms during the disaster. For example, Lagos State University, Nigeria, provided online education and training for her students and staff during COVID-19 lockdown using different e-learning platforms such as Zoom and Telegram to tie the gaps caused by this deadly virus. The 2019 Coronavirus Disease outbreak (COVID-19) made technology in education more apparent, and now it is necessary for the system to instil more viable applications of Web-based learning to support instruction. Web-based learning is not a novel phenomenon in the promotion of education in some parts of the world but has not been fully inculcated into the educational system.

Before the pandemic, the common method of instruction employed by teachers in secondary schools in Nigeria was the lecture method, which involves verbal presentation of the subject matter. The lecture method as a conventional method is undidactic, labelled, and

sometimes does not yield the expected outcome it ought to. It is often described as the 'talk and chalk' method because it conveys information to students who simply listen. The teacher does all the talking while the students listen and copy notes on the chalkboard after the lesson (Akpoghol, Ezeudu, Adzape, & Otor, 2016). The COVID-19 pandemic has caused a paradigm shift in the way learners' study throughout the world, in Africa and especially in Nigeria.

Anaekwe and Anaekwe (2020) observed that in the event of a pandemic such as Covid-19, e-learning is seen as the only alternative to keep the educational system running. Now that the new normal is revolutionising our classroom actions, education systems are being rebuilt to strengthen digital and online education around the world, but primary and secondary school students in rural and under-served communities remain behind because they seem to lack enough skills and resources required to adapt or transit into new learning opportunities. In addition, even university students who may have the ability to engage in Web-based learning encounter a shortage of regular electrical sources as well as weak internet infrastructure (Crawford, Butler-Henderson, Rudolph, & Glowatz, 2020; Zhong, 2020).). However, it is crucial to note that to improve both teachers' and students' knowledge proficiency, Web-based learning would also put an end to any educational discontinuity that could result from any form of outbreak such as the COVID-19 pandemic lockdown experienced.

Akinpelu and Fatoba (2018) define technology in education as machine technology, i.e. gadgets, and other appliances which are related to hardware such as projectors, cameras, radios, television, computers, etc. The fast-growing emphasis on digital learning tools demands exploring their effectiveness in enhancing the different fields of study, specifically commerce. Uwah and Ododo (2022) asserted that technology has modified teachers' methods from the traditional approach that often places them as knowledge dispensers to a more flexible approach where they act more as facilitators, mentors, and motivators to inspire students to participate and learn. One of the learning technologies that instructors can use in this era is web-based instruction, which is an interactive form of learning. Interactive learning media is a combination of images, animation, video, and sound in software that allows users to interact directly (Novitasari 2016). Web-Based Instructional Applications, with their interactive features and accessibility, present an opportunity to address these issues. According to Onyema, Anthonia and Deborah (2019), the integration of emerging technologies in the teaching and learning process is no longer a choice, but a need due to; the changing learning environment, the demand for flexibility in methodology, and the need to enhance creativity and productivity in learning. However, since Web-based learning has already been implemented in response to COVID-19, there has been a positive change in the delivery of instruction. Student learning achievement is now amplified by the teacher through the use of various technologies.

The commerce curriculum typically concentrates on areas associated with business activities, trade, and economic principles. Commerce is a branch of business that is made up of several subject areas. In other words, it is an integration of many subjects; it is offered as an integrated subject at the junior secondary level comprising office practice, business studies, shorthand, typewriting, and bookkeeping. However, at the Senior Secondary level, the subjects are separated into shorthand, typewriting, economics, bookkeeping, and accounting with a view of guiding students through their career part. The introduction of Commerce into the national curriculum as reflected in the national policy on Education (FRN, 2014) provides the business knowledge and vocational skills necessary for industrial, commercial, and economic development, provides trained manpower in applied technology and commerce, particularly at subprofessional grades, provides people who can apply scientific knowledge to better improve and provide solutions to economic and environmental problems for the use and convenience of man, and also to enable our young individuals to have an intelligent understanding of the increasing complexity of technology. As such, this has created an enormous challenge for the trainers of Commerce teachers at both the junior and senior secondary school levels to embrace suitable

instructional strategies while delivering Commerce content.

The academic achievement of Nigeria's senior secondary school students in commerce over the years appears unimpressive despite the importance of this subject, which could be tied to so many factors. The researcher observed from the WAEC report over the past few years that there has been a constant low academic achievement of candidates who sat for commerce in the Senior Secondary School Certificate Examination (SSSCE). This underachievement of candidates in this subject is a function of numerous factors that are commutual; these factors are internal or external. That is, it is within the control of everyone, for example inadequate preparation by the candidate, negative attitude toward the subject, etc., or outside its control, that is, teachers' personality, choice of teaching methods and strategies, etc. Emeasoba and Igwe (2016) pointed out that a person's attitude frequently influences the way they act towards something or an event. The attitude or mastery of the subject matter of the teacher determines what the students think, feel, and how they are likely to behave towards the subject. Thus, the student's perception of the characteristics of the teachers could influence their attitude towards the learning of commerce. The search for the causes of poor attitude by students towards learning about the subject of commerce is endless.

In a review of empirical studies, Devi (2014) noted that the development and evaluation of a web-based instructional application to teach the English language in secondary school improved students' academic achievement and improved students' knowledge and skills in the English language. The thesis developed and evaluated a web-based application to teach English at the secondary school level.

Aloys, Janvier, Ezechiel, Fidele, and Kizito (2022), in another study, explored Web-based discussions in teaching and learning: Secondary school teachers' and students' perception and potentiality to enhance students' performance in organic chemistry. A total of 138 participants comprising 83 males and 55 females were examined in the study. The result revealed that there is a statistically significant influence of web-based discussion on the performance of students after learning organic chemistry through web-based discussions.

Abd-El-Aziz, Muhammed, and Dawodu (2018) wanted to find the effects of web-based instruction on student attitudes, self-efficacy, anxiety, and academic achievement in general metalwork in technical colleges. The sample size for the study consisted of 56 Mechanical Trade students. It was evident that using WBI promotes student academic achievement; helps students develop positive attitudes; improves self-efficacy; and reduces anxiety about web-based instruction for learning.

Statement of the Problem

In Nigeria, poor academic achievement in external examinations such as West African Examination Council (WAEC) has been a major concern to all stakeholders, particularly in the fields of commerce as a subject. The West African Examination Council (WAEC) has observed that underperformance in commerce can be attributed to poor preparation for exams, poor responses to questions, inadequate knowledge of the subject, and unsuccessful application attempts. For instance, according to the general comment made by the West African Examination Council, 2022, it was observed that there was a decrease in the performance of the candidates who sat for the West African Secondary School Certificate Examination when compared to that of 2021. The academic performance of Lagos State Educational District V students is a serious problem, with several problems including bad study habits, a lack of resources, indiscipline, subpar facilities and inefficient teachers contributing to low academic achievement. There is a lot of evidence that Web-based instructional applications significantly increased the student's achievement (Al-Emran & Yusof; 2019; Akinpelu & Fatoba 2018; Al-Emran & Yusof 2022; Al-Azzawi & Almalki 2022; Abdelaziz & El-Shahawy 2018; Oluwaseun & Ayeni 2021; Owolabi, 2018) attitude (Akinyemi & Ogunleye 2017; Abdelaziz & El-Shahawy 2018; Owolabi 2017).).

Assuming from the foregoing, the revelation after reviewing the literation shows that

not many studies have been conducted on students' academic achievement in commerce subject, and little explanation has been provided in the literature on the effect of web-based instructional application on Lagos state senior secondary school students' academic achievement in and attitude towards commerce. This is a significant gap in the literature that accelerated the drive to pursue this research work, as commerce is an important subject that prepares students for future career opportunities. Also, students' attitudes towards commerce can have a major impact on their motivation to learn about this subject.

Therefore, this study considered developing a web-based instructional application to examine its effect on Lagos State high school students' academic achievement and attitude towards commerce.

Purpose of the Study

The purpose of the study is to develop a Web-Based Instructional Application and examine its effects on the Academic Achievement and Attitude of Secondary School Students in Commerce.

Specifically, the study intends to determine if there is a difference in the mean achievement and attitude scores of students taught commerce with a developed instructional Web-based Application and those taught with conventional learning methods.

Research Question

The following research question was used to guide the study.

Is there a difference in the mean achievement and attitude scores of students taught commerce with a developed Instructional Web-Based Application and those taught with conventional learning methods?

Research Hypothesis

The following null hypothesis was tested at a .05 level of significance.

H01: There are no statistically significant differences in the mean achievement and attitude score of the student's taught commerce with the developed Instructional Web-Based Application and those taught with the conventional teaching method.

Literature review

Theoretical Review

Connectivism Theory

This study is also connected to George Siemens and Stephen Downes. Connectivism Theory of Learning. Siemans and Downes (2009) developed a theory for the digital age, called connectivism, denouncing boundaries of behaviourism, cognitivism, and constructivism because of technological advancement in teaching and learning. Downes (2007) contends that 'knowledge is distributed throughout a network of connections, and therefore learning consists of the ability to construct and traverse these networks'. This knowledge is assembled from a network of connections arising from experience and interactions within a community.

This theory is governed by eight principles which are:

i. Learning and knowledge are based on diversity of opinions

ii. Learning is a process of connecting specialised nodes or information sources.

iii. Learning may reside in non-human appliances.

iv. The capacity to know more is more critical than what is currently known.

v. Nurturing and maintaining connections is needed to facilitate continuous learning.

vi. The ability to see connections between fields, ideas, and concepts is a core skill.

vii. Currency (accurate and up-to-date knowledge) is the intent of all connectivist learning activities.

viii. Decision-making is itself a learning process.

Unlike past theories, connectivism is a theory that believes that learning can happen from

outside. The foundation of this theory is based on the understanding that any decision taken at one point in time may change due to rapidly altering foundations. New information is constantly being generated and acquired. Connectivism aspires to redefine learning within the diverse contexts identified in the Introduction and to deliver a learning theory for the digital age (Bell 2011). It is one of the most prominent networks learning theories that have been developed for e-learning environments.

The use of web-based resources in instruction is no longer restricted to laboratories and four walls of the classroom. It is now ubiquitous, at home, on college campuses and in our day-to-day activities. This medium is a rich source of information that enables individuals and groups to not only share and publish, but also monitor sources that may be of interest to them rather than just a simple search. Trines (2018) also emphasised that institutions must understand the learning environment of the student and therefore should 'adopt a student-centred pedagogical methodology'.

Connectivism is a learning theory that emphasises the importance of connecting learners with resources and knowledge. According to this theory, learning is not just an individual process, but a social one that involves building connections and networks with others.

To apply connectivism in their instructional processes, teachers should consider the following strategies.

Encourage collaboration and communication: Provide opportunities for students to work together and share their ideas and perspectives. This can be done through group projects, discussions, or online forums.

Provide access to a wide range of resources: Give students access to a variety of resources such as online databases, videos, and articles. This can help students develop a deeper understanding of the topic and encourage them to explore different perspectives.

Encourage students to take an active role in their learning process: Encourage students to take ownership of their learning process by setting goals, reflecting on their progress, and asking others for feedback.

Use technology to facilitate learning: Use web-based instructional applications, online forums, and other digital tools to create an interactive and engaging learning environment that encourages students to connect with others and explore new ideas.

By applying these strategies, teachers can create a learning environment that is centred on collaboration, communication, and sharing of knowledge. This can help students develop a deeper understanding of the topic and improve their academic performance.

Methods

The quasi-experimental research design was adopted for the study. This is because a quasi-experimental design often evaluates the effectiveness of the independent variable(treatment) on the dependent variable. It consists of two experimental groups and two control groups, making it a total of four groups. The study adopted a pretest, and posttest group design; experimental groups were taught using a Web-Based Instructional Application, while the control group was taught using the conventional method of teaching. The population of this study comprises all senior secondary schools II (S.S.S. II) Commerce students in Lagos State, Nigeria preparing to move to Senior Secondary School III (S.S.S. III). The sample size for this study comprises 108 commerce students from four different secondary schools in Education District V in Lagos State. The district was selected using the convenience sampling technique for easy access, while the schools were selected using the purposive sampling technique. Purposive sampling being a non-probability sampling technique used to select sample elements from a given population based on the subjective choice of the researcher is considered appropriate. The major reason for adopting this technique is due to the homogeneity nature of this research work, because not all schools possess the facilities required to conduct this study. As such, the researcher ensured that there was availability of the same facilities across all schools, which helped reduce any form of untrue result. To establish that

this school possesses these facilities, the researcher surveyed the Education District. Intact classes of 27,29,28 and 24 students from each of these four schools were used as the sample size in this study. The Commerce Achievement Test (CAT), Web-Based Instructional Application Attitude Questionnaire (WIAAQ) & Web-Based Instructional Application were used to gather the quantitative data for the study.

The Commerce Achievement Test (TCAT) is a self-developed instrument consisting of 30 multiple choice questions from the West Africa Examination Council (WAEC) past questions on selected topics from the S.S.S. I & II commerce curriculum designed using Google form and sent via the web-based instructional application. The instrument is divided into two sections. Section A sought demographic information of the students that included gender and age. Section B of the instrument contains 30 multiple-choice items with four options in letter A. The items in the instrument were developed using Bloom's revised taxonomy and Okebukola's (2015) 20 golden rules for multiple choice questions. The Web-Based Instructional Application Questionnaire (WBIAAQ) is also self-structured and was used to collect data to measure the attitude of students towards the use of web-based learning platforms in the teaching and learning of commerce in senior secondary schools. The questionnaire was designed using the GOOGLE form; the link was shared with the student through the WhatsApp group created by the researcher for the study. Only those in the experimental group participated in the Web-based Instructional Attitude Questionnaire. The Web-Based Instructional Application Attitude Questionnaire (WIAAQ) also contains necessary information such as the name of the institution, faculty, and department of the researcher, instructions on how to complete the instrument followed by the two main sections (Sections A and B).). Section A of the WBIAQ contains the demographic data of the respondents such as gender and age range. Section B contains 15 question items seeking data on the attitude of students toward the use of Web-Based Instructional Applications in the teaching and learning of commerce. These questions were asked under three major headings which are Academic Performance after Learning using WBIA, Personal Growth and Achievement as a Result of Leaning using WBIA, and Student Perception on the use of WBIA in the teaching and learning of commerce. The instrument was developed using a four-point Likert scale response, Strongly Agreed (SA), Agreed (A), Strongly Disagreed (SD), and Disagreed (D). The Web-Based Instructional Application is a self-developed package; The Web-Based Instructional Application houses some learning experiences which aided the understanding of content taught, manage learner activities, set deadlines, and carry out evaluation. Other features include uploading of text, videos, images, and other file uploads. The application has standard features to upload and download instructional content for both instructors and learners.

These research instruments were subjected to validity of the face and content. It was validated with the help of my supervisor, two teachers who have significant years of teaching experience in senior schools and experts in the field of test and measurement. Another criterion for the selection of teachers to validate the instrument was their participation in the coordination exercise and the WASSCE marking. The reliability of the commerce achievement test was assessed using the test-retest method. The Pearson correlation coefficient (r) was used to analyse the test-retest reliability of the instrument. The correlation between scores in the first and second administrations was found to be $r = 0.83$ ($p < 0.01$). This indicates a strong positive correlation, suggesting that the test scores were consistent between the two administrations. Cronbach's Alpha (α) was used to assess the internal consistency of the Web-Based Instructional Application Attitude Questionnaire (WIAAQ). The analysis yielded a coefficient of $\alpha = .79$.

Method of data analysis

Demographic data of respondents are expressed in frequencies and percentages. Descriptive statistics of central tendency (mean and standard) were used to answer the research question formulated to guide this study. The hypotheses raised to obtain quantitative data were

analysed using IBM-SPSS Version 23. Multivariate Analysis of Covariance (MANCOVA) at the 0.05 alpha level is the suitable analysis tool to use in analysing the first hypothesis since it involved two dependent variables of interest, and no randomisation of the subjects was achieved. Before the data collected are inserted into the MANCOVA equation, the data was subjected to a parametric assumption test to determine whether all conditions for using the parametric statistical tool (MANCOVA) were met which include Test and the Levene Test of Equality of Error Variances. Upon the completion of meeting the parametric assumptions of both tests, the coded data was inserted into the MANCOVA equation for analysis. The result obtained from the multivariate F was followed up with the univariate F.

Data analysis and findings

Preliminary tests showed that the data satisfied the assumptions of homogeneity of variances (F= .11; P> .05) for the post achievement and (F= 1.53; P > .05) for the post attitude. The Shapiro -Wilk's test of normality was not favourable for both groups; (Achievement) control group (N=52) = .90; p< .05. Experimental group: (N=56) = .77; p<.05. (Attitude) control group (N=52) = .90; p< .05. Experimental group: (N=56) = .18; p<.05. The MANCOVA statistic applied on the pretest and post-test scores of the groups using the pre-test scores as the covariate.

Procedure

Descriptive statistics were applied to post-test achievement and attitude measures of students in the experimental and control groups. Thus, MANCOVA was applied to the achievement and attitude measures with the pre-achievement and pretest attitude as covariates. The univariate Fs were computed.

The results in Figure 4.1 showed that before treatment, the students in the experimental and control groups were similar in achievement and attitude measure. After treatment, the students taught commerce with the developed instructional web-based application had a higher mean score on post-performance 12.5 and post-attitude 36.71

Null Hypothesis (H0)

There is no statistically significant difference in the mean achievement and attitude score of students taught commerce with the developed Instructional Web-based Application and those taught with the conventional learning method.

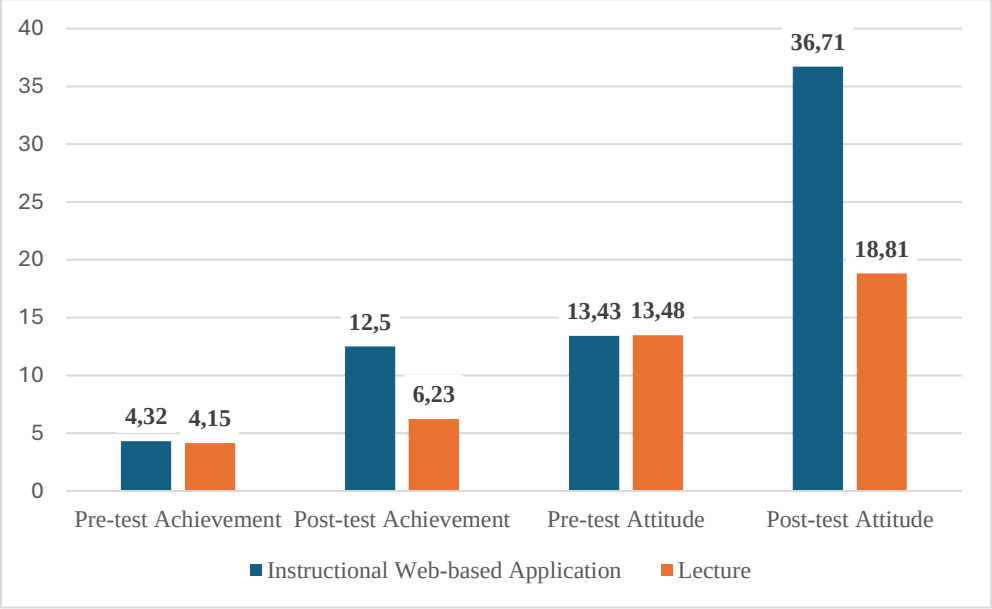

Figure 1: Mean scores on Pre- and Post-Achievement and Attitude Scores of Students in the Experimental and Control Group

Table 1: Multivariate Analysis of Covariance (MANCOVA) on Achievement and Attitude Scores

Effects		Value	F	Hypothesis df	Error df	Sig.
Group	**Pillai trace**	**.72**	**133.24**	**2.00**	**103.00**	**.00**

Table 2: Analysis of Covariance (ANCOVA) on Achievement and Attitude Scores with Pretest Achievement and Attitude as Covariates

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Correction Model	Post-test Achievement	1075.49	3	358.50	98.77	.00
	Post-test Attitude	10546.98	3	3515.66	4.09	.01
Intercept	Post-test Achievement	206.43	1	206.43	56.88	.00
	Post-test Attitude	6103.56	1	6103.56	7.10	.01
Pre-test	Post-test Achievement	3.17	1	3.17	.87	.35
Achievement	Post-test Attitude	149.44	1	149.44	.17	.68
Pretest Attitude	Post-test Achievement	11.84	1	11.84	3.26	.07
	Post-test Attitude	1805.44	1	1805.44	2.10	.15
Group	**Post-test Achievement**	**965.73**	**1**	**965.73**	**266.08**	**.00**
	Post-test Attitude	**8567.49**	**1**	**8567.49**	**9.96**	**.00**
Error	Post-test Achievement	377.47	104	3.63		
	Post-test Attitude	89454.09	104	860.14		
Total	Post-test Achievement	11162.00	108			
	Post-test Attitude	185234.00	108			
Corrected Total	Post-test Achievement	1452.96	107			
	Post-test Attitude	100001.07	107			

The multivariate F (Pillai trace) in Table 2 showed a significant F =0.72; $p < .05$. The univariate F associated with the achievement group F (1,104) = 266.08; $p < .05$, attitude F (1,104) = 9.96; $p < .05$ both achieved statistical significance.

Decision

The null hypothesis that states that there is no statistically significant difference in the mean achievement and attitude score of students taught commerce with developed Instructional Web-based Applications and those taught with conventional learning methods is rejected.

Discussion

The primary aim of the study was to ascertain whether there existed a statistically significant difference in the mean achievement and attitude score of students taught commerce with developed Instructional Web-based Application and those taught with conventional learning method. The results of Figure 4.1 showed that before treatment, the students in the experimental and control groups were similar in achievement and attitude measures. After treatment, the students taught commerce with the developed instructional web-based application had a higher mean score after achievement of 12.5, and after attitude 36.71. The multivariate F (Pillai's trace) in Table 4.1 showed a significant F =0.72; $p < .05$. The univariate F associated with the group on achievement F (1,104) = 266.08; $p < .05$, attitude F (1,104) = 9.96; $p < .05$ both attained statistical

significance. (See Table 4.2). Hence, the null hypothesis that states that there is no statistically significant difference in the mean achievement and attitude score of students taught commerce with developed Instructional Web-based Application and those taught with conventional learning methods is rejected. This implied that treatment had an impact on student achievement and attitude.

The findings from this study resonate with those of Asuquo Enyenihi and Simeon (2022); Enikanolaye, (2021); Oguguo et al., (2021); and Sudarwati et al., (2023), who asserted that the use of the instructional web-based application had a discernible impact on students' achievement and attitude. This implies that the intervention led to tangible improvements in both academic performance and disposition towards the subject matter. Such findings align with the theoretical expectations of the benefits associated with incorporating technology-enhanced learning tools into educational practices. Based on the analysis of the data, it can be observed that students who were exposed to the web-based application exhibited higher mean scores in post-achievement and post-attitude. This suggests that the interactive and multimedia-rich nature of the platform may have played a significant role in improving the learning outcomes of these students. Through the implementation of a web-based application, a more interactive and stimulating learning environment is possible. This could have potentially resulted in improved comprehension, better knowledge retention, and the development of favourable attitudes towards the specific subject matter. Through the implementation of various pedagogical strategies such as hands-on exploration, simulations, and real-world application of concepts, the platform effectively facilitated deeper comprehension and enhanced retention of the material compared to conventional passive learning approaches.

Conclusions

The primary focus of this study was to develop a Web-Based Instructional Application and examine its effects on the academic achievement of high school students and their attitude towards commerce. Following the outbreak of COVID-19, Web-based instruction became one of the learning technologies that teachers can use to improve instructional delivery. It is an interactive learning medium that combines images, animation, video, and sound. In essence, Web-based learning, by its very nature, requires active student participation in learning activities and a high level of student discipline, motivation, and control. The evidence from the study attested that the implementation of Web-Based Instructional Applications in the classroom improved student academic achievement and attitude.

Recommendations

From the study findings, the following recommendations were made within the limitations of the study:

For Students:

Explore the app thoroughly: they should dedicate time to navigate the entire web-based application. Familiarise yourself with all the features it offers, such as interactive lessons, quizzes, simulations, or discussion forums.

Set Learning Goals: they should use the web-based learning application to target specific areas of difficulty or topics that you find particularly interesting.

Connect and Collaborate with Classmates: Students should utilise the discussion forum or chat feature of the web-based learning application for proper interactions. They should use it to connect with classmates, share ideas, and ask questions.

For Teachers:

To meet the needs of their students at any given time and make commerce lessons student-centred rather than teacher-centred, teachers teaching this subject must adapt to changing their outdated teaching methods to accommodate web-based instructional applications.

To create a rewarding experience and maintain the attention and knowledge of learners, high school teachers should encourage and be encouraged to use Web-based instructional applications for their instructions.

The study recommends that teachers employ a blended learning approach as an

engaging and cutting-edge method of teaching different concepts in commerce. They should always combine traditional classroom teaching with activities and resources from Web-based instructional applications.

For School Authorities

School authorities should encourage with strict observation the use of mobile devices and relevant facilities within school premises, as the findings of this study showed a significant improvement in the achievement of students.

School administrators should encourage teachers to use web-based instructional applications as an instructional strategy to teach and learn commerce.

The use of modern web-based technologies for lesson delivery should be sourced by school administrators from time to time to keep abreast of the 21st-century learning style.

For Curriculum Planners

Curriculum planners such as the Nigerian Educational Research and Development Council (NERDC) should ensure that they collaborate on instructional strategies such as Web-based Instructional Applications as part of teaching technologies in secondary schools, since this study found it to be effective in improving student achievement and attitude toward commerce.

Ensure the creation and application of standard web-based instructional applications with meaningful academic content that emphasise cooperative learning and focus on developing student skills that are relevant to both the professional world and everyday activities.

Curriculum planners should also ensure that web-based instructional application's functionalities and content are aligned with the existing commerce curriculum standards and learning objectives for senior secondary schools in Lagos State.

For Ministry of Education/Government Agencies

The Ministry of Education and concerned government agencies should come up with tactics to encourage commerce teachers to explore web-based instructional applications in their classrooms, visit various schools to monitor them, and reward teachers who adhere strictly.

These organisations should provide commerce teachers with the necessary skills, knowledge, abilities, and competencies on how to seamlessly apply web-based instructional applications for effective teaching and learning through seminars, workshops, and conferences.

Consider proper funding of pilot programmes in different schools to allow them to assess the effectiveness of web-based instructional application, identify challenges, and refine implementation strategies before wider adoption.

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All authors have declared that there is no conflict of interest.

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