EFFECTS OF THREE MODES OF MOBILE INSTRUCTIONAL PACKAGE ON MATHEMATICS STUDENTS ACHIEVEMENT AND RETENTION IN COLLEGES OF EDUCATION, IN NORTH- CENTRAL NIGERIA

JIMOH, MUILI ADEYI; ALABI, THOMAS OMOTAYO; FALODE OLUWOLE CALEB & OLAYIWOLA, OYEYEMI RASAQ

Education Technology Department, School of Science and Technology Education
Federal University of Technology Minna
Email: muiunique@gmail.com   **Phone No:**+234-803-682-0949

Abstract

This study investigated the effects of three modes of mobile instructional package on mathematics students' achievement and retention in colleges of education; in North-Central Nigeria.The research adopted the pre-test – posttest control group design. A simple random sample of 160 students (100 male and 60 female) were drawn from four randomly selected colleges of education, in North-Central Nigeria. Three schools were assigned to experimental group and one to control group respectively. Two hypotheses were formulated and tested at 0.05 significant levels. The researcher developed mathematics mobile instructional package (MMIP) on mathematical concepts of trigonometry which was used as treatment for the experimental group while lecture method was used for the control group. A pilot study was carried out to test the research instrument. A reliability coefficient of 0.85 was obtained using the split-half method. Thirty multiple choice questions were administered to both groups before and after the treatment. The data collected was analysed using Mean, ANCOVA and Sidak post-hoc test. The study revealed that there is significant difference in the mean achievement score of students taught mathematics using Video Only, Audio+Text, Text Only and lecture method F(3, 160) = 63.798, P = 0.00. There is significant difference in the mean achievement score Video Only, Audio+Text, Text Only and lecture method of retention. Based on the finding, the study recommends that lecturers should be encouraged to use Mathematics Mobile Instructional Package (MMIP) for teaching and learning of mathematics.

Keywords: Mathematics Mobile Instructional Package (MMIP), Video only (VO), Audio with Text, Text only, Achievement, Retention.

Introduction
Every nation craves for science and technology advancement which can only be achieved through medium of science education. Developed nations lay more emphasis on science and technology; they continue to research, explore and invent in order to improve the lives of their citizens. Therefore, for Nigeria to be self reliant and attain a position of developed nation there is need to improve on the present status of science education. Mathematics remains core subject in both primary and secondary schools, Federal Republic of Nigeria (FRN, 2009). Without a credit pass in Mathematics at senior secondary school level, no student can access tertiary education in Nigeria and even at tertiary level mathematics is offered as a general course and is a requirement for graduation for all students. Many students dislike mathematics, this explain why students have the high failure rate in public examinations (Adegoke, 2011). This has been considered as a big clog in the wheel of progress and advancement in educational system. Failure in mathematics is a barrier to students' ambition to study science and engineering courses (Wamdeo, 2012). Many researchers have found out the causes of students' poor performance in mathematics. Some of the problems identified include: poor

teaching methods applied to teach mathematics; inadequate instructional materials; student's misconception of mathematics as a difficult subject (Yusuf, 2004). Mathematics teacher's attitude towards teaching the subject, poor teaching skills and lack of active participation by the students among others, could be responsible for students' poor performance in the subject (Matazu, 2010; Ajagbe, 2010). Therefore the proliferation of mobile technologies such as mobile phones and personal digital assistant, and their pedagogical capabilities calls for their educational use to enhance learning in tertiary institutions. As mobile phone becomes popular in the society and many people can afford the cost, the demand of mobility is extended to teaching and learning (Chi-Hung & Yuen-Yan, 2011). The devices are becoming highly valuable tools in the educational process because of their attractive features, mobile devices are portable, more affordable, in relation to desktop computers, they offer the opportunity for learning without local restrictions, use the possibilities offered by the wireless mobile technologies for easy access to information, promote the development of digital literacy, provide opportunities for independent learning, facilitate people with disabilities (Shuler, 2009).

In this study, three modes of mobile instructional package was considered; video only, audio with text and text only. Video only consist of mathematics mobile instructional package that depict mathematics video instruction only. Audio with text mathematics mobile instructional package consists of audio with on-screen text while text only mathematics mobile instructional package consists of on-screen text mathematics instruction only.

Miller and Joshua, (2017) investigated research topic titled mobile learning and its effects on academic achievement and students' motivation in middle grades students. The result revealed that the performance of students taught social study using mobile learning performed better than the students taught with lecture method. Mobile-learning is defined as "learning across multiple contexts, through social and content interactions, using personal electronic devices (Cromton, 2013). Also a form of distance education, mobile learning focuses on the mobility of the learner, interacting with portable technologies, using mobile tools for creating learning aids and materials becomes an important part of learning (Trentin & Repetto, 2013).

Mobile learning is convenient in the sense that it is accessible from virtually anywhere, sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips, this highly active process has proven to increase examination scores from the fiftieth to the seventieth percentile, and cut the dropout rate in technical fields by 22 percent (Saylor, 2012).

Statement of the Problem
One of the challenges of colleges of education is students' poor academic achievement in mathematics in spite of the use of technological devices in the 21st century classroom instructions. One major problem that has been identified with the conventional method is that students' attention span tend to be short, which affect their academic achievement. It was discovered from the previous mathematics examination results of 2013 to 2017 by the researcher, from various Mathematics Department Examiners of Colleges of Education in North Central Nigeria, that students are not performing well in trigonometry concepts in mathematics as a course offered in first semester in Nigeria Certificate in Education one (National Commission for Colleges of Education Digest and Colleges of education examiners, 2016). It is in the light of the above that the researcher intended to carry out this research using

mathematics mobile instructional package to find out if the package can enhance students' achievement and retention in trigonometry concepts.

Aim and Objectives of the Study
The aim of this research is to investigate the effects of three modes of mobile instructional package on mathematics students' achievement and retention in colleges of education, in North-Central Nigeria. The specific objectives are to:
(i)   Determine the effects of mathematics mobile instructional packages; with Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM) on students' achievement in mathematics.
(ii)   Determine the effects of mathematics mobile instructional packages; with Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM) on students' retention in mathematics.

Research Questions
The following research questions were raised to guide the study:
(i)   What are the mean achievement scores of students taught mathematics using mobile instructional package with Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM)?
(ii)   What are the mean retention scores of students taught mathematics using mobile instructional package with Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM)?

Research Hypotheses
The following null hypotheses questions were formulated and tested at 0.05 level of significance:
HO_1: There is no significant difference in the mean achievement scores of students taught mathematics using mobile instructional package with Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM).
HO_2: There is no significant difference in the mean retention scores of students taught mathematics using mobile instructional package with Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM).

Methodology
The research design is a pre-test, post-test experimental control design. The target population of the study was all NCE one mathematics students in North Central Nigeria. The 160 sample for the study was randomly drawn from four colleges of education in North Central Nigeria. The Instruments for data collection for the study is Trigonometry Achievement Test (TRAT). The TRAT comprised of 30 multiple choice objective questions. The (TRAT) was validated by three experts in mathematics education and education technology in the university and two experts from mathematics education and computer scientist in college of education,; because research was carried out in colleges of education. All the groups (experimental and control) were exposed to pretest before the treatment. Experimental group one was exposed to the use of Video only mathematics mobile instructional package '(VOMMIP)'; experimental group two was exposed to Audio with text mathematics mobile instructional package '(A+TMMIP)'; experimental group three was exposed to Text only mathematics mobile instructional package '(TOMMIP)'; while the control group was exposed to 'conventional lecture method. The posttest was administered on the groups after six weeks of treatment while retention test was

administered two weeks after posttest. The data analysis involved the use of mean, standard deviation, Analysis of Covariance and Sidak post-hoc test.

Presentation of Results

The results of the analysis of the data for this study are presented below. The analysis and result was done based on the research questions and null hypotheses.

Research Question One: What are the mean achievement scores of students taught mathematics with mathematics mobile instructional package Text only, Video only Audio with Text and Lecture Method?

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Experimental and Control Groups

Group	N	Pretest		Posttest		Mean Gain
		$\bar{X}$	SD	$\bar{X}$	SD	
Video Only	40	29.63	7.21	77.29	13.63	47.66
Audio+Text	40	21.63	6.12	68.15	12.50	46.16
Text Only	40	26.76	6.16	60.99	7.99	34.23
Control Group	40	28.24	7.35	45.58	6.67	17.34

Table 1 shows the mean and standard deviation of achievement scores of experimental group one, experimental group two, experimental group three and control group in pretest and posttest. The result revealed that mean and standard deviation scores of the pretest and posttest experimental group one are $\bar{X}$ =29.63, SD = 7.21 and $\bar{X}$ = 77.29, SD = 13.63 respectively. This gives a mean gain of 47.66 in favour of the posttest. Similarly, the mean and standard deviation of the pretest and posttest of the experimental group two are $\bar{X}$ = 21.63, SD= 6.12 and $\bar{X}$ = 68.15, SD = 12.50 respectively. This gives a mean gain of 46.16 in favour of posttest. Similarly, the mean and standard deviation of the pretest and posttest of the experimental group three are $\bar{X}$= 26.76, SD= 6.16 and $\bar{X}$ = 60.99, SD = 7.99 respectively. This gives a mean gain of 34.23 in favour of posttest. On the other hand, the mean and standard deviation of the pretest and posttest of the control group are $\bar{X}$ = 28.24, SD = 7.35 and $\bar{X}$ =45.58, SD 6.67 respectively and gives a mean score of 17.34 in favour of the posttest. The result also revealed that experimental group one, two, three and control group had mean gain of 47.66, 46.16, 34.23 and 17.34 respectively, and with the experimental group one having the highest mean gain of 47.66.

Research Question Two: What are the mean retention scores of students taught mathematics mobile instructional package with Text Only, Video Only, Audio with Text and Lecture Method?

Table 2: Mean and Standard Deviation of Retention Test of Video Only, Audio with Text, Text Only and Lecture.

Group	N	Posttest		Retention		Mean Gain
		$\bar{X}$	SD	$\bar{X}$	SD	
Video Only	40	77.29	13.63	80.03	10.50	2.74
Audio+Text	40	68.15	12.50	70.97	10.23	2.82
Text Only	40	60.99	7.99	65.58	9.91	4.59
Control Group	40	45.58	6.67	45.43	5.41	0.15

Table 2 shows the mean and standard deviation of retention scores of experimental group one, experimental group two, experimental group three and control group in posttest and retention test. The result revealed that mean and standard deviation scores of the posttest and retention test experimental group one Video only are $\overline{X}$=77.29, SD = 13.63 and $\overline{X}$ = 80.03, SD = 10.50 respectively. This gives a mean gain of 2.74 in favour of the retention test. Similarly, the mean and standard deviation of the posttest and retention test of the experimental group two Audio with Text are $\overline{X}$ = 68.15, SD = 12.50 and $\overline{X}$ = 70.97, SD = 10.23 respectively. This gives a mean gain of 2.82 in favour of retention test. Similarly, the mean and standard deviation of the posttest and retention test of the experimental group three Text only are $\overline{X}$ = 60.99, SD= 7.99 and $\overline{X}$ = 65.58, SD = 9.91 respectively. This gives a mean gain of 4.59 in favour of retention test. On the other hand, the mean and standard deviation of the posttest test and retention test of the control group are $\overline{X}$ = 28.24, SD = 7.35 and $\overline{X}$ = 45.58, SD 6.67 respectively and gives a mean gain score of 0.15 in favour of the posttest. The result also revealed that experimental group one (video only), two (Audio with text), three (Text only) and control group had mean gain of 2.74, 2.82, 4.59 and 0.15 respectively, and with the experimental group three (Audio with text) having the highest mean gain of 4.59.

Ho₁: There is no significant difference in the mean achievement scores of students taught mathematics mobile instructional package Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM).

Table 3: ANCOVA results of the post test mean achievement scores of the experimental groups I, II, III and control group (VO, A+T, TO and LM) Mathematics Mobile Instructional Package

Sources	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	21908.709[a]	4	5477.177	47.971	.000
Intercept	39233.232	1	39233.232	343.620	.000
PRETEST	114.503	1	114.503	1.003	.318
GROUP	21852.578	3	7284.193	63.798	.000
Error	17697.324	155	114.176		
Total	17697.324	160			
Corrected Total	39606.033	159			

*: Significant at 0.05

Table 3 shows the ANCOVA results of Posttest Scores of VO, A+T, TO and Lecture Method. An examination of Table 1 with F (3,155) = 63.798, p < 0.05, the results of the analysis indicates that hypothesis one is rejected on the basis that the main effect (treatment) was significant. The results revealed that the MMIP packages produced a significant effect on the posttest achievement scores of students when covariate effect (pretest) was controlled. The result indicates that the treatment, using VO, A+T, TO and Lecture Method accounted for the difference in the posttest achievement scores of the students. This implies that a statistical significant difference exists among the VO, A+T, TO and Control Group. Since it was established that there was a significant difference in the post-test scores of the groups, Sidak test post-hoc analysis was done to identify the direction of the difference among the treatment groups as shown in Table 4.

Table 4 Sidak Post-hoc Analyses of the Groups Mean Scores

Groups	Mean Scores	Group I (VideoOnly)	Group II (Audio+Text)	Group III (Text Only)	Group IV (Lecture Method)
Video Only	77.29		*7.473	*15.673	*31.404
Audio + Text	68.15	*-7.473		*8.199	*23.931
Text Only	60.99	*-15.673	*-8.199		*15.732
Control Group	45.58	*-31.404	*-23.931	*-15.732	

* The significant at 0.05 level

The result in Table 4 indicates significant difference in the posttest mean scores of Video only (X = 77.29) and Audio+Text (X = 68.15) in favour of Video Only. It also indicates significant difference in the posttest scores between Audio+Text (X = 68.15) and Text only (X = 60.99) in favour of Audio+Text. Significant difference was established in the posttest mean scores between Text only(X = 60.99) and Lecture method (X = 45.58) in favours of Text only. Since all the experimental groups performed better than the control group, then the three experimental methods are more effective than the lecture method.

Ho$_2$ There is no significant difference in the mean retention scores of students taught mathematics mobile instructional package Video Only (VO), Audio with Text (A+T), Text Only (TO), and Lecture Method (LM).

Table 5: ANCOVA results of the retention scores of the experimental groups I, II, III and control group (Video Only, Audio+Text, Text Only and Lecture Method) Mathematics Mobile Instructional Package

Sources	Type III Sum of Squares	Df.	Mean Square	F	Sig.
Corrected Model	31809.357[a]	4	7952.339	219.467	.000
Intercept	3655.377	1	3655.377	100.880	.000
PRETEST	5993.377	1	5993.503	165.420	.000
GROUP	2771.032	3	923.677	25.491	.000
Error	5616.398	155	36.235		
Total	716568.90	160			
Corrected Total	37425.755	159			

*: Significant at 0.05

Table 5 shows the ANCOVA results of retention Scores of, VO, A+T, TO and Control Group. An examination of Table 3 with F (3,160) = 25.491, p = .000, the results of the analysis indicates that this hypothesis is rejected on the basis that the main effect (treatment) was significant. The results revealed that the mathematics mobile instructional package (video only, Audio+Text, Text only) and Lecture Method produced a significant effect on the posttest achievement scores of students when covariate effect (pretest) was controlled. The result indicates that the treatment, using Video Only, Audio+Text, Text only and Lecture Method accounted for the difference in the posttest retention scores of the students. This implies that a statistical significant difference exists among the four groups of Video only, Audio+Text, Text only and Control Group. Since it was established that there was a significant difference in the

post-test scores of the groups, Sidak test post-hoc analysis was done to identify the direction of the difference among the treatment groups as shown in Table 6.

Table 6 Sidak Post-hoc Analyses of the Groups Retention Mean Scores

Groups	Mean Scores	Group I (Video only)	Group II (Audio +Text)	Group III (Text Only)	Group IV (Lecture Method)
Video Only	80.03		*3.843	*5.145	*16.490
Audi+Text	68.15	*-3.843		1.301	*12.647
Text Only	59.66	*-5.145	*-1.301		*11.346
Lecture Method	45.58	*-16.490	-12.647	*11.346	

* The significant at 0.05 level

The result in Table 6 indicates significant difference in the posttest mean scores of Video only (X = 80.03) and Audio+Text (X = 68.15) in favour of Video only. It also indicates significant difference in the posttest scores between Audio+Text (X = 68.15) and Text only (X = 59.66) in favour of Audio+Text. Significant difference was established in the posttest mean scores between Text only (X = 59.66) and Lecture method (X = 45.58) in favors of Text only.

Discussion
The result of data analyzed with regards to hypothesis one reveals that there is a significant difference in the achievement of experimental group one, experimental group two, experimental group three and control. The experimental groups performed better than the control group. This is in agreement with Miller and Joshua (2017) who investigated on mobile learning and its effects on academic achievement and student motivation in middle grades students in social studies. The study reported that performance of students taught social studies using mobile learning performed better than the students taught using lecture method. In line with the study conducted by Abdellah and Thouqan (2016) on the effect of mobile learning on students' achievement and conversational skills of students. The results showed that mobile learning had significant effect on both students' academic achievement and conversational skills.

The result on the comparison of the retention scores of the experimental groups Video only, Audio+Text, Text only and control group. The result of retention indicates that the treatment, using Video only, Audio+Text, Text only and Lecture Method accounted for the difference in the posttest retention scores of the students. This implies that a statistical significant difference exists among the four groups of Video only, Audio+Text, Text only and Control Group. This supports the findings of Khansarian, and Ahmad (2017) who conducted an experimental research on effects of mobile learning on acquisition and retention of vocabulary among Persian-speaking learners. The findings of the study reported that students taught vocabulary using mobile learning in experimental group outperformed those of the control group in retention. This is also in agreement with findings of Achor, Otor, and Umoru (2013) who determined the effects of computer-based instruction (CBI) on students' retention in biology in secondary school. It was revealed that students taught biology using computer-based instruction had higher retention than those taught using conventional method. Therefore computer-based instruction can improve students' retention.

Conclusion

The use of Video Only Mathematics Mobile Instructional Package (VOMMIP) was found to be effective for teaching mathematics students. Video Only Mathematics Mobile Instructional Package can improve students' performance more than other instructional delivery media such Audio + Text and Text only and lecture method.

Recommendations

It was recommended that:

(i)   Mathematics Mobile Instructional Package (MMIP) should be encouraged in schools for teaching mathematics by the lecturers.

(ii)   Teachers should be trained on the use of Mathematics Mobile Instructional Package (MMIP) presentation that can bring better results in teaching and learning of Mathematics in their students.

(iii)   Science, Technology and Mathematics in particular should be taught in such a way that students can see, feel and practise what have been taught on their own. Therefore mobile learning should be an integral part of Science, Technology and Mathematics instructions by the lecturers.

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