



## Effects of Two modes of Computer Assisted Instructional Packages on Colleges of Education Students' Achievement in Basic General Mathematics

<sup>1</sup>Adedapo Ismail Yemi & <sup>2</sup>Njoku Zephrinus Chidubem

<sup>1</sup>Department of Mathematics, Federal College of Education, Eha – Amufu, Enugu State.

<sup>2</sup>Department of Science Education, University of Nigeria, Nsukka

Corresponding author: ismailyemi72@gmail.com

### Abstract

This study explored how two different types of computer-aided learning programs impacted the performance of college education students in basic math. This study specifically adopted quasi experimental research design. The population of the study comprised of 2967 NCE 1 students in government owned colleges of education in south-east, Nigeria. The sample of the study comprised 137 NCE 1 students from four colleges of education (two states and two federal). Multi stage sampling technique was used to select the study sample. Two research questions and three null hypotheses were formulated to guide the study. The instruments used for the study were Basic General Mathematics Learning Package (BGMLP) and Basic General Mathematics Achievement Test (BGMAT). The BGMLP instrument demonstrated a high degree of internal consistency (reliability index of 0.85). Descriptive statistics (mean and standard deviation) were used to answer the research question. Analysis of covariance (ANCOVA) was employed to statistically test the hypotheses at a significance level of  $\alpha = 0.05$ . The study found that students learned more basic math (BGM) when using a program with audio, video, and text compared to a program with only video and text. Interestingly, gender didn't seem to affect how well students did in basic math. Based on the findings, the study recommends several improvements: Teachers should use computer-assisted instruction (CAI) that combines audio, video, and text (AVT) to help students excel in basic and general math, School leaders equip schools with the necessary facilities to support the use of AVT-CAI in classrooms. Government should Provide schools with the resources needed to effectively implement AVT-CAI for teaching basic general mathematics.

**Keywords:** Basic General Mathematics, Colleges of Education, Students Achievement, Smartphones, Learning

### Introduction

One of Nigeria's three pillars of postsecondary education is the College of Education system. Its main responsibility is to prepare instructors to receive the Nigeria Certificate in Education (NCE), the minimal national teaching credential. After completing the three-year training program, one can teach in Nigeria's elementary and junior secondary schools (JSS) with this degree. The Federal Republic of Nigeria (FRN, 2013) states that the purpose of the establishment of the COEs was to offer educational establishments with professionally qualified teachers whose curricula are designed to prepare them for carrying out their tasks in an effective manner. Formerly known as Advanced Teachers' Colleges, this teaching institution was connected to several Nigerian universities. Later on, the Advanced Teachers' Colleges became Colleges of Education, overseen by the National Commission for

Colleges of Education (NCCE), a single umbrella organization.

The National Commission for Colleges of Education (NCCE) was set up in order to monitor, supervise, and regulate the activities of Colleges of Education. The NCCE was tasked with creating a national policy framework for the complete development of teacher education and training, defining minimum requirements for all teacher education programs, and accrediting teachers' credentials and other academic honors (Mudashir, 2018). To prepare NCE students for their duties as teachers in the Primary/Junior Secondary Schools, the NCCE (2012) stated that candidates for award of NCE certificates are required, among others, to earn at least minimum of 32 credits each in two teaching subjects, 36 credits in



General Education including teaching practice and 18 credits in General Studies Education.

Basic General Mathematics is one of the compulsory courses for all NCE students irrespective of their course of study and its content covered elementary concepts on: number and numeration, algebra, and statistics. The aim of the course is to expose students to a wide range of information from other fields and aids in the development of critical thinking and inventiveness in the solution of common difficulties and gives aspiring NCE teachers the abilities they need to deal with primary Mathematics. Mathematics in general is a universal aspect of human civilization is a tool and language used in trade, engineering, and other sciences to help individuals discover patterns and understand the world around. Many fields of modern human endeavors rely on Mathematics, including space flight, protecting credit card information on the internet, preventing epidemics, predicting stock market prices, and making economic decisions (Abdulrahim, Gimba, Hassan & Jiya, 2019). To achieve this purpose, pupils should be taught to understand the significance of Mathematics in national growth, and qualified teachers are needed to teach the subject. Despite the importance of Basic General Mathematics to the NCE students', the students' achievement in the course has been poor and fluctuating over the years across Colleges of Education in Nigeria especially Basic General Mathematics 11 (GSE 122).

The poor achievement of students in Basic General Mathematics as observed above continues to baffle educators and researchers. Akinsola, Tella, and Tella (2007) stated that it is quite disappointing to discover that undergraduate students' achievements, particularly in Mathematics, have not been encouraging in recent years. According to other researchers, such as Gradwohl and Eichler (2018), Mathematics in tertiary Education courses is frequently cited as a substantial barrier for students and this may be one of the main reasons for students' dropping out from school. This issue is most acute in non-science oriented higher education programs, where the failure rate in Mathematics can easily reach 30% (Awaludin, Ab Razak, Azliana, Aridi & Selamat, 2015). Hence, mathematics teachers need to find better teaching methods that could be used to improve students' achievement in Basic General Mathematics and indeed mathematics.

Various researchers have proposed solutions to the problems that arise as a result of ineffective teaching approaches. According to Prendergast (2011),

Mathematics teachers can make learning of Mathematics more interesting for the students by exposing them to the topics through teaching technique that involves student-centered and emphasizes hands-on activities. Basham and Marino (2013) and Joubert (2013) advocated for teachers to include technology in teaching their lessons in order to promote individualized instruction and accommodate students' various learning levels. Alsowat (2016) stressed that there is a need for a change in educational pedagogies, with more interactive, student-friendly, and digitally enabled teaching methodologies such as computer assisted instruction.

Computer assisted instruction involves using a computer to interact with students for the purpose of learning and evaluating students' progress. According to Gambari and Adeghe (2008), computer-assisted instruction (CAI) is one of the best instructional tools for piquing students' interests and raising their academic performance. Computer-assisted instruction involves using a computer to interact directly with students for the purpose of learning and evaluating students' progress (Huang & Chuang, 2015). To improve learning outcomes, there are various forms of computer-assisted instruction (CAI) that integrate various media into the presentation of learning materials. These comprise, among many others, Text with Narration (TN), Graphic with Text, Audio, Video with Text (AVT), Video with Text (VT), Animation with Text (AT), Animation with Narration (AN), and Graphic with Text.

Previous research has corroborated the claims made above regarding the potential for one or two computer-assisted instruction modalities to improve student progress. Olatayo, Omiola and Adedapo reported that experimental groups that were taught using audio, video with text as an organizer perform better than those taught using conventional method. Also, according to Mahmood (2002), students' performance in mathematics is enhanced by CAI that incorporates Animation with Text (AT) and Animation with Narration (AN). Jolly (2003) found no statistically significant variations in the students' performance levels between animation-with-text and graphics-with-text when they were taught about the life cycle of a monarch butterfly in biology. There is a scarcity of research in Nigeria that investigates how computer-assisted instruction (CAI) can be used to teach basic general mathematics. This calls for the need to explore audio, video with text and audio with text for better achievement of NCE students in Basic General

Mathematics. Therefore, the present research was aimed at experimenting the effect of two modes of computer assisted instruction on colleges of education student in Basic General Mathematics.

### Research Questions

1. What are the mean achievement scores of NCE 1 students taught Basic General Mathematics using Audio, video with text (AVT) and those taught using Video with Text (VT)?
2. What is the influence of gender on mean achievement scores of NCE 1 students' in Basic General Mathematics?
3. What is the interaction effect of two modes of Computer Assisted Instructional packages and gender on NCE 1 students' achievement in Basic General Mathematics?

### Hypotheses

- HO<sub>1</sub>** There is no significant difference in the mean achievement scores of NCE 1 students taught Basic General Mathematics using Audio, video with text (AVT) and those taught using Video with Text (VT).
- HO<sub>2</sub>** There is no significant difference in the mean achievement scores of male and female NCE 1 students' in Basic General Mathematics.
- HO<sub>3</sub>** There is no significant interaction effect of two modes of Computer Assisted instructional packages and gender on NCE 1 students' achievement in Basic General Mathematics.

### Methods

The research design used in the study was quasi-experimental, more precisely, the non-equivalent group pretest-posttest design type. Four colleges of education were selected purposefully from the seven colleges in south-east, Nigeria. The population of the study comprised of 2967 (2242 female and 725 male) NCE 1 students in the seven government own (three Federal Colleges of Education, and four State Colleges of Education) South-East, Nigeria. The sample size comprised of 137 (101 female and 36 male) NCE 1 students. The sample size was drawn using multistage sampling procedure. In stage one purposeful sampling technique was to drawn two states out of seven. The criteria for selecting two states was that the states with state and federal college of education with reasonable number of students. Based on this Enugu and Anambra states was selected. The researchers used a random selection method (like flipping a coin) to assign the

chosen states to the experimental group. To pick a school within each college, they purposefully selected schools with a history of high failure rates in the General Science Education 122 (GSE 122) course among NCE 1 students. The experimental group 1 had 73 (54 females and 19 males) while experimental group 11 had 64 (47 females and 17 males) NCE 1 students.

The study used existing class groups (intact classes) without dividing them. Students took a test to assess their knowledge before the intervention (pretest). Then, both experimental groups received instruction in Basic General Mathematics (GSE 122) for eight weeks using mobile phones. However, the way the information was presented differed: Experimental Group 1: Learned through a combination of audio, video, and text (3 media). Experimental Group 2: Learned through video and text only (2 media). The type of instruction each class received was assigned randomly.

Two instruments were used for the experiment namely: Basic General Mathematics Learning Package (BGMLP) and Basic General Mathematics Achievement Test (BGMAT). BGMLP were instructional contents (one with video, audio and text and the other with video and text) were designed to teach Basic General Mathematics (GSE 122) content to NCE 1 students through a smartphone. The packages were used as the treatment to both groups. BGMAT was developed by the researcher was used for data collection. The content validity of the BGMAT was established through the development of a table of specification covering three topics that were found to be area of the difficulty of NCE 1 students in the Basic General Mathematics curriculum. The topics were: expansion and factorization of algebraic expression, simple algebraic equations and simple word problems leading algebraic equations. The test had 50 multiple choice items with four response option of A, B, C, and D. Each question on the Basic General Mathematics Learning Performance (BGMLP) and Basic General Mathematics Achievement Test (BGMAT) was awarded one point for a correct answer and zero points for an incorrect answer. To ensure the tests were accurate and relevant, three experts from the University of Nigeria, Nsukka validated them. These experts were specialists in Mathematics Education, Measurement and Evaluation, and Robotics and Computer Education. To check how consistent the Basic General Mathematics Achievement Test (BGMAT) was, the researchers used a statistical method called Kuder-Richardson 20 (KR20). This method focuses on internal consistency of the different questions on the test



measure the same thing. The KR20 score for the BGMAT was 0.85, which indicates good reliability.

### Procedure

To conduct the study, the researcher visited the chosen colleges of education. After introducing themselves to the college authorities and obtaining permission, they recruited four basic general mathematics lecturers (one from each college) to assist with the research. The researcher organized training for the research assistants in both experimental groups 1 and 11 using the training guide. He explained in details how to play and watch the learning package through smartphone. The researcher also handed over the lesson

plan for each of the groups to the research assistants. The students through their lecturer were directed to form WhatsApp group, send the video to their groups and directed them in the classroom to watch the learning package with their mobile phone.

The sessions for both groups were held for eight weeks in their lecture rooms using their regular BGM 122 period on their timetables. Each class lasted for a period of 60 minutes. After the eight-week treatment period ended (the last class), both experimental groups (1 and 2) took a final test (posttest). The data from both the initial test (pretest) and the final test were analyzed using mean, standard deviation and Analysis of Covariate (ANCOVA)

### Results

This chapter presents the research findings. The results are directly tied to the research questions posed and the null hypotheses formulated at the outset of the study.

**Table 1: The mean and Standard Deviation (SD) achievement scores of NCE 1 students taught Basic General Mathematics using Audio, video with text (AVT) and those taught using Video with Text (VT)**

Methods	N	Pretest		Posttest		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
AV	73	22.81	2.18	43.48	8.06	<b>20.67</b>
VT	64	23.28	1.65	38.64	10.24	<b>15.36</b>
<b>Difference</b>		<b>0.47</b>				

Result in table 1 above shows the mean achievement and standard deviation scores of NCE 1 students taught Basic General Mathematics using Audio, video with text (AVT) and those taught using Video with Text (VT). Result shows that the AV group (students who learned with audio, video, and text) had an average score of 22.81 on the pretest (with scores spread out by 2.18 points). On the posttest, their average score jumped to 43.48 (with scores spread out by 8.06 points). This means the AV group's average achievement increased by 20.67 points. Furthermore, the group taught Basic General Mathematics using VT had mean achievement score of 23.28 with standard deviation of 1.65 at pretest and mean achievement score of 38.64 with standard deviation of 10.24 at posttest recording a mean gain of 15.36. The table also revealed

small difference in the mean of the pre-test scores of the two groups of students to be 0.47. Also, the results showed that the pretest standard deviations for the two groups were smaller than the posttest standard deviations. This means that the pretest scores of the respondents were more homogeneous in each case and cluster around the means than the posttest scores. Analysis of the results revealed that posttest mean scores were consistently higher than pretest mean scores across all groups. Notably, the AV group exhibited the greatest improvement in mean score. This finding suggests that NCE 1 students who received instruction in basic general mathematics using audio-visual technology (AVT) achieved greater learning gains compared to those who received instruction using only video and text (VT).

**Table 2: Analysis of covariance on the mean achievement scores of NCE 1 students taught Basic General Mathematics with AVT and VT**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2119.360 <sup>a</sup>	4	529.840	7.021	.000	.175
Intercept	2286.299	1	2286.299	30.294	.000	.187
Pretest	40.999	1	40.999	.543	.462	.004
Techniques	397.621	1	397.621	5.269	.003	.038
Gender	1261.870	1	1261.870	16.720	.000	.112
Techniques * Gender	79.905	1	79.905	1.059	.305	.008
Error	9962.070	132	75.470			
Total	244845.000	137				
Corrected Total	12081.431	136				

a. R Squared = .175 (Adjusted R Squared = .150)

The analysis in Table 2 (F-ratio = 5.269, df = 1, p-value = .003) indicates a statistically significant difference between the two groups. We set a threshold for significance at 0.05 (5% chance of error). Since the p-value (0.003) is much lower than 0.05, we reject the null hypothesis which stated there would be no difference in achievement scores. This means there's a

statistically significant difference in the average scores of NCE 1 students who learned basic general mathematics using audio, video, and text (AVT) compared to those who learned with only video and text (VT). In other words, the AVT method appears to be more effective for improving student achievement in this context.

**Table 3: The mean and Standard Deviation (SD) scores of influence of gender on mean achievement of NCE 1 students' in Basic General Mathematics**

Gender	N	Pretest		Posttest		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	36	23.22	1.68	46.17	4.67	<b>22.95</b>
Female	101	22.96	2.05	39.46	10.06	<b>16.50</b>
<b>Difference</b>		<b>0.26</b>				

Table 3 shows the average achievement scores (means) and standard deviations for male and female NCE 1 students in Basic General Mathematics. Both groups improved their scores from pretest to posttest. Male students had a slightly higher average score at pretest (23.22) compared to females (22.96). However, both groups showed improvement with males achieving a larger average gain (22.95) compared to females (16.50). The standard deviations provide insight into the variability of scores within each group. The table shows that there was a very small difference (0.26) between the average scores (means) of male and female students on the pretest. This suggests that both groups had similar prior knowledge of the material before the experiment began. Interestingly, the data also reveals that the scores on the pretest were more tightly clustered (smaller standard deviations) for both males and females compared to the posttest scores. In other words, students' knowledge was more similar before the

intervention, and the scores became more spread out after the learning experience. Analysis of posttest scores revealed improvement for both male and female students compared to their pretest scores. However, male students exhibited a greater average increase in achievement scores compared to their female counterparts in Basic General Mathematics.

Table 2 shows a statistically significant difference (F-ratio = 16.720, df = 1, p-value = 0.000) in achievement scores between male and female students in Basic General Mathematics. Our significance level was set at 0.05. However, it's important to note that earlier results (Table 3) suggested similar prior knowledge between genders based on pretest scores. Further investigation might be needed to understand this apparent contradiction between the achievement gains and the initial knowledge levels.



**Table 4: The mean and Standard Deviation (SD) scores of two modes of computer assisted instructional packages and gender on NCE 1 students’ interest in Basic General Mathematics**

Methods	Gender	N	Pretest		Posttest		Mean Gain
			$\bar{x}$	SD	$\bar{x}$	SD	
AV	Male	19	49.58	1.12	98.11	15.31	<b>48.53</b>
	Female	54	49.70	1.08	81.72	14.65	<b>32.02</b>
VT	Male	17	49.53	1.12	85.18	7.42	<b>35.65</b>
	Female	47	49.66	1.09	73.62	12.58	<b>23.96</b>

According to Table 4, male students who learned Basic General Mathematics using Audio-Video-Text (AVT) reported an average interest score of 49.58 before the instruction (pretest), with scores spread out by 1.12 points. After the instruction (posttest), their average interest score jumped to 98.11, with scores spread out by 15.31 points. This suggests a significant increase in interest for this group. Both male and female students who learned with AVT showed increased interest in Basic General Mathematics. However, the increase was more substantial for males. Here is a breakdown:

Males: Their average interest score rose by 48.53 points between the pretest and posttest. Females: Their average interest score increased by 32.02 points (difference not explicitly mentioned in this sentence but can be calculated from the provided data). For the female group that was taught Basic General Mathematics utilizing AVT, the difference between the pretest and posttest interest mean was 32.02. Table 4 also demonstrates the pretest interest mean score of 49.53 with a standard deviation of 1.12 and the posttest interest mean score of 85.18 with a standard deviation of 7.42 for the male students who were taught Basic General Mathematics using VT. For the male group that received VT instruction in Basic General Mathematics, the interest mean difference between the pretest and posttest was 35.65. The pretest interest mean score of 49.66 with a standard deviation of 1.09 and the posttest interest mean score of 73.62 with a standard deviation of 12.58 were achieved by the female students who were taught Basic General Mathematics using VT. The interest mean for the female group taught Basic General Mathematics via VT differed by 23.96 between the pretest and posttest. The results indicated that the male students who were taught Basic General Mathematics using AVT had the highest mean interest gain, which was followed by the male students in the VT group, who in turn were followed by the female students in the AVT group, who had the lowest mean interest gain, and the

female students in the VT group. See hypothesis three to determine whether the interaction between gender and two types of computer-assisted instruction packages affects NCE 1 students' interest in Basic General Mathematics in a statistically meaningful way.

The analysis in Table 2 (F-ratio = 1.059, df = 1, p-value = 0.305) examines whether there's a combined effect of the instructional method (audio-video-text vs video-text) and gender on student achievement in Basic General Mathematics. We set a significance level of 0.05 (5% chance of error).

Since the p-value (0.305) is greater than 0.05, we fail to reject the null hypothesis. In other words, the data doesn't provide strong evidence to suggest that the instructional method and gender interact to influence student achievement. We can infer that the effect of the learning method on achievement scores was likely similar for both males and females.

**Discussion**

The finding of this study has shown that both AVT and VT modes of CAI are effective in increasing students’ achievement score in Basic General Mathematics, though students taught using AVT mode performed slightly better. However, additional analysis showed that the mean achievement score of students taught Basic General Mathematics using the AVT mode of CAI differs significantly from that of students taught the VT mode. This suggests that using AVT to raise pupils' Basic General Mathematics success scores is effective. This result aligns with some past research. For example, Olatayo et al. (2017) found that using video instruction improved student achievement compared to traditional methods. Omiola and Tiamiyu (2016) also revealed that video based mobile learning of CAI improved students’ achievement in mathematics than lecture method. The study's results might be explained by the engaging nature of the AVT method.



By incorporating audio and video, it likely stimulated both students' hearing and sight, potentially leading to more active participation in learning compared to traditional student-centered approaches. Instead of being limited to passive activities like listening, asking questions, or taking notes, students using AVT may have been actively involved in various learning tasks throughout the lesson. The instructor then could act more as a facilitator, guiding students through the activities.

This study found that male students performed slightly better in Basic General Mathematics than females. However, further analysis revealed a statistically significant influence of gender on achievement scores. In other words, gender appears to play a role. This finding aligns with Mutai's (2016) study where males also scored higher in mathematics. However, other research offers contrasting viewpoints. Ajai & Imoko (2015) found no significant difference in achievement between genders when using problem-based learning for algebra. Similarly, Gambari et al. (2014) reported no significant difference in geometry achievement scores for males and females when using animation with computer-assisted instruction. These conflicting findings highlight the need for further investigation into the complex relationship between gender and achievement in mathematics education.

Interestingly, the study found that the gender of the student and the instructional mode (AVT vs. VT) seemed to have some independent effects on achievement in Basic General Mathematics. Males performed slightly better with AVT, while females performed slightly better with VT. However, further analysis revealed that this wasn't a statistically significant interaction. In other words, overall, there wasn't a clear difference in achievement between males and females regardless of whether they learned with audio-video-text (AVT) or video-text only (VT). This suggests that both AVT and VT were effective for both genders in improving achievement in Basic General Mathematics, and neither mode seemed to favor one gender over the other.

### Conclusion

The study suggests that using audio, video, and text together in computer-assisted instruction (AVT mode) leads to greater improvement in students' achievement in Basic General Mathematics compared to using just video and text (VT mode). Gender did not appear to significantly influence students' achievement in Basic General Mathematics. This means there wasn't a major

difference in how well males and females learned the material. Interestingly, the effectiveness of the two instructional modes (AVT vs. VT) wasn't significantly impacted by the students' gender. In other words, both AVT and VT seemed to be beneficial for both male and female students in learning Basic General Mathematics.

### Recommendation

Based on the findings, the researcher recommended that:

1. Audio, video with text should be used by lecturers in teaching students to improve their achievement in basic general mathematics and mathematics in general.
2. School administrators should provide necessary facility that will enable the use of AVT mode of CAI in teaching students.
3. Government should furnish schools with needed facility that could enhance the use of AVT mode of CAI in teaching basic general mathematics.

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