EFFECTS OF CLAROLINE AND BLACKBOARD LEARNING MANAGEMENT SYSTEMS ON ACHIEVEMENT AND RETENTION IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS IN NORTH-CENTRAL, NIGERIA

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Abstract

This study investigated the effect of Claroline and Blackboard Learning Management Systems on achievement and retention in Mathematics among secondary school students in North-Central, Nigeria. A pre-test, post-test, a quasi-experimental research design was adopted. The sample consists of 225 (169 males, and 56 females) senior secondary school one (SS 1) mathematics students selected from six secondary schools in North-Central, Nigeria using a multi-stage sampling procedure. The instruments used were Mathematics Achievement Test (MAT). The instruments were validated by experts and pilot tested. The reliability coefficient of 0.75 was obtained for MAT using Pearson Product Moment Correlation. The data were analyzed using Mean and Standard Deviation to answer the research questions, and Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. Findings revealed that there was a significant difference in the mean achievement ($F_{(2,221)}$ =12.567, P-value=0.000) and mean retention, ($F_{(2,221)}$ =16.331, P-value=0.000) of students that were taught Algebra with Claroline and Blackboard LMS and conventional lecture method. It was recommended that Claroline and Blackboard LMS be adopted by lecturers to improve students' understanding of algebra concepts.

Keywords: Mathematics, Claroline and Blackboard Learning Management, Achievement, Retention

Introduction

Information and Communication Technologies (ICT) at present is influencing every aspect of human life with education as one of the major beneficiaries. For instance, at the school level, ICT is used in advertising school programs, conducting entry examinations, admission of students, managing contact with parents, and communicating with outside the school system. Indeed, Jo *et al.* (2015) stated that students use ICT for learning, conducting practical, reporting assignments, hosting peer interactions, and reaching out to other students from sister schools using collaborative software. In addition, Umunnakwe and Sello (2016) stated that ICT in education enables self-paced learning thus, making teaching and learning enterprise more productive and meaningful. It helps facilitate resource sharing between the teacher and the students through e-mail and web-based learning as enabled by the internet, intranet, extranet, CD-ROM, TV, and e-learning (Anu, 2011).

Therefore, to meet the needs of the modern information age, secondary education systems need to take advantage of remote learning resources in managing students' learning (Alturki *et al.,* 2016). This is done to provide opportunities continued due learning through collaboration with experts outside the classroom and to encourage students to be active learners through Learning Management System (LMS) as open classrooms (Williams & Whiting, 2016). Similarly, Ouadoud and Mohammed (2018) described Learning Management System (LMS) as a software application for the administration, documentation, tracking, reporting, and delivery of educational courses, training programs. A learning management system (LMS) is a software application or Web-based technology used to plan, implement, and assess a specific learning process.

Currently, there are many types of LMS that provide e-learning opportunities to users. For example, data obtained from docebo.com showed those different types of open-source software (OSS), LMS, and proprietary LMS. In the Docebo Benchmark document, the company conducted a study on different types of LMS in which most schools prefer to use Claroline LMS based on its functionalities. Claroline as a collaborative e-learning platform is a subset of Learning Management System released under an open-source license which allows hundreds of organisations, associations, and schools to create and administer courses over the web. The platform is used in more than 100 countries and is available in 35 languages (Darus, 2012). It is planned around the concept of spaces related to academic activity and each space provides a list of tools that enable one to create learning content, manage training activities and interact with the students (Sarachandran & Rajendra, 2012).

Additionally, Blackboard features also allow students to preview learning material, see marking points for the course and what scores and marks they have and what they need. It also facilitates the submission of important files like documents, student reports, assignments, and other announcements from teachers to their students. The Blackboard Learning Management System (LMS) represents one of the powerful academic solutions that provide true learning activities management, deep interactions with the course material which facilitate learner engagement and lead to a higher level of satisfaction with learning (Al-khresheh, 2021). Blackboard learning management system for many of its users has facilitated the process of posting and accessing content, completing assignments, performing online testing, managing students' learning outcomes, and improving students' achievements in Mathematics.

Achievement comes to fulfillment when learning a thing is done successfully with effort, skills or courage. Ndako (2017) defines achievement as an outcome that shows the extent to which a student has achieved identified educational objectives. As such, students with good academic achievement usually retain the knowledge gained.

Retention takes place when learning is coded into memory, and appropriate coding of incoming information provides the index that may be consulted so that retention takes place without an elaborate search in the memory lane (Achor *et al.,* 2013). Retention of the learned algebra concepts is another factor that contributes to students' academic challenges in mathematics, which in turn lead to discouragement.

According to Wamdeo (2012), algebra in mathematics is a concept taught in mathematics as many students' dislike algebra at the secondary school level and thereby have high failure rates in public Examinations. Failure in Mathematics stops students' ambition to study science and engineering courses (Wamdeo, 2012). In order to consolidate these variables: students' achievement and retention in learning mathematics, the researcher experimented with the use of Claroline and Blackboard tools in schools which are capable of leading to students centred learning approaches. Added to this, are the chances of increasing accessibility of remote learning resources, remote assessment and evaluation features, and improved management of course content and administrative tasks. However, despite an increase in the availability of the internet, research carried out in these areas (Claroline and Blackboard tools) is low and their potentiality in supporting e-learning has not been fully exploited. Additionally, little or no research has been carried out on the impact of LMS adoption in teaching secondary school mathematics in the study area.

Talal and Abeer (2016) investigated the impact of using e-learning based on blackboard applications upon the achievement and skill of solving mathematical problems among Preparatory Year female students at Najran University. The result shows a positive impact on the experimental group of students. Ugwoku (2018) carried out a study on the effect of the

flipped classroom on learning management systems, based on face-to-face Learning environments on students' gender, interest, and achievement in Accounting. Findings revealed that flipped classroom model on LMS has a significant effect on students' academic achievement in Elements of Accounting than the conventional method. Alajab and Ahamed (2018) investigate the impact of blackboard LMS on teaching technology studies of graduating students and found that the use of Blackboard as a learning management system facilitated students learning and enhanced their learning outcomes as well as their ability to retain facts and satisfaction with the learning experience. Firat (2016) carried out a study on the effects of LMS learning behaviors on academic achievement in a learning analytic perspective. It was revealed that students agreed that LMS helped increase their academic achievement only when LMSs included features such as effectiveness, interaction, reinforcement, attractive design, social media support, and accessibility. All these can only be ascertained through investigating the effects of claroline and blackboard learning management systems on learning outcomes in mathematics among secondary school students in North- Central, Nigeria.

Statement of the Research Problem

It was stated in the National Policy on Education that the contribution of mathematics is indispensable and very important for sustainable national development (FRN, 2009). With this declaration, students continue to record poor academic achievement in secondary school mathematics. The problems that have been identified with the conventional teaching method were an inappropriate use of relevant instructional media that foster students' collaboration, a lower rate of student's achievement, and retention of mathematical concepts. It was discovered from the previous mathematics examination results of WAEC, 2017 to 2021, Chief Examiners reported that students are not performing well in Algebra (Chief examiner report, 2018).

Claroline as a Learning Management System is specifically used for course content delivery where teachers upload the notes for students to download and at times some announcements, chats, and forums are used to engage students as well. Currently, Claroline platform has features for rapid learning, video conferences, integrated live conferencing, templates and styles for rapid online authoring, search engine, hotspots, open answers, and educational blogs. Similarly, in Blackboard, students access information for a course of study, the books needed for the course, deadlines for assignments, the assignment framework, quizzes, discussion subjects, voice presentations, and all the marks they have obtained during their session.

Furthermore, studies on Claroline and Blackboard learning management systems have been experimented with mostly in higher institutions of learning and found more effective in teaching which improves students' performance. Studies conducted by Umunnakwe and Sello (2016) investigated the effective utilization of Information and Communication Technology (ICT) by first-year undergraduates of the University of Botswana (UB), in their reading and writing skills with blackboard. However, studies in the area of mathematics in secondary schools in Nigeria are scarce and have not been exhaustive based on the knowledge of the researcher. It is in the light of the above that the researcher intends to carry out this study using Claroline and Blackboard learning management system on learning outcomes in Mathematics among Secondary school students in north-central Nigeria.

Research Questions

The following research questions were answered in the study:
(i)   What are the mean achievement scores of students taught Algebra with Claroline, Blackboard learning management systems, and conventional lecture method?

(ii)   What are the mean retention scores of students taught Algebra with Claroline, Blackboard learning management system, and conventional lecture method?

Null Hypotheses
The following null hypotheses were tested at a 0.05 level of significance:
HO$_1$:   There is no significant difference in the mean achievement scores of students taught Algebra with Claroline, Blackboard learning management systems, and conventional lecture method.
HO$_2$:   There is no significant difference in the mean retention scores of students taught Algebra with Claroline, Blackboard learning management system, and conventional lecture method.

Methodology
This study adopted a non-equivalent, non-randomized pretest-posttest quasi-experimental and control design. The independent variables of the study were Claroline and Blackboard Learning Management System and Conventional Lecture method while students' achievement and retention served as the dependent variables of the study.
The design layout of the study is presented in Table 1:

Table 1: Research Design Layout

Group	Pre-intervention	Treatment	Post-intervention	Post-Post-intervention (Retention)
Experimental 1	O_1	X_1	O_2	O_3
Experimental 2	O_1	X_2	O_2	O_3
Control Group	O_1	X_o	O_2	O_3

Key
O_1 represents the pre-intervention scores for the three groups
O_2 represents the post-intervention scores for the three groups
O_3 represents the retention scores for the three groups
X_1 represents the treatment using Claroline Learning Management System
X_2 represents the treatment using Claroline Learning Management System
X_o represents the conventional lecture method

The population for this study was made up of all mathematics students in all senior secondary schools in North Central, Nigeria. The North Central comprises of Niger, Kwara, Nassarawa, Kogi, Plateau, Benue states, and FCT Abuja. The target population was the entire SS I Mathematics students because Algebra is meant to be taught at that level for 2021/2022 academic session.

The sample for this research consists of 225 senior secondary school one (SS I) mathematics students selected from intact classes of six senior secondary schools in North Central Nigeria. Firstly, the states were clustered into two (A and B), and one state was selected randomly in each cluster. One state each was selected randomly from each of the two clusters. Thereafter, three senior secondary schools were purposively selected in each of the three selected states based on the availability of ICT facilities and mixed gender. This gives a total of six schools used for this study. Furthermore, the three schools in a state were randomly assigned to treatments. Two schools were therefore used for Experimental group one (Claroline), two schools for Experimental group two (Blackboard Learning Management System) and the remaining two schools were for the control group (Conventional Lecture Method).

The instruments used for this study were the treatment instrument and the Mathematics Achievement Test (MAT).

The instructional content was developed by the researcher based on the content of the senior secondary school Mathematics curriculum. The instructional content was scripted and given to a computer specialist in the learning management system who in collaboration with the researcher deployed the instructional contents on Claroline and Blackboard LMS. The instructional modules on Algebra concepts such as; Simultaneous Linear Equation and Quadratic Equations were presented in form of text, animations, narrations, graphical illustrations, and short videos. The development of the treatment instrument was designed by the researcher based on the SSI mathematics syllabus. Lesson plan was typed with the use of Microsoft Word and was converted into a script that was used to prepare instructional content in the studio by means of uploading the algebra concept to Claroline and Blackboard LMS. Claroline has the following features: learning paths, groups of users, compose exercise structure agenda with tasks and deadlines, notification post, propose home work to make online, view statistics of attendance and write collaborative documents. Claroline is capable of hosting a large number of users and it is compatible with Linux, Mac and Windows environments.

The same procedure was repeated and uploaded to Blackboard Learning Management. The Black board LMS has the following features: page tool, folder tool, legend, books, lectures tools, syllabus, dictionary, lesson plan, video, integration tools, discussion, chats, reports tools, inquiry tool, comments tool, blogs and survey (question form) tools, quick mail, tasks, tests and workshops tools, safe assignment tool, group mod, virtual classroom, internet mail tools, calendar, tracking and statistics tools, database and certificate tools and language adjustment tool.

In these platforms, students were given login details where they visit the homepage of the respective platforms; Claroline and Blackboard LMS and followed the instructions to begin lessons. The homepage admits students by adding their login details in the designated columns and automatically directs them to where they find relevant learning contents that were previously uploaded by the visitor who was their teacher. In the platforms, students have option to read the textual information, view animations, listen to narrations by mounting headset coupled with computer system or connected to external speakers and watch short videos. Conversely, students in the conventional lecture group were taught the same Mathematics lessons by using the usual chalk and talk method presented by the teacher.

Mathematics Achievement Test (MAT) which comprises of 50 multiple choice objective items was developed by the researcher with algebra concept taught; have options A-E with one option as the correct answer and the remaining four options as distractors. It was administered as pre-intervention post-intervention and retention test to the experimental and the control groups. In scoring the multiple-choice questions, each question was awarded two marks for a correct option chosen and later converted to percentage. The retention test was derived from the achievement test by reshuffling the items ordering. Though, the number of questions, options and instructions were the same with that of achievement test.

Both the Claroline and Blackboard LMS were validated by two computer experts, two Educational Technology experts and two Mathematics experts. Also, the Achievement test was validated by two Mathematics specialists. Based on their suggestions, the instruments were improved upon.

To determine the reliability of the Mathematics Achievement Test, a pilot test was administered to 20 secondary school one (SS I) Mathematics students. The students in the schools are part of the research population, but not part of the sample for the study. The test was administered using test-retest method in an interval of two weeks. The reliability coefficient of .751 was obtained using Pearson Product Moment Correlation formula. This implies that the instrument is reliable.

The data obtained from the students were analyzed using descriptive and inferential statistics. Inferential statistics was used to test the seven null hypotheses at 0.05 level of significance using Analysis of Variance (ANOVA) at pre-intervention. As the result returned a significant difference at pre-intervention, Analysis of Covariance (ANCOVA) was used at post-intervention with Sidak Post-hoc analysis to determine the direction of the difference. Statistical Package for Social Sciences (SPSS) version 22.0 was used for the analysis.

Results

Research Question One: What are the mean achievement scores of students taught Algebra with Claroline, Blackboard learning management systems and conventional lecture method?

To address this research question, Mean and Standard Deviations were computed at pre-intervention and post-intervention to compare the achievement of students exposed to Algebra concepts with Claroline LMS, Blackboard LMS and Conventional lecture method as indicated in table 2 below

Table 2: Mean and standard deviation of pre-test and post-test achievement scores of students taught Algebra with Claroline, Blackboard LMS and conventional lecture method

Group	N	Pre-intervention		Post-intervention		Mean Gain/Loss
		$\bar{X}$	SD	$\bar{X}$	SD	
Claroline LMS	64	23.86	6.23	69.75	15.81	45.89
Blackboard LMS	79	27.96	11.23	61.53	16.70	33.57
Lecture Method	82	32.24	11.23	54.85	10.60	22.61

Key: $\bar{X}$ = Mean, SD= Standard Deviations, N= Number in samples

Table 2 shows the Mean and Standard Deviation of achievement of students that were taught Algebra concepts with Claroline LMS, Blackboard LMS and Conventional lecture method at pre-test and post-test. The post-intervention mean achievement scores of students in Claroline LMS groups were higher ($\bar{X}$= 69.75, SD = 15.81) than the pre-intervention means scores ($\bar{X}$= 23.86, SD = 6.23), representing a major change in achievement from pre-intervention to post-intervention. For Blackboard LMS, the mean achievement scores on the post-intervention were higher ($\bar{X}$= 61.53, SD = 16.70) than the pre-intervention scores ($\bar{X}$= 27.96, SD = 11.23), signifying a major change in the achievement of the group. Nonetheless, the mean achievement scores of students at lecture method group were ($\bar{X}$= 54.85, SD = 10.60) at post-intervention which is lower than the previous groups but higher than the pre-intervention scores of the group ($\bar{X}$= 32.24, SD = 11.23). This implies that there is a difference in the mean achievement scores of students taught Algebra with Claroline, Blackboard learning

management systems and Conventional lecture method. The achievement of the groups was graphically presented in Figure 1.
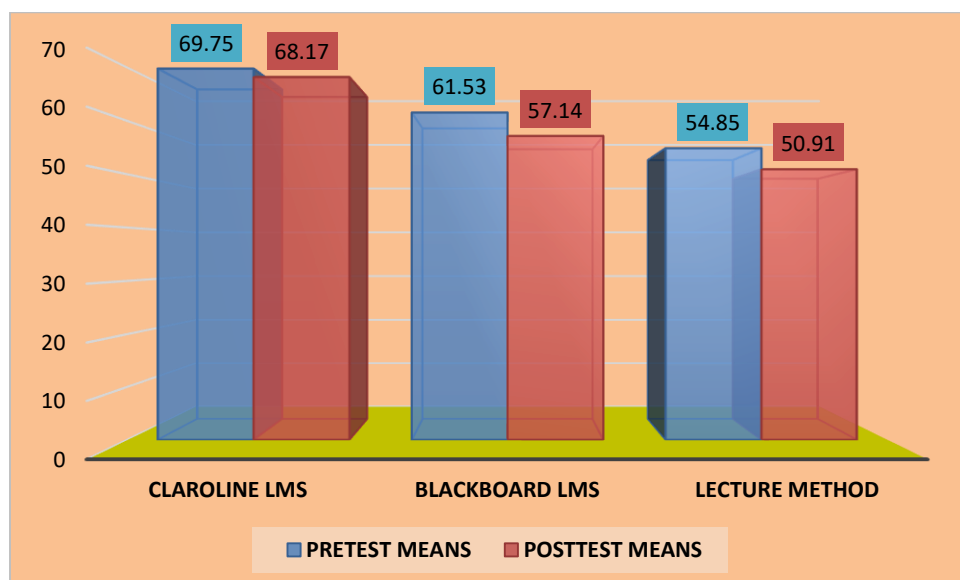

Figure 1: Graphical of pre-test and post-test achievement scores of students taught Algebra with Claroline, Blackboard LMS and conventional lecture method

The figure 1 shows graphical illustration of pre-test and post-test scores of students taught Algebra with Claroline, Blackboard LMS and conventional lecture method.

Research Question Two: What are the mean retention scores of students taught Algebra with Claroline, Blackboard learning management system and conventional lecture method?

To address this research question, Mean and Standard Deviations was computed to compare the level of students' retention exposed to Algebra concepts with Claroline LMS, Blackboard LMS and conventional lecture method as indicated in table 3.

Table 3:   Mean and Standard Deviation of Post-test and Retention Scores of students taught Algebra with Claroline, Blackboard LMS and Conventional lecture method

Group	N	Post-intervention		Retention		Mean Gain/Loss
		$\bar{X}$	SD	$\bar{X}$	SD	
Claroline LMS	64	69.75	15.81	68.17	12.90	-1.58
Blackboard LMS	79	61.53	16.70	57.14	14.04	-4.39
Lecture Method	82	54.85	10.60	50.91	9.56	-3.94

Key: $\bar{X}$ = Mean, SD= Standard Deviations, N= Number in samples

Table 3 shows the means and Standard Deviation of students' retention exposed to Algebra concepts with Claroline LMS, Blackboard LMS and Conventional lecture method at post-intervention and retention test. The mean retention scores of students in Claroline LMS groups were computed as ($\bar{X}$= 68.17, *SD* = 12.90) and is lesser than the post-intervention means

scores computed as ($\bar{X}$ = 69.75, SD = 15.81), thus, representing a minor loss. For Blackboard LMS, the mean retention scores were also lower ($\bar{X}$ = 57.14, SD = 14.04) than the post-intervention scores ($\bar{X}$ = 61.53, SD = 16.70), signifying a minor loss in their level of retention. Nonetheless, the mean retention scores of students at lecture method group were also lower ($\bar{X}$ = 50.91, SD = 9.56) than the post-intervention scores of the group ($\bar{X}$ = 54.85, SD = 10.60). This implies that there is a difference in the mean retention scores of students taught Algebra with Claroline, Blackboard learning management systems and Conventional lecture method. The mean retention scores of the groups were graphically presented in figure 2.
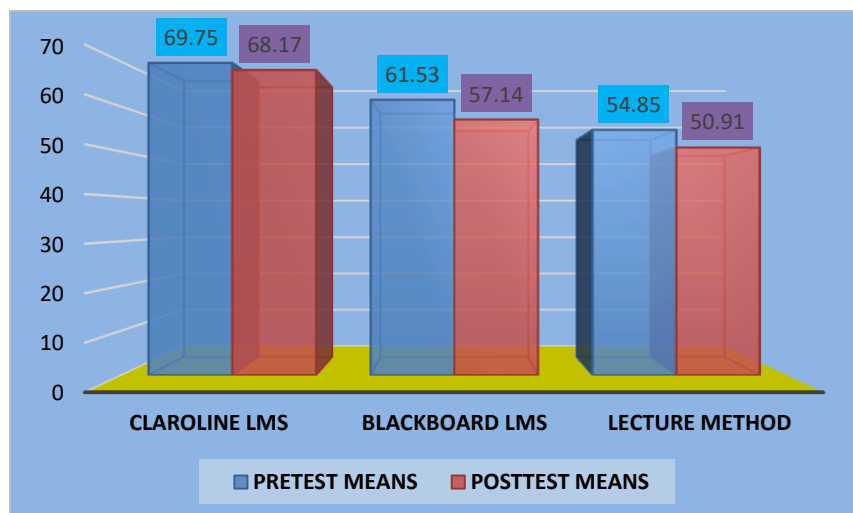

Figure 2: Mean and standard deviation of post-intervention and retention test scores of students taught Algebra with Claroline, Blackboard LMS and Conventional lecture method

The figure 2 displays the means and standard deviation of post-intervention and retention test scores of experimental and control groups. To ascertain the level of students' achievement at the onset of the study, a pre-intervention data was collected from the three groups; experimental group I and II and the control group to test for group equivalency and to measure the variation in group achievement from baseline (pre-intervention to post-intervention differences or possible gain scores). The pre-intervention data was analyzed using ANOVA statistic as indicated in table 4 below.

Table 4: ANOVA result of the pre-test mean achievement scores of experimental group I and II and the control groups

Source of Variation	Sum of Squares	df	Mean Square	F-value	P-value
Between Groups	2545.81	2	1272.91	12.57*	.000
Within Groups	22485.74	221	101.29		
Total	25031.56	224			

Significant at 0.05 level

In Table 4, ANOVA statistic was used to compare the mean scores of the experimental groups I, II and the control group at pre-intervention. The difference between the groups was revealed to be statistically significant $F_{(2, 221)}$ = 12.57, P-value = 0.000 at $P < 0.05$. This indicates a statistically significant group differences on the pre-intervention measures of experimental groups I, II and the control group at 0.05 level of significance. The finding shows that students assigned to experimental groups I, II and the control group are not equivalent

due to their prior knowledge of the subject matter, exposure, skills and background. Hence, ANCOVA was used to test the hypotheses.

Hypothesis One: There is no significant difference in the mean achievement scores of students taught Algebra with Claroline, Blackboard learning management systems and conventional lecture method.

Table 5: ANCOVA result of the post-test mean achievement scores of students taught Algebra with Claroline, Blackboard LMS and conventional lecture method

Source	Sum of Squares	df	Mean Square	F-value	P-value	Partial Eta Squared
Corrected Model	11658.78a	3	3886.26	20.01	.000	.214
Intercept	65228.01	1	65228.01	335.91	.000	.603
Covariate (Pre-test)	3681.38	1	3681.38	18.96	.000	.079
*Achievement	10811.92	2	5405.96	27.84	.000	.201
Error	42914.54	221	194.18			
Total	903797.00	225				
Corrected Total	54573.32	224				

Significant at 0.05 level

Table 5 show that the ANCOVA was used to test the significant difference between students taught Algebra with Claroline LMS in experimental groups I, and those taught the same concepts with Blackboard LMS in experimental groups II as compared to those in the control group. The difference between the three groups was found to be statistically significant $F_{(2, 221)}$ = 12.57, P-value = 0.000 at $P < 0.05$. The effect size calculation revealed a "small" effect (partial eta squared was $\eta_p^2 = 201$). Hence, hypothesis one was rejected. This shows that there was a significant difference in the mean achievement scores of students taught Algebra with Claroline and Blackboard LMS and conventional lecture method. To determine the direction of the differences of the significant difference, a post hoc analysis was carried out using Sidak statistic as indicated in table 6 below.

Table 6: Sidak post-hoc analysis of the post-test means achievement scores of students taught Algebra with Claroline, Blackboard LMS and conventional lecture method

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.[B]
	Control	18.289*	2.451	.000
Exp 2	Exp 1	-9.878*	2.374	.000
	Control	8.411*	2.233	.001
Control	Exp 1	-18.289*	2.451	.000
	Exp 2	-8.411*	2.233	.001

Based on estimated marginal means;
*The difference in the means is significant at 0.05 level.
*Adjustment for multiple comparisons: Sidak.

Table 6 displays the mean difference between experimental group I to experimental group II and the control group to be statistically significant ($P < .000$). The sidak post hoc was also

significant between experimental group II to experimental group I and the control group (P < .000). Similarly, the mean difference between control group and experimental group I and II was found to be statistically significant (P < .000). The results indicated that the three groups maintained a high level of achievement throughout the experiment with all the groups scoring higher than the average.

Hypothesis Two: There is no significant difference in the mean retention scores of students taught Algebra with Claroline, Blackboard learning management system and conventional lecture method.

Table 7: ANCOVA Result of the Post-intervention Mean Retention Scores of Students Taught Algebra with Claroline, Blackboard LMS and conventional lecture method

Source	Sum of Squares	df	Mean Square	F-value	P-value	Partial Eta Squared
Corrected Model	20238.720a	3	6746.240	62.582	.000	.459
Intercept	10898.585	1	10898.585	101.102	.000	.314
Covariate (Achievement)	9441.718	1	9441.718	87.587	.000	.284
*Retention	3520.846	2	1760.423	16.331	.000	.129
Error	23823.262	221	107.798			
Total	801194.000	225				
Corrected Total	44061.982	224				

Significant at 0.05 level

Table 7 shows that ANCOVA was used to test the significant difference between the retention of students taught Algebra with Claroline LMS in experimental group I, and those taught the same concepts with Blackboard LMS in experimental group II as compared to those in the control group. The difference among the three groups found to be statistically significant $F_{(2, 221)}$ = 16.331, P-value = 0.000 at P < 0.05. The effect size calculation revealed a "small" effect (partial eta squared was $\eta_p^2 = .129$). Hence, hypothesis two was rejected. This finding indicate that there was a significant difference in the mean retention scores of students taught Algebra with Claroline and Blackboard LMS and conventional lecture method. To understand the major contributors to the occurrence of the significant difference, a post hoc analysis was carried out using Sidak statistics as indicated in table 8

Table 8: Sidak post-hoc analysis of the post-test means achievement scores of students taught Algebra with Claroline, Blackboard LMS and conventional lecture method

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.B
	Control	10.552*	1.874	.000
Exp 2	Exp 1	-7.333*	1.790	.000
	Control	3.219	1.668	.156
Control	Exp 1	-10.552*	1.874	.000
	Exp 2	-3.219	1.668	.156

Based on estimated marginal means;
*The difference in the means is significant at 0.05 level.
*Adjustment for multiple comparisons: Sidak.

Table 8 displays the mean difference between experimental group I to experimental group II and the control group to be statistically significant ($P < .000$). The sidak post hoc was also significant between experimental group II to experimental group I. However, it was not significant between experimental group II and the control group ($P < .156$). Likewise, the mean difference between control group and experimental group I was also found to be statistically significant ($P < .000$). However, the mean difference between control group and experimental group II was not significant. The results indicated that the two experimental groups who received Algebra instructions with Claroline and Blackboard LMS on average retained higher than the one who received the same instruction through conventional lecture method.

Discussion of Findings
The study found that there is a difference in the mean achievement scores of students taught Algebra with Claroline, Blackboard learning management systems and Conventional lecture method favouring Claroline and Blackboard LMS. The difference was also found to be statistically significant with pairwise comparison indicating a high level of achievement among the three groups, with all the groups scoring higher than the average throughout the experiment. The high-level achievement recorded by students exposed to Claroline LMS is not startling because, the software is flexible for use by both tutors and students as it provides a list of tools that enable course manager to create learning contents, manage training activities and interact with the students. The finding was in agreement with the earlier finding of Firat (2016), who revealed that students agreed that LMSs helped to increase their academic achievement only when LMSs included features such as effectiveness, interaction, reinforcement, attractive design, social media support, and accessibility. The finding was also consistent with the finding of Talal and Abeer (2016), who revealed statistically significant difference at Alpha level of ($\alpha=0.05$) for the impact of the teaching strategy adopted in the post achievement test and the skill of solving mathematical problems in favor of the experimental group students. The finding was also in agreement with Ugwoke, *et al.* (2018), whose finding revealed that flipped classroom model on LMS has significant effect on students' academic achievement in Elements of Accounting than the conventional method.

The study found that there is a difference in the mean retention scores of students taught Algebra with Claroline, Blackboard learning management systems and Conventional lecture method. The difference was also found to be statistically significant indicating that the two experimental groups who received Algebra instructions with Claroline and Blackboard LMS on average retained higher than the one who received the same instruction through conventional lecture method. The finding supported the cognitive theory of multimedia learning which emphasize on multisensory learning approach that takes care of how the brain is stimulated via the visual, auditory and kinesthetic sense. Thus, the Claroline and Blackboard LMS are multisensory in nature as more than one sense is used to acquire and retain information about the algebra concept. The finding was supported by the finding of Alajab and Ahamed (2018) whose results revealed that using Blackboard as a learning management system facilitated students learning and enhanced their learning outcomes as well as their ability to retain facts and satisfaction with the learning experience.

Conclusion
It was concluded that a significant difference exists between the mean achievement scores of students taught Algebra with Claroline, Blackboard learning management systems and Conventional lecture method, thereby, favouring Claroline and Blackboard LMS. Similarly, a significant difference exists between the mean retention scores of students taught Algebra with Claroline, Blackboard LMS and Conventional lecture method indicating that the two experimental groups who received Algebra instructions with Claroline and Blackboard LMS on

average retained the course contents learnt higher than the one who received the same instruction through conventional lecture method.

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

(i)   As established from the findings of this study that Claroline and Blackboard LMS improved the achievement of students, therefore, lecturers in Colleges of Education should be trained by the management regarding the capabilities of Claroline and Blackboard LMS and their potential use for teaching algebra.

(ii)   The Ministry of Education empowered by the Federal government and State government should make adequate provisions for ICT facilities, online resources, and internet connections in all the public universities in order to use Blackboard LMS.

(iii)   Workshops, seminars and conferences should be organized by government and institutional authorities, this will equip lecturers with the needed ICT skills for Blackboard LMS.

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