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Effect of Algebra Tiles Teaching Approach on Students' Retention in Quadratic Equation in FCT, Abuja, Nigeria

Prof. Katcha Mohammad Abdullahi
Dept. of Science and Environmental Education, University of Abuja, FCT.
Email: *profkatcha22@gmail.com;*

Dr. Gidado Bello Kumo
Dept. of Educational Foundation, University of Abuja, FCT.
Email: *gbkumo@gmail.com*

Prof. Anaduaka Uche Scholatica
Dept. of Science and Environmental Education, University of Abuja, FCT.
uche.anaduaka@uniabuja.edu.ng

Nwabueze Maria Uchenna
Dept. of Science and Environmental Education, University of Abuja, FCT.
maria.nwabueze25@gmail.com

Abstract: This study investigated the effect of the algebra tiles teaching approach on students' retention in quadratic equations in the Federal Capital Territory, Nigeria. Two research questions and two null hypotheses guided the study. [1]The study adopted a quasi-experimental research design (intact class, pre-test, post-test control group design). A sample size of 122 SS2A students made up of 64 SS2A students drawn from Government Secondary School Gwagwalada; and 58 SS2A students drawn from Government Secondary School Kwali. A research instrument titled "Quadratic Equation Retention Test (QERT)" containing 20 multiple choice test items was developed to elicit data for the study. Mean scores and standard deviation were used to answer the research questions; while a t-test was used to test the null hypotheses. The findings of the study revealed that students taught quadratic equations using the algebra tiles teaching approach had higher mean retention scores than students taught quadratic equations using the conventional method. The study also found that male students had higher mean retention scores than female students after being taught quadratic equations using the Algebra Tiles Teaching Approach. The study concluded that the algebra tiles teaching approach had a significant effect on students' retention in the quadratic equation in FCT, Nigeria. It was recommended among others that to sustain

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the retention levels of students, mathematics educators should work assiduously towards re-teaching mathematical concepts that are critical to students' mathematics achievement in public examinations.

Keywords: Effect, Algebra Tiles, Retention, Quadratic Equation.

Introduction

In Nigeria, Education is a major means of achieving the aforementioned goals as enunciated in the National Policy on Education (which equally acknowledges "education as an instrument per excellence" (FRN, 2014). Education is, therefore, the key to becoming a self-sustaining country, and the guide towards a knowledge-based society. Any nation that neglects the education of its citizens is toying with the lives of the people and among the country of nations. As expected, Mathematics being an integral part of the educational process must be studied as a fundamental component of the development of a country.

It is in line with the above objectives that today's mathematics curriculum tries to prepare students for their future roles in society. It is aimed at equipping them with essential mathematical knowledge and skills, such as skills of reasoning, problem-solving, communication, and most importantly, the ability and motivation to continue learning on their own (Anyor & Abah, 2014).

Learning is said to have occurred when what is learnt remains relatively permanent in the mind of the learner. Thus, students must retain what is learnt. Retention is the capability to replicate the concept learnt when the need arises. It is the ability to reproduce a learned behaviour by the learner in due time. Therefore, a learner who repeats an acquired knowledge with less error is said to have retained the material learnt (Agu & Samuel, 2018). This implies that learning is incomplete when what is learned is not retained or fades away with time.

The main purpose of teaching is to transfer knowledge to learners. For effective teaching and learning to take place, teachers of mathematics need to use different methods and approaches in teaching various content of the subject. It could be that the traditional methods of teaching mathematics only accelerate poor concept formation by reducing students' retention, thus leading to poor achievement among secondary school students. This then calls for the use of the Algebra tiles method which is one of the contemporary teaching methods that could help to increase students' retention in quadratic equations. Researchers such as Bukunola and Idowu (2012), Osokoya (2013), Oni (2014) and Samuel (2017) attested that poor instructional strategies or teaching methods employed in the teaching of subjects by teachers contribute to reducing student retention.

The inclusion of mathematics as a core subject in the secondary school curriculum in Nigeria is due to the key role mathematics plays in the achievement of the objectives of secondary school education. These roles as provided in the National Policy on Education (FRN, 2014) include promoting science and technology, provision of trained manpower in the applied sciences, technology and commerce, and the acquisition of appropriate skills, abilities and competence both mental and physical as equipment for the individual to live on and contribute to the development of his society (FRN, 2014). Thus, the mathematics curriculum is intended to provide students with knowledge and skills that are essential in the changing technological world (Ngussa & Mbuti, 2017).

Mathematics is seen as a science of magnitude and number that is very useful virtually in all subject areas. This is because all fields of study are dependent on it for problem-solving and prediction of outcomes (Anigbo, 2016). Akinoso (2011) as cited in Anigbo (2016) perceived mathematics as the foundation for science and technology and the tool for achieving scientific and technological development.

Hence, mathematics has become an important discipline which any nation aspiring to develop in science and technology cannot afford to ignore. Mathematics is a cognitive subject and one of the five compulsory core cross-cutting subjects in the senior secondary school Curriculum in Nigeria (FRN, 2008; Ethe, 2012). Anigbo (2016)

further stated that competency in mathematics learning is vital to any individual and nation in domestic and business deals, scientific discoveries, technological breakthroughs, problem-solving and decision-making in different situations in life. This is because mathematics skills are essential in understanding other disciplines including engineering, sciences, social sciences and even the arts (Patena & Dinglasan, 2013; Phonapichat, et al, 2014). Thus, it is the backbone of science and technology. In justification of the importance of mathematics, Amidu, et al (2020) stated that: "Mathematics serves as the backbone to all technological eras without adequate and sufficient knowledge of mathematics. The study of mathematics enhances one's understanding of the world through the language of symbols and abstract representation of phenomena".

The objectives of senior secondary school mathematics in Nigeria include laying a solid foundation for the concept of numeracy and scientific thinking, developing students' ability to adapt to his/her changing environment, and allowing them to develop manipulative skills that will enable them to function effectively in the society within his capacity and to prepare them for higher education (FRN, 2014:14).

The implementation of the Senior Secondary Education (SSE) curriculum structure in September 2011 reflects the role of Mathematics in the cognitive development of students. According to the Nigerian Educational Research and Development Council [(NERDC), 2008], mathematics is one of the five compulsory core cross-cutting subjects that all students in senior secondary school stage must offer in their field of studies. This is because apart from the fact that success in the subject enhances the quality of the certificate, the trend has shown that to secure admission into the most lucrative/prestigious programmes at higher levels of education, a credit pass in mathematics is imperative (Abe & Gbenro, 2014).

The retention of learnt subject matter is one of the major goals of the educational system that relies on the assumption that learnt materials will be remembered to some degree sometimes after the learning, and this enables further courses to build upon this material (Matic, 2014). Retention could be defined as the ability to keep or retain the knowledge of mathematics learnt and to be able to recall it when required. Also, in today's classrooms, retention should be one of the most important factors required to understand the concepts that are taught to the students. Without retention, there cannot be a successful transfer of knowledge from one subject area to another (Makinde & Yusuf, 2019). Learning is said to have occurred when what is learnt remains relatively permanent in the mind of the learner. Thus, students must retain what is learnt. Retention is the capability to replicate the concept learnt when the need arises. It is the ability to reproduce a learned behaviour by the learner in due time. Therefore, a learner who repeats an acquired knowledge with less error is said to have retained the material learnt (Agu & Samuel, 2018). This implies that learning is incomplete if what is learned is not retained or fades away with time. Hence, retention is the ability of a learner to recall knowledge after receiving instruction.

Several studies have shown that retention promotes learning, for example, Ogunkunle and Onwunedo (2014) whose study revealed that the differentiated instructional strategies adopted by mathematics teachers in geometry enhanced the retention ability. The study of Makinde and Yusuf (2019) which investigated the effect of flipped classrooms on students' retention also revealed that students had higher levels of retention when exposed to treatment, unlike their counterparts who were taught conventionally. Also, the study of Kurumeh, Onah et al (2012) found that the student retention rate was affected positively by the ethnomathematics teaching approach when applied by mathematics teachers.

The phenomenon of students' retention of classroom tasks has been a major desire by all teachers since research efforts have pointed to its relevance. For example, Ugwuanyi's (2014) study on meta-analysis of students on the effect of teaching methods on students' retention in mathematics found that the results of the previous studies on the effect of teaching methods on students' retention in mathematics are positively significant at 0.05 levels; the

overall mean effect of teaching methods on students' retention in mathematics are respectively significant at 0.05 levels; the mean effect sizes for the studies on retention reported high effect sizes; there is variations in the mean effect sizes associated with the five categories of teaching methods examined under students retention in mathematics with cooperative learning method category having the largest effect size of all of them; and the percentage variance in students retention in mathematics attributable to teaching methods was 30.25%.

With these findings, using different types of concrete manipulative approaches, there may be higher levels of retention of students in SS2 class when exposed to the Algebra Tiles Approach, unlike their counterparts who will be taught using the conventional method approach.

Despite the importance given to mathematics in the educational system in Nigeria, Nigerian secondary school students continue to demonstrate an inability to recall knowledge of mathematics learnt when conventional methods were used as revealed in WASSCE mathematics examination over a decade. This was made clear by the reports by the WAEC Chief Examiner from 2012 to 2022 in which only 53.23% of the students who sat for the WASSCE passed mathematics; while 46.77% of the students failed the subject. The implication of these SSCE results is the need for improvement in the teaching of mathematical concepts and secondary school students' ability to retain what they were taught in mathematics; which is key to enhancing the quality of secondary education to achieve its stated objectives as enunciated in the National Policy on Education (FRN, 2014).

Research evidence has shown that the standard of mathematics teaching in Nigeria is low and identified teaching problems as one of the root causes of poor achievement in mathematics (Makinde & Yusuf, 2019; Nonyelum, et al, 2022). This claim is further supported by WAEC Chief Examiners' Reports (2012–2022) in the May/June Senior School Certificate Examination (SSCE) in which they attributed students' poor achievements in mathematics to ineffective teaching that leads to poor retention and stated that the overall performance of the candidates was generally poor and below average.

In an attempt to enhance pedagogy and help society produce more people who can think creatively in quantitative and qualitative terms, the search for more appropriate approaches to the teaching and learning of mathematics in general and quadratic equations, in particular, becomes necessary. This is because, from the researcher's experiences as a teacher, students find it difficult to retain the way conventional approaches involved in solving quadratic equations are being carried out. The WAEC Chief Examiners' Reports (2012–2022) also explained that many candidates missed full marks because of arithmetic errors committed in factorization and solutions of quadratic functions. These errors are traceable to the level of understanding of algebraic concepts by the students, and the problems of the students with mathematics, especially as algebraic concepts have to do with the abstract nature of the concept and the inability of the teachers of Mathematics to use concrete objects to represent algebraic concepts.

As a solution to this problem, therefore, Mckeague (2014) suggested that students should be encouraged to solve quadratic equations using either completing the square or factorization approaches because they are more involved and give deeper retention of the concept. Algebra Tiles Teaching Approach in solving quadratic equations is concerned mainly with completing the square or factorization approaches to solve quadratic equations. Hence, the need for the Algebra Tiles Teaching Approach to enable students to acquire mathematical skills.

Algebra Tiles are mathematical manipulative that allows you to better understand ways of Algebraic thinking and the concepts of Algebra. It allows both Algebraic and geometric approaches to Algebraic concepts. They give you other ways to solve Algebraic problems other than just abstract manipulation. Algebra Tiles are made up of rectangles large squares and small squares (Salifu, 2022). It can be defined as the application of geometric discovery in the instructional strategy of teaching quadratic equation concepts. This instructional approach is

assumed to be capable of resolving the cognitive conflict introduced in the minds of the learners when the algebraic concepts are taught abstractly. The use of the Algebra Tiles Teaching approach by mathematics teachers has become imperative due to its suitability as a contemporary approach for teachers to effectively teach all aspects of Algebra and in specific terms quadratic equations.

The researcher observed in some public senior secondary schools in the study area that the conventional methods adopted by teachers of mathematics in teaching quadratic equations which is a subset of Algebra seem to be inefficient in enhancing the retention levels of secondary school students. Thus, because mathematics is a core subject at the secondary school level of education and satisfactory academic outcomes in mathematics are critical to the educational development of students and the actualization of secondary education goals, investigating the effect of the Algebra Tiles Teaching Approach on students' retention in the quadratic equation which is a mathematics concept that is ever present in mathematical assessment in either internal and external examinations becomes imperative.

Variables in algebra are letters of the alphabet that are used to represent numbers or quantities that can vary or be varied while integers are positive, zero and negative whole numbers. Algebra tiles, therefore, are manipulative pieces with which one can represent algebraic expressions and perform polynomial operations. Each tile represents a specific monomial as will be represented in lesson plans based on the Algebra Tiles Teaching Approach. Algebra Tiles provide a useful way to introduce operations in algebraic concepts to students of all ages (Caylan & Haser, 2021).

A quadratic equation is a polynomial equation in which the highest power of x is exactly 2. In other words, it is a polynomial equation of degree 2 (Mckeague, 2014). Quadratic equation is an aspect of algebraic concepts and deals with unknown quantities (that is, variables), therefore, there is a need to use an active participation approach which will increase students' zeal to learn it, have interest and equally achieve better. One such way that may make the students have an interest in quadratic equations and get higher achievement is by using the Algebra Tiles Teaching Approach.

The issue of gender differences in male and female students' retention has been of concern to many researchers in the field of Mathematics. Gender is a construct used to differentiate male from female and has been contended to be a source of disparity in students' learning of Mathematics. There is a general belief that gender affects students' academic activities in Mathematics (Kurumeh & Onah, 2013; Ngumma, Itayavzua et al, 2020).

Jiang's (2021) study found that female students' mathematics academic performance was significantly better than male students; in sets, complex numbers, plane vectors, statistics, trigonometric functions, analytic geometry and functional knowledge modules. The study observed there were no significant differences between male students and female students in common logic, inequalities, algorithms, probability, sequence, solid geometry and derivative knowledge modules. In terms of basic skills, mathematical operations and data analysis, female students were significantly better than male students; and there were no significant differences between male students and female students in mathematical abstraction, logical reasoning and initiative imagination.

The study of Ajai and Imoko (2015) examined gender differences in mathematics achievement and retention by using Problem–Based Learning (PBL). The study revealed that male and female students taught Algebra using PBL did not significantly differ in achievement and retention scores, thereby revealing that male and female students are capable of competing and collaborating in mathematics.

In their study, Allahnana, et al (2018) assessed gender and interest in mathematics achievement in the Keffi Local Government area of Nasarawa State, Nigeria. The study found that male students excel in mathematics achievement more than their female counterparts, and male students have more interest in mathematics than

female students. In other words, the study found that there is a significant relationship between male and female achievement and interest in mathematics.

The study of Mwalya (2013) investigated gender differences in mathematics performance at the secondary school level in Kamdara, Sub-County, Muran'ga County, Kenya. The findings showed that male students outperform female students in mathematics. The study also found that though female students trail male students by performance in mathematics, some female students also outperform male learners in the subject.

The study of Okpe, et al (2022) investigated gender differences in mathematics achievement and retention among secondary school students in Nsukka Education Zone, Enugu State. The findings show that male students had higher achievement in mathematics than their female counterparts. Male students also had higher mathematics retention abilities than female students as this also manifested in their higher achievement in mathematics than female senior secondary school students. The study of Onwuka (2016) which examined the gender gap in mathematics through the use of mathematics games found out that there was no significant difference in the performance of male and female pupils. Although in the pre-test males performed slightly higher; while in the post-test, females performed better, the differences were not significant.

The study of Awing and Ismail (2017) investigated gender differences in mathematics learning in Malaysia. The secondary focused on gender differences in terms of the average overall mathematics scores as well as average achievement in each of the five content areas of mathematics namely; fractions and number bases; measurement; data representation, analysis and probability; geometry and algebra. The result from the study showed that girls had significantly higher scores in the overall average mathematics achievement as well as in three areas of mathematics content namely: number, algebra and data. Thus, it is imperative to determine the effect of the Algebra Tiles Teaching Approach on students' retention in quadratic equations in the Federal Capital Territory, Nigeria with gender as a moderating variable. Given the above, therefore, this study investigated the effect of the algebra tiles teaching approach on students' retention in the quadratic equation in the Federal Capital Territory, Nigeria. In light of the foregoing, the problem statement of the study revolves around establishing the effect of the algebra tiles teaching approach on students' retention in the quadratic equation in FCT, Nigeria.

Statement of the Problem

The primary objective of mathematics education is to enhance the quality of students' thought processes by using mathematical skills involving identification, description tackling and problem-solving. The teaching of mathematics is imperative if a nation is to develop in science and technology. This is the basis for making the subject of mathematics compulsory at the senior secondary school level of education in Nigeria. While the Federal Government continued to emphasize the relevance of mathematics at the secondary school level, it appears that student's performance in this subject area has continued to be poor as many students find it difficult to obtain credit passes in the subject.

In particular, quadratic equations which form a significant part of the contents of mathematics at the senior secondary school certificate level have continued to be a major focus, and any observed deficiency in performance will surely be a source of concern to educators and other stakeholders. It is generally believed that poor performance in mathematics by students may be connected to the conventional approaches to its teaching. The use of contemporary methods such as the Algebra tiles teaching approach is likely to enhance students' understanding and facilitate the retention of what is taught. It is against this background that the study looked at the effects of the Algebra tiles teaching approach on students' retention in its efforts towards proffering solutions to incidences of poor performance in mathematics, a situation that currently is not a healthy one.

Research Questions

The following research questions guided the study.

1. What is the difference in the mean retention scores of students taught quadratic equations using the algebra tiles teaching approach and their counterparts taught using the conventional teaching method?
2. What is the difference in the mean retention scores of male and female students taught quadratic equations using the algebra tiles teaching approach?

Hypotheses

The following null hypotheses were tested at a 0.05 level of significance:

Ho_1 There is no significant difference in the mean retention scores of students taught quadratic equations using the algebra tiles teaching approach and their counterparts taught using the conventional teaching method.

Ho_2 There is no significant difference in the mean retention scores of male and female students taught quadratic equations using the algebra tiles teaching approach.

METHODOLOGY

This study is a survey which adopted the quasi-experimental using pre-test, and post-test design. The population of the study consists of 17,913 senior secondary two (SS2) students. The sample size for the study comprised 122 SS2A students made up of 64 SS2A students drawn from Government Secondary School Gwagwalada; and 58 SS2A students drawn from Government Secondary School Kwali respectively. In both schools, the researcher purposively sampled SS2A students. This was because they are relatively science-based students. The SS2A students of GSS Gwagwalada served as an experimental group in the study (students taught Quadratic equations using the algebra tiles approach); while SS2A students of GSS Kwali served as a control group in the study (students taught Quadratic equations using the Conventional Method of Teaching). Furthermore, considering the adoption of intact classes of SS2A students for the study; the sampling procedure for the study was the homogeneous purposive sampling technique. A purposive sample is a non-probability sample that is selected based on the characteristics of a population and the objective of the study (Crossman, 2020). This technique was considered as being suitable as it enabled the researcher to identify respondents who possess the characteristics required for their involvement in the study. That is because the Quadratic Equation is in their syllabus.

The research instrument for the study was the "Quadratic Equation Retention Test (QERT)". The QERT is made up of five sections (A) and contains 20 multiple-choice test items with option A-D which include questions meant to test students' cognitive and affective domains of learning. The research instruments were validated by a team of three (3) experts in the Department of Science and Environmental Education, Faculty of Education, University of Abuja. Also, three (3) experienced Mathematics teachers in FCT were involved in the validation exercise. The validation of the research instruments focused on their construct and face validity. The validators scrutinized the test items of the instrument on retention and made suggestions for modifications in the instrument.

The reliability of the research instruments was determined through a pilot test conducted in two public senior secondary schools in FCT, Nigeria, that were within the study population but excluded from the main study. The pilot test involved 30 SS2 students. The Kuder-Richardson 20 formula (K-R20) was used to compute the reliability index of the QERT instrument. Using the K-R20 approach, a reliability index of 0.71 was obtained for the QERT.

Method of Data Analysis

The data analysis for the study was carried out using descriptive and inferential statistical tools. The research questions were answered using mean scores and standard deviation to ascertain the mean gain and mean difference after the pre-test, post-test and retention tests were administered to the experimental and control groups. The hypothesis was tested using the two-tailed sample test at a 0.05 level of significance.

RESULTS

Table 1

Analysis of the Difference in the Mean Retention Scores of Students taught Quadratic Equation using Algebra Tiles Teaching Approach and their Counterparts taught using the Conventional Teaching Method

Groups	N	Mean Scores		Standard Deviation		Mean Gain
		Post-test	Post-post-test	Post-test	Post-post-test	

Experimental	64	12.80	14.96	2.396	1.275	2.16
Control	58	9.49	9.98	2.680	1.881	0.49
Mean Difference		3.31	4.98			1.67
Total	122					

Table 1 shows that students taught quadratic equations using the algebra tiles teaching approach had mean retention scores of 12.80 in the pre-test and 14.96 in the pre-test with a standard deviation of 2.396 and 1.275 in the pre-test and post-test respectively; while the students taught quadratic equation using conventional method had mean retention scores of 9.49 in pre-test and 9.98 in post-test with standard deviation of 2.680 and 1.881 respectively. The mean differences were 3.31 and 4.98 for pre-test and post-test respectively, while the overall mean difference between the groups was 1.67.

Table 2

Analysis of the Difference in the Mean Retention Scores of Male and Female Students taught Quadratic Equation using Algebra Tiles Teaching Approach

Group	**Gender**	**N**	**Mean Scores**		**Standard Deviation**		**Mean Gain**
			Pre-test	**Post-test**	**Pre-test**	**Post-test**	
Experimental	Male	34	13.38	15.95	1.435	1.267	2.57
	Female	30	10.93	12.32	2.293	1.864	1.39
Mean Difference			2.45	3.63			1.18
Total		64					

Table 2 shows that male students taught quadratic equations using the algebra tiles teaching approach had mean retention scores of 13.38 on the pre-test and 15.95 on the post-test with standard deviations of 1.435 and 1.267. Female students taught quadratic equations using the algebra tiles teaching approach had mean retention scores of 10.93 in the pre-test and 12.32 in the post-test with standard deviations of 2.293 and 1.864 respectively. The mean differences were 2.45 and 3.63 for pre-test and post-test respectively, while the overall mean difference between male and female students was 1.18.

Table 3

t-test Analysis of Significant differences in the Mean Retention Scores of Students taught Quadratic Equations using the Algebra Tiles Teaching Approach and their Counterparts taught using the Conventional Teaching Method

	t-test for Equality of Means							
	Group	**N**	**Mean**	**Std. Deviation**	**t**	**df**	**Sig.**	**Decision**
Mean Retention Scores	Experimental	64	14.96	1.275	6.192	120	0.029	Rejected
	Control	58	9.98	1.881				

Table 3 shows a t-value of 6.192 and a corresponding p-value of 0.029. Testing at an alpha level of 0.05, the p-value is less than the alpha level. Therefore, the null hypothesis is rejected.

Table 4

t-test Analysis of Significant Difference in the Mean Retention Scores of Male and Female taught Quadratic Equations using Algebra Tiles Teaching Approach

Gender	N	Mean	Std. Deviation	t	df	Sig.	Decision
Male	34	15.95	1.267	3.657	62	0.009	Rejected
Female	30	12.32	1.864				

Table 4 shows a t-value of 3.657 and a corresponding p-value of 0.009. Testing at an alpha level of 0.05, the p-value is less than the alpha level. Therefore, the null hypothesis is rejected.

Discussion of Findings

The study found that students taught quadratic equations using the algebra tiles teaching approach had higher mean retention scores than their counterparts taught using the conventional teaching method. The descriptive analysis results indicated that the post-test (retention) mean score of the experimental group was 11.80; while the post-test (retention) mean score of the control group was 9.98. The findings from the corresponding null hypothesis revealed that there is a significant difference in the mean retention scores of students taught quadratic equations. In favour of those taught using the algebra tiles teaching approach. This implies that students taught quadratic equations using the algebra tiles teaching approach had the highest mean retention score than students taught quadratic equations using the conventional method. This indicates that the ability to produce a desired result is sustainable. This finding is supported by Ogunkunle and Onwunedo (2014) who found that differentiated instructional strategies adopted by Mathematics teaching enhanced the retention ability of senior secondary school students. The finding also corresponds with the studies of Makinde and Yusuf (2012) and Ugwuanyi (2014) which observed significant differences between the mean retention scores of students in the experimental group who were exposed to treatment and the mean retention scores of students in the control group who were taught using the conventional teaching method. This is further supported by Gidado, et al (2024). In their study on the impact of differentiated instruction on mathematics students, it was found that those taught with differentiated instruction had slow positive attitudes toward learning mathematics, with relatively improved achievements than other methods.

The findings of the study also showed that male students had higher mean retention scores than female students after being taught quadratic equations in favour of male students taught using the same algebra tiles teaching approach. The results therefore indicated that male students had higher mean retention scores than female students after being taught quadratic equations using the algebra tiles teaching approach. This finding is at variance with earlier findings by Ajai and Imoko (2015) but is synonymous with the findings of Okpe, et al (2022). Ajai and Imoko (2015) found that male and female students taught Algebra using problem-based learning did not significantly differ in retention scores.

This finding is also in conflict with earlier Gidado, et al (2024). In their study of teaching with algebra teaching tiles method in quadratic equations, they discovered that there was no significant gender difference between male and female students. It is further observed that, unlike the current study, Gidado's (2024) research found that there was an improvement in the mean score of all students in respective of gender, as against the current finding. However, this result is in agreement with earlier findings by Okpe, et al (2022), who found that male students had higher Mathematics retention abilities than female senior secondary school students.

Conclusion

Based on the findings, it is concluded that students taught quadratic equations using the algebra tiles teaching approach performed better than those taught using the conventional method. In addition, there was a significant difference in male and female performance using the algebra tiles teaching approach.

Recommendations

The following recommendations were made:

1. To sustain the retention levels of students, mathematics educators should use modern instructional resources that are critical to students' mathematics achievement.
2. Secondary school authorities should encourage and provide modern instructional resources that enable the teaching and learning of various mathematical concepts.
3. The mathematics laboratory in secondary schools should be equipped with modern instructional materials and mathematics apparatus that enable practical teaching and learning of various mathematical concepts.

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