EFFECT OF ANIMATED COMPUTER ASSISTED INSTRUCTION (ACAI) ON MALE AND FEMALE PRIMARY SCHOOL PUPILS' ACHIEVEMENT IN MATHEMATICS IN ANAMBRA STATE

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Abstract
This study investigated the effect of Animated Computer-Assisted Instruction on the mathematics achievement of male and female primary school pupils in Anambra State, Nigeria. Two research question and two hypothesis guided the study .The study was carried out In Awka Education zone of Anambra state, Nigeria and the population of the study was 4,634 primary public school pupils in the Awka Zone. Multistage sampling technique was used to select the sample size of 125 (64 males & 61 females) primary six pupils from four government schools in Awka Education zone. The study adopts a quasi-experimental design involving 125 primary school pupils, divided into experimental and control groups. The experimental group received mathematics instruction using ACAI, while the control group is taught using conventional teaching methods. Pre-tests and post-tests was administered to both groups to assess the effectiveness of ACAI in improving mathematics achievement. Mathematics Achievement Test (MAT) was used for data collection. The instrument was validated and Kuder-Richard (K-R21) method was used to establish the reliability of MAT at 0.89 which was found to be reliable. Mean and standard deviation was used to answer the research questions while ANCOVA was used to test the hypotheses at 0.05 level of significanceThe finding revealed that there is significant difference between the mean achievement scores of male and female primary school pupils taught mathematics using ACAI in favour of female and there is significant difference in the interaction effect of gender and teaching method in mathematics achievement. Based on the findings recommendations were made, that educational policymakers and school administrators in federal and State should integrate Animated Computer Assisted Instruction into the primary school mathematics curriculum with adequate resource and the developers of ACAI programs should consider gender differences in learning preferences and needs. Thi,ugs can be achieved by including features in ACAI software that address these differences, ensuring that both male and female pupils can equally benefit from the technology.

Keywords: Mathematics, Gender, Animated Computer Assisted Instruction, Achievement, Conventional Method and Primary School

Introduction

The importance of mathematics cannot be over emphasized. The survival of any human being in this competitive world is almost impossible without the knowledge and skill in mathematics. Karakolidis, et al (2016) viewed mathematics as the foundation of science and

technology without which a nation will not prosper and achieve economic independence. Mathematical skill is required in various disciplines, workplaces, and sectors. Even in production of weapons like the hydrogen bomb, missiles, space crafts, and satellites, it would not have been possible without the knowledge of mathematics. Mathematics has its application in a wide range of informal settings, including grocery, sewing, fishing, construction work, shopping, purchasing, carpet laying, video games, cabs and buses, farming, entertainment, sports, and everyday family activities (Pattison et al, 2017).

Mathematics affects all aspects of human life, it is essential in education to assist students and all categories of people in all occupations to execute their daily tasks efficiently and productively. Mathematics plays a vital role in everyday life of so many people (Ali &Jameel, 2016; Karakolidis et al, 2016). It is one of the most important subjects in the school curriculum, which acts as a bridge for all knowledge (Kafata & Mbetwa, 2016). In formal education, Mathematics is the basis for Science Technology Engineering and Mathematics (STEM) as well as the non-science disciplines such as Social Sciences, Commerce and Arts. Mathematics works as a tool to understand many other subjects and languages. Mathematics is an essential component of human reasoning and thought to comprehend the world. Mathematics is bedrock and an indispensable tool for scientific technological and economic advancement of any nation.

Despite the benefit accruing from the study of mathematics, the students' achievement at all level has been consistently low. This could be linked to the use of conventional method by teachers. Conventional method of teaching such as lecture method, demonstration, direct instruction and so on has been criticized by scholars such as Akinbola (2009) who blamed poor achievement of students in most school subjects on continuous use of conventional method.

Conventional method is teacher centered method, which is seen as the traditional “talk and chalk” method of teaching. Here the teacher does the talking while the students serve as receivers only by listening and taking down notes (Adeniyi & Awofala, 2023), without participating in active lesson which indirectly affect their achievement. Achievement is a direct and valid indicator to evaluate the effectiveness of teaching and learning, as well as the overall development of students. Achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school (Steinmayr et al, 2014). When the teaching method that encourage collaboration and active participation of pupils in teaching and learning is used, achievement will improve.

Okwuduba and Okigbo (2018) found out that teaching methods significantly affects student’s academic performances in sciences. As a matter of fact, Alio and Harbour cited by Adeola (2021) claimed that the instructional strategy employed by the teacher influences the cognitive and affective outcomes of the students. The poor a chievement in Mathematics may be attributed to the method of teaching it, this is because, conventional teaching methods are teacher-centred rather than students-centred and are predominantly used for instructional delivery in primary schools. Egbutu and Okeke (2021) noted the common means of instruction in schools is lecture method. Ojonugwa, et al (2020) defined the lecture method as the chalk-talk instructional strategy that places the students at the passive corner of the class and the teacher as the principal actor.In order to avert the ugly trend in the continuous poor achievement of primary school pupils in mathematics, the use of innovative technique should be more intensified

The applications of innovative strategies might be able to resolve the issue of poor performance and also close gender gap in Mathematics. Innovative teaching techniques are modern

methods of instructional delivery that are meant to foster quality teaching and learning. Farah and Hasan (2017) said that innovative teaching respond to diverse academic needs of the students, different innovative teaching and differentiated strategies and methods are being used by the teachers in their classes. Okoli, et al (2022) deduced that the need to adopt technology based packages to improve the teaching and learning of science for effective performance of students is urgently required. The use of technology such as Animated Computer Assisted Instruction has made the process of teaching and learning more enjoyable and also result to better learning outcome.

Animated Computer Assisted Instruction is the use of video, motion graphics, audio virtual, content translation into words to enhance learning. Ahmed and Inti (2021) added that a well-designed Animated Computer Assisted Instruction may help students learn quicker and stress-free. It is also an outstanding aid to teachers when it comes to elucidating tough subjects. Olatunde-Aiyedun (2021) reported a significant difference in the performance of those exposed to animation and conventional teaching method. Mogbo et al. (2021) found a substantial difference in the achievement and retention of students exposed to animation and concept map visualization. Ahmed and Inti (2021) also revealed a substantial difference in the achievement of students exposed to animation and lecture method. The use of technology in education provides students with a more suitable environment to learn, serves to stimulate interest and a learner centred atmosphere, and helps enhance students' academic achievement (Isman, et al, 2020)

However, there are some salient variables that could influence students' achievement among which is gender. Gender issue in recent years has brought about a strong point of view as regards to the influence of gender on pupils' achievement in Mathematics. Gender is an important variable in teaching and learning science in schools. Gender differences in achievement has remain

a contentious issue in Science, Technology, Engineering and Mathematics (STEM) education. One of the concerns that attracts public interest in Nigeria education sectors today is the gender gap in academic achievement of students in schools. In the opinion of Adigun, et al (2015) gender is the range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between the feminine and masculine (female and male) population.

Despite efforts to achieve gender equity in all aspects of society, there is still a gender gap in the number of professionals graduating from STEM careers. There's a well-known gender gap in science, technology, engineering, and mathematics (STEM) fields. Women have been historically underreprented in these fields (Okamgba, 2024) and are still underrepresented in many STEM roles today. According to the Nigerian Bureau of Statistics and the Financial Institutions Training Centre, approximately 22 percent of Science and Technology graduates in Nigeria are women, this gap has made the minister of Innovation, Science and Technology to lament about the inequality (Okamgba, 2024). The observable disparity in gender achievement and lack of interest in Mathematics has been blamed on a number of factors which including teaching methods. When a teaching method enhances collaboration with students active participation such as when Animated Computer Assisted Instruction is used, starting from primary school, the gap in achievement in mathematics and other science subjects based on gender could be closed.

Many effort has been made both national and international to close gender disparity in Science, Technology, Engineering and Mathematics (STEM) but much progress has not been made. So educators has a lot of roles to play by using an innovative method in teaching and learning that give boys and girls equal opportunity in STEM especially Mathematics right from primary school. Primary school is foundation upon which other levels of education is built upon,

if the foundation is faulty the whole system will be faulty. Primary education can expose and challenge preconceived notions and societal expectations about gender roles, promoting a more equitable understanding of capabilities and potential because meaningful development start between 6 to 12 years. Primary education could contribute significantly to addressing gender disparities by providing foundational knowledge and skills, equipping both girls and boys with opportunities to succeed, and promoting a more equitable society through education. Primary education is crucial because it lays the groundwork for a lifetime of learning, enabling individuals to develop critical thinking, problem-solving, and other essential skills. Primary education could challenge stereotypes in STEM education, promote gender equality in other aspects of life, and contributes to a society where everyone has the opportunity to reach their full potential through the use of technology.

Studies conducted across the world among the students studying in different levels, shows a significant gender differences in academic performance. Studies have also observed gender inequality in the classroom because of instructional design during teaching and learning process. Arthur et al (2019) conducted research on impact of computer assisted instruction and found out that the strategy was effective on students' academic performance with gender dimension in favour of male students. Afolabi (2018) report that gender has no influence on performance of male and female pupils exposed to CAI. Emeya (2021) showed that gender of the students had no effect on their achievement based on the teaching techniques used. O biora and Ndanwu (2020) computer aided instruction method of teaching enhances female students' academic achievement in Electronic Libraries more than the male students. Afolabi et al (2024) revealed that gender was observed to have no effect on students' achievement when taught photosynthesis using the CAI

package and there were no interaction effects among the cognitive style and gender. Okafor (2019) revealed that gender was not a significant factor in students' achievement in Geometry.

The study on gender differences among students is inconclusive. Also, much works have been done on gender at other level of education but only few works have been done at primary school level. Therefore, his study sought to find the effect of Animated Computer assisted instruction on males and females primary school pupils' achievement in Mathematics.

Statement of the Problem

The gender discrimination in STEM education has been a great issue of concern, it has caused a lot of problems such as negative stereotypes that paint Science and Technology as male-oriented fields, causing girls and young women to veer away from Science and Technology career tracks – despite their very real capabilities in these domains, the imbalance of male and female employment ratio in STEM career, poor achievement in STEM subjects such as Mathematics and so on. Gender stereotypes regarding who can succeed in Science and Technology threaten the career choices of women and can help explain why women who do pursue a Science and Technology career may perform poorly in STEM field especially Mathematics and eventually leave their chosen field. This is as a result of the belief that females are not allowed to grasp technical subjects such as Mathematics and science, as result of this, boys develop positive attitude towards learning of Mathematics more than girls and achieve better than them. Educators have crucial role in addressing this gap by creating a more inclusive and collaborative environment in STEM education through the use of innovative method such as Animated Computer Assisted Instruction starting from early stage, that is, primary school because considerable development occurs in young people aged between 6 and 12 years. The ACAI strategy could help to enhance hands-on activities, re-awaken students' interest, and engender their curiosity towards better

achievement in Mathematics. Therefore, the important question for which answer was sought in this study was: what is the effect of Animated Computer Assisted Instruction on male and female primary school pupils' achievement in Mathematics

Purpose of the Study

The purpose of the study was to determine the effect of Animated Computer Assisted Instruction on male and female primary school pupils' achievement in mathematics in Anambra State. In specific terms, the study sought to determine the difference in the:

1. Mean achievement scores of male and female pupils taught mathematics concepts using ACAI application and that of those taught with conventional method
2. Interaction effect of gender and teaching methods (ACAI & Conventional method) on pupils' achievement in mathematics.

Research Questions

1. What is the difference in mean achievement scores of male and female primary school pupils taught mathematics concepts using ACAI application and that of those taught with conventional method
2. What is the interaction effect of gender and teaching methods as measured by mathematics achievement test?

Hypotheses

1. There is no significant difference between the mean achievement scores of male and female primary school pupils taught mathematics using ACAI application and that of those taught using conventional method.

2. There is no significant difference in the interaction effect of gender and teaching methods on pupils' achievement test in mathematics.

Method

The research design used in this study was the quasi-experimental design. Specifically, it was the pre-test - 'post-test non-equivalent control group design. This design was chosen because intact classes were used as experimental and control groups as randomization of students was not possible. The population of the study comprised of all primary 6 pupils in Awka South Education Zone for 2023/2024 session. The sample of 125 (64 males & 61 females) primary six pupils were used for the study. Multistage sampling technique was used to draw the sample from four schools. Simple random sampling was used to select the four schools, on intact class was used in each school and the classes were assigned to experimental and control groups. There were two experimental and two control groups.

The research instrument was Mathematics Achievement Test (MAT) taken from Common Entrance Examination Paper. The achievement test was made up of fifty (50) item multiple choice objective question, the test was validated and its reliability determined as 0.79. The researchers used 4weeks to teach the control group using the traditional method. Similarly the experimental group was taught using Animated Computer Assisted Instruction for the same period of time. The test questions were administered to the students before the treatment and after the treatment. The tests were marked and the scores recorded. Mean and standard deviation was used to answer research question while ANCOVA was used to test the hypotheses at 0.05 level of significance.

Results

Research Question 1

What is the difference in mean achievement scores of male and female school pupils taught mathematics using animated CAI package and of those taught with conventional method?

Table 1: Mean and Standard Deviation Achievement Scores of Male and Female School Pupils taught Mathematics using animated CAI package and those taught with Conventional Method

			Pretest		Posttest		
Groups	Gender	N	Mean	SD	Mean	SD	Mean Gain
CAI							
	Male	22	18.09	8.86	24.59	7.73	6.5
	Female	32	16.91	5.46	28.31	6.33	11.4
Conventional Mtd							
	Male	39	16.45	5.66	16.17	6.73	0.28
	Female	32	11.88	4.35	13.09	3.33	1.21

Table 2 shows mean and standard deviation achievement scores of male and female pupils taught_Mathematics using ACAI package and those taught with conventional method. From the result the pretest mean achievement score and standard deviation of male pupils taught Mathematics with ACAI were 18.09 and 8.86. Their post- test mean achievement score and standard deviation were 24.59 and 7.73 respectively. This gave a mean gain scores of 6.5. Also, the pre-test mean achievement score and standard deviation of the female pupils taught Mathematics using ACAI 16.91 and 5.46. Their post-test mean achievement score and standard deviation were 28.31 and 6.33 respectively. This gave a mean gain scores of 11.40. The standard deviation scores for the pretest for the male and female pupils taught with ACAI were higher than the standard deviations for the post test. This suggests more variability in pretest scores of the primary school pupils than the post test scores. More of the scores near the mean in the post-test than in the pretest. Since posttest mean score for female is higher than the posttest mean score of the male, the female primary school pupils achieved higher than their male counterpart in use of

ACAI packages. However, the mean gain difference between male and female primary school pupils is 4.90 in favour of female. This implies that in the use of ACAI packages, female primary school pupils achieve higher in primary school Mathematics than their male counterpart.

More so, the result shown that the pre-test mean achievement score and standard deviation of male primary school pupils taught with conventional method were 16.45 and 5.66 respectively. Their post-test mean achievement score and standard deviation were 16.17 and 6.73 respectively. This gave a mean gain scores of 0.28 against the posttest. Also, the pretest mean achievement score and standard deviation of the female primary school pupils taught with conventional method were 11.88 and 4.35. Their post-test mean achievement score and standard deviation were 13.09 and 3.33 respectively. This gave a mean gain scores of 1.21. The standard deviation scores for the pretest for the male were lower than the standard deviations for the post test. This suggests less variability in pretest scores of the male primary school pupil than the post test scores while the standard deviation scores for the pretest for the female were higher than the standard deviations for the post test. This suggests variability in pretest scores of the female primary school pupil than the post test scores. More of the scores near the mean in the pretest than in the posttest in male primary school pupils in conventional method while more of the scores near the mean in the post-test than in the pretest in female primary school pupils in conventional method.

Since post-test mean score for male is higher than the post-test mean score of the female, the male achieved higher than their female counterpart in use of conventional method. However, the mean gain difference between male and female students is 0.93 in favour of male. This implies that in use of conventional method, male primary school pupils achieve higher in primary Mathematics than their female counterpart.

Research Question 2

What is the interaction effect of gender and teaching methods as measured by mathematics achievement test?

Table 2: Mean and Standard Deviation in the Interaction Effect of Gender and Teaching Methods as Measured by Mathematics Achievement Test

Teaching Method	Gender	Mean	SD	N
ACAI	Male	24.5909	7.73156	22
	Female	28.3125	6.33188	32
	Total	26.7963	7.10933	54
Conventional Method	Male	16.1795	6.73120	39
	Female	13.0937	3.33466	32
	Total	14.7887	5.64906	71
Total	Male	19.2131	8.13657	61
	Female	20.7031	9.16633	64
	Total	19.9760	8.67650	125

Table 2 shows the interaction effect of gender and teaching methods as measured by Mathematics achievement test. The result shown that male and female primary school pupils mean scores when using Animated Computer Assisted Instruction were 24.5909 and 28.3125 respectively while their standard deviation score were 7.73156 and 6.33188 respectively. Similarly the total mean and standard deviation interaction effect of gender and teaching method were 26.7963 and 7.10933. This indicated that their exist 26.7963% interaction effect of gender and teaching method in achievement among primary school pupils in the study while 73.2037% has no interaction in achievement of gender and teaching method among primary school pupils taught Mathematics using ACAI

Moreso, the result also shown that male and female primary school pupils mean scores when using conventional method were 16.1795 and 13.0937 respectively while their standard deviation score were 6.73120 and 3.33466 respectively. Similarly the total mean and standard

deviation interaction effect of gender and teaching method (conventional method) were 14.7887 and 5.64906. This indicated that there exist 14.7887% interaction effect of gender and teaching method (conventional method) in achievement among primary school pupils in the study while 85.212% has no interaction in achievement of gender and teaching among (conventional method) primary school pupils taught Mathematics using conventional method

Hypothesis 1

There is no significant difference between the mean achievement scores of male and female primary school pupils taught mathematics using Animated Computer Assisted Instruction and that of those taught using conventional method.

Table 3: Analysis of Covariance (ANCOVA) of Male and Female Pupils' Mean Achievement Scores Between Teaching Methods in Mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Decision
Corrected Model	4770.272[a]	3	1590.091	42.150	.000	
Intercept	50548.092	1	50548.092	1339.930	.000	
Teaching Method	4179.667	1	4179.667	110.795	.000	S
Gender CIA and Conventional * Teaching Method	346.866	1	346.866	9.195	.003	
Error	4564.656	121	37.724			
Total	59215.000	125				
Corrected Total	9334.928	124				

S= Significant, NS = Not Significant

The result in Table 3 shown that there is significant difference between the mean achievement scores of male and female primary school pupils taught Mathematics using ACAI application and that of those taught using conventional method, $F(1, 121) = 9.195$, $p = .003$. Since

the obtained p-value is less than the stipulated .05 level of significance, the nul Hypothesis which stated that there is no significant difference between the mean achievement scores of male and female primary school pupils taught Mathematics using ACAI and that of those taught using conventional method is rejected meaning there is a significant difference between the mean achievement scores of male and female primary school pupils taught Mathematics using ACAI application and that of those taught using conventional method. This implies that the mean achievement of moderating variable of gender are not the same or not slightly different in decimal to each other in the two teaching methods. The significant difference in ACAI favours' the female pupil while the significant difference in conventional method favours' the male pupils.

Table 4: Analysis of Covariance (ANCOVA) of Interaction effect of Gender and Teaching Methods on Pupils' Achievement in Mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Decision
Corrected Model	4770.272[a]	3	1138.206	32.694	.000	
Intercept	47102.199	1	47102.199	1352.980	.000	
Gender CIA and Conventional * Teaching Method	346.866	1	247.683	7.115	.003	S
Error	4212.454	121	34.814			
Total	54517.000	125				
Corrected Total	7627.072	124				

S= Significant, NS = Not Significant

The result shown in Table 4 shows that there is significant difference in the interaction effect of gender and teaching methods on pupils' achievement test in Mathematics F(1,121) =7.115 p=.003. Since the obtained p-value of .003 is less than the stipulated .05 significance level, the null hypothesis which stated that is no significant difference in the interaction effect of gender and teaching methods on pupils' achievement test in Mathematics is rejected meaning there is an

interaction effect between gender and teaching methods among pupils achievement in Mathematics.

Discussions

The first finding of this study shows that female primary school pupils achieve higher in primary school Mathematics than their male counterpart using ACAI while in conventional method male primary school pupils achieve higher in primary Mathematics than their female counterpart. Thus, there is significant difference between the mean achievement scores of male and female primary school pupils taught mathematics using Animated that of those taught using conventional method. This finding concur with Obiora and Ndanwu (2020) who revealed that computer aided instruction method of teaching enhances female students' academic achievement in Electronic Libraries more than the male students. The finding is in contrast with the findings of Arthur, et al (2019) who conducted research on impact of computer assisted instruction and found that the strategy was effective on students' academic performance with gender dimension in favour of male students. Also, Afolabi (2018) and Emeya (2021) reported that gender has no influence on performance of male and female pupils exposed to CAI. Nnorom and Odukwe (2021) revealed that gender has no significant difference in the achievement of male and female student taught biology.

The second finding of this study disclosed that there is significant difference in the interaction effect of gender and teaching methods on pupils' achievement test in Mathematics. This finding is in line with Ethel-Echedo (2021) that reported there was significant interaction effects of teaching methods and gender on students' mean achievement scores in financial accounting and in contrast with Afolabi et al (2024) which revealed,as it was observed to have no effect on students' achievement when taught photosynthesis using the as ACAI package and there

were no interaction effects among the cognitive style and gender.Also, Okafor(2019) stated that there no significant difference in interaction effect of method and gender on student achievement.

Conclusion

The study on the effect of Animated Computer Assisted Instruction (ACAI) on male and female primary school pupils' achievement in Mathematics in Anambra State reveals significant findings. The use of ACAI has been shown to positively impact pupils' Mathematics achievement, regardless of gender. Both male and female pupils exhibited improved performance when exposed to ACAI compared to traditional instructional methods. This suggests that ACAI is an effective tool in enhancing mathematical understanding and achievement among primary school pupils.

However, the study also highlighted that while ACAI benefits both genders, there are differences in the extent of improvement between male and female pupils, with each gender potentially responding differently to various aspects of the ACAI environment. These differences underscore the importance of considering gender-specific needs when designing and implementing ACAI programs to maximize their effectiveness

Implication of the Study

The study implied that the use of Animated Computer Assisted Instruction will help to bridge the gender gap in primary school pupils' achievement in Mathematics since the strategy enhance and promoted all the pupils' achievement in Mathematics. Educators should prioritize technology-enhanced learning tools to foster equity and boost girls' confidence in Mathematics. This approach can help mitigate gender disparities in academic achievement of primary school pupils in Mathematics.

Recommendations

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

1. It is recommended that educational policymakers and school administrators in State and federal should integrate Animated Computer Assisted Instruction into the primary school Mathematics curriculum. This integration should be systematic and supported by adequate resources to ensure that all pupils can benefit from this instructional method.
2. To effectively implement ACAI teachers should be provided with continuous professional development and training. This training should focus not only on how to use ACAI tools but also on how to tailor instruction to meet the diverse needs of male and female pupils.
3. Developers of ACAI programs should consider gender differences in learning preferences and needs. This can be achieved by including features in ACAI software that address these differences, ensuring that both male and female pupils can equally benefit from the technology.
4. Regular assessment of the impact of ACAI on pupils' achievement should be conducted to ensure its effectiveness. Feedback from these assessments should be used to make necessary adjustments to both the instructional content and the delivery method.
5. Parents should be encouraged to support the use of ACAI at home, reinforcing the learning that takes place at school. Schools could provide workshops or resources to help parents understand how to assist their children in using ACAI effectively.

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